

About CLEO

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CLEO

Laser Science to Photonic Applications

Technical Conference:

09 – 14 May 2021



All-Virtual CLEO 2021 Showcases Innovative Research and Applications in Laser Science

Distinguished speakers from across the globe described advances in quantum and silicon photonics, optical imaging and sensing and more during the all-virtual CLEO 2021 held 09 – 14 May. The conference drew more than 4,600 registrants from 73 countries.

Ultra-broadband nanophotonics, integrated nonlinear photonics, self-driving cars, ultrafast lasers and the optics community's response to COVID-19 were among topics for more than 2,000 technical and poster presentations across 241 Technical, Postdeadline Papers and Poster Sessions, workshops, Short Courses and special events. Registrants have access to recorded presentations to view on-demand for 60 days.

“The virtual event expanded our knowledge of research and technologies that are driving the industry forward,” said CLEO 2021 Program Chair Clara Saraceno. “The extraordinary developments in areas ranging from high harmonic and fiber-based light sources to photonic

computing illustrate the amazing work of researchers and industry leaders developing and bringing these products to market.”

Speakers from government, industry and academia participated in a workshop focused on biophotonics and nanophotonics optical approaches in fighting pandemics and challenges associated with those applications. Among them, UV radiation for effective decontamination and cleaning and spectroscopy techniques for rapid pathogen detection and virus probing.

“The presenters covered a wide-range of groundbreaking research that is rapidly changing our field,” said CLEO 2021 General Chair Christophe Dorrer. “We are investigating our world at the fundamental level and addressing concrete problems with photonics and advanced laser science.”

One presentation reviewed work underway to detect exoplanets with precision optical technology. “Small planets are very abundant in our galaxy,” said Dimitri Mawet of California Institute of Technology, USA, adding that direct imaging will enable scientists to learn more about their atmospheres.

The discovery of the supermassive black hole was the topic of a talk by Shep Doeleman of Harvard University, USA. This seminal achievement relied on optical sparse aperture systems for astronomical observations. The team used a technique called very-long-baseline interferometry (VLBI) using radio telescopes worldwide connected by a network of atomic clocks to observe the hole and digitize data, he said.

Industry Leading Companies in Lasers and Electro-Optics

The CLEO Virtual Exhibition featured 80 leading companies in laser science and photonic applications. Toptica Photonics, AIM Photonics, OptoSigma, Coherent, MKS, Synopsys, Oz Optics, Menlo Systems and many more showcased new products and engaged with attendees.

Plenary Speakers

Nicolas Gisin, Professor Emeritus, University of Geneva, Switzerland, described the evolution of quantum information science from Bell inequalities to commercial Quantum Key Distribution and Quantum Random Number Generator chips.

Jeremy O'Brien, CEO, PsiQuantum, USA, discussed the company’s approach to fault tolerant quantum computing. O’Brien described progress towards building a useful quantum computer but acknowledged a large-scale model with silicon photonic chips is years in the making.

Alan Eli Willner, Professor, University of Southern California, USA, described optical communications applications beyond conventional fiber systems that harness photonic technologies using photonic-integrated circuits.

Margaret Murnane, Director, STROBE, Fellow, JILA, Professor, University of Colorado at Boulder, USA, explored advances in high-harmonic light sources and efforts to harness and control short-wavelength light. The work has generated powerful new tools for x-ray imaging, manipulating quantum materials and designing more efficient nanoscale devices.

Stefanie K. Johnson, Associate Professor, University of Colorado at Boulder, USA, talked about unconscious bias in her presentation on diversity and inclusion and provided recommendations to improve decision-making in professional settings.

CLEO Technical Conference: 09 – 14 May 2021
CLEO Exhibition: 10 – 14 May 2021
A Virtual Conference - Pacific Daylight Time (PDT, UTC-07:00)

Agenda of Sessions — Sunday, 09 May

13:00–17:00	Short Courses (SC149, SC157, SC361, SC396, SC439, SC466, SC476, SC479, SC481)
17:00–18:30	Optimizing Career Paths in Optics: The Guide for Young Professionals

Please note the session and event titles are hyperlinked to the online conference schedule.

Agenda of Sessions — Monday, 10 May

	Virtual Room 1	Virtual Room 2	Virtual Room 3	Virtual Room 4	Virtual Room 5	Virtual Room 6	Virtual Room 7	Virtual Room 8	Virtual Room 9	Virtual Room 10	Virtual Room 11	Virtual Room 12	Virtual Room 13	Virtual Room 14	Virtual Room 15	Virtual Room 16	Virtual Room 17	Virtual Room 18	Virtual Room 19
03:00–07:00	Short Course (SC362)																		
05:00–07:00	SM1A • Active and Passive Photonic Integration	SM1B • Optical Machine Learning and Security	SM1C • Optical Metrology for Spectroscopy	SM1D • Photodetectors	SM1E • Plasma Sensing and Stand-off Detection	SM1F • Spatial and Polarization Dynamics in Fibers	SM1G • Time and Distance Metrology	SM1H • Lasers on Si and Hybrid Integratoin	SM1I • A&TTR Super Topical Review on High Power laser Technology I - New Perspectives on Pulse Post-Compression	FM1J • Novel Phenomena	SM1K • 2D Terahertz Spectroscopy and Quantum Cascade	FM1L • Electron-Photon Interactions	FM1M • Theory Metasurfaces and Metamaterials	FM1N • High-Dimensional Entanglement	FM1O • Ultrafast Imaging and Spectroscopy	SM1P • Control and Coupling of Light in Fibers	SM1Q • Quantum Photonics and Machine Learning	AM1R • Advances in Imaging, Microscopy, and Inspection	AM1S • Enabling Quantum Technologies with Photonics
07:00–08:00	OSA Technical Groups: What's Next in Integrated Photonics — Hot Topics at CLEO 2021																		
08:00–09:00	Dedicated Exhibit Time																		
09:00–11:15	JM2A • Plenary Session I																		
11:15–12:00	Technology Showcase																		
12:00–14:00	SM3A • Dual-comb Spectroscopy and Sensing	SM3B • Laser Micro-/ Nanostructuring	AM3C • Advances and Applications of Microscopy	SM3D • Metamaterials and Nano-structures I	AM3E • Frequency Comb Applications		JM3F • Super Symposium on Advances in Quantum Technologies: Engineering Nonclassical Light Sources	JM3G • Symposium - Hot Topics in THz Photonics: Spintronics and Biophotonics I - Spintronics and Ultrafast Magnetism - New Paradigms for Novel Terahertz Sources and Detectors	AM3H • A&TTR Super Topical Review on High Power Laser Technology II - Innovative Technologies for the Next Generation of Ultra-intense Lasers	FM3I • Structured Surfaces	SM3J • Nonlinear Optics and Photodetection in Integrated Mid-IR Devices	FM3K • Manipulation of Radiative Processes by Metasurfaces and Nanophotonics	FM3L • Scattering and Imaging	FM3M • Teleportation and Entanglement	FM3N • Quantum Enhanced Absorption and Emission	SM3O • Emerging Topics in Optical Sensing and Biomarker Detection	SM3P • Fiber Based Light Sources (ends at 13:45)	AM3Q • Environmental and Atmospheric Sensing I	AM3R • Physics of Laser Diodes
13:00–17:00	Short Courses (SC352, SC378, SC403, SC475, SC477)																		
14:00–15:00	OSA Technical Groups: OSA Quantum Optical Science and Technology Technical Group 20x20 Talks																		
14:00–18:00	Short Course (SC410)																		
15:00–17:00	SM4A • Free-space and Underwater Communication	SM4B • Heterogenous Photonic Integration	SM4C • New Approaches to Mode Coupling	JM4D • Super Symposium on Photonics Solutions for COVID-19 Challenge I			JM4E • Super Symposium on Advances in Quantum Technologies I	JM4F • Symposium - Hot Topics in THz Photonics: Spintronics and Biophotonics II - Terahertz Biophotonics from Fundamental Science to Real Life Applications	AM4G • A&TTR Super Topical Review on High Power Laser Technology III - Advanced Laser Metrology in the Context of High Power, High Energy Laser Facilities	FM4H • Photonics in Cavities and Resonators I	SM4I • Imaging Techniques/Light Manipulation	FM4J • Spatio-temporal Manipulation and Measurement of Light	SM4K • Linewidth Management of Fiber Sources	SM4L • Lithium Niobate Photonics	SM4M • Quantum Memory	SM4N • Precision Molecular Spectroscopy	AM4O • Quantum Networks	AM4P • Environmental and Atmospheric Sensing II (ends at 16:30)	AM4Q • C UV and Soft X-ray

Please note the session and event titles are hyperlinked to the online conference schedule.

Agenda of Sessions — Tuesday, 11 May

	Virtual Room 1	Virtual Room 2	Virtual Room 3	Virtual Room 4	Virtual Room 5	Virtual Room 6	Virtual Room 7	Virtual Room 8	Virtual Room 9	Virtual Room 10	Virtual Room 11	Virtual Room 12	Virtual Room 13	Virtual Room 14	Virtual Room 15	Virtual Room 16	Virtual Room 17	Virtual Room 18	Virtual Room 19	Virtual Room 20
03:00–07:00	Short Courses (SC270, SC455, SC478)																			
04:00–05:00	Meet the Editors																			
04:00–05:00	OSA Technical Groups: What's Next in Ultrafast Optical Phenomena — Hot Topics at CLEO 2021																			
05:00–07:00	STu1A • Active Nanophotonic Sensing and Detection	STu1B • Laser Based Emerging Technologies	STu1C • Emerging Photonic Materials and Applications	STu1D • Generation of Ultrafast Pulses	STu1E • Space Division Multiplexing-based Communication Systems	STu1F • Microresonators	STu1G • Photonic Computing	STu1H • THz and Mid-IR Lasers	JTu1I • Symposium - Micro-Photonic Positioning, Navigation and Timing I	STu1J • High Speed Sources and Data Centre Applications (ends at 06:30)	FTu1K • Plasma Optics	FTu1L • High- and Low-Harmonic Generation	FTu1M • Topological Photonics I	FTu1N • Quantum Engineering Challenges	FTu1O • Exciton Dynamics in Two-dimensional Semiconductors	JTu1P • Symposium - Emerging Materials for Light Emission and Non-volatile Photonic Memories I: Light Emission	STu1Q • Hollow Core Fibers	JTu1R • Super Symposium on Photonics Solutions for COVID-19 Challenge II	ATu1S • Quantum Communication	ATu1T • QCL
07:00–08:00	Technology Showcase																			
08:00–10:00	STu2A • Applications of Optical Interferometry	STu2B • Novel Communication Techniques and Devices	STu2C • Nanophotonic Light Emitters on Chip	STu2D • Low Noise Optical and Microwave Sources	STu2E • Beam Combining and Frequency Combs	STu2F • Seeing Through Obstructions and Turbulence	STu2G • Integrated Microcombs	STu2H • Optomechanics	JTu2I • Symposium - Micro-Photonic Positioning, Navigation and Timing II	FTu2J • THz and Frequency Comb Photonics	FTu2K • Thermal Effects in Nano-optics for Thermal Radiation (ends at 09:45)	FTu2L • Non-Hermitian Photonics	FTu2M • Metasurfaces and Wavefronts	FTu2N • Integrated Quantum Photonics	FTu2O • High-repetition-rate HHG and XFEL Sources	JTu2P • Symposium - Emerging Materials for Light Emission and Non-volatile Photonic Memories II - Non-volatile Photonic Memories	STu2Q • Large-scale Photonic Integration	JTu2R • Super Symposium on Photonics Solutions for COVID-19 Challenge III	ATu2S • Quantum Sensing	ATu2T • THz Sources and Applications
08:00–13:00	Arthur Ashkin Memorial Symposium																			
09:00–11:00	Advancing Mid-Managers Summit																			
10:00–11:00	Successfully Navigate an OSA Virtual Meeting																			
10:00–11:00	The Brightest Light Initiative: Update on the U.S. Strategy for Intense Ultrafast Lasers																			
10:00–12:00	Workshop: How Can Optics Contribute Towards Addressing Future Pandemics: From Advanced Developments to Challenges and Limitations?																			
12:00–14:00	JTU3A • Joint Poster Session I																			
13:00–17:00	Short Courses (SC376, SC438)																			
14:00–15:00	Dedicated Exhibit Time																			
15:00–16:00	OSA Technical Groups: Discussion of Seminal Papers and Outlook: From Statistical Ray Optics to the Physics of Solar Cells																			
17:00–19:00	STu4A • Applications of Multimode and Multicore Fibers (ends at 18:30)	JTu4B • Super Symposium on Advances in Quantum Technologies II								STu4C • Optical Parametric Oscillators and Amplifiers	STu4D • Innovative Applications	FTu4E • Photonics in Cavities and Resonators II	FTu4F • Topological Photonics IV	FTu4G • Quantum States Creation, Amplification and Attenuation	FTu4H • Imaging with Meta-Optics	FTu4I • Quantum Materials Studied by Novel Ultrafast Spectroscopy and Microscopy	FTu4J • Ultrafast XUV and X-ray Spectroscopy		ATu4K • Non-conventional Optics and Imaging	ATu4L • Machine Learning Enhanced Biological Imaging

Please note the session and event titles are hyperlinked to the online conference schedule.

Agenda of Sessions — Wednesday, 12 May

	Virtual Room 1	Virtual Room 2	Virtual Room 3	Virtual Room 4	Virtual Room 5	Virtual Room 6	Virtual Room 7	Virtual Room 8	Virtual Room 9	Virtual Room 10	Virtual Room 11	Virtual Room 12	Virtual Room 13	Virtual Room 14	Virtual Room 15	Virtual Room 16	Virtual Room 17	Virtual Room 18	Virtual Room 19	Virtual Room 20	
05:00–07:00	JW1A • Joint Poster Session II																				
07:00–08:00	OSA Technical Groups: Role and Applications of Lasers in Additive Manufacturing																				
07:00–08:00	PhD-Level Transferrable Skills That Stand Out During Economic Downturns																				
07:00–08:30	Workshop: Analog vs. Digital Photonic Information Processing Workshop: Achieving Level 5 Autonomy in Self Driving Cars Workshop: Is Quantum Technology Ready for Prime Time?!																				
09:00–11:00	SW2A • UV and Visible Lasers	SW2B • Fiber Amplifiers and Oscillators	SW2C • High-bandwidth Devices and Systems	SW2D • Neural Imaging Tools	AW2E • A&TTR on Integrated Photonics in Neural Networks I	SW2F • Photonics of Low Dimensional Materials I	JW2G • Mid-infrared and Thermal Photonics I: Thermal Radiation Control and Energy	SW2H • Microresonators and Microcombs	SW2I • Atomic and Solid-state Quantum Sensors	SW2J • Tools for Ultrafast Spectroscopy	SW2K • Terahertz Near-field Imaging and Field Confinement	FW2L • Nonlinear Photonics I	FW2M • Topological Photonics II	FW2N • Nanophotonic Platforms for Light Manipulation	FW2O • Metamaterials	FW2P • Advanced Photon Detection	FW2Q • Novel Spectroscopy Techniques Developed for Materials Research	SW2R • Nonlinear Optical Phenomena at High Laser Intensities	AW2S • Atmospheric and Gas Sensing	AW2T • Advanced Optical Imaging of Cancer	
11:00–12:00	Dedicated Exhibit Time																				
12:00–14:00	SW3A • Microwave Photonics	SW3B • Novel Device Applications	SW3C • Silicon Photonics	SW3D • Novel Biophotonic Illumination and Sources	AW3E • A&TTR on Integrated Photonics in Neural Networks II	SW3F • Photonics of Low Dimensional Materials II	JW3G • Symposium - Mid-infrared and Thermal Photonics II: Mid-IR Photonics from Glass to Gas (ends at 13:45)	SW3H • Light Interaction with High/Low Dimensional Materials	AW3I • A&TTR on Optical Technologies for Autonomous Cars and Mobility (ends at 13:30)	SW3J • Ultrafast Pulse Measurements	SW3K • Terahertz Emission and Pulse Shaping	FW3L • Nonlinear Photonics at Surface and Membranes	FW3M • Optical Forces and Single-molecule Manipulation (ends at 13:45)	FW3N • Machine Learning and Applications	FW3O • Metasurfaces and Lasers	FW3P • Cold Atoms and Quantum Measurement	SW3Q • Particle Acceleration, Far-IR and High Harmonic Source Generation	SW3R • Ultrafast Nonlinear Dynamics and Frequency Conversion	AW3S • LiDAR	AW3T • Advances in Compact Devices and Clinical Applications	
15:00–17:00	SW4A • Integrated Frequency Combs	JW4B • Super Symposium on Advanced in Quantum Technologies: Rydberg Quantum Technologies	SW4C • Intense Field Light - Matter Interaction						AW4D • A&TTR on Light-based Micro and Nano Manufacturing	SW4E • On-Chip Optical Signal Routing	SW4F • Terahertz Spectroscopy and Applications	FW4G • Applications of Structured Light	FW4H • Nonlinear Nano-optics	FW4I • Photon Emitters and Interaces	FW4J • Metasurfaces and Materials	FW4K • Topological Physics Studied by Optical Spectroscopies	JW4L • Quantum Transduction			AW4M • Light Monitoring and Control	AW4N • ATI Enhanced Contrast and Quantitative Phase Imaging in Microscopy
17:00–18:00	Technology Showcase																				

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Agenda of Sessions — Thursday, 13 May

	Virtual Room 1	Virtual Room 2	Virtual Room 3	Virtual Room 4	Virtual Room 5	Virtual Room 6	Virtual Room 7	Virtual Room 8	Virtual Room 9	Virtual Room 10	Virtual Room 11	Virtual Room 12	Virtual Room 13	Virtual Room 14	Virtual Room 15	Virtual Room 16	Virtual Room 17	Virtual Room 18	Virtual Room 19	Virtual Room 20
03:00–04:00	Dedicated Exhibit Time																			
04:00–06:00	STh1A • Application of Hollow Core Fibers (ends at 05:45)	STh1B • Structured Light Sources	STh1C • Precision Timing and Synchronization	STh1D • Quantum Science with Photons, Atoms, Ions, and Phonons	STh1E • THz and Infrared Photonics	STh1F • Network Management and Machine Learning	STh1G • Novel Laser Concepts	STh1H • Biophotonic Sensors and Devices	STh1I • Short-reach Communications	FTh1J • Nonlinear Photonics II	FTh1K • Near-field Imaging and Enhanced Sensing	STh1L • Laser-based Nonlinear Sources in the Mid-IR	FTh1M • BICS and More	FTh1N • Novel Ideas in Quantum Information	FTh1O • Engineering Multiphoton Sources	FTh1P • Quantum Emitters Coupled to Nanophotonics	STh1Q • Active Devices for Photonic Integrated Circuits	Ath1R • Micro, Nano Fabrication and 3D Printing	Ath1S • Optical Fibers for Sensing Applications I	
06:00–07:00	OSA Technical Groups: OSA Nonlinear Optics Technical Group Coffee Break																			
07:00–09:00	STh2A • Wideband Optical Communication Systems and Amplifiers (ends at 08:15)	STh2B • Non-linear process Based Light and Laser Sources	STh2C • Terahertz Imaging and Detection	STh2D • Computational Microscopy	STh2E • Frequency Combs for Open-path Sensing and Imaging	STh2F • Terahertz Devices and Communications	STh2G • Novel Fiber Systems and Devices	STh2H • Integrated Photonics	STh2I • Ultrabroad-band Sources and Post Compression	FTh2J • Complex Quantum Photonics	FTh2K • Strong Coupling in Excitonic and Polaritonic Systems	STh2L • MIR Emitting Lasers	FTh2M • Inverse Design	FTh2N • Photonic Computing	FTh2O • Quantum Measurement I	FTh2P • Quantum Optomechanical Systems	STh2Q • quantum technology for Fundamental Physics	Ath2R • Ultrafast Laser-based Welding and Waveguide Writing	Ath2S • Optical Fibers for Sensing Applications II	Ath2T • ATTR: Space Optics Astronomical Imaging I: Free-Space Optical Communications in Orbital Platforms
10:00–12:00	JTh3A • Joint Poster Session III																			
12:00–13:00	OSA Technical Groups: Dialogues on Metamaterials: Past, Present, Future																			
12:00–13:30	What Does It Take to be a Quantum (Optical) Engineer?																			
12:00–13:30	Publishing in 2021: Challenges and Solutions																			
13:00–15:00		STh4A • Precision Spectroscopy and Miniaturization Technology	STh4B • Novel Photonics	JTh4C • Super Symposium on Advances in Quantum Technologies: Quantum Lidars and Super Resolution	STh4D • High Energy, High Power Lasers I	ATH4E • Optical Energy Conversion and Radiative Cooling	ATH4F • Optical Coherence Tomography and Holographic Imaging	ATH4G • Laser Diodes and Application		ATH4H • Topological Photonics III	FTh4I • Quantum Nanophotonics	STh4J • Novel Fabrication and Characterization	FTh4K • Dynamic Metamaterials	FTh4L • Nonlinear and THz Spectroscopy for Studying Quantum Materials	FTh4M • Solid-state Qubits and Emitters	STh4N • Ultrafast Amplifiers	STh4O • Metastructure-based Nanophotonic Devices	ATH4P • Ultrafast Laser Enabled Structures and Functional Devices	ATH4Q • Optical Sensors	ATH4R • ATTR: Space Optics Astronomical Imaging II: Astronomical Imaging
17:00–18:00	Dedicated Exhibit Time																			
20:00–22:00											STh5A • Nonlinear Fiber Optics and Mid-IR Generation	STh5B • 2D Materials and Topological Photonics								

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Agenda of Sessions — Friday, 14 May

	Virtual Room 1	Virtual Room 2	Virtual Room 3	Virtual Room 4	Virtual Room 5	Virtual Room 6	Virtual Room 7	Virtual Room 8	Virtual Room 9	Virtual Room 10	Virtual Room 11	Virtual Room 12	Virtual Room 13	Virtual Room 14	Virtual Room 15	Virtual Room 16	Virtual Room 17	Virtual Room 18	Virtual Room 19	Virtual Room 20
04:00–06:00	FF1A • Postdeadline Session I	SF1B • Postdeadline Session II	SF1C • Postdeadline Session III																	
07:00–09:00	SF2A • Emerging Photonic Materials	SF2B • Design and Fabrication Techniques for Photonic Integrated Circuits		AF2C • A&TTR on Millimeter Wave Over Fiber for Fronthauling of 5G and Beyond	SF2D • Optical Communication Systems and Subsystems (ends at 08:45)	JF2E • Super Syposium on Advances in Quantum Technologies: Microwave-to-optical Quantum Interconnects	SF2F • Ultrafast Lasers	JF2G • Quantum Computing with Trapped Ions - Implementations and Funding	AF2S • ATTR: Space Optics Astronomical Imaging III: Earth Remote Sensing	FF2H • Temporal Photonics	FF2I • Quantum Measurements II	FF2J • Quantum Networks	FF2K • Novel Tools for Ultrafast Science - Structured Light and Waveform Synthesis	FF2L • Ultrafast and Out-of-equilibrium Dynamics in Strongly Correlated Electron Systems	SF2M • Femtosecond Oscillators	SF2N • High Energy, High Power Lasers II	SF2O • Integrated Nonlinear Photonics	SF2P • Optical Clocks and the Future of Time	AF2Q • New Technologies for Optical Imaging and Sensing	AF2R • Visible Lasers and Integrated Technology
10:00–11:30	JF3A • Plenary Session II																			
14:00–15:30	How Can CLEO Improve Inclusion at Its Meeting?																			

Please note the session and event titles are hyperlinked to the online conference schedule.

Committees

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CLEO: Applications & Technology

Jin Kang, *Johns Hopkins University, USA*, **General Chair**

Stephanie Tomasulo, *Naval Research Laboratory, USA*, **General Chair**

Ilko Ilev, *Food and Drug Administration, USA*, **Program Chair**

Dirk Müller, *Coherent Inc., USA*, **Program Chair**

CLEO A&T 1: Biomedical Applications

Tilman Schmoll, *Carl Zeiss Meditec Inc., USA*, **Subcommittee Chair**

Utkarsh Sharma, *Catapult Sky, USA*, **Subcommittee Chair**

Elisabeth Brunner, *Medical University of Vienna, Austria*

Amanda Carpenter, *Carl Zeiss Meditec Inc., USA*

Brian Cullum, *Univ. of Maryland Baltimore County, USA*

Sam Kavusi, *Verily, USA*

Antonia Lichtenegger, *Medical University of Vienna, Japan*

Samantha McBirney, *University of Southern California, USA*

Nishant Mohan, *Boston University, USA*

Kartikeya Murari, *University of Calgary, Canada*

David Nolte, *Purdue University, USA*

YongKeun Park, *Korea Advanced Inst. of Science & Tech., South Korea*

Amit Paranjape, *Syneron-Candela, USA*

Yicong Wu, *NIH National Inst. of Biomed Imaging & Bioeng, USA*

CLEO A&T 2: Laser-based Manufacturing, Machining and Nanoprinting

Michael Krainak, *NASA Goddard Space Flight Center, USA*, **Subcommittee Chair**

Jie Qiao, *Rochester Institute of Technology, USA*, **Subcommittee Chair**

Ya Cheng, *Shanghai Inst. of Opt. & Fine Mech., China*

Heather George, *TRUMPF Inc., Germany*

Clemens Hoenninger, *Amplitude Systemes, France*

Zhibin Lin, *Electro Scientific Industries, USA*

Manyalibo Matthews, *Lawrence Livermore National Lab., USA*

Sean McDaniel, *AFRL, USA*

Beat Neuenschwander, *Bern Univ. of Applied Sciences, Switzerland*

Stefan Nolte, *Friedrich-Schiller-Universität Jena, Germany*

Ye Pu, *Ecole Polytechnique Federale de Lausanne, Switzerland*

Kristen Tebo, *Rofin-Sinar, USA*

CLEO A&T 3: Optical Instrumentation for Measurements and Monitoring

Alexandra Artusio-Glimpse, *National Inst. of Standards & Tech. USA*, **Subcommittee Chair**

Fabio Di Teodoro, *Raytheon Space and Airborne Systems, USA*, **Subcommittee Chair**

Daniel Adams, *Colorado School of Mines, USA*

Bikash Basnet, *Global Science and Technology, Inc. USA*

Brian Boland, *Raytheon Technologies, USA*

Javier Concha, *CNR, Italy*

Clément Fallet, *Prophesee, France*

James Fraser, *Queen's University, Canada*

Nazanin Hoghooghi, *University of Colorado Boulder, USA*

Alexandra Latshaw, *Raytheon Technologies, USA*

Kara Peters, *North Carolina State Univ., USA*

Matt Simons, *University of Colorado, USA*

Steven Wagner, *Technische Universität Darmstadt, Germany*

CLEO A&T 4: Applications in Energy & Environment

David Bomse, *Mesa Photonics, LLC USA, Subcommittee Chair*

Daniel Law, *The Boeing Company USA, Subcommittee Chair*

D. Michelle Bailey, *National Inst. of Standards & Tech., USA*

Nikhil Jain, *X Display Company, Inc., USA*

Mohammad Khan, *Delaware State University, USA*

Eric Schiff, *Syracuse University, USA*

CLEO A&T 5: Quantum Technology in Transition

Peter Fendel, *Thorlabs Inc., USA, Subcommittee Chair*

Wilhelm Kaenders, *TOPTICA Photonics Inc., Germany, Subcommittee Chair*

David Anderson, *Rydberg Technologies Inc., USA*

Bettina Heim, *OHB System, Germany*

John Jost, *MicroR Systems Sarl, Switzerland*

Jonathan Matthews, *University of Bristol, UK*

Kathy-anne Soderberg, *AFRL/RITQ, USA*

Rik van Gorsel, *id Quantique, USA*

CLEO A&T 6: Advances in Semiconductor Technology

Oleg Khodykin, *KLA USA, Subcommittee Chair*

Edik Rafailov, *Aston University, UK, Subcommittee Chair*

Alexander Bykanov, *KLA-Tencor, USA*

Igor Fomenkov, *ASML US LP, USA*

Sven Höfling, *Wuerzburg University, Germany*

Richard Hogg, *University of Glasgow, UK*

Heiko Kissel, *DILAS|Coherent, Germany*

Katrin Paschke, *Ferdinand-Braun-Institut (FBH), Germany*

Thomas Slight, *CSTG, UK*

Grigorii Sokolovskii, *Ioffe Institute, Russia*

CLEO: Fundamental Science

Natalia Litchinitser, *Duke University, USA*, **General Chair**

Sergey Polyakov, *National Institute of Standards & Technology, USA*, **General Chair**

Viktor Podolskiy, *University of Massachusetts, Lowell, USA*, **Program Chair**

Josh Nunn, *University of Bath, UK*, **Program Chair**

FS 1: Quantum Optics of Atoms, Molecules and Solids

Elizabeth Goldschmidt, *Univ. of Illinois at Urbana-Champaign USA*, **Subcommittee Chair**

Ana Asenjo-Garcia, *Columbia University, USA*

Quentin Glorieux, *Laboratoire Kastler Brossel, France*

Rudolph Kohn, *Space Dynamics Laboratory, USA*

Paul Kunz, *Army Research Labs, USA*

Lucas Lamata, *Universidad de Sevilla, Spain*

Pavel Lougovski, *Oak Ridge National Laboratory, USA*

Ruth Oulton, *University of Bristol, UK*

Tom Purdy, *University of Pittsburgh, USA*

Glenn Solomon, *Joint Quantum Institute, USA*

Costanza Toninelli, *Universita degli Studi di Firenze, Italy*

Tian Zhong, *University of Chicago, USA*

FS 2: Quantum Information and Communication

Michael Brodsky, *US Army Research Laboratory, USA*, **Subcommittee Chair**

Eleni Diamanti, *Universite Pierre et Marie Curie, France*

Thomas Gerrits, *National Inst. of Standards & Tech., USA*

Xianmin Jin, *Shanghai Jiao Tong University, China*

Steve Kolthammer, *Imperial College, UK*

Anthony Laing, *University of Bristol, UK*

Jeff Lundeen, *University of Ottawa, Canada*

William Munro, *NTT Basic Research Laboratories, Japan*

Peter Mosley, *University of Bath, UK*

Valentina Parigi, *Laboratoire Kastler Brossel, France*

Fabrizio Piacentini, *INRIM, Italy*

Eilon Poem, *Weizmann Institute of Science, Israel*

Polina Sharapova, *University of Paderborn, Germany*

FS 3: Quantum Photonics

Martin Stevens, *National Inst. of Standards & Tech., USA*, **Subcommittee Chair**

Tim Bartley, *Universität Paderborn, Germany*

Nadia Belabas, *Centre National Recherche Scientifique, France*

Sonia Buckley, *National Inst. of Standards & Tech., USA*

Matthew Collins, *Xanadu Quantum Technologies, Canada*

Dirk Englund, *Massachusetts Institute of Tech., USA*

Paulina Kuo, *National Inst. of Standards & Tech., USA*

Alexander Ling, *Centre for Quantum Technologies, Singapore*

Galan Moody, *University of California Santa Barbara, USA*

Tina Muller, *Toshiba, UK*

Geoffrey Pryde, *Griffith University, Australia*

Hiroki Takesue, *NTT Basic Research Laboratories, Japan*

Alejandra Valencia, *Universidad de los Andes, Colombia*

FS 4: Optical Excitations and Ultrafast Phenomena in Condensed Matter

Liuyan Zhao, *University of Michigan, USA*, **Subcommittee Chair**

John Harter, *California Institute of Technology, USA*

Wencan Jin, *Auburn University, USA*

Mackillo Kira, *University of Michigan, USA*

Anshul Kogar, *University of California Los Angeles, USA*

Fahad Mahmood, *University of Illinois Urbana Champaign, USA*

Alon Ron, *Tel-Aviv University, Israel*

Edbert Sie, *Facebook, USA*

Julia Stähler, *Fritz Haber Institute, Germany*

Vasily Temnov, *The Institute of Molecules and Materials of Le Mans, France*

Ulrike Woggon, *Technische Universität Berlin, Germany*

Jingdi Zhang, *Hong Kong Univ. of Science & Tech., China*

Shuyun Zhou, *Tsinghua University, China*

FS 5: Nonlinear Optics and Novel Phenomena

Alexander Szameit, *Universität Rostock, Germany*, **Subcommittee Chair**

Anna Bezryadina, *California State Univ. Northridge, USA*

Andrea Blanco-Redondo, *Nokia Bell Labs, USA*

Daniel Brunner, *CNRS, France*

Hrvoje Buljan, *Technion Israel Institute of Tech., Croatia*

Demetrios Christodoulides, *University of Central Florida, USA*

Ksenia Dolgaleva, *University of Ottawa, Canada*

Tobias Herr, *Center for Free-Electron Laser Science, Switzerland*

Mona Jarrahi, *University of California Los Angeles, USA*

Arash Mafi, *University of New Mexico, USA*

Konstantinos Makris, *University of Crete, Greece*

Alireza Marandi, *California Institute of Tech. USA*

Christelle Monat, *École Centrale Lyon, France*

Sahin Ozdemir, *Pennsylvania State University, USA*

Bo Zhen, *University of Pennsylvania, USA*

FS 6: Nano-Optics and Plasmonics

Esther Wertz, *Rensselaer Polytechnic Institute, USA*, **Subcommittee Chair**

Amit Agrawal, *National Inst. of Standards & Tech., USA*

Peter Catrysse, *Stanford University, USA*

Andrea Di Falco, *SUPA, University of St Andrews, UK*

Andrea Fratalocchi, *King Abdullah Univ. of Science & Tech., Saudia Arabia*

Kelly Mauser, *AMOLF, Netherlands*

Sophie Meuret, *Laboratoire de Physique des Solides, France*

Justus Ndukaife, *Vanderbilt University, USA*

Moussa N'Gom, *Rensselaer Polytechnic Institute, USA*

Giulia Tagliabue, *EPFL, Switzerland*

Wei Zhou, *Virginia Tech, USA*

Wenqi Zhu, *National Inst. of Standards and Tech., USA*

FS 7: Ultrafast Science of Attosecond, X-Ray Free-Electron-Laser, and Ultra-Intense Light

Julia Mikhailova, *Princeton University, USA*, **Subcommittee Chair**

Cord Arnold, *Lunds Universitet, Sweden*

Boris Bergues, *Max-Planck-Institut für Quantenoptik, Germany*

Eric Cunningham, *SLAC National Accelerator Laboratory, USA*

Li Fang, *University of Central Florida, USA*

Paul Gibbon, *Institute for Advanced Simulation, Germany*

Mohammed Hassan, *University of Arizona, USA*

Peter Kraus, *ARCNL, Netherlands*

Alexandra Landsman, *ETH Zurich, USA*

Guillaume Laurent, *Auburn University, USA*

Gilad Marcus, *The Hebrew University, Jerusalem, Israel*

Hiroki Mashiko, *NTT Basic Research Laboratories, Japan*

John Nees, *University of Michigan, USA*

Alicia Palacios, *Universidad Autonoma de Madrid, Spain*

Alexander Pukhov, *Heinrich-Heine-Universität Dusseldorf, Germany*

Emma Springate, *STFC Rutherford Appleton Lab., UK*

FS 8: Metamaterials and Complex Media

Rajesh Menon, *University of Utah USA*, **Subcommittee Chair**

Precious Cantu, *Sandia, USA*

Jie Gao, *Missouri Univ. of Science & Tech., USA*

Ning Liu, *University of Limerick, Ireland*

Arka Majumdar, *University of Washington, USA*

Sean Molesky, *Princeton University, USA*

Sushil Mujumdar, *Tata Institute of Fundamental Research, India*

Xingjie Ni, *Pennsylvania State University, USA*

Mikael Rechtsman, *Pennsylvania State University, USA*

Junsuk Rho, *POSTECH, Korea*

Elena Semouchkina, *Michigan Technological Univ., USA*

Yu Yao, *Arizona State University, USA*

CLEO: Science & Innovations

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Tara Fortier, *National Institute of Standards and Tech., USA, General Chair*

Qiaoqiang Gan, *State University of New York at Buffalo, USA, Program Chair*

Clara Saraceno, *Ruhr Universität Bochum, Germany, Program Chair*

CLEO S&I 1: Light-Matter Interactions and Materials Processing

Carl Liebig, *US AFRL Wright Patterson USA, Subcommittee Chair*

Nadezhda Bulgakova, *HiLASE, Inst. of Physics CAS, Czech Republic*

Enam Chowdhury, *Ohio State University, USA*

Maria Dinescu, *NILPRP, Romania*

Vitaly Gruzdev, *University of New Mexico, USA*

Maria Kandyla, *National Hellenic Research Foundation, Greece*

Edward Kinzel, *University of Notre Dame, USA*

Takashige Omatsu, *Chiba University, Japan*

Renee Sher, *Wesleyan University, USA*

Anthony Valenzuela, *US Army Research Laboratory, USA*

Yaguo Wang, *University of Texas at Austin, USA*

CLEO S&I 2: Laser Systems and Facilities

Lutz Winkelmann, *DESY, Germany*, **Subcommittee Chair**

Marwan Ahmed, *Universität Stuttgart, Germany*

Lynda Busse, *US Naval Research Laboratory, USA*

Ioan Dancus, *IFIN-HH, ELI-NP, Romania*

Aurelie Jullien, *INPHYNI - CNRS-UCA - UNS France*

Junji Kawanaka, *Osaka University, Japan*

Katalin Mecseki, *SLAC National Accelerator Laboratory, USA*

Sandrine Ricaud, *Institut d'Optique, France*

Emily Sistrunk Link, *Lawrence Livermore National Lab., USA*

Gabrielle Thomas, *M Squared Lasers Ltd., UK*

Fan Wei, *Shanghai Inst. of Optics and Fine Mech., China*

Shang-da Yang, *National Tsing Hua University, Taiwan*

CLEO S&I 3: Semiconductor Lasers

Qing Gu, *The University of Texas at Dallas, USA*, **Subcommittee Chair**

Shamsul Arafin, *Ohio State University, USA*

Paul Crump, *Ferdinand-Braun-Institut, Germany*

Peter Heim, *Thorlabs Inc., USA*

Martin Hill, *The University of Western Australia, Australia*

Arkadiy Lyakh, *University of Central Florida, USA*

Jiaxing Wang, *University of California Berkeley, USA*

Dan Wasserman, *University of Texas at Austin, USA*

Benjamin Williams, *University of California Los Angeles, USA*

Jing Zhang, *Rochester Institute of Technology, USA*

Yuji Zhao, *Arizona State University, USA*

CLEO S&I 4: Nonlinear Optical Technologies

Sergey Vasilyev, *IPG Photonics Corp USA*, **Subcommittee Chair**

Victor Brasch, *CSEM, Switzerland*

Jaime Cardenas, *University of Rochester, USA*

Geraldine Dantelle, *CNRS, University Grenoble Alpes, France*

Ayhan Demircan, *Leibniz University Hannover, Germany*

Kavita Devi, *Indian Institute of Tech. Dharwad, India*

Miro Erkintalo, *University of Auckland, New Zealand*

Sze Set, *University of Tokyo, Japan*

Brandon Shaw, *US Naval Research Laboratory, USA*

Katia Shtyrkova, *MIT Lincoln Laboratory, USA*

Youjian Song, *Tianjin University, China*

Dawn Tan, *Singapore Univ. of Technology & Design, Singapore*

CLEO S&I 5: Terahertz Science and Technology

Pernille Pedersen, *Aarhus Universitet, Denmark*, **Subcommittee Chair**

M. Hassan Arbab, *Stony Brook University, USA*

Mattias Beck, *ETH Zurich, Switzerland*

Jessica Boland, *University of Manchester, UK*

Frank Hegmann, *University of Alberta, Canada*

George Keiser, *Washington College, USA*

Rebecca Milot, *University of Warwick, UK*

Martin Mittendorff, *Universitaet Duisburg-Essen, Germany*

Minah Seo, *Korea Institute of Science & Tech., South Korea*

Xiaojun Wu, *Beihang University, China*

CLEO S&I 6: Optical Materials, Fabrication and Characterization

Jifeng Liu, *Dartmouth College USA, Subcommittee Chair*

Jiming Bao, *University of Houston, USA*

Tingyi Gu, *University of Delaware, USA*

Shengxi Huang, *Pennsylvania State University, USA*

Lih Lin, *University of Washington, USA*

Oana Malis, *Purdue University, USA*

Donguk Nam, *Nanyang Technological University, Singapore*

Richard Osgood, *Columbia University, USA*

Roberto Paiella, *Boston University, USA*

Georgia Papadakis, *Stanford University, Spain*

Fengnian Xia, *Yale University, USA*

CLEO S&I 7: Micro- and Nano-Photonic Devices

Karen Grutter, *The Laboratory for Physical Sciences, USA, Subcommittee Chair*

Kristinn Gylfason, *Kungliga Tekniska Hogskolan, Sweden*

Benjamin Lee, *IBM TJ Watson Research Center, USA*

Marko Loncar, *Harvard University, USA*

Kengo Nozaki, *NTT Corporation, Japan*

Yasutomo Ota, *University of Tokyo, Japan*

Joyce Poon, *Max-Planck-Inst. fur Mikrostrukturphysik, Germany*

Milos Popovic, *Boston University, USA*

Michelle Povinelli, *University of Southern California, USA*

Minhao Pu, *Danmarks Tekniske Universitet, Denmark*

Amir Safavi-Naeini, *Stanford University, USA*

Harish Subbaraman, *Boise State University, USA*

Joel Yang, *Singapore Univ. of Technology & Design, Singapore*

Nathan Youngblood, *University of Oxford, USA*

CLEO S&I 8: Ultrafast Optics & Applications

Csaba Toth, *Lawrence Berkeley National Laboratory, USA*, **Subcommittee Chair**

Ticijana Ban, *Institut za Fiziku, Croatia*

Olivier Chalus, *Thales Optronique SA, France*

Giacomo Coslovich, *SLAC USA*

Hiromitsu Kiriya, *National Inst. Quantum & Rad Science & Tech., Japan*

Manchikanti Krishnamurthy, *Tata Institute of Fundamental Research, India*

Ming-wei Lin, *National Tsing Hua University, Taiwan*

Andreas Maier, *University of Hamburg, Germany*

Zsuzsanna Slattery-Major, *GSI Helmholtzzentrum für Schwerionenfors, Germany*

Lucia Akemi, *Saito Mackenzie, Brazil*

CLEO S&I 9: Photonic Integration

Alan Wang, *Oregon State University USA*, **Subcommittee Chair**

Andreas Beling, *University of Virginia, USA*

Ozdal Boyraz, *University of California Irvine, USA*

Jonathan Bradley, *McMaster University, Canada*

Lukas Chrostowski, *University of British Columbia, Canada*

Sungwon Chung, *Neuralink Corporation, USA*

Martin Cryan, *University of Bristol, UK*

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Wei Jiang, *Nanjing University, China*

Laurent Schares, *IBM, USA*

Xiankai Sun, *Chinese University of Hong Kong, USA*

Yuze Sun, *University of Texas at Arlington, USA*

Shumin Xiao, *HIT Shenzhen, China*

Beibei Zeng, *Lehigh University, USA*

CLEO S&I 10: Photonic Innovations for Biological Sciences

Emily Gibson, *University of Colorado Denver USA, Subcommittee Chair*

Mark Foster, *Johns Hopkins University, USA*

Juliet Gopinath, *University of Colorado at Boulder, USA*

Hao He, *Shanghai Jiao Tong University, China*

Jakub Nedbal, *King's College London, UK*

Nicolas Pégard, *Univ. of North Carolina at Chapel Hill, USA*

Zhenpeng Qin, *The University of Texas at Dallas, USA*

Mahsa Ranji, *University of Wisconsin-Milwaukee, USA*

Michelle Sander, *Boston University, USA*

Miho Suzuki, *Saitama University, Japan*

Fan Xiong, *Bio-Rad Laboratories, Inc., USA*

CLEO S&I 11: Fiber Photonics: Novel Phenomena, Lasers, Systems and Fabrication

Camille-Sophie, *Brès Ecole Polytechnique Federale de Lausanne, Switzerland, Subcommittee Chair*

Raja Ahmad, *OFS Laboratories, USA*

Rodrigo Amezcua, *Correa University of Central Florida, CREOL, USA*

Sonia Boscolo, *Aston University, UK*

Guoqing Chang, *Institute of Physics, CAS, China*

Maria Chernysheva, *Leibniz Institute of Photonic Technology, Germany*

Marc Eichhorn, *Fraunhofer IOSB, Germany*

Takemi Hasegawa, *Sumitomo Electric Industries Ltd., Japan*

Darren Hudson, *Macquarie University, USA*

Shibin Jiang, *AdValue Photonics Inc., USA*

Li Qian, *University of Toronto, Canada*

William Renninger, *University of Rochester, USA*

Martin Rochette, *McGill University, Canada*

Yingying Wang, *Jinan University, China*

Logan Wright, *Cornell University, USA*

CLEO S&I 12: Lightwave Communications and Optical Networks

Francesco Da Ros, *DTU Fotonik, Denmark, Subcommittee Chair*

Nan Chi, *Fudan University, China*

Mihaela Dinu, *LGS Innovations LLC, USA*

Amirhossein Ghazisaeidi, *Nokia Bell Labs France, France*

Kiyo Ishii, *AIST Tokyo, Japan*

Fotini Karinou, *Microsoft Research Ltd., UK*

Magnus Karlsson, *Chalmers Tekniska Hogskola, Sweden*

Christina Lim, *University of Melbourne, Australia*

Giovanni Milione, *NEC Laboratories America Inc., USA*

Edson Porto da Silva, *Federal University of Campina Grande, Brazil*

Jade Wang, *MIT Lincoln Laboratory, USA*

CLEO S&I 13: Active Optical Sensing

Adam Fleisher, National Inst. of Standards & Tech., USA, **Subcommittee Chair**

Denis Donlagic, *University of Maribor, Slovenia*

Erik Emmons, *US Army CCDC CBC, USA*

Nicolas Le Thomas, *Ghent University, INTEC Belgium*

Madhavi Martin, *Oak Ridge National Laboratory, USA*

Andrey Muraviev, *CREOL, University of Central Florida, USA*

Zachary Reed, *National Inst. of Standards & Tech. USA*

Lucile Rutkowski, *Institute of Physics of Rennes, France*

Garwing Truong, *Thorlabs Inc., USA*

Eric Zhang, *IBM T. J. Watson Research Center, USA*

CLEO S&I 14: Optical Metrology

Ladan Arissian, *National Institute of Standards and Technology (NIST), USA*,
Subcommittee Chair

Florian Adler, *Tiger Optics, USA*

Esther Baumann, *National Inst. of Standards & Tech., USA*

Fred Baynes, *University of Adelaide, Australia*

Pierre-François Cohadon, *Ecole Normale Supérieure – Université PSL, France*

Flavio C. Cruz, *Universidade Estadual de Campinas, Brazil*

Pascal Del'Haye, *Max Planck Inst. for Science of Light, Germany*

Jérôme Genest, *Universite Laval, Canada*

Haifeng Jiang, *University of Science and Technology of China (USTC), China*

Yanyi Jiang, *East China Normal University, China*

Jungwon Kim, *Korea Advanced Inst. of Science & Tech., Korea*

Matthew Kirchner, *Thorlabs Inc., USA*

John McFerran, *University of Western Australia, Australia*

Takeshi Yasui, *Tokushima University, Japan*

Tai Hyun Yoon, *Korea University, South Korea*

CLEO S&I 15: Quantum and Atomic Devices and Instrumentation

Eisuke Abe, *RIKEN, Japan*, **Subcommittee Chair**

Hannes Bernien, *University of Chicago, USA*

Warwick Bowen, *University of Queensland, Australia*

Paul Hamilton, *University of California, USA*

Shau-Yu Lan, *Nanyang Technology University, Singapore*

Franck Pereira dos Santos, *SYRTE, France*

Qudsia Quraishi, *US Army Research Laboratory, USA*

Erling Riis, *University of Strathclyde, UK*

Marianna Safronova, *University of Delaware, USA*

Kasturi Saha, *Indian Institute of Tech., Bombay India*

Susan Schima, *National Inst. of Standards and Tech., USA*

James Shaffer, *Quantum Valley Ideas Laboratory, Canada*

CLEO Diversity & Inclusion Task Force

Mission: The purpose of this taskforce is to find ways to expand and focus diversity and inclusivity efforts at the CLEO conference with the goals of improving innovation and technical excellence by fostering community vitality, openness and inclusion.

Arti Agrawal, *University of Technology Sydney, Australia*

Peter Andersen, *Danmarks Tekniske Universitet, Denmark*

Ben Eggleton, *University of Sydney, Australia*

Tara Fortier, *National Institute of Standards and Technology, USA*

Niamh Kavanagh, *Tyndall National Institute, Ireland*

Michal Lipson, *Columbia University, USA*

Michael Mielke, *Iradion Laser Inc., USA*

Irina Novikova, *College of William & Mary, USA*

Rohit Prativadi Prasankumar, *Los Alamos National Lab., USA*

Stephanie Tomasulo, *Naval Research Laboratory, USA*

CLEO 2022 Chairs

Applications & Technology

Ilko Ilev, *Food and Drug Administration, USA, General Chair*

Dirk Müller, *Coherent Inc., USA, Program Chair*

Stephanie Tomasulo, *Naval Research Laboratory, USA, General Chair*

Jie Qiao, *Rochester Institute of Tech., USA, Program Chair*

Fundamental Science

Mercedeh Khajavikhan, *University of Southern California, USA, General Chair*

Tracy Northup, *University of Innsbruck, Austria, General Chair*

Julia Mikhailova, *Princeton University, USA, Program Chair*

Alexander Szameit, *Universität Rostock, Germany, Program Chair*

Science & Innovations

Rohit Prativadi Prasankumar, *Los Alamos National Laboratory, USA, General Chair*

Takasumi Tanabe, *Keio University, Japan, General Chair*

Camille Sophie Brès, *Ecole Polytechnique Federale de Lausanne, France, Program Chair*

Roberto Paiella, *Boston University, USA, Program Chair*

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IEEE/Photonics Society

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Anna Claire Peacock, *University of Southampton, UK*

Michelle Sander, *Boston University, USA*

Ping-kong Alexander Wai, *Hong Kong Polytechnic University, Hong Kong*

APS/Division of Laser Science

Peter Delfyett, *CREOL, University of Central Florida, USA*

Rohit Prasankumar, *Los Alamos National Laboratory, USA*

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Tara Fortier, *National Institute of Standards & Tech., USA*

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Ilko Ilev, *Food and Drug Administration, USA*

Jin Kang, *Johns Hopkins University, USA*

Mercedeh Khajavikhan, *Univ. of Southern California, USA*

Natalia Litchinitser, *Duke University, USA*

Julia Mikhailova, *Princeton University, USA*

Eric Mottay, *Amplitude Systemes, France*

Dirk Müller, *Coherent Inc., USA*

Tracy Northup, *Universität Innsbruck, Austria*

Josh Nunn, *University of Bath, UK*

Roberto Paiella, *Boston University, USA*

Viktor Podolskiy, *University of Massachusetts, Lowell, USA*

Sergey Polyakov, *National Institute of Standards & Tech., USA*

Jie Qiao, *Rochester Institute of Tech., USA*

Clara Saraceno, *Ruhr Universität Bochum, Germany*

Alexander Szameit, *Universität Rostock, Germany*

Takasumi Tanabe, *Keio University, Japan*

Stephanie Tomasulo, *Naval Research Laboratory, USA*

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Elizabeth A. Rogan, *The Optical Society, USA*

Joint Council on Applications

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Amy Eskilson, *Inrad Optics, USA*

Peter Fendel, *Thorlabs Inc., USA*

Klausa Klein, *Coherent, Inc., USA*

Rick Plympton, *Optimax Systems, USA*

Mark Tolbert, *Toptica Photonics, USA*

Diversity & Inclusion

The purpose of this Task Force is to find ways to expand and focus diversity and inclusivity efforts at the CLEO conference with the goals of improving innovation and technical excellence by fostering community vitality, openness and inclusion.

The Task Force aims to reach the following diversity targets for the CLEO program:

Diverse members, speakers and panelists are currently defined as persons other than cisgender, heterosexual, able-bodied, white men. Targets will be measured on a 3-year rolling average basis and should roughly comprise an overlapping representation of 33% women, 20% geographical diversity, and 15% racial/ethnic minorities. The definition of diverse members and targets will be periodically re-evaluated based on changes to diversity and inclusion standards and to ensure that the technical excellence of the conference is being upheld.

- **Steering Committee** (33% by 2024, 50% by 2026)
- **General Chairs** (33% by 2024, 50% by 2026)
- **Program Chairs** (33% by 2024, 50% by 2026)
- **Sub-committee Chairs** (33% by 2024, 50% by 2026)
- **Committee Members** (33% by 2024, 50% by 2026)
- **Plenary Speakers** (50% by 2024)
- **Invited Talks** (33% by 2024, 50% by 2026)
- **Tutorial Speakers** (20% by 2024, 33% by 2026)
- **Workshop Panelists:** (33% by 2024, 50% by 2026)
- **D&I Task Force Members:** (50%)
- **Short List for CLEO Award Winners** (30% by 2024)

Recruitment to the Task Force is open to the community at large. New members may be considered for membership on the Task Force in June of each year.

CLEO Diversity & Inclusion Task Force Members

Arti Agrawal, *University of Technology Sydney, Australia*

Peter Andersen, *Danmarks Tekniske Universitet, Denmark*

Ben Eggleton, *University of Sydney, Australia*

Tara Fortier, *National Institute of Standards and Technology, USA*

Niamh Kavanagh, *Tyndall National Institute, Ireland*

Michal Lipson, *Columbia University, USA*

Michael Mielke, *Iradion Laser Inc., USA*

Irina Novikova, *College of William & Mary, USA*

Rohit Prativadi Prasankumar, *Los Alamos National Lab., USA*

Grants, Awards and Prizes

CLEO cleoconference.org/home/about-cleo/recognition-support

Recognition and Assistance: In Support of the CLEO Community

The CLEO Conference supports a community of scientists working on the latest advances in the science and applications of lasers and opto-electronics. The goal of co-sponsors and committee members is to create a meeting experience that truly represents the global community. We provide awards, prizes and grants to ensure an experience that is professionally inclusive and geographically diverse.

Specific information on eligibility, the application process and deadlines can be found in [Submit Papers](#).

Awards and Prizes

Students, recent graduates and early-career professionals are encouraged to present their research. The experience offers invaluable opportunities to get your name and research in front of an esteemed, international audience – at a career stage when building professional relationships is most essential for future success. CLEO supports your professional goals with several recognition opportunities.

American Physics Society - Division of Laser Science (APS/DLS)

Poster Presentation and Award

Undergraduate and graduate students who present at CLEO are invited to participate in a poster competition hosted by the Division of Laser Science of the American Physical Society. Three best-poster awards are given. Recipients receive a certificate and USD 100. Membership in APS and DLS is required to participate.

OSA Foundation

Maiman Student Paper Competition

The Maiman Paper Competition recognizes student innovation, research excellence and presentation skills in the areas of laser technology and electro-optics. The competition, established in 2008, is endowed by a grant from HRL Laboratories, LLC, IEEE Photonics Society and APS Division of Laser Science and is administered by the OSA Foundation.

Finalists present their papers to a panel of judges virtually the week before the meeting. One winner receives USD 3,000; two honorable mention recipients each receive a certificate.

Tingye Li Innovation Prize

The Tingye Li Innovation Prize is presented to an early-career professional who has demonstrated innovative research via a paper and reference documents submitted for consideration during the CLEO Conference. The prize, established in 2013, is endowed by Alliance Fiber Optic Products, Inc., AT&T, The Optical Society, IEEE Photonics Society, IEEE Communications Society, Thorlabs, Inc, The Li Family and supporters of the Tingye Li Memorial Fund, and is administered by the OSA Foundation.

The grand prize recipient receives USD 3,000, a special invitation to the Chairs' Reception and recognition during the conference.

James P. Gordon Memorial Speakership Program

The James P. Gordon Memorial Endowment funds a speakership on quantum information and quantum optics to a CLEO invited speaker. This speakership, established in 2014, is endowed by the Gordon family, and supporters of the James P. Gordon Memorial Fund, and is administered by The OSA Foundation.

One recipient will receive an honorarium of USD 1,500. His/her presentation will be recorded and archived in the OSA Media Library.

Grants

The co-sponsors and committee believe that all individuals with accepted papers should have the ability to present at CLEO, regardless of financial concerns or family obligations. Speakers can consider the following support options.

American Physics Society - Division of Laser Science (APS/DLS)

Child Care Grant Program

Grants of up to USD 500 are available to assist DLS members who are bringing children to CLEO or who incur extra expenses in leaving them at home (e.g., extra daycare or babysitting services). Funds will be distributed on a first-come, first-served basis.

Student Travel Grant Program

DLS provides partial funding up to USD 500/grant for a limited number of graduate students to attend and participate in CLEO.

OSA Foundation

Incubic/Milton Chang Travel Grant

Travel grants of USD 500 each are provided to 10 students presenting papers at CLEO. Travel grants are awarded to the presenter and usually the first author of the paper. The program is funded by an endowment from Milton and Rosalind Chang and managed by the OSA Foundation.

Other Co-sponsor Awards

Each of the three CLEO co-sponsors manages awards programs that seek to recognize the considerable professional achievements of their members. While the awards and medals are not contingent upon a CLEO presentation, recipients are a vital part of our community. They make extraordinary contributions to research, engineering, education and industry.

American Physical Society - Division of Laser Science Awards

Division of Laser Science was established in 1985. DLS promotes laser science interests within the APS and represents such interests with other societies. Sponsors awards and educational programs, including APS Arthur L. Schawlow Prize in Laser Science, APS Fellowship, Distinguished Traveling Lecturer Program and New Laser Scientists Conference.

IEEE Photonics Society Awards

The IEEE Photonics Society Awards Program was established to honor the outstanding achievements of its members by recognizing their contributions in advancing the fields of interest to the benefit of society, and enhancing the quality of life for all people throughout the world. For eligibility/submission requirements, please visit photonicsociety.org/awards.

The Optical Society (OSA) Awards and Medals

OSA recognizes and celebrates the field's technical, research, engineering, education, business, leadership and service accomplishments. Awards program spans all areas of optics and photonics, as well as contributions made to the community. Several awards, including the Charles Hard Townes Medal, are of interest and relevance to the CLEO community. Use the award category guide to find appropriate options.

Program & Speakers

CLEO cleoconference.org/home/program

Programs

2,000+ technical sessions will be presented at CLEO, including talks from more than 200 invited speakers, will cover 29 topic categories — from breakthrough ideas to real-world applications. Contributed talks are rigorously peer reviewed by the CLEO Committees.

A&T Topical Reviews | Special Symposia | Workshops | Short Courses | Special Events

Applications & Technology Topical Reviews

Emphasizes significant recent advances in the application of photonics technologies to address current real world problems. Presentations by leaders in their fields highlight how important advances are being realized.

Special Symposia

Comprised of invited and contributed papers, on areas deemed to be topical and of special interest to conference attendees.

Workshops

Provides convivial, interactive, open fora to address topics not covered by traditional presentations, but that are of interest and importance to the CLEO community. Workshops offer an informal format to enable open discussion between moderators and panels of specialists and the audience to address technical or strategic questions that may lack clear consensus.

Short Courses

Covers a broad range of topic areas at a variety of educational levels, and taught by highly-regarded industry experts on a number of subjects. Whether you choose a course designed for beginners or for more advanced instruction, the small size of each class gives you an excellent opportunity for personalized instruction. Registrants receive one copy of the Course Notes, which will be distributed onsite.

Special Events

Make the most of your attendance at CLEO with a range of networking and educational events. Special events range from receptions to career development programs.

Plenary Speakers

CLEO cleoconference.org/home/program/plenary-speakers

CLEO presents two plenary sessions. Each program includes plenary talks as well as recognition of honors and awards bestowed by the three conference co-sponsors.

Join the American Physical Society - Division of Laser Science, IEEE Photonics Society, The Optical Society and the OSA Foundation as they celebrate the considerable professional achievements of their members. Recognitions include Fellows from each Society, the Arthur L. Schawlow Prize in Laser Science (ASP-DLS), the Andrew S. Grove Award (ISP), and the Charles Hard Townes Medal (OSA).

Speakers

Nicolas Gisin, *Professor Emeritus, University of Geneva*

From Quantum Foundations to Quantum Communications and Back

Plenary Session I: Monday, 09:00 - 11:15

Quantum information science emerged from studies on the foundations of quantum physics. The talk will illustrate this, starting from Bell inequalities all the way to commercial Quantum Key Distribution and Quantum Random Number Generator chips. However, the story does not stop here. Quantum information science, in turn, feeds back into the foundations, asking questions like, e.g., “how does non-locality manifest in quantum networks”.



Biography: Nicolas Gisin was born in Geneva, Switzerland, in 1952. After a master in physics and a degree in mathematics, he received his PhD degree in Physics from the University of Geneva in 1981 for his dissertation in quantum and statistical physics. The “Fondation Louis de Broglie” recognised this work with an award.

After a post-doc at the University of Rochester, NY, he joined a start-up company, Alphatronic, dedicated to fiber instrumentation for the telecommunication industry. Initially head of the software, he quickly became responsible for the hardware-software interface. Four years later he joined a Swiss software company developing an image processing package, which received the attention of the American journal “PC Magazine”.

In 1988 an opportunity to join the Group of Applied Physics at the University of Geneva as head of the optics section brought him back to the academic life. At the time the optics section was entirely devoted to support of the Swiss PTT (now Swisscom). In order to get a critical mass and stability, the optics section under the impulse of Gisin started two new research directions, one in optical sensors, one in quantum optics. The telecom and the

sensing activities led to many patents and technological transfers to Swiss and international industries. Several products had and still have a commercial success. The quantum optics activities are more basic research oriented. The main theme is to combine the large expertise of the group in optical fibers with basic quantum effects. More recently, the demonstration of quantum cryptography and of long distance quantum entanglement received quite a lot of attention as well from the international scientific community as from the press “grand public”.

Stefanie K. Johnson, *Associate Professor, University of Colorado Boulder, Leeds School of Business, USA*



Diversity, Equity and Inclusion Talk: Inclusify 2021

Plenary Session II: Friday, 10:00 - 11:30

This talk demonstrates the nature of unconscious bias in a visceral way and then provides simple, research-based practices that interrupt bias and improve decision-making. The talk then moves to a focus on how to be proactively inclusive. Most leaders want to be inclusive but just don't know what steps to take to get there. I will explain what it takes to make people feel included by digging into our two most basic human needs: to be unique and to belong.

Biography: Stefanie K. Johnson is a researcher focused on the intersection of leadership and diversity and works with the best companies to implement evidence-based practices to reduce unconscious bias and increase inclusion. She is a member of the MG 100 Coaches, was selected for the 2020 Thinkers50 Radar List and is the author of the National Bestseller, *Inclusify: Harnessing the power of uniqueness and belonging to build innovative teams*. She publishes her work in the top journals and has received US\$ 3,800,000 in external grant funding. She has presented her work at over 170 meetings around the world including at the White House for a 2016 summit on diversity in corporate America. Media outlets featuring her work include: *The Economist*, *Newsweek*, *Time*, *Wall Street Journal*, Bloomberg, HuffPost, *Marie Claire*, *Washington Post*, Quartz, Discover, CNN, ABC, NBC and CNBC. She has appeared on Fox, ABC, NBC, CNN and CNN International.

Margaret Murnane, *STROBE and JILA, University of Colorado at Boulder, USA*

Harnessing Attosecond Quantum Technologies

Plenary Session II: Friday, 10:00 - 11:30

High harmonic quantum light sources provide an exquisite ability to harness and control short wavelength light, with unprecedented



control over the spectral, temporal, polarization and orbital angular momentum waveforms. These represent the most-complex coherent electromagnetic fields ever created, controlled on sub-Å spatial scales and sub-attosecond temporal scales, from the UV to the keV photon energy region. These advances are providing powerful new tools for near-perfect x-ray imaging, for coherently manipulating quantum materials using light, and for designing more efficient nanoscale devices.

Biography: Margaret Murnane is the Director of the National Science Foundation STROBE Center on Real Time Functional Imaging, and a Fellow of JILA at the University of Colorado, Boulder. She runs a joint, multi-disciplinary, research group with her husband Henry Kapteyn. She received her BS and MS degrees from University College Cork, Ireland, and her PhD degree from the University of California, Berkeley. Murnane, with students and collaborators, uses coherent beams of laser and x-ray light to capture the fastest dynamics in materials at the nanoscale.

Jeremy O'Brien, *CEO, PsiQuantum, USA*

Silicon Photonic Quantum Computing'

Plenary Session I: Monday, 09:00 - 11:15

PsiQuantum's goal is to build the world's first useful quantum computer using silicon photonic chips to process quantum information with single photons. A linear optical approach to quantum computing offers highly coherent qubits, high fidelity single qubit gates, and probabilistic entangling operations that can be implemented using well-known quantum optical methods. Architectures for fault tolerant quantum computing based on these operations can have very low optical depth and extremely high tolerance to optical loss. The key advantage of photonic quantum computing is the fact that the required photonic chips can be produced in conventional fabrication facilities used for commercial silicon photonics, allowing scaling to achieve large-scale error correction. We will discuss PsiQuantum's approach to fault tolerant quantum computing.



Biography: Jeremy O'Brien is Co-founder and CEO of PsiQuantum, which is building a large-scale general purpose silicon photonic quantum computer. Prior to founding the company, Jeremy was Professor of Physics and Electrical Engineering at the University of Bristol and Director of the Centre for Quantum Photonics. He holds a Royal Academy of Engineering Research Chair in Emerging Technologies. He received his PhD from the University of New South Wales and held research positions at the University of Queensland before joining the University of Bristol. He is a Fellow of the American Physical Society and the Institute of Physics. His research on quantum optics and quantum information science with single photons has focused on the fundamental and applied quantum mechanics at the

heart of quantum information science and technology, ranging from prototypes for scalable quantum computing to generalized quantum measurements, quantum control and quantum metrology.

Alan Eli Willner, *Professor, University of Southern California, USA*

Optical Communications: Innovations and Applications Abound

Plenary Session I: Monday, 09:00 - 11:15

Optical fiber is a key enabler of high-capacity and long-distance communications. However, many applications of optical communications beyond conventional fiber systems are emerging that harness photonic technologies, especially using photonic-integrated-circuits. This plenary will explore innovations towards enabling important applications of optical communications, including: links through air, underwater and to satellites; targeted and efficient signal processing; and systems using non-conventional wavelengths.



Biography: Alan Willner received the BA/HonDHL (Yeshiva University) and PhD (Columbia University), and he is the Steven & Kathryn Sample Chair at the University of Southern California. His honors include: Member of US National Academy of Engineering; International Fellow of UK Royal Academy of Engineering; NSF Presidential Faculty Fellows Award from White House; Bush, Fulbright, Guggenheim and Packard Fellowships; IEEE Sumner Award; Egleston Medal from Columbia Engineering Alumni Association; Ellis Island Medal of Honor; OSA Forman Engineering Excellence Award; IET Thomson Medal; IEEE Globecom Best Paper Award; Eddy Best Technical Paper Award; Fellow of National Academy of Inventors; and SPIE President's Award. He was Co-chair of US National Academies' Study on Optics & Photonics; President of The Optical Society and IEEE Photonics Society; Member of US Army Science Board; and Editor-in-Chief of Optics Letters and IEEE/OSA J. Lightwave Technology.

Workshops

CLEO cleoconference.org/home/program/workshops

The goal of workshops is to provide a convivial, interactive, open forum to address technical topics not covered by traditional presentations, but that are of interest and importance to the CLEO community. The format is less formal than a technical session or symposium so as to enable open discussion of technical and strategic questions for which there is no clear consensus.

Workshop topics:

Achieving Level 5 Autonomy in Self Driving Cars

Analog vs. Digital Photonic Information Processing

How can Optics Contribute Towards Addressing Future Pandemics?: From Advanced Developments to Challenges and Limitations

Is Quantum Technology Ready for Prime Time?!

Achieving Level 5 Autonomy in Self Driving Cars

There are five levels of autonomy in self driving cars, with level 5 being the most advanced (i.e. not requiring the presence of a human driver at all). This is also the most difficult problem to solve, with numerous hardware challenges such as cost, size, weight, power consumption, and limited processing power of the sensing systems, as well as the numerous edge cases that need to be addressed by the perception software. Moreover, the infrastructure of cities may have to be upgraded to support autonomous vehicles, and legislation will have to evolve to address concerns of liability and accountability. This workshop will aim to answer the fundamental question: will we ever achieve Level 5 autonomy? And if so, how do we get there?

Organizers:

Barry Behnken, *York Space Systems, USA*

Ilko Ilev, *U.S. Food and Drug Administration, USA*

Paul McManamon, *University of Dayton, Ohio, USA*

Michael Mielke, *Iradion Laser Inc., USA*

Umar Piracha, *Zoox Inc., US*

Speakers:

Sharon Di, *Columbia University, USA*

Luis Dussan, *AEye Lidar, USA*

Gail Gottehrer, *Law Office of Gail Gottehrer, LLC, USA*

Christy Fernandez-Cull, *Lyft, USA*

Analog vs. Digital Photonic Information Processing

The physics of optical and PIC-based information processing and non-van Neumann computing, including machine learning, offers compelling arguments such as non-iterative $O(1)$ runtime complexity, ps-short signal delay, massive (10^6) parallelism of free-space, a natural spatial Fourier transformation, low-loss 'wire', and foundry fabrication maturity. However, an outstanding question this workshop aims to address is, whether optics and PICs can be a competitive technology not only for digital data communication, but also for analog computing and processing. Recent advances in photonic tensor cores, VMMs, photonic FPGAs, and special-purpose accelerators including neural networks point to competitive systems specifically where the signals are already in the optical domain and hence are analog in nature. Thus, what are the trade-offs and opportunities for digital vs. analog optical information processing?

Organizers:

Viktor Podolskiy, *University of Massachusetts Lowell, USA*

Sergey Polyakov, *National Institute of Standards and Technology, USA*

Volker Sorger, *George Washington University, USA*

Speakers:

Bahram Jalali, *University of California Los Angeles, USA*

Achuta Kadambi, *University of California Los Angeles, USA*

Ken-ichi Kitayama, *Osaka University, Japan*

Volker Sorger, *George Washington University, USA*

How can Optics Contribute Towards Addressing Future Pandemics?: From Advanced Developments to Challenges and Limitations

Unprecedented severity of the ongoing pathogen contamination outbreak caused by COVID-19 threatens the world and requires urgent measures including development and implementation of innovative and effective diagnostics and therapeutics techniques to

address the current and future pandemics. Biophotonics and nanobiophotonics optical approaches offer unique capabilities in developing advanced modalities for high-resolution, label-free, remote and rapid detection and quantification of novel viral pathogens. However, the optical approaches face some challenges and limitations related to potential applications such as the use of: UV radiation for effective decontamination and cleaning; spectroscopy techniques for rapid and sensitive pathogen detection and virus probing; and label-free fast IR sensing of decontamination in portable clinical settings. The present workshop aims to highlight and discuss these challenges along with advanced optical contributions.

Organizers:

Tara Fortier, *National Institute of Standards and Technology, USA*

Emily Gibson, *University of Colorado, Denver, USA*

Ilko Ilev, *U.S. Food and Drug Administration, USA*

Utkarsh Sharma, *Catapult Sky, USA*

Speakers:

Andrea Armani, *University of Southern California, USA*

Eric Diebold, *BD, USA*

Ilko Ilev, *FDA, USA*

Laura Lechuga, *Catalan Institute of Nanoscience and Nanotechnology, Spain*

Chris Myatt, *LightDeck Diagnostics, USA*

Juergen Popp, *Leibniz Institute of Photonic Technology, Germany*

Is Quantum Technology Ready for Prime Time?!

Quantum technologies are seeking to serve a massive application space including quantum cryptography, quantum information and networks, as well as quantum sensing and metrology. While success in these areas might result in a second quantum revolution, how will the quantum community face the significant technological hurdles en route to practical implementation? For instance, given that entangled systems are inherently fragile, how will commercial systems overcome decoherence, loss and low SNR to create robust and reliable quantum-ready products? This workshop will bring together leaders in industry, policy, researchers and program managers to discuss whether we are on the verge of a commercial breakthrough, or whether quantum technology will go down in history as just hype.

Organizers:

Peter Fendel, *Thorlabs Inc., USA*

Tara Fortier, *National Institute of Standards and Technology, USA*

Wilhelm Kaenders, *TOPTICA Photonics Inc., Germany*

Josh Nunn, *University of Bath, UK*

Sergey Polyakov, *National Institute of Standards and Technology, USA*

Speakers:

Tatjana Curcic, *DARPA, USA*

Bruno Desruelle, *MUQUANS, France*

Justin Ging, *Honeywell Quantum Solutions, USA*

Sir Peter Knight, *Imperial College, UK*

Celia Merzbacher, *SRI International, USA*

Carmen Palacios-Berraquero, *NuQuantum, UK*

Zheng-Shen Yuan, *University of Science and Technology of China, China*

Special Events

CLEO cleoconference.org/home/program/special-events

Award and Fellow Presentations

Join the American Physical Society - Division of Laser Science Awards, IEEE Photonics Society, and The Optical Society as they celebrate the considerable professional achievements of their members. Recognitions include Fellows from each Society, the Arthur L. Schawlow Prize in Laser Science (APS-DLS), the Andrew S. Grove Award (IEEE PS), and the Charles Hard Townes Medal (OSA).

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Optimizing Career Paths in Optics: The Guide for Young Professionals

Sunday, 9 May, 17:00 – 18:30

Hosted by CLEO

Career planning is very important for young professionals in optics. Different career paths are available, each with its own requirements, challenges, and rewards. We invite you to hear firsthand from your early career and more seasoned colleagues alike about their jobs and the paths they took to get there. Practical questions on how to excel in an optics-related career will be answered in addition to an open Q&A to tackle the questions most pressing to you.

Organizers:

- Christophe Dorrer, *University of Rochester, USA*
- Natalia Litchinitser, *Duke University, USA*
- Sergey Polyakov, *National Institute of Standards and Technology, USA*
- Stephanie Tomasulo, *U.S. Naval Research Laboratory, USA*

Presenters:

- Andrea Blanco-Redondo, *Nokia Bell Labs, USA*
- Alan Fry, *SLAC National Accelerator Laboratory, USA*
- Randy Giles, *The Optical Society, USA*
- Daehwan Jung, *KIST, Korea*
- Gregory Rieker, *University of Colorado at Boulder, USA*
- Jelena Vuckovic, *Stanford University, USA*

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What's Next in Integrated Photonics – Hot Topics at CLEO: 2021

Monday, 10 May, 07:00 – 08:00

Join the OSA Integrated Photonics Technical Group for a panel discussion on Monday. Our featured presenters will give their perspective on the exciting research that will be presented at CLEO: 2021. These presentations will be followed by a moderated question and answer session, discussing the highlights in integrated photonics at the conference. This event is an excellent opportunity to hear from experts in the field on exciting new areas in integrated photonics. Panelists include Juejun Hu, Massachusetts Institute of Technology; Roel Baets, Ghent University; Mercedeh Khajavikhan, University of Southern California; and Rachel Grange, ETH Zurich.

Hosted by:



Technology Showcase: Simple Operation & Locking of a Continuously Tunable Laser

Monday, 10 May, 11:15 – 11:35

Toptica Photonics, Inc.: TOPTICA's continuously tunable laser, the CTL, enables mode-hop-free wavelength tuning up to 120 nm with narrow linewidth and highest accuracy. In this demo, we show how to operate the laser with the fully digital, low noise and drift DLC pro controller using intuitive touch screen controls. To illustrate the convenient features of the laser and DLC pro controller, the system is connected to a spectroscopy cell and the transmission spectra is measured by a photodiode and recorded by the DLC pro. The ability to review the live data live and use the new Auto-PID feature to lock the laser to a specific laser line will be demonstrated as well. With applications in device characterization, quantum and materials analysis, it is ideal for any application requiring high precision mode-hop free laser operation over a wide tuning range.

Speaker: Rudolf Neuhaus, *Toptica Photonics, Inc., Germany*

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Technology Showcase: New and Featured Products for Laser Applications

Monday, 10 May, 11:40 – 12:00

OptoSigma Corporation: Join us for an exciting and concise presentation on our newest and featured products, all suitable for research or commercial laser applications. A few examples are the OUCI imaging and laser induction modules, our in-house manufactured UV and NIR Objectives and our expanding product line of MHX Stainless-Steel, high performance mirror mounts. We think you'll appreciate and enjoy our presentation.

Speaker: Dan Denison, *OptoSigma Corporation, USA*

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OSA Quantum Optical Science and Technology Technical Group 20x20 Talks

Monday, 10 May, 14:00 – 15:00

This special session hosted by the OSA Quantum Optical Science and Technology Technical Group offers a unique platform for individuals to present their research in a creative and concise fashion that differs from the usual oral or poster session. Join us as selected participants from the technical group showcase their research in a presentation of 20 images. Our presenters will talk along to the images in their presentation as each slide advances automatically after just 20 seconds.

Hosted by:



What's Next in Ultrafast Optical Phenomena – Hot Topics at CLEO: 2021

Tuesday, 11 May, 04:00 – 05:00

Join the OSA Ultrafast Phenomena Technical Group for a panel discussion on Tuesday. Our featured presenters will give their perspectives on the exciting research that will be presented at CLEO 2021. These presentations will be followed by a moderated question and answer session, discussing the highlights in Ultrafast Phenomena at the Conference. This event is an excellent opportunity to hear from experts in the field on exciting new areas in Ultrafast Optical Phenomena. Panelists include Dr. Zsuzsanna Slattery-Major, GSI Helmholtzzentrum für Schwerionenfors, Prof. Julia Mikhailova, Princeton University, Dr. Alicia Palacios, Universidad Autónoma de Madrid, and Prof. Giuseppe Sansone, Albert-Ludwigs-Universität Freiburg.

Hosted by:



Meet the OSA Journals Editors

Tuesday, 11 May, 04:00 – 05:00

Hosted by OSA

The OSA Publishing journal Editors welcome your questions, ideas, and concerns. Join this online event to learn more about journal acceptance criteria, responding to review requests, addressing reviewer feedback, and other topics of interest. All are welcome!

Moderators:

- Kelly Cohen, *The Optical Society, USA*
- Alison Taylor, *The Optical Society, USA*

Panelists:

- Miguel Alonso, *University of Rochester, USA*
- Alexandra Boltasseva, *Purdue University, USA*
- Kurt Busch, *Humboldt University of Berlin, Germany*
- James Leger, *University of Minnesota, USA*

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Technology Showcase: A Comprehensive Simulation Environment for Active and Passive Photonic Component Design

Tuesday, 11 May, 07:00 – 07:20

Photon Design: This presentation will introduce you to Photon Design's innovative simulation tools for the design of photonic components including silicon photonics, AWGs and other waveguide components, semiconductor lasers, optical modulators, as well as complete photonic integrated circuits.

Speaker: Dominic Gallagher, *Photon Design, UK*

Presented By

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Technology Showcase: AIM Photonics Integrated Silicon Photonic Chip Fabrication and Test, Assembly & Packaging Offerings

Tuesday, 11 May, 07:20 – 07:40

AIM Photonics: Join us for the latest updates in electronic-photonic design automation, multi project wafer platform offering, as well as test, assembly, and packaging. Learn how this PIC ecosystem enables quick turn photonic development through proof of concept, validation, qualification, and commercialization under one national institute, ensuring manufacturing readiness for years to come.

Speaker: David Harame, *AIM Photonics, USA*

Presented By

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Technology Showcase: New Interoperable Software Platform for the Design of Photonic Devices

Tuesday, 11 May, 07:40 – 08:00

VPIphotonics: As a leader in photonic design automation for components, systems and networks, we will introduce a new interoperable software platform for the design of photonic devices, empowering researchers to explore new designs for photonic integrated circuit (PIC) passive components and optical fibers. This new platform streamlines the migration of device-level simulation data into a circuit-level simulator for the design and optimization of PICs. We will give an overview of the new platform and describe how it fits into our current ecosystem of photonic design and simulation tools.\

Speakers: Chris Maloney and Eugene Sokolov, *VPIphotonics, USA*

Presented By



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Arthur Ashkin Memorial Symposium

Tuesday, 11 May, 08:00 – 13:00

Hosted by CLEO

This special memorial symposium will describe and honor the contributions of Arthur Ashkin.

Organizers:

- Gary Bjorklund, *Bjorklund Enterprises, USA*
- Steve Harris, *Stanford University, USA*

Presenters:

- Aline Ashkin, *USA*
- John Bjorkholm, *Bell Labs, USA*
- Gary Bjorklund, *Bjorklund Enterprises, USA*
- Steve Block, *Stanford University, USA*
- Gary Boyd, *Nokia Bell Labs, USA*
- Bob Byer, *Stanford University, USA*
- Steve Chu, *Stanford University, USA*
- Joe Dziedzic, *Bell Labs, USA*
- Rene Essiambre, *Nokia Bell Labs, USA*
- Steve Harris, *Stanford University, USA*
- Erich Ippen, *MIT, USA*
- Elizabeth Rogan, *The Optical Society, USA*
- Erik Schäffer, *University of Tübingen, Germany*
- Roger Stolen, *Clemson University, USA*

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Advancing Mid-Manager Summit: Won't you be my Manager?

Tuesday, 11 May, 09:00 – 11:00

Hosted by OSA

Millions of people have watched the TV show “Mr. Rogers’ Neighborhood,” delighting in how its gentle host used stories, dialogue, interaction, and kindness to inspire children and adults alike to change the world. Mr. Rogers employed simple yet powerful techniques to create memorable lessons that have stayed with people for generations. There are some remarkable parallels between his goals and those shared by managers at all levels as they set goals, adapt to changes, and support their people and organizations along the way. After all, truly

effective managers know teams and companies thrive when people are encouraged, challenged, and—most importantly—treated with kindness. Join us for this interactive session hosted by the OSA Booth.

Presenter: Alison Torrillo French, *Managing Director, Alto Solutions, USA*

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Successfully Navigating OSA Virtual Meetings

Tuesday, 11 May, 10:00 – 11:00

The post-COVID world has new challenges in regards to virtual meetings – are you prepared? Listen to Isaiah Hankel, Cheeky Scientist, help guide you through the different platforms OSA uses and how you can effectively network and get the most out of your meeting experience.

Speaker: Isaiah Hankel, *Cheeky Scientist, USA*

Hosted by:



The Brightest Light Initiative: Update on the U.S. Strategy for Intense Ultrafast Lasers

Tuesday, 11 May, 10:00 – 11:00

Hosted by OSA

The U.S. intense ultrafast laser community is pursuing a community strategy to prioritize research and build new facilities. Join the session to learn about progress over the past year and plans to invigorate U.S. research in this exciting field.

Speakers:

- Félicie Albert, *Lawrence Livermore National Laboratory, USA*
- Jon Zuegel, *University of Rochester, USA*
- Roger Falcone, *UC Berkeley, USA*

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Discussion of Seminal Papers and Outlook: From Statistical Ray Optics to the Physics of Solar Cells

Tuesday, 11 May, 15:00 – 16:00

Join the OSA Photonic Metamaterials Technical Group for this special session featuring Prof. Eli Yablonovitch from the University of California, Berkeley. Prof. Yablonovitch will be discussing his seminal paper “Statistical Ray Optics” (JOSA, 1982) and will provide insights into what controls the voltage of a solar cell.

Hosted by:



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PhD-Level Transferrable Skills That Stand Out During Economic Downturns

Wednesday, 12 May, 07:00 – 08:00

Hosted by OSA

The global management consulting firm McKinsey & Company recently released a report showing that there is a 20% deficit in the job market for job candidates who can do two things - research, and analysis. These two transferable skills are key skill that all PhDs have regardless of their background and makes them highly valuable job candidates, especially in times of uncertainty. In this webinar, we will detail the top 10 transferable skills that PhDs need to communicate on their resume and during their job search as a while, as well as the 3 categories of core competencies that PhDs must master and leverage in order to get hired in industry.

Speaker: Isaiah Hankel, *Cheeky Scientist, USA*

Hosted by:



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Role and Applications of Lasers in Additive Manufacturing

Wednesday, 12 May, 07:00 – 08:00

You are invited to join the OSA Lasers in Manufacturing Technical Group for a panel discussion on the role and application of lasers in additive manufacturing. Our panelists will discuss the applicability of lasers for different additive manufacturing processes, such as laser powder bed fusion process, laser powder directed energy deposition process, and laser wire directed energy deposition process. The panel will also discuss the advantages and disadvantages of lasers compared to other energy sources, such as electron beam. Our panelists for this event will include Paul Gradl, NASA Marshall Space Flight Center; Ankit Saharan, EOS; Yashwanth Bandari, MELTIO; and Mike Vasquez, 3Degrees Consulting.

Hosted by:

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Technology Showcase: Going Beyond Laser Test and Measurement: New Power Meters and Energy Meters for Emerging Laser Applications

Wednesday, 12 May, 17:00 – 17:20

Gentec Electro-Optics, Inc.: With recent advances in the science and applications of lasers, emerging applications are now using higher power sources, faster pulsed lasers with high repetition rates, non-conventional wavelengths and increasingly efficient sources. These advances come with new challenges for laser power and energy measurement. At Gentec-EO, we remain on the lookout for new trends and applications, and we adapt our offer to these new opportunities. In this technology showcase, we will present our latest developments in terms of laser measurement instruments: - FASTER energy detectors that can measure pulse-to-pulse energy at higher repetition rates, - SMARTER power meters that communicate via bluetooth to allow for remote monitoring of your laser processes, and TOUGHER high-power detectors that can withstand incredibly high damage thresholds.

Speaker: Félicien Legrand, *Gentec Electro-Optics, Inc.*

Presented By



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Technology Showcase: Simulation of Micro-LEDs by Synopsys Photonic Device Tools

Wednesday, 12 May, 17:20 – 17:40

Synopsys: This talk demonstrates how to simulate micro-LEDs with the improved LED Utility in the 2021.03 release of RSoft Photonic Device Tools. It covers both thin-film and nano-wire types of micro-LEDs. Advanced features and tips will be demonstrated to deal with complex structures.

Speaker: Chenglin Xu, *Synopsys, Inc., USA*

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OSA Nonlinear Optics Technical Group Coffee Break

Thursday, 13 May, 06:00 – 07:00

Join the OSA Nonlinear Optics Technical Group for a virtual coffee break at CLEO. This informal networking session will offer students and junior researchers a chance to connect with senior researchers in the field. Attendees will have the opportunity to move around Zoom breakout rooms to have small group discussions with their fellow nonlinear optics community members.

Hosted by:



What Does it Take to be a Quantum (Optical) Engineer?

Thursday, 13 May, 12:00 – 13:30

Hosted by CLEO

In the past, experience in quantum science was only suitable for a handful of academic job openings so that most career advisers recommended removing any mention of this experience from resumes. As the quantum industry is being born, there is a growing demand for qualified personnel. Who are the people who fill these jobs: engineers or scientists? What do they do? Which skills and experiences are most valuable for today's and tomorrow's workforce? Would additional training help? Who is hiring: academia, research labs, large companies, startups, or... perhaps you will identify an entrepreneurial aspiration in yourself? Most importantly, are quantum careers here to stay? Join the panel of experts with diverse backgrounds to find out.

Organizers:

- Peter Fendel, *Thorlabs Inc., USA*
- Wilhelm Kaenders, *TOPTICA Photonics Inc., Germany*
- Sergey Polyakov, *National Institute of Standards and Technology, USA*

Moderator:

Josh Nunn, *University of Bath, UK*

Speakers:

- Dave Bacon, *IonQ, USA*
- Gretchen Campbell, *National Institute of Standards & Technology, USA*
- Warren Grice, *Qubitekk, Inc., USA*
- Wilhelm Kaenders, *TOPTICA Photonics Inc., Germany*
- Paul Kwiat, *University of Illinois at Urbana-Champaign, USA*

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Publishing in 2021: challenges and solutions

Thursday, 13 May, 12:00 – 13:30

Hosted by CLEO

Publishing is the main avenue for dissemination of novel ideas and methods, and is often used to measure the productivity of a research group. Therefore, scientific publishing is essential for both career development and successful grant applications. However, with the emergence of many new journals, as well as with the expansion of open access and for-profit publishing, the publishing landscape in optics and photonics is rapidly changing. This workshop, through interaction between the audience and a panel of relevant actors in the publication process, aims to explore the impact of publishing cost, confidentiality barriers, and impact factor, on the progress of optical science and engineering.

Organizers:

- Christophe Dorrer, *University of Rochester, USA*
- Tara Fortier, *National Institute of Standards and Technology, USA*
- Jin Kang, *Johns Hopkins University, USA*
- Viktor Podolskiy, *University of Massachusetts Lowell, USA*
- Clara Saraceno, *Ruhr Universität Bochum, Germany*

Moderator:

Ben Eggleton, *University of Sydney, Australia*

Speakers:

- Jose Capmany, *Universidad Politecnica de Valencia, Spain*
- Alex Gaeta, *Columbia University, USA*
- Elizabeth Nolan, *The Optical Society, USA*
- Anna Peacock, *University of Southampton, UK*
- Michael Thoennessen, *APS Editor-in-Chief, USA*
- Rachel Won, *Nature Photonics, UK*

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Dialogues on Metamaterials: Past, Present, Future

Thursday, 13 May, 12:00 – 13:00

You are invited to join the OSA Photonic Metamaterials Technical Group for a special panel discussion exploring the past, present and future of metamaterials. Attendees will have the opportunity to hear from prominent members of the photonic metamaterials community as they discuss emerging, controversial, anecdotal, and active hot topics in the field. Our panelists for this event will include Andrea Alù, CUNY Advanced Science Research Center; Jennifer Dionne, Stanford University; Nader Engheta, University of Pennsylvania; Ari Sihvola, Aalto University; and Isabelle Staude, University of Jena.

Hosted by:

[\[top\]](#)



How can CLEO improve inclusion at its meeting?

Friday, 14 May, 14:00 – 15:30

Hosted by CLEO

While CLEO is committed to improving diversity at its meeting, inclusion is the key to fostering and maintaining vitality in our diverse community. By bringing together experts in diversity, and diverse members of our and other communities, this workshop seeks to understand, hear and learn about what actions the conference can take to improve inclusivity. This workshop is open to all CLEO attendees and it values ALL opinions on the subject. Finally, ideas from this workshop will be used by CLEO's Diversity and Inclusion (D&I) Taskforce to help expand its efforts in D&I.

Organizers:

- Tara Fortier, *National Institute of Standards & Technology, USA*
- Michael Mielke, *Iradion Laser Inc., USA*

- Rohit Prasankumar, *Los Alamos National Laboratory, USA*

Presenters:

- Peter Delfyett, *University of Central Florida, USA*
- Theodore Hodapp, *APS, USA*
- Stefanie Johnson, *University of Colorado Leeds Business School, USA*
- Gabriel Montano, *Northern Arizona University, USA*
- Jessie Rosenberg, *IBM, USA*
- Thomas Searles, *Howard University, USA*

[\[top\]](#)

Sunday, 09 May

13:00 - 17:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

SC149

Short Course - SC149: Foundations of Nonlinear Optics

SC157

Short Course - SC157: Laser Beam Analysis, Propagation, and Spatial Shaping Techniques

SC361

Short Course - SC361: Coherent Mid-IR Light: Generation and Applications

SC396

Short Course - SC396: Frontiers of Guided Wave Nonlinear Optics

SC439

Short Course - SC439: Attosecond Optics: From Few-Cycle High Power MIR Driving Lasers to Phase-Controlled Water Window X-rays

SC466

Short Course - SC466: Silicon Integrated Nanophotonics

SC476

Short Course - SC476: Quantum Cascade Lasers and Their Role in Producing Optical Frequency Combs

SC479

Short Course - SC479: Introduction to Quantum Optics

SC481

Short Course - SC481: Fundamentals and Applications of VCSELs: Billion \$/Year and Growing Enterprise

17:00 - 18:30 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - Optimizing Career Paths in Optics: The Guide for Young Professionals

Career planning is very important for young professionals in optics. Different career paths are available, each with its own requirements, challenges, and rewards. We invite you to hear firsthand from your early career and more seasoned colleagues alike about their jobs and the paths they took to get there. Practical questions on how to excel in an optics-related career will be answered in addition to an open Q&A to tackle the questions most pressing to you.

Monday, 10 May

3:00 - 7:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

SC362

Short Course - SC362: Cavity Optomechanics: Fundamentals and Applications of Controlling and Measuring Nano- and Micro-mechanical Oscillators with Laser Light

5:00 - 7:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FM1N

High-Dimensional Entanglement

Presenter: Nadia Belabas , *Centre National Recherche Scientifique*

FM1N.1

High Dimensional Frequency-bin Entanglement From Domain Engineered Parametric Downconversion

Highlighted Talk

Presenter: Christopher Morrison , *Heriot-Watt University*

We demonstrate the generation of high-dimensional frequency entangled photon pairs using domain engineered parametric down conversion. A natural application of this source would be multi-user quantum key distribution using ITU standard wavelength division multiplexing systems.

Authors: Christopher Morrison, Heriot-Watt University / Francesco Graffitti, Heriot-Watt University / Joseph Ho, Heriot-Watt University / Peter Barrow, Heriot-Watt University / Alessandro Fedrizzi, Heriot-Watt University

FM1N.2

High-Dimensional Frequency-bin Tomography With Random Measurements

Presenter: Hsuan-Hao Lu , *Purdue University*

Utilizing electro-optic modulation and pulse shaping for random measurements, we reconstruct the full density matrix of biphoton frequency combs for entangled qudits up to $d=5$. Our method relies on simple experimental settings and can be applied to any frequency-bin quantum system.

Authors:Hsuan-Hao Lu, Purdue University / Joseph Lukens, Oak Ridge National Laboratory / Andrew Weiner, Purdue University

FM1N.3

Multipartite d-Level Photon Cluster States and Practical Entanglement Detection Through Witness Operators

Presenter: Stefania Sciara , *INRS-EMT*

We develop witness operators enabling the practical detection of arbitrary complex photon states and apply them to validate the entanglement of the first multipartite d-level cluster state achieved through simultaneous time- and frequency-entanglement.

Authors:Stefania Sciara, INRS-EMT / Christian Reimer, HyperLight Corporation / Piotr Roztock, INRS-EMT / David Moss, Swinburne University of Technology / Lucia Caspani, University of Strathclyde / William J. Munro, NTT Corporation / Michael Kues, Leibniz University Hannover / Roberto Morandotti, INRS-EMT

FM1N.4

Enabling Scalability of Photonic Frequency-Domain Quantum Processing

Presenter: Anahita Khodadad Kashi , *Leibniz University Hannover*

Via a reconfigurable photonic frequency circuit, we show spectral bosonic and fermionic Hong-Ou-Mandel interference between independently created pure single photons, demonstrating photon number scalability and versatility of the frequency processing approach.

Authors:Anahita Khodadad Kashi, Leibniz University Hannover / Michael Kues, Leibniz University Hannover

FM1N.5

Benchmarking Quantum Correlations in Scalable Photonic Systems

Presenter: Jan Sperling , *University of Paderborn*

A benchmark protocol is established to certify quantum correlations, demanding an exponential increase of resources. We handle this scaling and show nonclassicality of up to ten photons distributed over more than sixty modes.

Authors:Jan Sperling, University of Paderborn / Johannes Tiedau, University of Paderborn / Melanie Engelkemeier, University of Paderborn / Benjamin Brecht, University of Paderborn / Christine Silberhorn, University of Paderborn

FM1N.6

Tree-Type Photonic Cluster State Generation With a Single Quantum Emitter

Presenter: Yuan Zhan , *University of Colorado Boulder*

We propose to deterministically generate photonic tree states and repeater graph states of arbitrary size with a single quantum emitter. Photonic entanglement is established through emission and rescattering from the same emitter.

Authors:Yuan Zhan, University of Colorado Boulder / Shuo Sun, University of Colorado Boulder

FM1N.7

Inverse Design of Quantum Holograms in Three-Dimensional Nonlinear Photonic Crystals

Presenter: Eyal Rozenberg , *Technion*

We introduce a systematic approach for designing 3D nonlinear photonic crystals and pump beams for generating desired quantum correlations between structured photon-pairs. Our model is fully differentiable, allowing accurate and efficient learning and discovery of novel designs.

Authors:Eyal Rozenberg, Technion / Aviv Karnieli, Tel Aviv University / Ofir Yescharim, Tel Aviv University / Sivan Trajtenberg-Mills, Tel Aviv University / Daniel Freedman, Google Research / Alex Bronstein, Technion / Ady Arie, Tel Aviv University

FM1J

Novel Phenomena

Presenter: Fan Wu , *University of Central Florida*

FM1J.1

The Fock-State Laser: Macroscopic Quantum States of Light Based on Deep Strong Light-Matter Coupling

Highlighted Talk

Presenter: Nicholas Rivera , *Massachusetts Institute of Technology*

We show that coupled light-matter systems reaching the deep strong coupling regime can be coupled to gain media to form novel types of lasers emitting macroscopic quantum states of light, e.g. many-photon Fock states.

Authors:Nicholas Rivera, Massachusetts Institute of Technology / Jamison Sloan, Massachusetts Institute of Technology / Ido Kaminer, Technion / Marin Soljačić, Massachusetts Institute of Technology

FM1J.2

Experimental Demonstration of Dynamic Band Structure Measurement Along a Synthetic Dimension

Presenter: Guangzhen Li , *Shanghai Jiao Tong Univeristy*

We propose the experimentally dynamic band structure measurement, which exhibits the evolution of the wavevector along the synthetic dimension and simulates the momentum movement in the one-dimensional solid-state system under a constant force.

Authors:Guangzhen Li, Shanghai Jiao Tong Univeristy / Yuanlin Zheng, Shanghai Jiao Tong Univeristy / Avik Dutt, Stanford University / Danying Yu, Shanghai Jiao Tong Univeristy / Qingrou Shan, Shanghai Jiao Tong Univeristy / Shijie Liu, Shanghai Jiao Tong Univeristy / Luqi Yuan, Shanghai Jiao Tong Univeristy / Shanhui Fan, Stanford University / Xianfeng Chen, Shanghai Jiao Tong Univeristy

FM1J.3

Laser Tractor-Beam of 2D Flow in Soap Films

Presenter: Anatoly Patsyk , *Technion-Israel Institute of Technology*

We present the first observation of laser tractor-beam of 2D flow in soap films.

Authors:Anatoly Patsyk, Technion-Israel Institute of Technology / Yonatan Sharabi, Technion-Israel Institute of Technology / Miguel Bandres, CREOL / Uri Sivan, Technion-Israel Institute of Technology / Mordechai segev, Technion-Israel Institute of Technology

FM1J.4

Observation of the Fundamental Length Scale of Branched Flow of Light

Presenter: Shruti Saiji , *University of Central Florida, CREOL*

Branched flow is a universal phenomenon in which waves form channels of enhance intensity that keep dividing as they propagate. We experimentally demonstrate the scaling behavior of the fundamental branching length for general anisotropic media.

Authors:Shruti Saiji, University of Central Florida, CREOL / Miguel Bandres, University of Central Florida, CREOL

FM1J.5

Combinatorial Optimization With the Optical Potts Machine

Presenter: Mostafa Honari-Latifpour , *City University of New York*

We show that networks of phase-tristable optical parametric oscillators simulate the three-state Potts model. A direct simulation of the underlying nonlinear dynamical model provides an efficient path toward combinatorial optimization.

Authors:Mostafa Honari-Latifpour, City University of New York / Mohammad-Ali Miri, City University of New York

FM1J.6**Light Stopping by Reflection From a Moving Index Front**

Presenter: Mahmoud Gaafar , *Hamburg University of technology*

Nonlinearly generated refractive index fronts in waveguides can change the signal frequency and wavenumber leading to the indirect transitions. Here, we discuss how dynamic light stopping and pulse time reversal can be implemented in dispersive waveguides via these transitions.

Authors: Mahmoud Gaafar, Hamburg University of technology

FM1J.7**Skymionic Supertoroidal Light Pulses**

Presenter: Yijie Shen , *University of Southampton*

We report that the "Focused Doughnut" introduced by Hellwarth and Nouchi in 1996 is only a single member of an extended family of electromagnetic toroidal pulses with skyrmion topology propagating at the speed of light.

Authors: Yijie Shen, University of Southampton / Apostolos Zdagkas, University of Southampton / Yaonan Hou, University of Southampton / Nikitas Papasimakis, University of Southampton / Nikolay Zheludev, University of Southampton

FM1L**Electron-Photon Interactions**

Presider: Sophie Meuret , *Laboratoire de Physique des Solides*

FM1L.1**Optical Coherence Transfer Mediated by Free Electrons**

Presenter: Ofer Kfir , *Max Planck Institute for Biophysical Chemistry*

We investigate the optical coherence properties carried by the quantum state of a single free-flying charged and massive particle – the electron. We propose feasible Mach-Zehnder-like linear and nonlinear optical interferometric detection, incorporating electron-microscope beams.

Authors: Ofer Kfir, Max Planck Institute for Biophysical Chemistry / Valerio Di Giulio, ICFO - The Barcelona Institute of Science and Technology / F. Javier García de Abajo, ICFO - The Barcelona Institute of Science and Technology / Claus Ropers, Max Planck Institute for Biophysical Chemistry

FM1L.2

Active Spatial Modulation of Free Electrons by Controlling the Shape and Intensity of Plasmonic Fields

Presenter: Shai Tseses , *Technion-Israeli institute of technology*

We present active spatial shaping of free-electron wavepackets through their interaction with specially-designed interference patterns of surface plasmons and via the nonlinear intensity dependence of the electron-plasmon interaction.

Authors:Shai Tseses, Technion-Israeli institute of technology / Raphael Dahan, Technion-Israeli institute of technology / Kangpeng Wang, Technion-Israeli institute of technology / Ori Reinhardt, Technion-Israeli institute of technology / Guy Bartal, Technion-Israeli institute of technology / Ido Kaminer, Technion-Israeli institute of technology

FM1L.3

Free-Electron Quantum Optics

Invited

Presenter: Ido Kaminer , *Technion Israel Institute of Technology*

Recent years created a paradigm-shift in our understanding of the fundamental interaction between free electrons and light. We use these developments for novel free-electron-polariton interactions in 2D materials, ultrastrong single-electron-single-photon interactions, and free-electron-light entanglement.

Authors:Ido Kaminer, Technion Israel Institute of Technology

FM1L.4

Quantum-to-Classical Transition of Laser-Shaped Ultrafast Free Electrons in Phase Space

Presenter: Bin Zhang , *Tel Aviv University*

Here, we propose a Smith-Purcell model for shaping free electrons with laser. We find that the quantum interference and deformation of the modulated electrons in phase space are vital for understanding the quantum-to-classical transition.

Authors:Bin Zhang, Tel Aviv University

FM1L.5

A General Framework for Shaping Luminescence in Materials

Presenter: Charles Roques-Carmes , *MIT*

We develop a general framework to describe non-equilibrium radiation by materials in nanophotonic structures (such as photoluminescence/cathodoluminescence/scintillation). We demonstrate the concept experimentally, enhancing and shaping cathodoluminescence from a silica photonic crystal.

Authors: Charles Roques-Carmes, MIT / Nicholas Rivera, MIT / Ali Ghorashi, MIT / Steven Kooi, Institute for Soldier Nanotechnologies / Yi Yang, MIT / Zin Lin, MIT / Justin Beroz, MIT / John Joannopoulos, MIT / Ido Kaminer, Technion / Steven Johnson, MIT / Marin Soljačić, MIT

FM1L.6

Observation of 2D Cherenkov Radiation and its Quantized Photonic Nature Using Free-Electrons

Presenter: Yuval Adiv, *Technion-Israeli institute of technology*

Using a dispersion-engineered structure supporting hybrid photonic-plasmonic surface polaritons, we present the first observation of 2D Cherenkov radiation from free electrons, with record-strong electron-polariton quantum coupling that reaches the single-electron-single-photon interaction regime.

Authors: Yuval Adiv, Technion-Israeli institute of technology / Hu Hao, Nanyang Technological University / Shai Tseses, Technion-Israeli institute of technology / Raphael Dahan, Technion-Israeli institute of technology / Kangpeng Wang, Technion-Israeli institute of technology / Yaniv Kurman, Technion-Israeli institute of technology / Hongsheng Chen, Zhejiang University / Xiao Lin, Zhejiang University / Guy Bartal, Technion-Israeli institute of technology / Ido Kaminer, Technion-Israeli institute of technology

FM1L.7

Enhanced Photon Emission of Metallic Cylindrical Ridges Upon Interaction With a Free Electron

Presenter: Ayan Nussupbekov, *Nanyang Technological University*

We show that free electron radiation from metal films can be enhanced by over two orders of magnitude with the introduction of a cylindrical nanoridge, compared to previously studied structures such as bullseye gratings.

Authors: Ayan Nussupbekov, Nanyang Technological University / Giorgio Adamo, Nanyang Technological University / Jin-Kyu So, Nanyang Technological University / Lin Wu, A*STAR / Yidong Chong, Nanyang Technological University / Liang Jie Wong, Nanyang Technological University

FM1O

Ultrafast Imaging and Spectroscopy

Presenter: Emma Springate, *STFC Rutherford Appleton Laboratory*

FM10.1

Attosecond Coherent Diffractive Imaging

Invited

Presenter: Julius Huijts, *Commissariat a l'Energie Atomique*

We present a method of numerical monochromatisation that potentially allows performing coherent diffractive imaging with broadband attosecond source.

Authors: Hamed Merdji, *Commissariat a l'Energie Atomique* / Julius Huijts, *Commissariat a l'Energie Atomique*

FM10.2

Ultrafast Electron Diffractometer With Terahertz-Driven Pulse Compression

Presenter: Dongfang Zhang, *Deutsches Elektronen Synchrotron (DESY)*

We built an ultrafast electron diffractometer, which utilizes a Terahertz driven pulse compressor to probe the ultrafast dynamics of single-crystal silicon. We demonstrate high-quality diffraction with improved time resolution.

Authors: Dongfang Zhang, *Deutsches Elektronen Synchrotron (DESY)* / Tobias Kroh, *Deutsches Elektronen Synchrotron (DESY)* / Felix Ritzkowsky, *Deutsches Elektronen Synchrotron (DESY)* / Timm Rohwer, *Deutsches Elektronen Synchrotron (DESY)* / Moein Fakhari, *Deutsches Elektronen Synchrotron (DESY)* / Huseyin Cankaya, *Deutsches Elektronen Synchrotron (DESY)* / Anne-Laure Calendron, *Deutsches Elektronen Synchrotron (DESY)* / Nicholas Matlis, *Deutsches Elektronen Synchrotron (DESY)* / Franz Kärtner, *Deutsches Elektronen Synchrotron (DESY)*

FM10.3

Charge Dynamics Electron Microscopy

Presenter: Simone Gargiulo, *EPFL*

We probe plasma dynamics with nm-fs resolution through electron spectroscopy performed in an ultrafast transmission electron microscope. This approach would allow to disentangle the dynamic evolution of plasma parameters and observe previously inaccessible energy inhomogeneities.

Authors: Simone Gargiulo, *EPFL* / Ivan Madan, *EPFL* / Francesco Barantani, *EPFL* / Gabriele Berruto, *EPFL* / Michael Yannai, *Technion Israel Institute of Technology* / Eduardo Dias, *ICFO-Institut de Ciencies Fotoniques* / Raphael Dahan, *Technion Israel Institute of Technology* / Ido Kaminer, *Technion Israel Institute of Technology* / Giovanni Maria Vanacore, *University of Milano-Bicocca* / Javier García de Abajo, *ICFO-Institut de Ciencies Fotoniques* / Fabrizio Carbone, *EPFL*

FM10.4

Coherent Diffractive Extreme-Ultraviolet Generation From Nanostructured Silica.

Presenter: Sylvianne Roscam Abbing , *ARCNL*

We introduce extreme-ultraviolet high-harmonic generation from nanostructured silica. Generation inside micron and nanoscale sub-wavelength structures with periodic as well as aperiodic features leads to emission of structured extreme-ultraviolet pulses, useful for spectroscopy and imaging.

Authors: Sylvianne Roscam Abbing, *ARCNL* / Zhuang-Yan Zhang, *ARCNL* / Radoslaw Kolkowski, *AMOLF* / Filippo Campi, *ARCNL* / Femius Koenderink, *AMOLF* / Peter Kraus, *ARCNL*

FM10.5

Attosecond Photoionization Dynamics in Model Diatomic Molecules

Invited

Presenter: Laura Cattaneo , *ETH Zurich*

Investigation of photoionization dynamics in two model diatomic molecules: H₂ and CO, highlighting a specific aspect of their molecular nature and confirming the paramount importance of angular resolution and electron-ion coincidence detection.

Authors: Laura Cattaneo, *ETH Zurich*

FM10.6

Decoherence and Revival of Attosecond Charge Migration Driven by Non-Adiabatic Dynamics

Presenter: Danylo Matselyukh , *ETH Zurich*

The attosecond quantum beat of an electronic state superposition was captured in SiH₄ using soft-X-Ray attosecond transient-absorption spectroscopy. Its decoherence and revival, induced by non-adiabatic vibrational dynamics, were reproduced using MCTDH calculations.

Authors: Danylo Matselyukh, *ETH Zurich* / Victor Despré, *Heidelberg University* / Nikolay Golubev, *EPFL* / Alexander Kuleff, *Heidelberg University* / Hans Jakob Wörner, *ETH Zurich*

FM1M

Theory of Metasurfaces and Metamaterials

Presenter: Sushil Mujumdar , *Tata Institute of Fundamental Research*

FM1M.1

Photonic Meron Spin Texture in Momentum Space

Presenter: Cheng Guo , *Stanford University*

We show that a momentum-space meron spin texture for electromagnetic fields in free space can be generated using a photonic crystal slab having a nonzero Berry curvature. Our work highlights the opportunities of using photonic structures for the exploration of topological spin textures.

Authors:Cheng Guo, Stanford University / Meng Xiao, Stanford University / Yu Guo, Stanford University / Luqi Yuan, Stanford University / Shanhui Fan, Stanford University

FM1M.2

Non-Abelian Charged Nodal Rings in Dielectric Medium

Presenter: Sang Soon Oh , *Cardiff University*

We show linked nodal rings in momentum space with a dielectric photonic crystal. From evolutions of the eigenstates polarizations along the loops which enclose the nodal line(s) of the rings, their non-Abelian topological charges are also analyzed.

Authors:Haedong Park, Cardiff University / Stephan Wong, Cardiff University / Xiao Zhang, Sun Yet-sen University / Sang Soon Oh, Cardiff University

FM1M.3

Inhibited Optical Turbulence in Near-Zero-Index Media

Presenter: Iñigo Liberal , *Universidad Publica de Navarra*

We theoretically demonstrate that near-zero-index (NZI) media behave as ideal electromagnetic fluids where optical turbulence is intrinsically inhibited. This result provides a new perspective of NZI wave phenomena and poses interesting technological possibilities.

Authors:Iñigo Liberal, Universidad Publica de Navarra / Michaël Lobet, University of Namur / Yue Li, Tsinghua University / Nader Engheta, University of Pennsylvania

FM1M.4

Guiding Light at Criticality and Beyond

Presenter: Janderson Rodrigues , *Columbia University*

We experimentally demonstrate waveguiding at the critical angle in a dielectric multi-layered structure. At this exceptional point, the waveguide becomes scale invariant and the field is confined to the low-index region, with a spatially-uniform transverse profile.

Authors:Janderson Rodrigues, Columbia University / Utsav Dave, Columbia University / Aseema Mohanty, Columbia University / Xingchen Ji, Columbia University / Ipshita Datta, Columbia University / Ricardo Gutierrez-Jauregui, Columbia University / Vilson Almeida, Columbia University / Ana Ansejo-Garcia, Columbia University / Michal Lipson, Columbia University

FM1M.5

Investigation of a Negative Next-Nearest-Neighbor-Coupling in Evanescently Coupled Dielectric Waveguides

Presenter: Julian Schulz , *Physics Department and Research Center OPTIMAS, TU Kaiserslautern*

We experimentally demonstrate a negative NNN-coupling constant, arising naturally in a dielectric waveguide structure, fabricated by direct-laser-writing, and show how we can tune between positive and negative ratios for NN and NNN coupling.

Authors: Julian Schulz, Physics Department and Research Center OPTIMAS, TU Kaiserslautern / Christina Jörg, Physics Department and Research Center OPTIMAS, TU Kaiserslautern / Georg von Freymann, Physics Department and Research Center OPTIMAS, TU Kaiserslautern

FM1M.6

Time Diffraction in an Epsilon-Near-Zero Metasurface

Presenter: Emanuele Galiffi , *Imperial College London*

We observe strong, efficient all-optical modulations and frequency-shift due to time diffraction in a thin film of ITO over gold. Excitation of the Berreman mode leads to redshift and spectral broadening from a nonlinear grating.

Authors: Romain Tirole, Imperial College London / Taran Attavar, Imperial College London / Jakub Dranczewski, Imperial College London / Emanuele Galiffi, Imperial College London / John Pendry, Imperial College London / Stefan Maier, Imperial College London / Stefano Vezzoli, Imperial College London / Riccardo Sapienza, Imperial College London

FM1M.7

(Withdrawn) Non-Hermitian Chrono-Metamaterials and Spectral Causality

Invited

Presenter: Francesco Monticone , *Cornell University*

We present our recent work on a new class of metamaterials with temporally-modulated loss and gain, and we discuss their intriguing response and anomalous effects, such as broadband reflectionless absorption, broadband light trapping in bound-states-in-the-continuum, temporal cloaking, and unidirectional propagation along a synthetic dimension.

Authors: Francesco Monticone, Cornell University / Zeki Hayran, Cornell University

AM1R

Advances in Imaging, Microscopy, and Inspection

Presenter: Clément Fallet , *Prophesee*

AM1R.1

Optical Metrology of Low-Loss Substrate-Transferred Crystalline Coatings

Invited

Presenter: Garrett Cole , *Thorlabs Crystalline Solutions*

Advancing the capabilities of our substrate-transferred crystalline coatings requires a suite of parts-per-million-resolution metrology tools including spatial scanning cavity ring-down for probing total optical losses, transmittance spectroscopy, and direct absorption measurements via photothermal common-path interferometry.

Authors:Garrett Cole, Thorlabs Crystalline Solutions / Garwing Truong, Thorlabs Crystalline Solutions / Georg Winkler, University of Vienna / Lukas Perner, University of Vienna / Aline Mayer, University of Vienna / Jakob Fellingner, University of Vienna / David Follman, Thorlabs Crystalline Solutions / Oliver Heckl, University of Vienna

AM1R.2

Hyperspectral Imaging Reflectometry for 3D Semiconductor Metrology

Presenter: Jinseob Kim , *Samsung Electronics Co., Ltd*

We present the hyperspectral imaging reflectometry technique for the critical dimension measurement of the advanced semiconductor devices. The proposed line scan based broadband system can enable high speed & non-destructive 3D measurements with great precision.

Authors:Jinseob Kim, Samsung Electronics Co., Ltd / Gwangsik Park, Samsung Electronics Co., Ltd / Daehoon Han, Samsung Electronics Co., Ltd / Wookrae Kim, Samsung Electronics Co., Ltd / Myungjun Lee, Samsung Electronics Co., Ltd

AM1R.3

Gap Mode Tip-Enhanced Raman and AFM Imaging of RNA Strands

Presenter: Zhe He , *Texas A&M University*

Gap-mode tip-enhanced Raman spectroscopy (TERS) maps molecules with a high resolution. In this work, we demonstrate Raman spectroscopic imaging of RNA strands using TERS in comparison with atomic force microscopy.

Authors:Zhe He, Texas A&M University / Weiwei Qiu, Zhejiang University of Science and Technology / Megan Kizer, Massachusetts Institute of Technology / Jizhou Wang, Texas A&M University / Alexei Sokolov, Texas A&M University / Xing Wang, University of Illinois at Urbana-Champaign / Jonathan Hu, Baylor University / Marlan Scully, Texas A&M University

AM1R.4

Deep Learning-Based 3d Imaging for Advanced Inspection in Manufacturing and Material Science

Invited

Presenter: Yunhui Zhu , *Virginia Tech*

We discuss how advances in deep learning-based 3D imaging bring novel inspection schemes in manufacturing and material science with 1) high-throughput internal detection, 2) automated feature registration and 3) large-scale data analysis.

Authors:Yunhui Zhu, Virginia Tech

AM1R.5

Photothermal Characterization of Au/BaTiO₃ Nanocomposite Films

Presenter: BIJEESH Meethale Mangalassery , *BITS PILANI K K BIRLA GOA CAMPUS*

We report on the development of a photothermal microscope capable of detecting and characterizing nonfluorescent metallic nanoparticles in a nanocomposite film. The distribution of gold nanoparticles in Au/BaTiO₃ nanocomposite films with different Au/Ba molar ratio is studied by the microscope.

Authors:BIJEESH Meethale Mangalassery, BITS PILANI K K BIRLA GOA CAMPUS / Shakhi P K, BITS PILANI K K BIRLA GOA CAMPUS / Arunkarthick S, BITS PILANI K K BIRLA GOA CAMPUS / Geetha K Varier, BITS PILANI K K BIRLA GOA CAMPUS / Nandakumar P, BITS PILANI K K BIRLA GOA CAMPUS

AM1R.6

(Withdrawn) Doping Concentration Profiling of Semiconductors via Terahertz 3D Spectroscopy, Volume Imaging, and Reflectance Modeling

Presenter: Anis Rahman , *Applied Research and Photonics Inc*

Characterization of doping concentration profile across the depth of semiconductors via terahertz 3D spectroscopy and volume imaging is demonstrated. An empirical approach has also been described for mapping the resistivity of a whole wafer.

Authors:Anis Rahman, Applied Research and Photonics Inc

AM1S

Enabling Quantum Technologies with Photonics

Presenter: John Jost , *MicroR Systems*

AM1S.1

Enabling Quantum Technologies With Photonics

Invited

Presenter: Michael Foertsch , *Q.ANT GmbH*

Through the systematic exploitation of Quantum mechanical effects, we will experience technological revolutions in 21st century. With the foundation of Q.ANT, we have made it our mission to make a significant contribution to this revolution.

Authors:Michael Foertsch, Q.ANT GmbH

AM1S.2

Fractal Superconducting Nanowire Avalanche Photodetectors With 84% System Efficiency at 1600 nm, 1.02 Polarization Sensitivity, and 29 ps Timing Resolution

Presenter: Yun Meng , *Tianjin University*

We demonstrate a fractal superconducting nanowire single-photon detector with 84% system efficiency at 1600 nm, 1.02 polarization sensitivity, and 29 ps timing resolution, which have never been simultaneously achieved before.

Authors:Yun Meng, Tianjin University / Kai Zou, Tianjin University / Nan Hu, Tianjin University / Liang Xu, Tianjin University / Xiaojian Lan, Tianjin University / Stephan Steinhauer, Royal Institute of Technology (KTH) / Samuel Gyger, Royal Institute of Technology (KTH) / Val Zwiller, Royal Institute of Technology (KTH) / Xiaolong Hu, Tianjin University

AM1S.3

Configurable Heralded Two-Photon Fock-States on a Chip

Presenter: xin hua , *Université Côte d'Azur, CNRS, Institut de Physique de Nice*

We report a monolithic integrated quantum photonic realization on lithium niobate, which enables producing various path-coded heralded two-photon states, showing 94% raw visibility for Hong-Ou-Mandel interference.

Authors:xin hua, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Tommaso Lunghi, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Florent Doutre, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Panagiotis Vergyris, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Grégory Sauder, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Pierrick Charlier, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Laurent Labonté, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Virginia D'Auria, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Martin Anthony, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Tascu Sorin, Research Center on Advanced Materials and Technologies, Institute of Interdisciplinary Research, Alexandru Ioan Cuza University of Iasi / Sébastien Tanzilli, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Olivier Alibert, Université Côte d'Azur, CNRS, Institut de Physique de Nice

AM1S.4

Waveguide Resonators for Optical Squeezing

Presenter: Michael Stefszky , *Paderborn University*

An integrated source of squeezed states is required for many quantum optics applications. We present a 1 cm long Ti:LiNbO₃ waveguide resonator producing up to 4.9 dB of single-mode squeezing and efforts towards incorporating an electro-optic modulator into the device.

Authors: Michael Stefszky, Paderborn University / Matteo Santandrea, Paderborn University / Felix vom Bruch, Paderborn University / Christof Eigner, Paderborn University / Raimund Ricken, Paderborn University / Viktor Quiring, Paderborn University / Harald Herrmann, Paderborn University / Christine Silberhorn, Paderborn University

AM1S.5

Superconducting NbN Plasmonic Perfect Absorbers for Tunable Single Photon Near- and mid-IR Photodetection

Presenter: Philipp Karl, *Universität Stuttgart 4. Physikalisches*

We demonstrate a superconducting niobium nitride plasmonic perfect absorber structure and use its tunable plasmonic resonance to create a polarization dependent photodetector with near-100% absorption efficiency in the near- and mid-infrared spectral range.

Authors: Philipp Karl, Universität Stuttgart 4. Physikalisches / Harald Giessen, Universität Stuttgart 4. Physikalisches / Monika Ubl, Universität Stuttgart 4. Physikalisches / Mario Hentschel, Universität Stuttgart 4. Physikalisches / Philipp Flad, Universität Stuttgart 4. Physikalisches / Yu-Jung Lu, Research Center for Applied Sciences / Jing-Wei Yang, Research Center for Applied Sciences / Ahmed Farag, Universität Stuttgart 4. Physikalisches

AM1S.6

A Scalable Design for Photonic Quantum Random Number Generators

Presenter: Shashwath Bharadwaj, *Institut National de la Recherche Scientifique (INRS)*

We introduce a novel method to controllably improve the performance of photonic quantum random number generators by using minimum information entropy per bit as a standalone design parameter.

Authors: Shashwath Bharadwaj, Institut National de la Recherche Scientifique (INRS) / James van Howe, Augustana College / Simone Atzeni, Politecnico di Milano / Piotr Roztocki, Institut National de la Recherche Scientifique (INRS) / Renuka Narayanan, Indian Institute of Science Education and Research / roberto osellame, Istituto di Fotonica e Nanotecnologie, CNR / Jose Azana, Institut National de la Recherche Scientifique (INRS) / William Munro, NTT Basic Research Laboratories / Roberto Morandotti, Institut National de la Recherche Scientifique (INRS)

AM1S.7

Highly Efficient and Pure Single Photon Streams at Room-Temperature by Deterministic Nano Positioning of Quantum Emitters

Presenter: Hamza Abudayyeh, *Hebrew University of Jerusalem*

We fabricate several nanoantenna devices that enhance the directionality (over 80%) and emission rate (by a factor of 20) of a room-temperature quantum dot thus achieving a single photon brightness enhancement factor of over 1000.

Authors:Hamza Abudayyeh, Hebrew University of Jerusalem / Anastasia Blake, Los Alamos National Laboratory / Annika Bräuer, University of Tuebingen / Dror Liran, Hebrew University of Jerusalem / Boaz Lubotzky, Hebrew University of Jerusalem / Somak Majumder, Los Alamos National Laboratory / Jennifer Hollingsworth, Los Alamos National Laboratory / Monika Fleischer, University of Tuebingen / Ronen Rapaport, Hebrew University of Jerusalem

SM1H

Lasers on Si and Hybrid Integration

Presenter: Shamsul Arafin , *ECE, Ohio State University*

SM1H.1

III-v-on-Silicon 1-GHz Mode-Locked Lasers Towards Frequency-Comb Applications

Presenter: Kasper Van Gasse , *Ghent University-imec*

Fundamental and technical noise sources in III-V-on-silicon mode-locked lasers are investigated and minimized. Their frequency stability is optimized to make them suited to applications such as dual-comb spectroscopy or dual-comb LIDAR.

Authors:Kasper Van Gasse, Ghent University-imec / Zhechao Wang, Ghent University-imec / Gunther Roelkens, Ghent University-imec / Theodor Hänsch, Max Planck Institute of Quantum Optics / Bart Kuyken, Ghent University-imec / Nathalie Picqué, Max Planck Institute of Quantum Optics

SM1H.2

A Nanosecond-Tunable Capacitive III-v/Si Distributed Feedback Baser

Presenter: Pierre Fanneau de La Horie , *III-V Lab*

We demonstrate a heterogeneously integrated III-V/Si capacitive distributed feedback laser, which is continuously tunable across a 10 GHz band in less than 2 ns, with record-low power consumption

Authors:Pierre Fanneau de La Horie, III-V Lab / Theo Verolet, III-V Lab / Jean-Guy Provost, III-V Lab / Thibaut Renaud, III-V Lab / Delphine Neel, III-V Lab / Stéphane Malhouitre, CEA-Leti / Valentin Ramez, CEA-Leti / Karim Hassan, CEA-Leti / Arnaud Wilk, III-V Lab / Alexandre Shen, III-V Lab / Joan Manel Ramirez, III-V Lab / David Bitauld, III-V Lab

SM1H.3

O and C/L Band InAs Quantum dot Lasers Epitaxially Grown on SOI Platform for Silicon Photonic Integration

Presenter: Wei Qi , *Institute of Physics*

Optically and electrically pumped InAs quantum dot (QD) lasers at O and C/L band telecommunication wavelengths are both demonstrated on SOI substrates by using homo-epitaxially formed (111)-faceted silicon hollow structures.

Authors:Wei Qi, Institute of Physics

SM1H.4

Electrically Injected GeSn Laser on Si Operating up to 110K

Presenter: Solomon Ojo , *University of Arkansas*

We demonstrated electrically injected GeSn laser with the threshold to as low as 353 A/cm^2 at 10 K. The threshold reduction was achieved by introducing a thicker SiGeSn cap. The peak power was measured as 2.75 mW/facet at 10 K. At 110 K, the emission peak is at 2604 nm.

Authors:Sylvester Amoah, University of Arkansas / Solomon Ojo, University of Arkansas / Huong Tran, University of Arkansas / Grey Abernathy, University of Arkansas / Yiyin Zhou, University of Arkansas / Wei Du, Wilkes University / Joe Margetis, Arizona State University / John Tolle, Arizona State University / Baohua Li, Arktonics / Shui-Qing Yu, University of Arkansas

SM1H.5

1.55-um Si-Photonics-Based Heterogeneous Tunable Laser Integrated With Highly Stacked QD-RSOA

Presenter: Atsushi Matsumoto , *National Inst of Information & Comm Tech*

We demonstrated a Si-photonics-based heterogeneous tunable laser in the 1.55-um-band with quantum dot reflective semiconductor optical amplifier. Relatively low threshold current could be achieved owing to high gain characteristic.

Authors:Atsushi Matsumoto, National Inst of Information & Comm Tech / Wataru Masuda, Waseda University / Kouichi Akahane, National Inst of Information & Comm Tech / Toshimasa Umezawa, National Inst of Information & Comm Tech / Naokatsu Yamamoto, National Inst of Information & Comm Tech / Tomohiro Kita, Waseda University

SM1H.6

1.3 μm Regrown Quantum-dot Distributed Feedback Lasers on (001) Si: a Pathway to Scale Towards 1 Tbit/s

Presenter: Yating Wan , *University of California Santa Barbara*

Regrown quantum-dot distributed feedback lasers on (001) Si demonstrated a SMSR of 50 dBm, a threshold current density of 440 A/cm^2 , a CW operation temperature of 70°C , and a path towards high-volume, low-cost transceivers.

Authors: Yating Wan, University of California Santa Barbara / Justin Norman, University of California Santa Barbara / Yeyu Tong, The Chinese University of Hong Kong / MJ Kennedy, University of California Santa Barbara / Chen Shang, University of California Santa Barbara / Jenny Selvidge, University of California Santa Barbara / Hon Ki Tsang, The Chinese University of Hong Kong / Arthur Gossard, University of California Santa Barbara / John Bowers, University of California Santa Barbara

SM1H.7

Low-Noise, Frequency-Agile, Hybrid Integrated Lasers for LiDAR

Presenter: Grigorii Likhachev, *EPFL*

We demonstrate a hybrid photonic integrated laser that exhibit intrinsic linewidth of 40 Hz, while offering megahertz actuation bandwidth with the tuning range larger than 1 GHz, attained by a DFB laser self-injection locking to a high-Q silicon nitride microresonator.

Authors: Grigorii Likhachev, EPFL / Johann Riemensberger, EPFL / Wenle Weng, EPFL / Junqiu Liu, EPFL / Hao Tian, Purdue / Anat Siddharth, EPFL / Rui Wang, EPFL / Viacheslav Snigirev, EPFL / sunil bhav, Purdue / Tobias Kippenberg, EPFL

SM1H.8

Surface Grating VCSEL-Integrated Amplifier/Beam Scanner With High Power and Single Mode Operation

Presenter: SHANTING HU, *Tokyo Institute of Technology*

We demonstrate a single-mode surface-grating VCSEL-integrated amplifier/beam scanner. The output power is over 500mW under pulsed operation. The continuous fan beam steering of 1.5° and a diffraction-limited narrow beam divergence of 0.06° are achieved.

Authors: SHANTING HU, Tokyo Institute of Technology / XIAODONG GU, Tokyo Institute of Technology / AHMED HASSAN, Tokyo Institute of Technology / MASANORI NAKAHAMA, Tokyo Institute of Technology / FUMIO KOYAMA, Tokyo Institute of Technology

SM1K

2D Terahertz Spectroscopy and Quantum Cascade Lasers

Presider: Xiaojun Wu, *Beihang University*

SM1K.2

Understanding Nonlinear Phononic Processes With Two-Dimensional Spectroscopy

Presenter: Megan Nielson , *Brigham Young University*

Two-dimensional terahertz spectroscopy reveals information about nonlinear energy transfer. Power dependent measurements help determine the order of nonlinear mechanism. We used first-principles calculations to calculate coupling constants for phonons and compared with nonlinear 2D spectra.

Authors: Megan Nielson, Brigham Young University / Brittany Knighton, Brigham Young University / Lauren Davis, Brigham Young University / Aldair Alejandro, Brigham Young University / Jeremy Johnson, Brigham Young University

SM1K.3

Custom Terahertz Pulses for Nonlinear Vibrational Excitation

Presenter: Claire Rader , *BYU*

We combine THz pulses from two complimentary crystals to increase peak field strength and create a broad, smooth spectrum. We show the utility of using this strong THz pulse to nonlinearly excite vibrations in solids.

Authors: Claire Rader, BYU / Brittany Knighton, BYU / Zachary Zaccardi, BYU / Jeremy Johnson, BYU / David Michaelis, BYU

SM1K.4

Time-Resolved 2D THz-Spectroscopy on a THz Quantum Cascade Structure

Presenter: Sergej Markmann , *Institute for Quantum Electronics, ETH Zürich*

We have performed two-dimensional THz spectroscopy on an unbiased quantum cascade structure (QCS), and observe multiple nonlinear pump-probe signals originating from the engineered intersubband system. Moreover, we provide experimental and simulation evidence for coherent population transport.

Authors: Sergej Markmann, Institute for Quantum Electronics, ETH Zürich / Martin Franckie, Institute for Quantum Electronics, ETH Zürich / Shovon Pal, Department of Materials, ETH Zürich / David Stark, Institute for Quantum Electronics, ETH Zürich / Mattias Beck, Institute for Quantum Electronics, ETH Zürich / Manfred Fiebig, Department of Materials, ETH Zürich / Giacomo Scalari, Institute for Quantum Electronics, ETH Zürich / Jérôme Faist, Institute for Quantum Electronics, ETH Zürich

SM1K.5

Compact, low Threshold Methyl Fluoride Terahertz Laser Pumped by a Quantum Cascade Laser

Presenter: Paul Chevalier , *Harvard University*

We demonstrate a quantum cascade laser-pumped terahertz laser using methyl fluoride gas. The large dipole moment of this molecule allows for a low threshold laser with frequency tunable emission spanning more than one terahertz.

Authors: Paul Chevalier, Harvard University / Arman Amirzhan, Harvard University / Jeremy Rowlette, DRS Daylight Solutions / Ted Stinson, DRS Daylight Solutions / Michael Pushkarsky, DRS Daylight Solutions / Timothy Day, DRS Daylight Solutions / Henry Everitt, Duke University / Federico Capasso, Harvard University

SM1K.6

Y-Coupled THz Quantum Cascade Laser Frequency Comb

Presenter: Urban Senica, *ETH Zurich*

We present a planarized Y-coupled THz quantum cascade laser operating as a frequency comb. Broadband phase locking is maintained between the two arms through the whole operating range, as confirmed by far-field measurements.

Authors: Urban Senica, ETH Zurich / Tudor Olariu, ETH Zurich / Paolo Micheletti, ETH Zurich / Mattias Beck, ETH Zurich / Jérôme Faist, ETH Zurich / Giacomo Scalari, ETH Zurich

SM1K.7

Towards Holistic Control of THz Quantum Cascade Random Lasers

Presenter: Benedikt Limbacher, *TU Wien*

We present a method to gain control of Quantum Cascade Random Lasers by illuminating them with spatially modulated near-infrared light. We employ deep learning to predict the response of the system to the near-infrared illumination.

Authors: Benedikt Limbacher, TU Wien / Sebastian Schönhuber, TU Wien / Nicolas Bachelard, TU Wien / Martin Kainz, TU Wien / Aaron Andrews, TU Wien / Hermann Detz, CEITEC / Gottfried Strasser, TU Wien / Juraj Darmo, TU Wien / Stefan Rotter, TU Wien / Karl Unterrainer, TU Wien

SM1Q

Quantum Photonics and Machine Learning

Presenter: Zi Wang

SM1Q.1

(Withdrawn) Title to be Announced

Invited

Presenter: Jennifer Dionne, *Stanford University*

Abstract not available.

Authors:Jennifer Dionne, Stanford University

SM1Q.2

Bright Quantum Dot Single-Photon Source at 1.55 μm Heterogeneously Integrated on Si

Presenter: Pawel Holewa , *Technical University of Denmark*

We demonstrate high single-photon purity from an InAs/InP QD sources on Si operating at 1.55 μm . The single-photon extraction efficiency reaches up to 10% using a simple mesa structure.

Authors:Pawel Holewa, Technical University of Denmark / Aurimas Sakanas, Technical University of Denmark / Ugur Gür, Technical University of Denmark / Pawel Mrowinski, Wroclaw University of Science and Technology / Niels Gregersen, Technical University of Denmark / Marcin Syperek, Wroclaw University of Science and Technology / Elizaveta Semenova, Technical University of Denmark

SM1Q.3

Pump-Probe Experiments of the Excited State Dynamics of GR1 Centers in Diamond

Presenter: shova subedi , *Univ of Alabama at Birmingham*

The 658 nm probe kinetics revealed strong bleaching and multiexponential decay of the excited level with additional relaxation via intersystem crossing. The origin of induced excited state absorption was due to some other center impurity center.

Authors:shova subedi, Univ of Alabama at Birmingham / Vladimir Fedorov, Univ of Alabama at Birmingham / Sergey Mirov, Univ of Alabama at Birmingham / Matthew Markham, Element 6

SM1Q.4

Quantum Prescription of Electron Energy Loss Spectroscopy in Crystalline Films

Presenter: Alvaro Rodriguez Echarri , *ICFO – The Institute of Photonic Sciences*

A quantum mechanical model is used to study EELS from crystalline noble metal films, which show intrinsic features associated with their crystallographic orientation.

Authors:Alvaro Rodriguez Echarri, ICFO – The Institute of Photonic Sciences / Enok Johannes Haahr Skjølstrup, Department of Materials and Production, Aalborg University / Thomas Garm Pedersen, Department of Materials and Production, Aalborg University / Javier García de Abajo, ICFO – The Institute of Photonic Sciences

SM1Q.5

Intelligent Decision Support System (IDSS) to Optimize 2D Materials Detection Using Digital Image Processing and Deep Learning

Presenter: Jesus Sanchez Juarez , *Univeristy of Rochester*

We develop intelligent algorithm to detect Monolayers of WSe₂, MoS₂, and h-BN autonomously using Digital Image Processing and Deep Learning with 100% accuracy, avoiding any additional characterization techniques such as photoluminescence or Raman.

Authors:Jesus Sanchez Juarez, Univeristy of Rochester / Marissa Granados Baez, Univeristy of Rochester / Alberto Alfonso Aguilar Lasserre, Instituto Tecnologico de Orizaba / Jaime Cardenas, Univeristy of Rochester

SM1Q.6

Plasmonic and Dielectric Nanostructures: Distinguishing Size, Material, and Dielectric Environment via Machine Learning

Presenter: Aniket Pant , *University of Alabama at Birmingham*

We employ machine learning, coupled with linear and nonlinear dimensionality reduction strategies, to distinguish between plasmonic and dielectric optical response of nanostructures and to understand the role of structural parameters and local environment.

Authors:Aniket Pant, University of Alabama at Birmingham / Kannatassen Appavoo, University of Alabama at Birmingham

SM1Q.7

OTF Gym: a Set of Reinforcement Learning Environment of Layered Optical Thin Film Inverse Design

Presenter: An Qing Jiang , *Waseda University*

OTF gym is a python library for optical thin film inverse design. We develop environments based on TMM simulation to solve various optimization targets(material, thickness, structural) with a single-agent and multi-agent reinforcement learning algorithm.

<gdiv></gdiv>

Authors:An Qing Jiang, Waseda University / liangyao chen, Fudan University / Osamu Yoshie, Waseda University

SM1D

Photodetectors

Prsieder: Anna Lena Giesecke , *AMO GmbH*

SM1D.1

Record Schottky Detector Sensitivity Using Hybrid Plasmonic Supermode Hybridization

Presenter: PoHan Chang , *University of Toronto*

A supermode hybridization-based light-matter-interaction enhancement mechanism is experimentally demonstrated, enabling broadband and athermal amorphous Schottky detectors with record responsivity per volume and sensitivity (-55dBm) approaching crystalline Ge counterparts that are 36× larger.

Authors: Charles Lin, University of Toronto / PoHan Chang, University of Toronto / Amr Helmy, University of Toronto

SM1D.2

Plasmonic Directional Photodetectors for Edge Enhancement

Presenter: Jianing Liu , *Boston University*

Angle-sensitive plasmonic photodetectors that can perform optical-domain spatial filtering operations are developed. The edge enhancement capabilities of these devices are demonstrated via computational imaging simulations based on their measured angular response.

Authors: Jianing Liu, Boston University / Hao Wang, Boston University / Yunzhe Li, Boston University / Leonard Kogos, Neural Dynamics Technologies LLC / Yuyu Li, Boston University / Lei Tian, Boston University / Roberto Paiella, Boston University

SM1D.3

Ultrafast Modified Uni-Traveling Carrier Photodiode With 3-dB Bandwidth of 150 GHz

Presenter: Enfei Chao , *Tsinghua University*

Ultrafast modified uni-traveling carrier photodiodes are designed based on a comprehensive model. The 3-dB bandwidths of fabricated devices with 4.5- and 6.5- μ m diameters are 150 GHz and 110 GHz, respectively, in agreement with our simulations.

Authors: Enfei Chao, Tsinghua University / Bing Xiong, Tsinghua University / Changzheng Sun, Tsinghua University / Zhibiao Hao, Tsinghua University / Jian Wang, Tsinghua University / Lai Wang, Tsinghua University / Yanjun Han, Tsinghua University / Hongtao Li, Tsinghua University / Jiadong Yu, Tsinghua University / Yi Luo, Tsinghua University

SM1D.4

High Performance Silicon Waveguide Photodetector at Communication Wavelengths by Deep Cooling

Presenter: Xingyan Zhao , *Shanghai Jiao Tong University*

A novel deep cooling process was applied to treat Er/O doped silicon waveguide photodiodes. Compared with RTA process, the deep cooling process leads to an enhanced photoresponsivity to 12 mA/W at 1510 nm.

Authors:Xingyan Zhao, Shanghai Jiao Tong University / Yaping Dan, Shanghai Jiao Tong University

SM1D.5

(Withdrawn) Explicit Gain Equation for Hybrid Graphene/Quantum Dots Photodetector

Presenter: Kaixiang Chen , *Shanghai Jiao Tong University*

Hybrid graphene/quantum dots photodetectors have significantly high photogain. The classical gain theory is questionable and fail to explain the negative photoresponse. An explicit gain equation is proposed in the paper and verified by photo Hall effect experiment.

Authors:Kaixiang Chen, Shanghai Jiao Tong University

SM1D.6

Triple-Mesa InGaAs/InAlAs Single-Photon Avalanche Diode Array for 1550 nm Photon Detection

Presenter: Jishen Zhang , *National University of Singapore*

We present a novel InGaAs/InAlAs single-photon avalanche diodes array with a triple-mesa structure. High photon detection efficiency of 36% with decent dark count rate of 1.9×10^7 Hz is achieved at 240 K.

Authors:Jishen Zhang, National University of Singapore / Haibo Wang, National University of Singapore / Gong Zhang, National University of Singapore / Haiwen Xu, National University of Singapore / Kian Hua Tan, National University of Singapore / Satrio Wicaksono, National University of Singapore / Chao Wang, National University of Singapore / Tianhua Ren, National University of Singapore / Chen Sun, National University of Singapore / Yue Chen, National University of Singapore / Yan Liang, University of Shanghai for Science and Technology / Charles Ci Wen Lim, National University of Singapore / Soon-Fatt Yoon, National University of Singapore / Xiao Gong, National University of Singapore

SM1D.7

Low Energy APD Optical Links

Invited

Presenter: Zhihong Huang , *Hewlett Packard Laboratories*

Abstract not available.

Authors:Zhihong Huang, Hewlett Packard Laboratories

SM1A

Active and Passive Photonic Integration

Presenter: Beibei Zeng , *Lehigh University*

SM1A.1

III-v-on-Silicon-Nitride Mode-Locked Laser With 2 pJ on-Chip Pulse Energy

Presenter: Artur Hermans , *Ghent University - imec*

We demonstrate a III-V-on-silicon-nitride electrically pumped mode-locked laser emitting at $\lambda = 1.6 \mu\text{m}$ with an on-chip pulse energy of approximately 2 pJ, significantly higher than on III-V-on-Si and InP photonic integration platforms.

Authors: Artur Hermans, Ghent University - imec / Kasper Van Gasse, Ghent University - imec / Jon Kjellman, Imec / Charles Caër, Imec / Tasuku Nakamura, Panasonic Corporation / Yasuhisa Inada, Panasonic Corporation / Kazuya Hisada, Panasonic Corporation / Taku Hirasawa, Panasonic Corporation / Sulakshna Kumari, Ghent University - imec / Aleksandrs Marinins, Imec / Roelof Jansen, Imec / Gunther Roelkens, Ghent University - imec / Philippe Soussan, Imec / Xavier Rottenberg, Imec / Bart Kuyken, Ghent University - imec

SM1A.2

Hertz-Level-Linewidth Semiconductor Laser via Injection Locking to an Ultra-High Q Silicon Nitride Microresonator

Presenter: Warren Jin , *University of California Santa Barbara*

A conventional semiconductor DFB laser is self-injection-locked to a CMOS-foundry-fabricated ultra-high Q silicon nitride microresonator, suppressing high-offset frequency noise to $0.2 \text{ Hz}^2 \text{ Hz}^{-1}$ and yielding instantaneous linewidth of 1.2 Hz.

Authors: Warren Jin, University of California Santa Barbara / Qifan Yang, California Institute of Technology / Lin Chang, University of California Santa Barbara / Boqiang Shen, California Institute of Technology / Heming Wang, California Institute of Technology / Mark Leal, University of California Santa Barbara / LUE WU, California Institute of Technology / Maodong Gao, California Institute of Technology / Avi Feshali, Anello Photonics / Mario Paniccia, Anello Photonics / Kerry Vahala, California Institute of Technology / John Bowers, University of California Santa Barbara

SM1A.3

Silicon Nitride Waveguide-Integrated Silicon Photodiodes for Blue Light

Presenter: Yiding Lin , *Max Planck Institute of Microstructure Physics*

We demonstrate silicon nitride waveguide-integrated silicon lateral *p-i-n* photodiodes at $\lambda=488\text{nm}$. A 50- μm long device exhibits a dark current of 178pA at -5V, a responsivity of $0.31\pm 0.01\text{A/W}$, and an external quantum efficiency of $\sim 78\%$.

Authors: Yiding Lin, Max Planck Institute of Microstructure Physics / Zheng Yong, University of Toronto / Xianshu Luo, Advanced Micro Foundry / Patrick Lo, Advanced Micro Foundry / Wesley Sacher, Max Planck Institute of Microstructure Physics / Joyce Poon, Max Planck Institute of Microstructure Physics

SM1A.4

Highly Efficient Photon Pair Generation in AlGaAs-on-Insulator Waveguides

Presenter: Hatam Mahmudlu, *Institute of Photonics, Leibniz University Hannover*

We demonstrate the generation of correlated photon pairs in AlGaAs-on-insulator waveguides through spontaneous four-wave mixing at telecom wavelengths with a generation efficiency of $\sim 0.096 \times 10^{12}$ pairs/(s \cdot W 2), one of the highest achieved in integrated structures.

Authors: Hatam Mahmudlu, Institute of Photonics, Leibniz University Hannover / Stuart May, School of Engineering, University of Glasgow / Ali Angulo, Institute of Photonics, Leibniz University Hannover / Marc Sorel, School of Engineering, University of Glasgow / Michael Kues, Institute of Photonics, Leibniz University Hannover

SM1A.5

Monolithic Integration of Active Materials Onto Passive Integrated Photonics Platforms

Invited

Presenter: Sonia Garcia-Blanco, *MESA+ Institute for Nanotechnology, University of Twente*

The monolithic integration of active materials to passive integrated photonic platforms is necessary to produce highly complex photonic circuits. In this talk, I will summarize our latest advances in the integration of rare-earth ion doped Al $_2$ O $_3$ and TiO $_2$ onto the Si $_3$ N $_4$ platform.

Authors: Sonia Garcia-Blanco, MESA+ Institute for Nanotechnology, University of Twente

SM1A.6

Thulium-Doped Tellurium Oxide Laser for Optical Communication at 2- μm Window

Presenter: Khadijeh Mirabbas Kiani, *McMaster University*

We demonstrate compact thulium-doped tellurium oxide microring lasers integrated on a low-loss silicon nitride platform with the output powers of up to 4.1 mW. We observe lasing in the wavelength range of 1.84–1.88 μm under 1.6 μm resonant pumping at 1.3 μm waveguide-microring gap size.

Authors: Khadijeh Mirabbas Kiani, McMaster University / Henry Frankis, McMaster University / Richard Mateman, LioniX International BV / Arne Leinse, LioniX International BV / Andrew Knights, McMaster University / Jonathan Bradley, McMaster University

SM1A.7

Up to 50 dB Extinction in Broadband Single-Stage Thermo-Optic Mach-Zehnder Interferometers for Programmable Low-Loss Silicon Nitride Photonic Circuits

Presenter: Ashutosh Rao, *National Institute of Standards and Technology*

We demonstrate single-stage thermo-optic Si_3N_4 interferometers with (46.1 ± 2.5) dB average extinction ratio over 1460–1640 nm ($50\times$ of typical devices). We analyze performance requirements for creating reconfigurable high-quality-factor resonators in programmable circuits using such interferometers.

Authors: Ashutosh Rao, National Institute of Standards and Technology / Gregory Moille, National Institute of Standards and Technology / Xiyuan Lu, National Institute of Standards and Technology / Daron Westly, National Institute of Standards and Technology / Michael Geiselmann, Ligentec / Michael Zervas, Ligentec / Kartik Srinivasan, National Institute of Standards and Technology

SM1P

Control and Coupling of Light in Fibers

Presenter: Takemi Hasegawa, *Sumitomo Electric Industries Ltd*

SM1P.1

Spatiotemporal Control of Light

Tutorial

Presenter: Joel Carpenter, *University of Queensland*

In this tutorial, I'll present recent advances in the spatial and temporal manipulation of light. In particular, the creation of arbitrary spatial transformations, and the generation of arbitrary spatiotemporal optical fields.

Authors: Joel Carpenter, University of Queensland

SM1P.2

Inverse Designed Arbitrary Fiber Mode Convertors With High Efficiency for OAM Generations and MDM Applications

Presenter: zhoutian Liu , *Tsinghua University*

We propose a set of inverse-designed nanostructured fibers capable of performing arbitrary mode conversion and OAM generations with configurable topological charge $1 \sim 3$, with high mode-purity exceeding 98% and ultrabroad bandwidth over 370 nm.

Authors:zhoutian Liu, Tsinghua University / Yuan Meng, Tsinghua University / Zhuorun Zhou, Tsinghua University / Lue Wang, Tsinghua University / Xiao Qirong, Tsinghua University / Dan li, Tsinghua University / Ping Yan, Tsinghua University / Mali Gong, Tsinghua University

SM1P.3

In-Fiber Polarization Control Using Nematic Liquid Crystal in Nano-Capillary Bragg Grating Array

Presenter: Abdullah Rahnama , *University of Toronto*

Nematic liquid crystal was introduced into a nano-hole array grating formed by femtosecond laser filaments in a telecommunication fiber. Capillary alignment has resulted in a strong polarization extinction ratio within a broad Bragg resonance.

Authors:Abdullah Rahnama, University of Toronto / Tigran Dadalyan, Université Laval / Keivan Mahmoud Aghdami, University of Toronto / Tigran Galstian, Université Laval / Peter R. Herman, University of Toronto

SM1P.4

Exceptionally High Coupling of Light Into Optical Fibers via all-Dielectric Nanostructures

Presenter: Oleh Yermakov , *V. N. Karazin Kharkiv National University*

We demonstrate experimentally and in simulation record-high efficiencies for coupling of light into step-index fibers at almost grazing incidence via the inclusion of axial-symmetric dielectric nanostructures, realized by electron-beam-lithography, onto the fiber facet.

Authors:Oleh Yermakov, V. N. Karazin Kharkiv National University / Henrik Schneidewind, Leibniz Institute of Photonic Technology / Uwe Hubner, Leibniz Institute of Photonic Technology / Torsten Wieduwilt, Leibniz Institute of Photonic Technology / Matthias Zeisberger, Leibniz Institute of Photonic Technology / Andrey Bogdanov, ITMO University / Yuri Kivshar, ITMO University / Markus Schmidt, Leibniz Institute of Photonic Technology

SM1P.5

Demonstration of Ring-Core Fiber Coupling System for Tailored Optical Vortex Beams Assisted by Diffraction Neural Networks

Presenter: xuanyu Hu , *WuhanNationalLaboratory for Optoelectron*

We propose and experimentally demonstrate a visualized ring-core fiber coupling alignment system. A two-layer fully connected diffraction neural network is used to tailor the input optical vortex beam for accurate size match.

Authors: Yize Liang, Wuhan National Laboratory for Optoelectron / Xuanyu Hu, Wuhan National Laboratory for Optoelectron / Zhe Zhao, Wuhan National Laboratory for Optoelectron / Xi Zhang, Wuhan National Laboratory for Optoelectron / Jian Wang, Wuhan National Laboratory for Optoelectron

SM1F

Spatial and Polarization Dynamics in Fibers

Presenter: Logan Wright, *Cornell University*

SM1F.1

Topological Charge Mediated Raman Gain Modulation

Presenter: Xiao Liu, *Boston University*

We demonstrate that conventional Raman gain spectra can be non-trivially modulated by the OAM that fiber-modes carry. An attendant “phase-matching” condition allows Raman spectra shifts by ~8 THz and strength modulations by ~20 dB.

Authors: Xiao Liu, Boston University / Aku Antikainen, Boston University / Siddharth Ramachandran, Boston University

SM1F.2

Chromatic Dispersion Properties of Highly Localized Anderson Modes in Random Silica-air Fiber

Presenter: Stefan Gausmann, *University of Central Florida - CREOL*

We present in this work chromatic dispersion measurements of highly localized Anderson modes in silica-air fiber using white light interferometry and confirmed our experimental results with rigorous FEM simulations.

Authors: Stefan Gausmann, University of Central Florida - CREOL / Xiaowen Hu, University of Central Florida - CREOL / Jose Antonio-Lopez, University of Central Florida - CREOL / Rodrigo Amezcua Correa, University of Central Florida - CREOL / Axel Schülzgen, University of Central Florida - CREOL

SM1F.3

Spatial Beam Evolution in Nonlinear Multimode Fibers

Invited

Presenter: Alessandro Tonello , *Université de Limoges, XLIM UMR CNRS 7253*

We discuss some recent results illustrating the role of input wave-front shaping, propagation dynamics and output beam diagnostics in order to observe spatial beam cleaning in nonlinear multimode fibers and amplifiers.

Authors: Mesay Addisu Jima, Dipartimento di Ingegneria dell'Informazione, Università degli Studi di Brescia / Etienne Deliancourt, Université de Limoges, XLIM UMR CNRS 7253 / Raphael Jauberteau, Dipartimento di Ingegneria dell'Informazione, Università degli Studi di Brescia / Yann Leventoux, Université de Limoges, XLIM UMR CNRS 7253 / Alioune Niang, Dipartimento di Ingegneria dell'Informazione, Università degli Studi di Brescia / Katarzyna Krupa, Institute of Physical Chemistry Polish Academy of Sciences / Tigran Mansuryan, Université de Limoges, XLIM UMR CNRS 7253 / Marc Fabert, Université de Limoges, XLIM UMR CNRS 7253 / Sebastien Fevrier, Université de Limoges, XLIM UMR CNRS 7253 / Alessandro Tonello, Université de Limoges, XLIM UMR CNRS 7253 / Daniele Modotto, Dipartimento di Ingegneria dell'Informazione, Università degli Studi di Brescia / Oleg Sidelnikov, Novosibirsk state University / Stefan Wabnitz, DIET, Sapienza Università di Roma / Alain Barthélémy, Université de Limoges, XLIM UMR CNRS 7253 / Vincent Kermene, Université de Limoges, XLIM UMR CNRS 7253 / Agnès Desfarges-Berthelemot, Université de Limoges, XLIM UMR CNRS 7253 / Guy Millot, Université Bourgogne Franche-Comté, ICB UMR CNRS 6303 / Vincent Couderc, Université de Limoges, XLIM UMR CNRS 7253

SM1F.4

Light Guidance Based on Topological Confinement Yielding Fiber Mode Counts Exceeding 50

Presenter: Zelin Ma , *Boston University*

We exploit a novel waveguiding regime that enables low-loss guidance for high angular momentum modes while avoiding coupling to other modes, yielding a 25-m long fiber propagating > 52 modes with purity > 19 dB.

Authors: Zelin Ma, Boston University / Poul Kristensen, OFS-Fitel / Siddharth Ramachandran, Boston University

SM1F.5

Toward OAM-Selective Frequency Conversion in a Three-Mode Fiber

Presenter: Afshin Shamshooli , *University of Texas at Arlington*

We describe OAM-compatible mode-selective frequency conversion in a few-mode fiber and experimentally demonstrate downconversion of various superpositions of signal modes LP11a and LP11b to the same LP11b mode with conversion efficiency differences <0.8 dB.

Authors: Afshin Shamshooli, University of Texas at Arlington / Cheng Guo, University of Texas at Arlington / Francesca Parmigiani, Microsoft Research / Xiaoying Li, Tianjin University / Michael Vasilyev, University of Texas at Arlington

SM1F.6

Inter-Modal Forward Stimulated Brillouin Scattering and Non-Reciprocity in Standard Polarization Maintaining Fiber

Presenter: Avi Zadok , *Bar-Ilan University*

Inter-polarization forward stimulated Brillouin scattering is studied in standard, polarization maintaining fibers. The process is driven by two orthogonally polarized pump tones. The stimulated acoustic waves induce non-reciprocal polarization switching of optical probe fields.

Authors: Gil Bashan, Bar-Ilan University / Hilel Diamandi, Bar-Ilan University / Yosef London, Bar-Ilan University / Keren Shemer, Bar-Ilan University / Kavita Sharma, Bar-Ilan University / Avi Zadok, Bar-Ilan University

SM1F.7

Tunable All-Fiber Multi-Wavelength and Orbital Angular Momentum Laser Assisted by Fiber Bragg Grating and Fabry-Perot Interferometer Directly Inscribed in Erbium-Doped Fiber by Femtosecond Laser

Presenter: Jian Wang , *Huazhong University of Science and Technology*

We demonstrate an all-fiber wavelength-switchable orbital angular momentum (OAM) laser assisted by fiber Bragg grating (FBG) and Fabry-Perot interferometer (FPI), which are directly inscribed by femtosecond laser in ring-core erbium-doped fiber.

Authors: Feng Cui, Huazhong University of Science and Technology / Jun Liu, Huazhong University of Science and Technology / Jue Wang, Huazhong University of Science and Technology / Chengkun Cai, Huazhong University of Science and Technology / Wei Li, Fiberhome Telecommunication Technologies Co. Ltd / Cheng Du, Fiberhome Telecommunication Technologies Co. Ltd / Jian Wang, Huazhong University of Science and Technology

SM1B

Optical Machine Learning and Security

Presenter: Giovanni Milione , *NEC Laboratories America Inc*

SM1B.1

(Withdrawn) Design of Shift-, Scale- and Rotation Invariant Diffractive Optical Networks

Presenter: Deniz Mengu , *University of California, Los Angeles*

We investigate the sensitivity of diffractive optical networks to random object translation, scaling and rotation operations, and present a deep learning-based training strategy to design shift-, scale- and rotation invariant diffractive networks.

Authors: Deniz Mengü, University of California, Los Angeles / Yair Rivenson, University of California, Los Angeles / Aydoğan Özcan, University of California, Los Angeles

SM1B.2

Multimode Fiber Transmission Matrix Inversion With Densely Connected Convolutional Network for Physical Layer Security

Presenter: Qian Zhang, *Technische Universität Dresden*

For exploiting multimode fiber optic communication networks towards physical layer security, we have trained a neural network performing mode decomposition of 10 modes. The approach is based on intensity-only camera images and works in real-time.

Authors: Qian Zhang, Technische Universität Dresden / Stefan Rothe, Technische Universität Dresden / Nektarios Koukourakis, Technische Universität Dresden / Jürgen Czarske, Technische Universität Dresden

SM1B.3

Advances in Fiber-Based Time-Delay Reservoir Computing

Invited

Presenter: Apostolos Argyris, *Instituto de Física Interdisciplinar y Sistemas Complejos - IFISC(UIB-CSIC)*

Here we present the recent advances of time-delay reservoir computing systems, built with standard fiber optic components and applied to the post-detection processing of optical communication signals.

Authors: Apostolos Argyris, Instituto de Física Interdisciplinar y Sistemas Complejos - IFISC(UIB-CSIC) / Ingo Fischer, Instituto de Física Interdisciplinar y Sistemas Complejos - IFISC(UIB-CSIC)

SM1B.4

Multi-Wavelength, Multi-Level Inputs for an All-Optical SOA-Based Neuron

Presenter: Bin Shi, *Institute for Photonic Integration, Eindhoven University of Technology*

We demonstrate the first optical processing of up to 9-bit/symbol multi-level modulated channels on a complete all-optical SOA-based neuron, with an error of 0.08. A higher number of modulation levels and inputs can improve accuracy.

Authors: Bin Shi, Institute for Photonic Integration, Eindhoven University of Technology / Bitao Pan, Institute for Photonic Integration, Eindhoven University of Technology / Nicola Calabretta, Institute for Photonic Integration, Eindhoven University of Technology / Ripalta Stabile, Institute for Photonic Integration, Eindhoven University of Technology

SM1B.5**On-Chip Online Learning and Inference for Photonic Pattern Recognition**

Presenter: Bicky Marquez , *Queen's University*

Recent investigations in neuromorphic photonics exploits photonics for neuron models. Here, we experimentally demonstrate a silicon photonic chip that can perform training and testing of a Hopfield network to reconstruct corrupted input patterns.

Authors:Bicky Marquez, Queen's University / Zhimu Guo, Queen's University / Hugh Morison, Queen's University / Sudip Shekhar, University of British Columbia / Lukas Chrostowski, University of British Columbia / Paul Prucnal, Princeton University / Bhavin Shastri, Queen's University

SM1B.6**All-Optical Wideband Chaos Synchronization and Communications Based on Mutual Injection of Semiconductor Lasers**

Presenter: Shunkai Xiang , *WNLO&HUST*

We experimentally demonstrate all-optical wideband chaos synchronization and communications based on mutual injection of semiconductor lasers. The 10-Gbaud quadrature phase shift keying signals are successfully encrypted and transmitted.

Authors:Shunkai Xiang, WNLO&HUST

SM1B.7**Key Update Using Y-00 Quantum Noise Stream Cipher With 20-bit Intensity Levels in a 1,000-km Optical Fiber Link**

Presenter: Fumio Futami , *Tamagawa University*

We demonstrate simultaneous intensity-modulated Y-00 cipher transmission of a private key at 200 kb/s and 1.5-Gb/s data over 1,000 km fiber. Highly secure key transmission with 1,048,576 ($=2^{20}$) intensity levels and key update are achieved.

Authors:Fumio Futami, Tamagawa University / Ken Tanizawa, Tamagawa University

SM1E**Plasma Sensing and Stand-off Detection**

Presenter: Zachary Reed , *National Inst of Standards & Technology*

SM1E.1

Non-Invasive Neutral Atom Density Measurements Using fs-TALIF in a Magnetic Linear Plasma Device

Presenter: Arthur Dogariu , *Princeton University*

We report on femtosecond TALIF measurements of neutral density in a mirror plasma device. We have measured H density down to 10^{11} cm^{-3} , and the dynamics of the H neutrals in quasi-CW and pulsed plasma.

Authors: Arthur Dogariu, Princeton University / Eugene Evans, Princeton Plasma Physics Lab / Sangeeta Vinoth, Princeton Plasma Physics Lab / Samuel Cohen, Princeton Plasma Physics Lab

SM1E.2

Laser-Induced Fluorescence of Ultrafast Laser Filament Generated Plasmas for Standoff Detection

Presenter: Sivanandan Harilal , *Pacific Northwest National Laboratory*

Ultrafast laser filament produced plasmas are made at a standoff distance of $\sim 10 \text{ m}$. The AI emission signal is enhanced by laser-induced fluorescence signals are measured. A comparison is made between the standoff signatures of LIBS and LIF emission.

Authors: Elizabeth Kautz, Pacific Northwest National Laboratory / Jeremy Yeak, Opticslah, Inc. / Mark Phillips, University of Arizona / Sivanandan Harilal, Pacific Northwest National Laboratory

SM1E.3

Analysis of Traces by LIBS: Methods to Maximize the Detection Sensitivity

Invited

Presenter: Violeta Lazic , *ENEA*

Chemical analysis of small sample amounts represents a special problem in Laser Induced Breakdown Spectroscopy (LIBS). The methods for sensitive LIBS measurements on small volumes of liquids and on trace particles will be discussed.

Authors: Violeta Lazic, ENEA

SM1E.4

Simultaneous Measurement of Optical Spectroscopic Signatures From Ultrafast Laser-Produced Plasmas

Presenter: Sivanandan Harilal , *Pacific Northwest National Laboratory*

We performed simultaneous measurement of absorption, emission, and laser-induced fluorescence spectroscopic signatures for determining femtosecond laser-produced plasma's physical properties throughout its lifecycle.

Authors:Sivanandan Harilal, Pacific Northwest National Laboratory / Elizabeth Kautz, Pacific Northwest National Laboratory / R. Jason Jones, University of Arizona / Mark Phillips, University of Arizona

SM1E.5

Kilometer-Range Distributed Acoustic Sensing by Time-Expanded Phase-Sensitive Time-Domain Reflectometry

Presenter: Vicente Durán , *Universitat Jaume I*

We demonstrate acoustic sensing over 1 km with 4-cm resolution, using megahertz detection bandwidth and a sampling rate of 40 Hz, by means of two electro-optic frequency combs with very dissimilar line spacing.

Authors:Miguel Soriano-Amat, Universidad de Alcalá de Henares / Hugo Martins, Instituto de Óptica "Daza de Valdés" CSIC / Luis Costa, Universidad de Alcalá de Henares / Sonia Martinez-Lopez, Universidad de Alcalá de Henares / Miguel González-Herraez, Universidad de Alcalá de Henares / María R. Fernández-Ruiz, Universidad de Alcalá de Henares / Vicente Durán, Universitat Jaume I

SM1E.6

Ultrafast Parallel LiDAR With All-Optical Spectro-Temporal Encoding

Presenter: Zihan Zang , *Tsinghua University*

The speed of a single-pixel LiDAR is limited by the round-trip delay and the speed of beam steering. We exploit optical code division multiplexing and inertia-free spectral scanning to break the speed limit.

Authors:Zihan Zang, Tsinghua University / Zhi Li, Tsinghua University / Yi Luo, Tsinghua University / Yanjun Han, Tsinghua University / Xuanyi Liu, Tsinghua University / Lican Wu, Tsinghua University / H. Y. Fu, Tsinghua University

SM1E.7

Dynamic Measurement of Fiber-Birefringence Spatial Distribution by Coherent Heterodyne Detection of Rayleigh Backscattered Light

Presenter: Nanako Takei , *Meiji University*

Dynamic measurement of fiber-birefringence spatial distribution along the fibers is performed by coherent heterodyne detection of Rayleigh backscattered light. Local fiber vibration at 250 Hz over the 80-km-long fibers was successfully measured by the technique.

Authors:Nanako Takei, Meiji University / Shiro Ryu, Meiji University

SM1C

Optical Metrology for Spectroscopy

Presenter: Florian Adler , *Tiger Optics*

SM1C.1

Highly Functional Dual-Comb Spectroscopy for Versatile Physical Property Evaluation of Solid Samples

Presenter: Takuto Adachi , *University of Electro-Communications*

We developed a technique for evaluating versatile physical properties of solid materials with polarization-sensitive dual-comb spectroscopy. Complex and dynamical optical responses of solid samples to external fields were successfully demonstrated in magneto-optic and electro-optic effects.

Authors: Takuto Adachi, University of Electro-Communications / Ruichen Zhu, University of Electro-Communications / Seishiro Akiyama, University of Electro-Communications / Akifumi Asahara, University of Electro-Communications / Yusuke Odagiri, University of Electro-Communications / Chikako Ishibashi, Neoark Corporation / Satoshi Hatano, Neoark Corporation / Kaoru Minoshima, University of Electro-Communications

SM1C.2

Multispectrum Rotational States Distribution Thermometry

Presenter: Marco Lamperti , *Politecnico di Milano*

We exploit a widely tunable comb-locked frequency-swept synthesizer to test a new optical approach to primary gas thermometry based on a global fitting of multiple molecular absorption lines of the same band at different pressures

Authors: Riccardo Gotti, Politecnico di Milano / Marco Lamperti, Politecnico di Milano / Davide Gatti, Politecnico di Milano / Szymon Wójtewicz, Nicolaus Copernicus University / Thomas Puppe, TOPTICA Photonics AG / Yuriy Mayzlin, TOPTICA Photonics AG / Bidoor Al Saif, King Abdullah University for Science and Technology / Julian Robinson-Tait, TOPTICA Photonics AG / Felix Rohde, TOPTICA Photonics AG / Rafal Wilk, TOPTICA Photonics AG / Patrick Leisching, TOPTICA Photonics AG / Wilhelm Kaenders, TOPTICA Photonics AG / Paolo Laporta, Politecnico di Milano / Marco Marangoni, Politecnico di Milano

SM1C.3

Optical-Optical Double-Resonance Spectroscopy of Methane Using a Cavity-Enhanced Comb Probe

Presenter: Vinicius Silva de Oliveira , *Umea University*

We implement a cavity to enhance the absorption of a frequency comb probe in a double-resonance measurement of sub-Doppler $3\nu_3 \leftarrow \nu_3$ methane transitions. This yields two orders of magnitude better sensitivity in 15 times shorter acquisition time compared to previous work using a single-pass cell.

Authors: Vinicius Silva de Oliveira, Umea University / Isak Silander, Umea University / Lucile Rutkowski, University Rennes / Grzegorz Sobon, Wroclaw University of Science and Technology / Ove Axner, Umea University / Kevin Lehmann, University of Virginia / Aleksandra Foltynowicz, Umea University

SM1C.4

Precision Measurements of $^{14}\text{N}_2^{16}\text{O}$ Using a Comb-Based Fourier Transform Spectrometer at $7.8\ \mu\text{m}$

Presenter: Adrian Hjältén, *Umea University*

Using a compact fiber-based difference frequency generation comb and a Fourier transform spectrometer we record spectra of the N_2O ν_1 band at $1285\ \text{cm}^{-1}$ in the Doppler limit. Fitting Gaussian line shapes to the individual absorption lines yields center frequencies with $<200\ \text{kHz}$ average precision.

Authors: Adrian Hjältén, Umea University / Matthias Germann, Umea University / Karol Krzempek, Wroclaw University of Science and Technology / Arkadiusz Hudzikowski, Wroclaw University of Science and Technology / Aleksander Gluszek, Wroclaw University of Science and Technology / Dorota Tomaszewska, Wroclaw University of Science and Technology / Grzegorz Sobon, Wroclaw University of Science and Technology / Aleksandra Foltynowicz, Umea University

SM1C.5

Dual Species Frequency Comb Cooling

Invited

Presenter: Damir Aumiler, *Institute of Physics*

We demonstrate 1D simultaneous laser cooling of ^{87}Rb and ^{85}Rb atoms using two counter-propagating σ^+ and σ^- polarized beams from the frequency comb. The results imply that several atomic species could be cooled simultaneously using a single frequency comb source. This comb-based multichannel laser cooling could bring significant advances in multispecies atom interferometers for space applications and in the study of multispecies interactions.

Authors: Danijel Buhin, Institute of Physics / Domagoj Kovačić, Institute of Physics / Fabian Schmid, Max-Planck-Institut für Quantenoptik / Mateo Kruljac, Institute of Physics / Vjekoslav Vulić, Institute of Physics / Ticijana Ban, Institute of Physics / Damir Aumiler, Institute of Physics

SM1C.6

Comb-Referenced Stimulated Raman Spectrometer: Application to the Collisional Physics of H_2

Presenter: Marco Lamperti , *Politecnico di Milano and CNR-IFN*

H₂ is a benchmark system for fundamental physics, yet spectroscopy is hindered by the lack of dipole moment. We present a comb-calibrated coherent Raman spectrometer for advanced studies of the collisional physics of the molecule.

Authors: Marco Lamperti, Politecnico di Milano and CNR-IFN / Lucile Rutkowski, Univ Rennes, CNRS, IPR (Institut de Physique de Rennes) / Daniele Ronchetti, Politecnico di Milano and CNR-IFN / Davide Gatti, Politecnico di Milano and CNR-IFN / Riccardo Gotti, Politecnico di Milano and CNR-IFN / Giulio Cerullo, Politecnico di Milano and CNR-IFN / Franck Thibault, Univ Rennes, CNRS, IPR (Institut de Physique de Rennes) / Hubert Józwiak, Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University / Szymon Wójtewicz, Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University / Piotr Maslowski, Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University / Piotr Wcislo, Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University / Dario Polli, Politecnico di Milano and CNR-IFN / Marco Marangoni, Politecnico di Milano and CNR-IFN

SM1C.7

Bending Modes Metrology in the 12-15 μm Region

Presenter: Marco Lamperti , *Politecnico di Milano*

Bending modes metrology through a comb-referenced widely tunable nonlinear laser source is demonstrated. We report center frequencies of CO₂ lines determined with 30 kHz uncertainty and an extensive study of the ν_{11} band of benzene.

Authors: Marco Lamperti, Politecnico di Milano / Riccardo Gotti, Politecnico di Milano / Davide Gatti, Politecnico di Milano / M. Khaled Shakfa, King Abdullah University for Science and Technology / Elisabetta Cané, Università di Bologna / Filippo Tamassia, Università di Bologna / Peter Schunemann, BAE Systems / Paolo Laporta, Politecnico di Milano / Aamir Farooq, King Abdullah University for Science and Technology / Marco Marangoni, Politecnico di Milano

SM1G

Time and Distance Metrology

Presenter: Ladan Arissian , *National Research Council Canada*

SM1G.1

Dual-Comb Digital Holography With High Spectral Resolution

Presenter: Edoardo Vicentini , *Istituto di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche*

The many evenly-spaced lines of a frequency comb are harnessed for a new approach digital holography, using dual-comb interferometry. A “movie” of recorded holograms enables 3-dimensional hyperspectral imaging with high spatial and spectral resolution.

Authors: Edoardo Vicentini, Istituto di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche / Zhenhai Wang, Tsinghua University / Kasper Van Gasse, Ghent University / Theodor Hänsch, Max-Planck Institute of Quantum Optics / Nathalie Picqué, Max-Planck Institute of Quantum Optics

SM1G.2

High-Precision and Large-Dynamic-Range Three-Dimensional Surface Profilometry by Comb-Based Time-of-Flight Detection

Presenter: Yongjin Na, *Korea Advanced Inst of Science & Tech*

We demonstrate high-precision (~10-nm repeatability) and large-dynamic-range (120 dB dynamic-range with ~9-mm ambiguity range) three-dimensional surface profile imaging technique by combining an optical frequency comb, an electro-optic-sampling-based timing detector, and a fast beam scanner.

Authors: Yongjin Na, Korea Advanced Inst of Science & Tech / Changmin Ahn, Korea Advanced Inst of Science & Tech / Chan-Gi Jeon, Korea Advanced Inst of Science & Tech / Jungwon Kim, Korea Advanced Inst of Science & Tech

SM1G.3

3D Tracking of Water-Dispersed-Nanosphere in Microstructured Fibers

Presenter: Shiqi Jiang, *Leibniz Institute of Photonic Technology*

We presented two designs of microstructured fibers which can be applied to 3D tracking of water-dispersed-nanoparticles with high spatiotemporal resolution and long observation time by retrieving the depth information from the scattered intensity.

Authors: Shiqi Jiang, Leibniz Institute of Photonic Technology / Ronny Förster, Leibniz Institute of Photonic Technology / Jens Kobelke, Leibniz Institute of Photonic Technology / Markus Schmidt, Leibniz Institute of Photonic Technology

SM1G.4

Simultaneous Detection of Distance and Velocity via Asymmetric Carrier-Suppressed Double Sideband Modulation With a Kerr-Microresonator Soliton Comb

Presenter: Hiroki Kitora, *Tokushima University*

We propose and demonstrate a new LiDAR technique with the capability of the simultaneous measurement of distance and velocity, in which an asymmetric carrier-suppressed double sideband modulation is applied to a Kerr-microresonator frequency comb.

Authors:Hiroki Kitora, Tokushima University / Takeshi Yasui, Tokushima University / Kaoru Minoshima, University of Electro-Communications / Naoya Kuse, Tokushima University

SM1G.5

Carrier-Free Dual-Comb Distance Metrology Using Two-Photon Detection

Presenter: Hollie Wright , *Heriot-Watt University*

By using cross-polarized dual combs and two-photon detection we demonstrate carrier-phase-insensitive time-of-flight distance measurement at 1555 nm with 93 nm precision and sampling rates exceeding by 2.4x the conventional dual-comb metrology aliasing limit.

Authors:Hollie Wright, Heriot-Watt University / Jinghua Sun, Dongguan University / David McKendrick, Renishaw Plc / Nick Weston, Renishaw Plc / Derryck Reid, Heriot-Watt University

SM1G.6

Frequency-Modulated Comb LiDAR Without Wavelength Division de-Multiplexer

Presenter: Kenji Nishimoto , *Tokushima University*

We propose and demonstrate frequency-modulated comb LiDAR without a wavelength division de-multiplexer, in which the LiDAR signals from the comb modes are separated in the RF domain at a single photo detector.

Authors:Kenji Nishimoto, Tokushima University / Kaoru Minoshima, University of Electro-Communications / Takeshi Yasui, Tokushima University / Naoya Kuse, Tokushima University

SM1G.7

Ultra-Precise Complex Refractive Index Measurement Using Dual-Comb Spectroscopy

Presenter: Kana Sumihara , *Keio University*

We determined complex refractive index and thickness of a silicon wafer with unprecedented precision using dual-comb spectroscopy. The standard deviations of the refractive index and the thickness are 8.9×10^{-6} and 1.0 nm, respectively.

Authors:Kana Sumihara, Keio University / Sho Okubo, NMIJ, AIST / Makoto Okano, Keio University / Hajime Inaba, NMIJ, AIST / Shinichi Watanabe, Keio University

SM1G.8

LWIR Dual-Comb Spectroscopy Using Time-Domain Etalon Calibration

Presenter: Ryan Rhoades , *University of Arizona*

We demonstrate a technique for improving performance in dual-comb spectroscopy when utilizing sources based on difference frequency generation without stabilization of the offset frequency by utilizing an etalon to recalibrate time-domain data in post-processing.

Authors: Ryan Rhoades, University of Arizona / Caroline Lecaplain, University of Arizona / Mark Phillips, University of Arizona / R. Jason Jones, University of Arizona

AM11

A&TTR Super Topical Review on High Power Laser Technology I: New Perspectives on Pulse Post-compression

Presenter: Anne-Lise Viotti, *Lund University*

AM11.1

Latest Advances in Industrial Nonlinear Compression

Invited

Presenter: Yoann Zaouter, *Amplitude Systemes*

We will review the latest achievements for nonlinear compression using gas-filled multipass cells for the temporal compression of industrial Ytterbium laser. Challenges and alternatives for the production of few cycle pulse will be discussed.

Authors: Yoann Zaouter, Amplitude Systemes

AM11.2

High-Energy Solitons: Towards TW-Scale Sub-Cycle Pulses

Invited

Presenter: John Travers, *Heriot-Watt University*

Energy scaling of soliton dynamics in gas-filled hollow capillary fibres enables self-compression of optical pulses to sub-cycle and sub-femtosecond pulse durations with peak powers exceeding one terawatt.

Authors: John Travers, Heriot-Watt University / Chris Brahms, Heriot-Watt University / Federico Belli, Heriot-Watt University

AM11.3

High-Energy Multidimensional Solitary States in Hollow-Core Fibers

Presenter: reza safaei, *INRS-EMT*

We report the first time observation of the formation of highly-stable multidimensional solitary states (MDSS) in gas-filled Hollow-core fibers. The MDSS have broadband red-shifted spectra with an uncommon negative quadratic spectral phase at output, originating from strong intermodal interactions.

Authors: reza safaei, INRS-EMT / Guangyu Fan, INRS-EMT / Ojoon Kwon, INRS-EMT / Katherine LÉGARÉ, INRS-EMT / Philippe Lassonde, INRS-EMT / Heide Ibrahim, INRS-EMT / François Légaré, INRS-EMT

AM11.4

Pulse Energy Scaling of Multipass Spectral Broadening Beyond 100 mJ

Presenter: Martin Kaumanns , *Ludwig-Maximilians-Universität München*

We spectrally broaden 1.3 ps pulses and show compressibility to 37 fs for energies >100 mJ at a repetition rate of 5 kHz by using a first order Laguerre-Gaussian mode in an argon-filled multipass cell.

Authors: Martin Kaumanns, Ludwig-Maximilians-Universität München / Dmitrii Kormin, Ludwig-Maximilians-Universität München / Thomas Nubbemeyer, Ludwig-Maximilians-Universität München / Vladimir Pervak, Ludwig-Maximilians-Universität München / Stefan Karsch, Ludwig-Maximilians-Universität München

AM11.5

40mJ Nonlinear Compression and Energy Scaling Route for Yb Amplifier Using Large-Core Hollow Fibers

Presenter: Guangyu Fan , *INRS*

We illustrate the energy scaling rules of hollow-core fiber nonlinear compression for high energy Yb technologies. As a demonstration, 70 mJ 230 fs pulses were compressed down to 25 fs with 1.3 TW peak power.

Authors: Guangyu Fan, INRS / Paolo Carpeggiani, Technische Universität Wien / Zhensheng Tao, Fudan University / Giulio Coccia, Technische Universität Wien / reza safaei, INRS / Edgar Kaksis, Technische Universität Wien / Audrius Pugzlys, Technische Universität Wien / François Légaré, INRS / Bruno Schmidt, Few-cycle Inc. / Andrius Baltuska, Technische Universität Wien

AM11.6

Spatial-Spectral Characteristics of Pulses From Multi-Pass Cell and Multiple-Plate Continuum Compressors

Presenter: Shang-da Yang , *National Tsing-Hua University*

Spatial-spectral characteristics of Yb:KGW laser pulses passing through a multi-pass cell and a multiple-plate continuum are analyzed. The former exhibits slightly better spectral homogeneity under the same degree of spectral broadening due to less B-integral per pass.

Authors:An-Yuan Liang, National Tsing-Hua University / Chia-Lun Tsai, National Tsing-Hua University / Chih-Hsuan Lu, National Tsing-Hua University / Ming-Chang Chen, National Tsing-Hua University / Shang-da Yang, National Tsing-Hua University

7:00 - 8:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - What's Next in Integrated Photonics - Hot Topics at CLEO 2021

Join the OSA Integrated Photonics Technical Group for a panel discussion on Monday. Our featured presenters will give their perspective on the exciting research that will be presented at CLEO: 2021. These presentations will be followed by a moderated question and answer session, discussing the highlights in integrated photonics at the conference. This event is an excellent opportunity to hear from experts in the field on exciting new areas in integrated photonics. Panelists include Juejun Hu, Massachusetts Institute of Technology; Roel Baets, Ghent University; Mercedeh Khajavikhan, University of Southern California; and Rachel Grange, ETH Zurich.

9:00 - 11:15 (Pacific Time (US & Canada) DST, UTC - 07:00)

JM2A

Joint Plenary Session I

JM2A.1

From Quantum Foundations to Quantum Communications and Back

Plenary

Presenter: Nicolas Gisin, *Universite de Geneve*

Quantum information science emerged from studies on the foundations of quantum physics. The talk will illustrate this, starting from Bell inequalities all the way to commercial Quantum Key Distribution and Quantum Random Number Generator chips. However, the story does not stop here. Quantum information science, in turn, feeds back into the foundations, asking questions like, e.g., "how does non-locality manifest in quantum networks".

Authors:Nicolas Gisin, *Universite de Geneve*

JM2A.2

Silicon Photonic Quantum Computing

Plenary

Presenter: Jeremy O'Brien , *University of Bristol*

PsiQuantum's goal is to build the world's first useful quantum computer using silicon photonic chips to process quantum information with single photons. A linear optical approach to quantum computing offers highly coherent qubits, high fidelity single qubit gates, and probabilistic entangling operations that can be implemented using well-known quantum optical methods.

Authors:Jeremy O'Brien, University of Bristol

JM2A.3

Optical Communications: Innovations and Applications Abound

Plenary

Presenter: Alan Eli Willner , *University of Southern California*

Optical fiber is a key enabler of high-capacity and long-distance communications. However, many applications of optical communications beyond conventional fiber systems are emerging that harness photonic technologies, especially using photonic-integrated-circuits.

Authors:Alan Eli Willner, University of Southern California

11:15 - 11:35 (Pacific Time (US & Canada) DST, UTC - 07:00)

Exhibit Hall Event - Technology Showcase: Simple Operation & Locking of a Continuously Tunable Laser

Toptica Photonics, Inc.: TOPTICA's continuously tunable laser, the CTL, enables mode-hop-free wavelength tuning up to 120 nm with narrow linewidth and highest accuracy. In this demo, we show how to operate the laser with the fully digital, low noise and drift DLC pro controller using intuitive touch screen controls. To illustrate the convenient features of the laser and DLC pro controller, the system is connected to a spectroscopy cell and the transmission spectra is measured by a photodiode and recorded by the DLC pro. The ability to review the live data live and use the new Auto-PID feature to lock the laser to a specific laser line will be demonstrated as well. With applications in device characterization, quantum and materials analysis, it is ideal for any application requiring high precision mode-hop free laser operation over a wide tuning range. Speaker: Rudolf Neuhaus, Toptica Photonics, Inc., Germany

11:40 - 12:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Exhibit Hall Event - Technology Showcase: New and Featured Products for Laser Applications

OptoSigma Corporation: Join us for an exciting and concise presentation on our newest and featured products, all suitable for research or commercial laser applications. A few examples are the OUCI imaging and laser induction modules, our in-house manufactured UV and NIR Objectives and our expanding product line of MHX Stainless-Steel, high performance mirror mounts. We think you'll appreciate and enjoy our presentation. Speaker: Dan Denison, OptoSigma Corporation, USA

12:00 - 13:45 (Pacific Time (US & Canada) DST, UTC - 07:00)

SM3P

Fiber Based Light Sources

Presider: William Renninger , *University of Rochester*

SM3P.1

All-Fiber High-Energy 174 fs Laser at 1.78 μm Using Parabolic W-Type Normal Dispersion Thulium-Doped Fiber

Presenter: Shaoxiang Chen , *Nanyang Technological University*

With the combination of proper dispersion management and W-type normal-dispersion thulium-doped fiber, we demonstrated an all-fiber 127.8nJ laser, exhibiting the shortest pulse duration of 174fs and highest peak power of 0.2MW in the 1.7 μm region.

Authors:Shaoxiang Chen, Nanyang Technological University / Yuhao Chen, Nanyang Technological University / Kun Liu, Nanyang Technological University / Sidharthan Raghuraman, Nanyang Technological University / Huizi Li, Nanyang Technological University / Chenjian Chang, Nanyang Technological University / Qi jie Wang, Nanyang Technological University / Dingyuan Tang, Nanyang Technological University / Seongwoo Yoo, Nanyang Technological University

SM3P.2

Complex Swift Hohenberg Equation (CSHE) Dissipative Soliton Fiber Laser

Presenter: Ankita Khanolkar , *University of Dayton*

We report dissipative solitons of CSHE in a mode-locked fiber laser by employing a unique fiber filter which produces a fourth order spectral response. The laser generates moving, asymmetric pulses with a highly asymmetric spectrum.

Authors:Ankita Khanolkar, University of Dayton / Yimin Zang, University of Dayton / Andy Chong, University of Dayton

SM3P.3

Generation of Noise-Like Pulses in a High Numerical Aperture Fiber Seeded by Soliton Pulses at 1.9 μm

Presenter: Ahmet Turnali , *Boston University*

We demonstrate that soliton pulses centered at 1.9 μm can evolve into noise-like pulses in a high numerical aperture fiber. The amplified pulses have an energy of 56 nJ and a duration of 210 fs after compression.

Authors:Ahmet Turnali, Boston University / Shutao Xu, Boston University / Michelle Sander, Boston University

SM3P.4

Self-Mode-Locking in a Thulium-Doped All-Fibre Ring Laser Providing 1.18 nJ, 350 fs Solitons

Presenter: Dennis Kirsch , *Leibniz Institut of Photonic Technology*

Implication of self-mode-locking originated from non-excited Thulium ions is investigated to construct a cost-effective 1.9 μm all-fibre laser. The laser generates 350 fs solitons with 1.18 nJ energy at 44.8 MHz repetition rate in flawless mode-locking.

Authors:Dennis Kirsch, Leibniz Institut of Photonic Technology / Maria Chernysheva, Leibniz Institut of Photonic Technology

SM3P.5

Ultrafast Vacuum-Ultraviolet Light Sources at Megahertz Repetition Rates

Invited

Presenter: Dan Hickstein , *KMLabs*

Utilizing two-color-pumped harmonic generation in xenon gas, we upconvert a MHz fiber laser to the vacuum ultraviolet. We engineer several compact VUV sources and apply them to mass spectroscopy and angle-resolved photoemission (ARPES) experiments.

Authors:Dan Hickstein, KMLabs

SM3P.6

10-Hz, 636-ps, 1064-nm, All Polarization-Maintaining Fiber Front-End Based on Ultrafast Optical Fiber Pulse Chopping

Presenter: Yizhou Liu , *Hamburg University*

We propose a robust 10-Hz, 1064-nm, 636-ps, sub- μJ , all polarization-maintaining fiber front-end, which was realized by a combination of Sagnac loop and EO phase modulator for sub-ns-level optical chopping together with two AOM stages.

Authors:Yizhou Liu, Hamburg University / Hua Yi, Hamburg University / Sedigheh Mohamadi, CFEL / Mikhail Pergament, CFEL / Franz Kärtner, CFEL

12:00 - 14:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FM3N

Quantum Enhanced Absorption and Emission

Presenter: Samuele Grandi , *ICFO*

FM3N.1

Two-Photon Absorption in Molecules by Time-Frequency-Entangled Photon Pairs: the Roles of Photon-Number Correlations and Spectral Correlations

Presenter: Michael Raymer , *University of Oregon*

Two-photon absorption is enhanced by time-frequency entanglement of photon pairs at extremely low optical flux, yet we find theoretically that for typical molecules TPA event rates are so low as to be unobservable.

Authors:Michael Raymer, University of Oregon / Tiemo Landes, University of Oregon / Markus Allgaier, University of Oregon / Sofiane Merkouche, University of Oregon / Brian Smith, University of Oregon / Andrew Marcus, University of Oregon

FM3N.2

Bounding Entangled Two-Photon Absorption With Sensitive Transmittance Measurements

Presenter: Michael Mazurek , *NIST Boulder*

Two-photon absorption rates may be enhanced with energy-time entangled states of light. Using a sensitive transmittance measurement we find no evidence of this enhancement, in disagreement with previously reported results.

Authors:Michael Mazurek, NIST Boulder / Kristen Parzuchowski, University of Colorado / Alexander Mikhaylov, University of Colorado / Sae Woo Nam, NIST Boulder / Charles Camp Jr., NIST Gaithersburg / Thomas Gerrits, NIST Gaithersburg / Ralph Jimenez, University of Colorado / Martin Stevens, NIST Boulder

FM3N.3

Experimental Bounds on Entangled Two Photon Absorption in Rhodamine 6G

Presenter: Tiemo Landes , *University of Oregon*

Entangled photons have been reported to enhance two-photon absorption by many orders of magnitude. Recent theoretical work predicts smaller increases for common molecular dyes. We present experimental results supporting this claim in Rhodamine 6G.

Authors:Tiemo Landes, University of Oregon / Markus Allgaier, University of Oregon / Sofiane Merkouche, University of Oregon / Brian Smith, University of Oregon / Andrew Marcus, University of Oregon / Michael Raymer, University of Oregon

FM3N.4

Two Photon Emission From Superluminal and Accelerating Index Changes

Presenter: Jamison Sloan , *Massachusetts Institute of Technology*

We show that superluminal and accelerating index perturbations in dielectric media can act as sources of entangled photon pairs. We show how these sources can be realized in various nonlinear nanophotonic platforms.

Authors: Jamison Sloan, Massachusetts Institute of Technology / Nicholas Rivera, Massachusetts Institute of Technology / John Joannopoulos, Massachusetts Institute of Technology / Marin Soljačić, Massachusetts Institute of Technology

FM3N.5

Nonlinear Optics With One Molecule and Two Photons

Highlighted Talk

Presenter: André Pscherer, *Max-Planck Institute for the Science of Light*

We use single solid state organic molecules strongly coupled to a tunable Fabry-Perot microcavity to perform nonlinear optics experiments at the single quantum limit.

Authors: André Pscherer, Max-Planck Institute for the Science of Light / Manuel Meierhofer, Max-Planck Institute for the Science of Light / Daqing Wang, Max-Planck Institute for the Science of Light / Hrishikesh Kelkar, Max-Planck Institute for the Science of Light / Diego Martín-Cano, Max-Planck Institute for the Science of Light / Tobias Utikal, Max-Planck Institute for the Science of Light / Stephan Götzinger, Friedrich-Alexander University Erlangen-Nürnberg / Vahid Sandoghdar, Max-Planck Institute for the Science of Light

FM3N.6

Quantum Entanglement and Modulation Enhancement of Free-Electron-Bound-Electron Interaction

Presenter: Zhexin Zhao, *Stanford University*

We study the modulation enhancement of interaction and entanglement between distant atoms in the interaction between free electron and two-level atoms.

Authors: Zhexin Zhao, Stanford University / Xiaoqi Sun, Stanford University / Shanhui Fan, Stanford University

FM3N.7

Superradiant and Subradiant Light Emission From Entangled Free Electrons

Presenter: Aviv Karnieli, *Tel Aviv University*

We show how quantum correlations such as entanglement give rise to a new quantum regime of superradiance and subradiance from free-electrons, demonstrating that light emission can be sensitive to the quantum state of many-body wavefunctions.

Authors: Aviv Karnieli, Tel Aviv University / Nicholas Rivera, MIT / Ady Arie, Tel Aviv University / Ido Kaminer, Technion

FM3M

Teleportation and Entanglement

Presenter: Thomas Gerrits , *National Inst of Standards & Technology*

FM3M.1

Teleportation-Based Protocols With Hybrid Entanglement of Light.

Presenter: Tom Darras , *Laboratoire Kastler Brossel*

We report an entanglement swapping protocol implemented between single-photon entanglement and hybrid discrete- and continuous-variables entanglement of light, allowing the connection of disparate nodes in a heterogeneously-structured quantum internet.

Authors: Tom Darras, Laboratoire Kastler Brossel / Adrien Cavallès, Laboratoire Kastler Brossel / Hanna Le Jeannic, Niels Bohr Institute / Huazhuo Dong, Laboratoire Kastler Brossel / Beate Asenbeck, Laboratoire Kastler Brossel / Giovanni Guccione, Laboratoire Kastler Brossel / Julien Laurat, Laboratoire Kastler Brossel

FM3M.2

High-Performance Quantum Teleportation Systems at Telecom C-Band

Presenter: Qiang Zhou , *University of Electronic Science and Technology of China*

Based on performance improved entangled photon pair source at $1.5 \mu\text{m}$, we experimentally demonstrated quantum teleportation with the rate and fidelity of $6.41 \pm 0.37 \text{ Hz}$ and $87.70 \pm 5.75\%$ over a state-transfer distance of 40 km.

Authors: Si Shen, University of Electronic Science and Technology of China / Chenzhi Yuan, University of Electronic Science and Technology of China / Zi-Chang Zhang, University of Electronic Science and Technology of China / Heqing Wang, Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Science / Hao Li, Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Science / Lixing You, Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Science / Zhen Wang, Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Science / You Wang, University of Electronic Science and Technology of China / Guangwei Deng, University of Electronic Science and Technology of China / Haizhi Song, University of Electronic Science and Technology of China / Guang-Can Guo, University of Electronic Science and Technology of China / Qiang Zhou, University of Electronic Science and Technology of China

FM3M.3

Coherent Frequency-Conversion of Quantum dot Photons to the Telecommunication C-Band for Quantum Communication Applications

Presenter: Francesco Graffitti , *Heriot-Watt University*

We demonstrate frequency-conversion of quantum dot photons to the telecom C-band enabled by a custom-built, tunable mid-infrared laser. We achieve high brightness while preserving the photons' coherence properties, outperforming state-of-the-art solid-state emitters at telecom wavelengths.

Authors: Francesco Graffitti, Heriot-Watt University / Christopher Morrison, Heriot-Watt University / Markus Rambach, University of Queensland / Zhe Xian Koong, Heriot-Watt University / Fiona Thorburn, Heriot-Watt University / Ajoy Kar, Heriot-Watt University / Jin Dong Song, Center for Opto-Electronic Materials and Devices Research, Korea Institute of Science and Technology, / S Park, Center for Opto-Electronic Materials and Devices Research, Korea Institute of Science and Technology, / Y Ma, Center for Opto-Electronic Materials and Devices Research, Korea Institute of Science and Technology, / Alessandro Fedrizzi, Heriot-Watt University / Brian Gerardot, Heriot-Watt University

FM3M.4

Shaping Spatially Entangled Photons in Real-Time by Classical Control and Feedback

Presenter: Ohad Lib , *Hebrew University of Jerusalem*

We present a method for compensating scattering of spatially entangled photons in real-time, by using feedback from the classical pump beam that stimulates their creation, paving the way for implementing wavefront shaping in quantum communications.

Authors: Ohad Lib, Hebrew University of Jerusalem / Yaron Bromberg, Hebrew University of Jerusalem

FM3M.5

Conjugate-Franson Interferometry for Testing Nonlocality of Time-Energy Entangled Biphotons

Presenter: Changchen Chen , *Massachusetts Institute of Technology*

We report the first experimental demonstration of a conjugate-Franson interferometer, i.e., a nonlocal interferometer that can certify time-energy entanglement. Our measured 96% visibility tightly bounds the temporal correlation of biphotons generated by spontaneous parametric down-conversion.

Authors: Changchen Chen, Massachusetts Institute of Technology / Jeffrey Shapiro, Massachusetts Institute of Technology / Franco Wong, Massachusetts Institute of Technology

FM3M.6

Quantification of High-Dimensional Energy-Time Entanglement in a Biphoton Frequency Comb

Presenter: KAI-CHI CHANG , *UCLA*

We quantify high-dimensional energy-time entanglement with a filtered biphoton frequency comb. Franson interference measurements are performed, with the entanglement of formation up to 1.89 ± 0.03 ebits for a 45.32 GHz biphoton frequency comb.

Authors: KAI-CHI CHANG, UCLA / Xiang Cheng, UCLA / Murat Can Sarihan, UCLA / Abhinav Kumar Vinod, UCLA / Tian Zhong, University of Chicago / Yan-Xiao Gong, Nanjing university / Zhenda Xie, Nanjing university / Jeffrey Shapiro, MIT / Franco Wong, MIT / Chee Wei Wong, UCLA

FM3M.7

Entanglement-Assisted Communication Surpassing the Ultimate Classical Capacity

Presenter: Shuhong Hao , *University of Arizona*

We report experimental entanglement-assisted communication above the ultimate classical capacity set by the Holevo-Schumacher-Westmorel bound. A high-efficiency entanglement source and a phase-conjugate quantum receiver reap the benefit of pre-shared entanglement over lossy and noisy channels.

Authors: Shuhong Hao, University of Arizona / Haowei Shi, University of Arizona / Wei Li, University of Arizona / Quntao Zhuang, University of Arizona / Zheshen Zhang, University of Arizona

FM3M.8

Testing a New Strong No-Go Theorem for the Wigner's Friend Scenario

Presenter: Geoffrey Pryde , *Griffith University*

The Wigner's friend paradox illuminates the quantum measurement problem. We derive—and study, in a series of entangled-photon experiments—a new and robust no-go theorem based on the paradox, with stronger constraints than Bell's theorem.

Authors: Geoffrey Pryde, Griffith University / Kok-Wei Bong, Griffith University / Anibal Utreras-Alarcón, Griffith University / Farzad Ghafari, Griffith University / Yeong-Cherng Liang, National Cheng Kung University / Nora Tischler, Griffith University / Eric Cavalcanti, Griffith University / Howard Wiseman, Griffith University

FM3I

Structured Surfaces

Presenter: Andrew Weiner , *Purdue University*

FM3I.1

Spontaneous and Light-Induced Chiral Plasmons Without Magnetic Field

Invited

Presenter: Mark Rudner , *Copenhagen University*

I will discuss how plasmonic chirality can be achieved in the absence of an applied magnetic field. The direction of chirality can be chosen by a circularly-polarized excitation field, or spontaneously through nonlinear light-matter interaction.

Authors:Mark Rudner, Copenhagen University / Justin Song, Nanyang Technological University

FM3I.2

Control of Second-Harmonic Generation in Dielectric Polaritonic Metasurfaces Using $\chi^{(2)}$ Polarity Switching

Presenter: Raktim Sarma , *Sandia National Labs*

We demonstrate microscopic control of nonlinearities in dielectric metasurfaces comprising of Mie resonators embedded with semiconductor heterostructures. Through heterostructure design, we control the polarity of the resonant $\chi^{(2)}$ leading to suppression or enhancement of second-harmonic generation.

Authors:Raktim Sarma, Sandia National Labs / Jiaming Xu, University of Texas / Domenico de Ceglia, University of Padova / John Klem, Sandia National Labs / Michael Sinclair, Sandia National Labs / Mikhail Belkin, University of Texas / Igal Brener, Sandia National Labs

FM3I.3

Mid-Infrared METasurface Based on a PHase-CHange MAterial for Enhanced Third-Harmonic Generation

Presenter: Fuyong Yue , *Institut national de la recherche scientifique*

We report on the nonlinear optical properties of the phase change material $\text{Ge}_2\text{Sb}_2\text{Se}_4\text{Te}_1$ (GSST). A 30-fold enhancement of third-harmonic generation is also demonstrated using a GSST metasurface operating in the mid-wave infrared region.

Authors:Fuyong Yue, Institut national de la recherche scientifique / Riccardo Piccoli, Institut national de la recherche scientifique / Mikhail Shalaginov, Massachusetts Institute of Technology / Tian Gu, Massachusetts Institute of Technology / Kathleen Richardson, University of Central Florida / Roberto Morandotti, Institut national de la recherche scientifique / Juejun Hu, Massachusetts Institute of Technology / Luca Razzari, Institut national de la recherche scientifique

FM3I.4

Enhanced Third-Harmonic Dichroism in Chiral all-Dielectric Metasurfaces Driven by Quasi-BIC

Presenter: marco gandolfi , *CNR-INO (National Institute of Optics)*

We develop a new approach based on quasi-BICs to develop chiral metasurfaces exhibiting nonlinear circular dichroism (up to 99.9%) and high conversion efficiency (10^{-2} W^{-2}). Tuning mode interference allows selective linear and nonlinear circular dichroism.

Authors: marco gandolfi, CNR-INO (National Institute of Optics) / Andrea Tognazzi, CNR-INO (National Institute of Optics) / Davide Rocco, CNR-INO (National Institute of Optics) / Luca Carletti, University of Brescia / Costantino De Angelis, CNR-INO (National Institute of Optics)

FM3I.5

The Temporal Talbot Effect on the Surface of Water

Presenter: Georgi Rozenman , *Tel Aviv University*

We study the evolution of linear and nonlinear Talbot carpets emerging in surface gravity water waves. In our measurements, we are able to record both amplitude and phase of the Temporal Talbot effect.

Authors:Georgi Rozenman, Tel Aviv University / Lev Shemer, Tel Aviv University / Ady Arie, Tel Aviv University / Wolfgang P. Schleich, Institute of Quantum Technologies, German Aerospace Center (DLR), D-89077 Ulm, German / Matthias Zimmermann, Institute of Quantum Technologies, German Aerospace Center (DLR), D-89077 Ulm, German / Maxim A. Efremov, Institute of Quantum Technologies, German Aerospace Center (DLR), D-89077 Ulm, German

FM3I.6

Observation of Ultrafast Self-Action Effects in Resonant Dielectric Metasurfaces

Presenter: kirill koshelev , *ITMO University*

We observe a blueshift of the generated third-harmonic signal on subpicosecond timescales enabled by multiphoton absorption in resonant silicon metasurfaces. We demonstrate a transition from a super-cubic to sub-cubic regime for the third-harmonic generation efficiency.

Authors:Ivan Sinev, ITMO University / Zhuojun Liu, Sun Yat-sen University / Anton Rudenko, Université de Lyon / kirill koshelev, ITMO University / Konstantin Ladutenko, ITMO University / Alexey Shcherbakov, ITMO University / Zarina Sadrieva, ITMO University / Tatiana Itina, ITMO University / Andrey Bogdanov, ITMO University / Yuri Kivshar, ITMO University

FM3I.7

Probing Nonlinear Plasmonic Near-Fields in Crystalline Atomically-Thin Films

Presenter: Alvaro Rodriguez Echarri , *ICFO – The Institute of Photonic Sciences*

Transdimensional materials as atomically thin-films of noble metals show promising optical properties for next-generation nanophotonic devices. We reveal their linear and nonlinear optical properties when combined with their plasmonic response.

Authors:Alvaro Rodriguez Echarri, ICFO – The Institute of Photonic Sciences / Fadil Iyikanat, ICFO – The Institute of Photonic Sciences / Joel Cox, Center for Nano Optics, University of Southern Denmark / Javier García de Abajo, ICFO – The Institute of Photonic Sciences

FM3K

Manipulation of Radiative Processes by Metasurfaces and Nanophotonics

Presenter: Wenqi Zhu , *NIST*

FM3K.1

Light Emission by Thermalized Emitters Coupled to Metasurfaces

Tutorial

Presenter: Jean-Jacques Greffet , *Institut d'Optique*

In this talk, basic concepts regarding light emission will be introduced. We will review antennas and cavities for single emitters, assemblies of emitters in contact with metasurfaces and finally discuss the role of thermalization.

Authors:Jean-Jacques Greffet, Institut d'Optique

FM3K.2

Controlling Spontaneous Emission With Nanohole-Based Phased-Array Metasurfaces

Presenter: Yahya Mohtashami , *University of California Santa Barbara*

We present metasurfaces made from GaN nanoholes with embedded quantum-well emitters. Using nanolithography, we fabricate 1D beam deflectors and 2D meta-axicons and show that we can manipulate the emitted photoluminescence at will.

Authors:Yahya Mohtashami, University of California Santa Barbara / Larry Heki, University of California Santa Barbara / Abdullah Alhassan, University of California Santa Barbara / Shuji Nakamura, University of California Santa Barbara / Steven DenBaars, University of California Santa Barbara / Jon Schuller, University of California Santa Barbara

FM3K.3

Enhanced Luminescence of CdSe/ZnS Quantum Dots in Epsilon-Near-Zero Waveguide

Presenter: Jin-Kyu So , *Nanyang Technological University*

We report a long awaited experimental observation of resonant enhancement of luminescence from an ensemble of quantum dots embedded in a photonic waveguide operating in the epsilon-near-zero cutoff regime.

Authors:Jin-Kyu So, Nanyang Technological University / Guanghui Yuan, Nanyang Technological University / Cesare Soci, Nanyang Technological University / Nikolay Zheludev, Nanyang Technological University

FM3K.4

Exciton Diffusion and Annihilation in Nanophotonic Purcell Landscapes

Presenter: Raziman Thottungal Valapu , *Eindhoven University of Technology*

Conventional nanophotonic emission enhancement neglects excitonic phenomena of diffusion and annihilation. We go beyond the localized Purcell effect and identify the enhancement mechanisms to turn their detrimental impact into additional emission.

Authors:Raziman Thottungal Valapu, Eindhoven University of Technology / C. Peter Visser, Eindhoven University of Technology / Shaojun Wang, Eindhoven University of Technology / Jaime Gómez Rivas, Eindhoven University of Technology / Alberto G. Curto, Eindhoven University of Technology

FM3K.5

Exceptional Points in Photonic Grating Band Diagrams Lead to Decay-Free Radiation

Presenter: Alexander Yulaev , *University of Maryland/PML-NIST*

We demonstrate that exceptional points in a photonic band diagram lead to constant-intensity free-space beams projected from grating couplers. Our findings pave the way for projecting spatially broad free-space beams with decay-free profiles.

Authors:Alexander Yulaev, University of Maryland/PML-NIST / Sangsik Kim, Texas Tech University / Qing Li, Carnegie Mellon University / Daron Westly, NIST / Brian J. Roxworthy, Aeva, Inc / Kartik Srinivasan, NIST / Vladimir Aksyuk, NIST

FM3L

Scattering and Imaging

Presenter: Rajesh Menon , *University of Utah*

FM3L.1

Intensity Statistics: a Fingerprint for Waves Evolution in the Diffusion Regime

Presenter: Ruitao Wu , *CREOL*

We demonstrate that intensity statistics is nonstationary in diffusive regimes of waves in reflection from random media. A statistical model based on recurrent scattering and near field coupling is proposed and confirmed experimentally.

Authors:Ruitao Wu, CREOL / Aristide Dogariu, CREOL

FM3L.2

Anderson Localization of Hybrid Quasiparticles: Anomalous Transmission due to Necklace States

Presenter: Sandip Mondal , *Tata Institute of Fundamental Research*

We report a novel transport regime under Anderson-localizing disorder conditions, wherein hybrid photon-plasmon quasiparticles undergo strong transmission. The effect occurs due to creation of necklace states enabled by closely-spaced eigenstates that exchange energy due to inherent non-Hermiticity.

Authors:Sandip Mondal, Tata Institute of Fundamental Research / M. Balasubrahmaniam, Tata Institute of Fundamental Research / Hitaisini Sahoo, Tata Institute of Fundamental Research / Meghan Patankar, Tata Institute of Fundamental Research / R. Vijayaraghavan, Tata Institute of Fundamental Research / Sushil Mujumdar, Tata Institute of Fundamental Research

FM3L.3

Light Scattering of Random Close Packed Nanorods

Presenter: Mutasem ODEH , *UC Berkeley*

In this work, we investigate the scattering behavior of nanorods that are randomly packed at various densities and aspect ratios. We show that the maximum packing density, maximum scattering density, and the percolation threshold are all tightly related to Onsager excluded-area principle.

Authors:Mutasem ODEH, UC Berkeley / Matthieu Dupre, UCSD / Kevin Kim, UCSD / Boubacar Kanté, UC Berkeley

FM3L.4

Stabilized Depth Cell Imaging Through Disordered Fiber System With Semi-Supervised Learning Algorithm

Presenter: Xiaowen Hu , *University of Central Florida*

With ground truths only at 0 imaging depth, we reconstruct high-quality cell images through disordered optical fiber system up to 3mm imaging depth by tracing the state of the system using cycle-consistent adversarial networks.

Authors:Xiaowen Hu, University of Central Florida / Jian Zhao, University of Central Florida / Jose Antonio-Lopez, University of Central Florida / Youyou Cheng, University of Central Florida / Rodrigo Amezcua Correa, University of Central Florida / Axel Schülzgen, University of Central Florida

FM3L.5

Single-Shot Imaging Through Scattering Media Under Strong Background Interferences

Presenter: shunfu he , *Xidian University*

We report and demonstrate experimentally an approach to retrieving the object from a single-shot speckle pattern under a strong background light interference. This approach provides a practical solution to natural scene scattering imaging.

Authors:shunfu he, Xidian University / Wei Li, Xidian University / Teli Xi, Xidian University / Yangfan Sun, Xidian University / Jietao Liu, Xidian University / Xiaopeng Shao, Xidian University

FM3L.6

Super-Resolution Sensing With a Randomly Scattering Analyzer

Presenter: Justin Patel , *Purdue University*

A randomly scattering analyzer is presented as means to access super-resolution spatial sensing information associated with subwavelength motion of a coherent incident field or remote object and illustrated using cross-correlations of normalized laser speckle patterns.

Authors:Justin Patel, Purdue University / Qiaoen Luo, Purdue University / Kevin Webb, Purdue University

FM3L.7

Misalignment Tolerant Diffractive Optical Networks

Presenter: Deniz Mengü , *University of California, Los Angeles*

Design of diffractive optical networks that are resilient against physical misalignments is reported. The success of this design framework is also experimentally demonstrated using 3D printed diffractive networks that operate at THz wavelengths.

Authors:Deniz Mengü, University of California, Los Angeles / Yifan Zhao, University of California, Los Angeles / Nezih Yardimci, University of California, Los Angeles / Yair Rivenson, University of California, Los Angeles / Mona Jarrahi, University of California, Los Angeles / Aydogan Ozcan, University of California, Los Angeles

FM3L.8

Single-Pixel Machine Vision Using Spectral Encoding Through Diffractive Optical Networks

Presenter: Jingxi Li , *University of California, Los Angeles*

We present and experimentally demonstrate a deep learning-driven machine-vision framework that trains diffractive surfaces to encode the spatial information objects into the output power spectrum for all-optical image classification using a single-pixel spectroscopic detector.

Authors:Jingxi Li, University of California, Los Angeles / Deniz Mengu, University of California, Los Angeles / Nezhil Yardimci, University of California, Los Angeles / Yi Luo, University of California, Los Angeles / Xurong Li, University of California, Los Angeles / Muhammed Veli, University of California, Los Angeles / Yair Rivenson, University of California, Los Angeles / Mona Jarrahi, University of California, Los Angeles / Aydogan Ozcan, University of California, Los Angeles

AM3C

Advances and Applications of Microscopy

Presenter: Emily Gibson , *University of Colorado Denver*

AM3C.1

Magnetoplasmonic Nanoparticles for Enhanced Nucleic Acid Detection

Presenter: Li-Jing Cheng , *Oregon State University*

We report a highly sensitive DNA fluorescence sensor using molecular beacon-functionalized magnetoplasmonic nanoparticles. The sensor possesses both plasmonic and magnetic properties to enhance the sensing signal. The limit of detection of 1 pM was achieved.

Authors:Ye Liu, Oregon State University / Bo Wu, Oregon State University / Sanjida Yeasmin, Oregon State University / Li-Jing Cheng, Oregon State University

AM3C.2

Inkjet Printed Optofluidic Biolasers for Laser Imaging Analysis of Living Organism

Presenter: GONG XUERUI , *Nanyang Technological University*

An inkjet-printed biolaser microarray encapsulated with *E.coli* was developed, where laser emission images were employed for quantitative analysis. This work represents a milestone to implement biological microlaser technology towards high-throughput on-chip analysis of living organisms.

Authors:GONG XUERUI, Nanyang Technological University / Shilun Feng, Chinese Academy of Sciences / Zhen Qiao, Nanyang Technological University / Zhiyi Yuan, Nanyang Technological University / YU-CHENG CHEN, Nanyang Technological University

AM3C.3

Multi-Plane Encoded Light-Sheet Microscopy for Fast Volumetric Imaging

Presenter: Alessandro Zunino , *Istituto Italiano di Tecnologia*

We propose a novel light-sheet microscope, capable of high-speed volumetric imaging with high contrast and signal-to-noise ratio. The working principle is founded on extending the depth-of-field and encoding the illumination with multiple light-sheets.

Authors:Alessandro Zunino, Istituto Italiano di Tecnologia / Francesco Garzella, Istituto Italiano di Tecnologia / Alberta Trianni, Istituto Italiano di Tecnologia / Peter Saggau, Istituto Italiano di Tecnologia / Paolo Bianchini, Istituto Italiano di Tecnologia / Alberto Diaspro, Istituto Italiano di Tecnologia / Martí Duocastella, Istituto Italiano di Tecnologia

AM3C.4

Overcoming Pile-up Limitation in Fluorescence Lifetime Imaging

Presenter: Serena Farina , *Politecnico di Milano*

We present the first compact Time-Correlated Single-Photon Counting single-channel system, capable of overcoming the typical pile-up limitation of Fluorescence Lifetime Imaging. An ultra-fast acquisition is obtained (40 Mcps), along with excellent timing results and negligible distortion.

Authors:Serena Farina, Politecnico di Milano / Ivan Labanca, Politecnico di Milano / Giulia Acconcia, Politecnico di Milano / Massimo Ghioni, Politecnico di Milano / Ivan Rech, Politecnico di Milano

AM3C.5

Fluorescence Lifetime Imaging Microscopy for Label-Free Metabolic Imaging

Invited

Presenter: Rupsa Datta , *Morgridge Institute for Research*

Fluorescence lifetime imaging microscopy (FLIM) can probe the molecular environment of fluorophores. FLIM of metabolic cofactor reduced nicotinamide adenine dinucleotide (phosphate)(NAD(P)H) and oxidized flavin adenine dinucleotide (FAD) provides a label-free quantitative assessment of cellular metabolism.

Authors:Rupsa Datta, Morgridge Institute for Research

AM3C.6

***in Vivo* Shortwave Infrared (SWIR) Confocal Fluorescence Imaging of Deep Mouse Brain With a Single-Photon Superconducting Nanowire Detector**

Presenter: Fei Xia , *Cornell University*

We demonstrate *in vivo* 1-photon fluorescence confocal microscopy of adult mouse brain with >1 mm penetration depth using quantum dots with 1300 nm excitation and 1700 nm emission and a single-photon superconducting nanowire detector.

Authors:Fei Xia, Cornell University / Chris Xu, Cornell University

AM3C.7

Photonics Probing of Probiotics Effect on Chronic Alcoholic Brain Cell Nuclei Using Light Localization via Confocal Imaging

Presenter: Prakash Adhikari , *Mississippi State University*

We develop a probing method for molecular specific density fluctuations using light localization technique via confocal imaging. This work reports the effect of the probiotic in chronic alcoholic brain nuclei chromatin in a mouse model.

Authors:Prakash Adhikari, Mississippi State University / Pradeep Shukla, University of Tennessee Health Science Center / Radhakrishna Rao, University of Tennessee Health Science Center / Prabhakar Pradhan, Mississippi State University

AM3E

Frequency Comb Applications

Presenter: Matthew Simons , *NIST*

AM3E.1

Designer Terahertz Frequency Comb Generation

Presenter: Dominik Theiner , *TU Wien*

We present a simple method to generate almost arbitrary Terahertz frequency combs, between 0.1 and 3.6 THz with single line linewidths of 10 MHz, based on a robust optical system built from standard fiber-optic components.

Authors: Dominik Theiner, TU Wien / Benedikt Limbacher, TU Wien / Juraj Darmo, TU Wien / Karl Unterrainer, TU Wien

AM3E.2

Portable Optical Two-way Time Transfer in Outdoor Atmospheric Link With CPLD-Based Time Codec

Presenter: Junwei Ren, *Univ. of Elect. Sci. and Tech. of China*

We demonstrated a portable optical two-way time transfer scheme over a 120-m outdoor atmospheric link. The measured root-mean-square (RMS) fluctuation of the time deference between the two sites is about 81 ps within 11 hours.

Authors: Junwei Ren, Univ. of Elect. Sci. and Tech. of China / Bisong Pan, Univ. of Elect. Sci. and Tech. of China / Ze Li, Univ. of Elect. Sci. and Tech. of China / Ke Liu, Univ. of Elect. Sci. and Tech. of China / Jianye Zhao, Peking University / Dong Hou, Univ. of Elect. Sci. and Tech. of China

AM3E.3

Dual Frequency Comb Applications in Atmospheric Sensing, Ranging, and Timing

Invited

Presenter: Nathan Newbury, *National Inst of Standards & Technology*

Coherent heterodyne laser measurements can provide high sensitivity and precision. With coherent frequency combs, these advantages can be coupled with high optical bandwidths leading to new capabilities in atmospheric sensing, optical ranging and time transfer.

Authors: Nathan Newbury, National Inst of Standards & Technology

AM3E.4

Fiber Laser Based Dual-Comb Spectroscopy With Dynamically Controlled Spectral Resolution

Presenter: Fabrizio Giorgetta, *National Inst of Standards & Technology*

A versatile method of dual-comb spectroscopy is presented. Digital control of the comb frequencies enables dynamically adaptable spectrometer resolution to efficiently match a sample's feature width, optimizing the system for new applications.

Authors: Fabrizio Giorgetta, National Inst of Standards & Technology / Jean-Daniel Deschênes, Octosig Consulting / Ian Coddington, National Inst of Standards & Technology / Nathan Newbury, National Inst of Standards & Technology / Esther Baumann, National Inst of Standards & Technology

AM3E.5**Multiheterodyne Differential Spectroscopy Using Dual-Comb Generation Based on a Dual-Drive Mach Zehnder Modulator**

Presenter: Dragos Poiana , *University Carlos III of Madrid*

We present a multiheterodyne spectroscopy system that is able to measure the first derivative absorption characteristics with a single dual drive Mach Zehnder modulator and we apply the technique to read HCN gas cell.

Authors: Dragos Poiana, University Carlos III of Madrid / Pedro Martín-Mateos, University Carlos III of Madrid / Jose Antonio Garcia Souto, University Carlos III of Madrid

AM3E.6**EOM-Based Repetition Rate Modulation for Dual-Comb Coherent Anti-Stokes Raman Scattering Spectroscopy**

Presenter: Yujia Zhang , *Tsinghua University*

We present an EOM-based repetition rate modulation method for dual-comb coherent anti-Stokes Raman scattering spectroscopy. The duty cycle of the system reaches 90% and the refresh rate is 18 kHz.

Authors: Yujia Zhang, Tsinghua University / MINJIAN LU, Tsinghua University / Tao Wu, Tsinghua University / YAN LI, Tsinghua University / HAOYUN WEI, Tsinghua University

AM3E.7**Calibration of Electronic Distance Meters Using Autocorrelation of Femtosecond Pulses**

Presenter: Osama Terra , *National Institute of Standards, Egypt*

Calibration of Electronic Distance Meters is crucial since they are used in surveying and construction. A method is proposed here to calibrate EDMs using the autocorrelation of femtosecond pulses generated from an Optical Frequency Comb.

Authors: Osama Terra, National Institute of Standards, Egypt / Haitham M. Hussein, National Institute of Standards, Egypt / Hatem Hussein, National Institute of Standards, Egypt / Mohamed Medhat, Faculty of science- Ain Shams University

AM3Q**Environmental and Atmospheric Sensing I**

Presider: David Bomse , *Mesa Photonics, LLC*

AM3Q.1

Fielded Dual Frequency Comb Spectrometry for Methane Emissions From Oil & Gas

Invited

Presenter: Caroline Alden , *LongPath Technologies, Inc.*

Dual Frequency Comb Spectrometry is used to characterize methane emissions from oil and gas operations at remote field sites. The value of continuous monitoring for accurate characterization of emissions distributions is demonstrated.

Authors:Caroline Alden, LongPath Technologies, Inc.

AM3Q.2

Remote Methane Sensing System With Retroreflecting Target Tracking

Presenter: Michael Soskind , *Princeton University*

We present a methane sensing system based on chirped laser dispersion spectroscopy. The system is capable of actively tracking a drone-based retroreflector at up to 40m distance. The system has also shown sensitivities of 2.3 ppm-m.

Authors:Michael Soskind, Princeton University / Nathan L, Princeton University / Daniel Moore, Princeton University / Yifeng Chen, Princeton University / Charles Patrick, Princeton University / Lars Wendt, Princeton University / James McSpirtt, Princeton University / Mark Zondlo, Princeton University / Gerard Wysocki, Princeton University

AM3Q.3

Measurement of Dissolved Gases Using a Hollow Core Optical Fiber and Capillary Membrane Inlet

Presenter: Jason Kapit , *Woods Hole Oceanographic Institution*

Here we present an optical technique for continuously measuring dissolved gases in liquids. The method uses a capillary membrane inlet to extract gas from the liquid sample, which then travels through an anti-resonant hollow core fiber (AR-HCF) for analysis by absorption spectroscopy.

Authors:Jason Kapit, Woods Hole Oceanographic Institution / Anna Michel, Woods Hole Oceanographic Institution

AM3Q.4

Open-Path Dual-Comb Spectroscopy in the Mid-Infrared

Invited

Presenter: Kevin Cossel , *NIST-Boulder*

To be provided

Authors:Kevin Cossel, NIST-Boulder

AM3Q.5

(Withdrawn) a Quantum Cascade Laser Based Real-Time CRDS Methane Sensor for Deep Ocean Science and Exploration

Presenter: Anna Michel , *Woods Hole Oceanographic Inst*

Robust, sensitive and submersible sensors of dissolved methane represent critical advances towards an improved understanding of methane dynamics across oceanographic environments. Here we demonstrate a novel deep-sea methane sensor utilizing Quantum cascade laser-based rtCRDS.

Authors:Anna Michel, Woods Hole Oceanographic Inst / Jason Kapit, Woods Hole Oceanographic Inst / Scott Wankel, Woods Hole Oceanographic Inst / William Pardis, Woods Hole Oceanographic Inst / Ruwini Rajapaksha, Ring-IR / Charles Harb, Ring-IR

AM3Q.6

Laser-Induced Water Condensation Mediated by Resonance Excitation of Volatile Organic Compounds

Presenter: Valentina Shumakova , *Vienna University of Technology*

We demonstrate the first application of mid-IR filaments to laser-induced water condensation. We show that by controlling the spectral dynamics of filamenting pulses an additional channel of aerosol formation (via photooxidation of ambient VOCs) is enabled

Authors:Valentina Shumakova, Vienna University of Technology / Elise Schubert, Université de Genève / Skirmantas Alisauskas, Vienna University of Technology / Denis Mongin, Université de Genève / Mary Matthews, Université de Genève / Audrius Pugzlys, Vienna University of Technology / Jerome Kasparian, Université de Genève / Andrius Baltuska, Vienna University of Technology / Jean-Pierre Wolf, Université de Genève

AM3R

Physics of Laser Diodes

Presider: Alexander Bykanov , *KLA-Tencor*

AM3R.1

Optimizing the Quantum Dot Lasers for High-Speed Operation: Novel Versus Conventional Designs

Invited

Presenter: Levon Asryan , *Virginia Polytechnic Inst and State Univ*

Direct modulation bandwidth and optimum dc current maximizing it are discussed for double tunneling-injection quantum dot (QD) lasers and QD lasers with asymmetric barrier layers and compared to those for conventional QD lasers.

Authors: Levon Asryan, Virginia Polytechnic Inst and State Univ

AM3R.3

a New Assessment of the Performance of Low-Noise Organic Photodetectors

Presenter: Canek Fuentes Hernandez, *Georgia Institute of Technology*

An improved characterization of organic photodiode performance enables a reassessment of electronic noise and optimization of large-area organic photodetectors that at visible wavelengths are comparable to low-noise silicon photodiodes in all metrics except response time.

Authors: Canek Fuentes Hernandez, Georgia Institute of Technology / Wen-Fang Chou, Georgia Institute of Technology / Victor Rodriguez-Toro, Georgia Institute of Technology / Youngrak Park, Georgia Institute of Technology / Yi-Chien Chang, Georgia Institute of Technology / Felipe Larrain, Georgia Institute of Technology / Bernard Kippelen, Georgia Institute of Technology

AM3R.4

Integrated Dielectric Micro-Optical Elements on VCSELs Using Grayscale Photolithography

Presenter: Raman Kumar, *University of Illinois*

We present fabrication of silicon nitride integrated micro-optical elements on VCSELs using grayscale photolithography and dry etching. The optical characteristics of VCSELs with spirals are investigated.

Authors: Raman Kumar, University of Illinois / Katherine Lakomy, University of Illinois / William North, University of Illinois / Pawel Strzebonski, University of Illinois / Kent Choquette, University of Illinois

AM3R.5

Carrier Confinement Enhancement of Deep Ultraviolet Light Emitting Diode by Incorporating Inverted-v-Shaped Quantum Barriers

Presenter: Yang Kang, *University of Science and Technology of China*

We demonstrated an AlGaIn-based deep-ultraviolet light-emitting diodes (DUV LEDs) structure with the incorporation of inverted-V-shaped quantum barriers, which act as carrier reservoir layers and greatly improve the carrier confinement.

Authors: Yang Kang, University of Science and Technology of China / Huabin Yu, University of Science and Technology of China / Zhongjie Ren, Jacobs School of Engineering, University of California San Diego / Danhao Wang, University of Science and Technology of China / Jia Hongfeng, University of Science and Technology of China / Haiding Sun, University of Science and Technology of China

AM3R.6

Bias Voltage Dependency of Plasmonic Instability and Terahertz Radiation in a Dual-Grating-Gate High-Electron-Mobility Transistor

Presenter: Taiichi Otsuji, *RIEC, Tohoku University*

We report on terahertz (THz) radiation from a current-driven InGaAs-based dual-grating-gate high-electron-mobility transistor (DGG-HEMT) excited by photomixed laser irradiation. We show the bias voltage dependency of THz radiation emission spectra on DC-current-driven plasmonic instabilities.

Authors: Tomotaka Hosotani, RIEC, Tohoku University / Akira Satou, RIEC, Tohoku University / Taiichi Otsuji, RIEC, Tohoku University

AM3R.2

(Withdrawn) Volume Bragg Gratings - Robust and Efficient Elements for Spectral Brightness Enhancement of Lasers Diodes

Invited

Presenter: Vadim Smirnov, *OptiGrate Corp*

To be provided

Authors: Vadim Smirnov, *OptiGrate Corp*

SM3B

Laser Micro-/Nanostructuring

Presenter: Anthony Valenzuela, *US Army Research Laboratory*

SM3B.1

Laser Nanostructuring by Tailored Free Carrier Generation in Designer Semiconductor Metasurfaces

Presenter: Maxim Shcherbakov, *Cornell University*

We demonstrate the formation of high aspect ratio nano-trenches in laser-illuminated semiconductor meta-atoms enabled by photoinduced free-carrier generation inside localized hot spots.

Authors: Maxim Shcherbakov, Cornell University / Giovanni Sartorello, Cornell University / Michael Tripepi, The Ohio State University / Abdullah AlShafey, The Ohio State University / Melissa Bosch, Cornell University / Noah Talisa, The Ohio State University / Enam Chowdhury, The Ohio State University / Gennady Shvets, Cornell University

SM3B.2

Laser-Structured ZnO/p-Si Photodetector With Enhanced and Broadband Responsivity

Presenter: George Chatzigiannakis, *National Hellenic Research Foundation*

We develop ZnO/p-Si photodetectors by ALD deposition of ZnO thin films on laser-microstructured Si, which demonstrate high sensitivity and broadband operation (UV-Vis-NIR), due to increased specific surface area of the heterojunction and increased light absorption.

Authors: George Chatzigiannakis, National Hellenic Research Foundation / Angelina Jaros, Braunschweig University of Technology / Renaud Leturcq, Luxembourg Institute of Science and Technology / Jorgen Jungclaus, Braunschweig University of Technology / Tobias Voss, Braunschweig University of Technology / Spiros Gardelis, National and Kapodistrian University of Athens / Maria Kandyla, National Hellenic Research Foundation

SM3B.3

Desorption Driven High Spatial Frequency LIPSS Formation in GaAs

Presenter: Alex Sarracino, *University of Michigan*

A new mechanism of High Spatial Frequency Laser Induced Periodic Surface Structures (HSFL) formation is presented, where desorption of atomic constituents from 390 nm light irradiation leads to HSFL with a period of 65 nm.

Authors: Alex Sarracino, University of Michigan / Ben Torralva, University of Michigan / Abdul Ansari, University of Michigan / Steven Yalisove, University of Michigan

SM3B.4

Time-Resolved Dynamics for Ultrashort Pulse Damage of Single-Crystal YAG in the Near-Infrared

Presenter: Michael Tripepi, *The Ohio State University*

We investigate time-resolved dynamics of single-shot laser damage on YAG for ~9fs pulses near 760nm and compare to damage thresholds of ~264fs pulses at 1025nm. Results are benchmarked against a modified Keldysh photoionization model

Authors:Michael Tripepi, The Ohio State University / Noah Talisa, The Ohio State University / Enam Chowdhury, The Ohio State University

SM3B.5

Sub-100nm Surface Self-Organization by Ultrafast Laser Irradiation

Invited

Presenter: Jean-Philippe Colombier , *Laboratoire Hubert Curien*

Driven by local field enhancements enhancing feedback, novel structuring features demonstrate the potential of ultrafast laser for the fabrication of self-organized patterns with a periodic topography well below the diffraction limit. We report the achievement of laser-induced nanocavities that results from the control of a Marangoni convection instability at the nanoscale.

Authors:Jean-Philippe Colombier, Laboratoire Hubert Curien / Anton Rudenko, Laboratoire Hubert Curien / Anthony Nakhoul, Laboratoire Hubert Curien / Anthony Abou-Saleh, Laboratoire Hubert Curien / Claire Maurice, Laboratoire Georges Friedel / Florent Pigeon, Laboratoire Hubert Curien / Florence Garrelie, Laboratoire Hubert Curien

SM3B.6

Internal Structuring of Silicon With Multi-Timescale Irradiations

Presenter: AMLAN DAS , *Aix-Marseille Université, CNRS, LP3, F-13288*

By combining and synchronizing pulses of different durations from 170 fs to 5 ns, we benchmark the appropriate temporal characteristics of laser pulses for 3D writing applications inside silicon.

Authors:AMLAN DAS, Aix-Marseille Université, CNRS, LP3, F-13288 / Andong Wang, Aix-Marseille Université, CNRS, LP3, F-13288 / Olivier Uteza, Aix-Marseille Université, CNRS, LP3, F-13288 / David Grojo, Aix-Marseille Université, CNRS, LP3, F-13288

SM3B.7

Polarization Controlled Femtosecond Laser Induced Birefringence in Isotropic Crystals

Presenter: Yuhao Lei , *University of Southampton*

Polarization controlled birefringent modification by femtosecond laser writing in isotropic crystals is demonstrated. Multiplexed optical data storage with high density in bismuth germanate crystal can be achieved.

Authors:Yuhao Lei, University of Southampton / Huijun Wang, University of Southampton / Gholamreza Shayeganrad, University of Southampton / Peter Kazansky, University of Southampton

SM3D

Metamaterials and Nanostructures I

President: Oana Malis

SM3D.1

Plasmonic Metasurfaces for Directional Light Emission and Photodetection

Invited

Presenter: Roberto Paiella , *Boston University*

We report the development of near-infrared plasmonic metasurfaces integrated with optoelectronic active materials for the demonstration of geometrically tunable collimated light emission and angle-sensitive photodetection.

Authors:Roberto Paiella, Boston University

SM3D.2

Printing Grayscale Optical Metasurface at Sub-10-nm-Resolution via Light-Controlled Capillary Force Lithography

Presenter: Myung Gi Ji , *Iowa State University*

By applying optical control to nanoscale capillary effect, we realize grayscale printing of polymer nanopixels with a sub-10-nm vertical resolution. Through spatial modulation of the control-light, we print various grayscale optical metasurfaces on-demand.

Authors:Myung Gi Ji, Iowa State University / Qiang Li, Iowa State University / Jaeyoun Kim, Iowa State University

SM3D.3

Second Harmonic Generation in a Fiberized Amorphous Silicon Metamaterial

Presenter: Jie Xu , *University of Southampton*

Patterning of amorphous silicon with chevron grooves yields a metamaterial frequency converter with a resonant second harmonic conversion efficiency of $\sim 10^{-11}/W$, exceeding the previously achieved value for silicon metamaterial by two orders of magnitude.

Authors:Jie Xu, University of Southampton / Eric Plum, University of Southampton / Vassili Savinov, University of Southampton / Nikolay Zheludev, University of Southampton

SM3D.4

Achieving Effective Solar-Blind Photoelectrochemical-Type Photodetection via Pt-Decorated AlGa_N Nanostructures

Presenter: Danhao Wang , *University of Sci. & Tech. of China*

Self-powered solar-blind photoelectrochemical-type photodetectors based on platinum-decorated self-assembled AlGa_N nanostructures were constructed for the first time, demonstrating high responsivity and record fast response/recovery time without an external power source.

Authors: Danhao Wang, University of Sci. & Tech. of China / Huabin Yu, University of Sci. & Tech. of China / Haochen Zhang, University of Sci. & Tech. of China / Chong Xing, University of Sci. & Tech. of China / Zhongling Liu, University of Sci. & Tech. of China / Haiding Sun, University of Sci. & Tech. of China

SM3D.5

Structural Coloration From Self-Limiting Films of Self-Assembled Dielectric Mie Scatters

Presenter: Jichao Fan , *University of Utah*

We demonstrate structural coloration from self-limiting films of self-assembled nano to microspheres with accurate layer control. Colors originate from Mie scattering and multilayer structures cover broad colors, which are inferred from structures using neural networks.

Authors: Jichao Fan, University of Utah / Liang Zhao, Villanova University / Yingheng Tang, Purdue University / Bo Li, Villanova University / Weilu Gao, University of Utah

SM3D.6

Efficiency Improvement of InGa_N LEDs at Elevated Temperature With Dome-Shaped Patterned-Sapphire Substrates

Presenter: Vin-Cent Su , *National United University*

The efficiency of InGa_N LEDs working at elevated temperatures has been improved by introducing patterned-sapphire substrates with dome-shaped nanostructures of the optimized height through the analysis of electroluminescence of devices using an integrating sphere.

Authors: Meng-Hsin Chen, Graduate Institute of Photonics and Optoelectronics, National Taiwan University / Chieh-Hsiung Kuan, Graduate Institute of Photonics and Optoelectronics, National Taiwan University / Vin-Cent Su, National United University

SM3D.7

A Novel Geometry for Integrated Photonic Characteristics of Colloidal Quantum Dots and Micro-LED

Presenter: Chien-Chung Lin , *National Chiao-Tung University*

We report a novel structure of U-shaped micro-LED to reduce the lateral leakage and explore the impact on QDs beside the quantum wells. Furtherly, optimize the utilized region of red QDs to reduce cost. Finally, make reliability test at 100 A/cm^2 to make sure the usage region for red QDs.

Authors: Shou Wei Wang, National Chiao-Tung University / Sheng-Kai Huang, National Chiao-Tung University / Yi-Yang Lee, National Chiao-Tung University / Shao-Yi Weng, National Chiao-Tung University / Hao-Chung Kuo, National Chiao-Tung University / Chien-Chung Lin, National Chiao-Tung University

SM3J

Nonlinear Optics and Photodetection in Integrated Mid-IR Devices

Presenter: Kristinn Gylfason , *Kungliga Tekniska Hogskolan*

SM3J.1

Mid-Infrared Nonlinear Optics in Thin-Film Lithium Niobate on Sapphire

Presenter: Jatadhari Mishra , *Stanford University*

We demonstrate frequency conversion in the mid-IR using periodically poled lithium niobate thin-film ridge waveguides on sapphire. These devices are characterized by measuring both the wavelength tuning and transfer functions vs. poling period for second-harmonic and difference-frequency generation.

Authors: Jatadhari Mishra, Stanford University / Timothy McKenna, Stanford University / Edwin Ng, Stanford University / Hubert Stokowski, Stanford University / Marc Jankowski, Stanford University / Carsten Langrock, Stanford University / David Heydari, Stanford University / Hideo Mabuchi, Stanford University / Amir Safavi-Naeini, Stanford University / Martin Fejer, Stanford University

SM3J.2

Long-Wave-Infrared Integrated Photonics With Germanium-on-Silicon Waveguides

Presenter: Dmitry Kozak , *US Naval Research Laboratory*

We describe propagation loss, ring resonance, and thermo-optics in germanium-on-silicon (GOS) waveguides throughout the long-wave-infrared. These measurements show the potential of this platform for photonic integration at wavelengths from 7 microns to beyond 11 microns.

Authors: Dmitry Kozak, US Naval Research Laboratory / Nathan Tyndall, US Naval Research Laboratory / Marcel Pruessner, US Naval Research Laboratory / William Rabinovich, US Naval Research Laboratory / Todd Stievater, US Naval Research Laboratory

SM3J.3

Germanium Mid-Infrared Integrated Photonics on GeOI Platform

Invited

Presenter: Mitsuru Takenaka , *University of Tokyo*

We present a Ge-on-insulator (GeOI) photonics platform for mid-infrared wavelengths. The strong optical confinement in GeOI enables ultracompact passive waveguide devices as well as efficient thermo-optic switch, carrier-injection optical modulator, and defect-mediated photodetector.

Authors: Mitsuru Takenaka, University of Tokyo / Ziqiang Zhao, University of Tokyo / Chong Pei Ho, University of Tokyo / Takumi Fujigaki, University of Tokyo / Kasidit Toprasertpong, University of Tokyo / Shinichi Takagi, University of Tokyo

SM3J.4

Mid-Infrared Supercontinuum Generation in a Pure Germanium-on-Silicon Ridge Waveguide

Presenter: Alberto Della Torre , *Institut des Nanotechnologies de Lyon*

We experimentally demonstrate mid-infrared supercontinuum generation (from 3.53 up to 5.83 μm) in a pure germanium on silicon waveguide. We attribute the long wavelength limit of the supercontinuum to free-carrier absorption.

Authors: Alberto Della Torre, Institut des Nanotechnologies de Lyon / Milan Sinobad, Institut des Nanotechnologies de Lyon / Rémi Armand, Institut des Nanotechnologies de Lyon / Barry Luther-Davies, Australian National University / Pan Ma, Australian National University / Stephen Madden, Australian National University / David Moss, Swinburne University of Technology / Arnan Mitchell, RMIT University / Jean-Michel Hartmann, CEA LETI / Vincent Reboud, CEA LETI / Jean-Marc Fedeli, CEA LETI / Christelle Monat, Institut des Nanotechnologies de Lyon / Christian Grillet, Institut des Nanotechnologies de Lyon

SM3J.5

Two-Octaves mid-Infrared Supercontinuum Generation in Integrated SiGe Waveguides

Presenter: Miguel Montesinos Ballester , *C2N*

Experimental demonstration of on-chip two-octave supercontinuum generation in the mid-infrared wavelength, ranging from 3 to 13 μm (larger than 2500 cm^{-1}), by using graded-index SiGe waveguides that allow dispersion tailoring and low propagation losses.

Authors: Miguel Montesinos Ballester, C2N / Christian Lafforgue, C2N / Jacopo Frigerio, Politecnico di Milano / Andrea Ballabio, Politecnico di Milano / Vladyslav Vakarin, C2N / Qiankun Liu, C2N / Joan Manel Ramirez, C2N / Xavier Le Roux, C2N / Etienne Herth, C2N / Jean Rene Coudevylle, C2N / David Bouville, C2N / Andrea Barzaghi, Politecnico di Milano / Carlos Alonso Ramos, C2N / Laurent Vivien, C2N / Giovanni Isella, Politecnico di Milano / Delphine Marris-Morini, C2N

SM3J.6

Guided-Mode Resonance Enhanced Ultra-Thin HOT Mid-Wave Infrared Detectors

Presenter: Abhilasha Kamboj , *The University of Texas at Austin*

We demonstrate all-epitaxial ultra-thin mid-wave infrared detectors integrated into guided-mode resonance structures. Peak external quantum efficiency above 50 % is reported at $\lambda = 4.5 \mu\text{m}$ in a 250 nm thick absorber at 200 K.

Authors: Abhilasha Kamboj, The University of Texas at Austin / Leland Nordin, The University of Texas at Austin / Priyanka Petluru, The University of Texas at Austin / Aaron Muhowski, The University of Texas at Austin / David Woolf, Physical Sciences Inc. / Dan Wasserman, The University of Texas at Austin

SM3J.7

Ultra-Thin All-Epitaxial Plasmonically Enhanced Long-Wave Infrared Detectors

Presenter: Leland Nordin , *Univ of Texas*

We demonstrate all-epitaxial surface plasmon-polariton enhanced type-II superlattice nBn infrared detectors with sub-diffractive absorber thicknesses. Our devices show peak external quantum efficiencies of 50% at 10.4 μm in a 300 nm absorber ($\sim \lambda_0/35$)

Authors: Leland Nordin, Univ of Texas / Trent Garrett, Univ of Texas / Priyanka Petluru, Univ of Texas / Abhilasha Kamboj, Univ of Texas / Aaron Muhowski, Univ of Texas / Dan Wasserman, Univ of Texas

SM3A

Dual-comb Spectroscopy and Sensing

Presider: Adam Fleisher , *National Inst of Standards & Technology*

SM3A.1

Rapid Passage Signals From CO₂ at 1.6 μm Using a Dual Chirped-Pulse Electro-Optic Comb System With High-Order Interleaving

Presenter: Jasper Stroud , *NIST*

We demonstrate a method for interleaving high-order sidebands in a fast-sweeping electro-optic dual-comb system. We probe CO₂ at 1.6 μm and show sweep-rate dependent rapid-passage effects modeled with the Maxwell-Bloch equations.

Authors:Jasper Stroud, NIST / James Simon, NIST / Gerd Wagner, Institute of Technical Physics / David Plusquellic, NIST

SM3A.2

Isotopic Ratio Measurements With Mid-Infrared Electro-Optic Dual-Comb Spectrometer

Presenter: Alexandre Parriaux , *Laboratoire Interdisciplinaire Carnot de Bourgogne*

We present an electro-optic dual-comb spectrometer operating in the mid-infrared for carbon dioxide sensing. Isotopic ratio measurements of ¹³CO₂/¹²CO₂ are performed and the results show good agreements with the expectations.

Authors:Alexandre Parriaux, Laboratoire Interdisciplinaire Carnot de Bourgogne / Kamal Hammani, Laboratoire Interdisciplinaire Carnot de Bourgogne / Guy Millot, Laboratoire Interdisciplinaire Carnot de Bourgogne

SM3A.3

Time-Resolved Multispecies Analysis of a Laser-Induced Plasma Using Dual-Comb Spectroscopy

Presenter: REAGAN WEEKS , *University of Arizona*

A laser-induced plasma plume containing multiple atomic species is probed using dual-comb spectroscopy, and quantitative analysis is performed by fitting modelled absorption spectra to experimental spectra to obtain number densities and excitation temperatures.

Authors:REAGAN WEEKS, University of Arizona / Yu Zhang, University of Arizona / Caroline Lecaplain, University of Arizona / Jeremy Yeak, Opticslab / Sivanandan Harilal, Pacific Northwest National Laboratory / Mark Phillips, University of Arizona / R. Jason Jones, University of Arizona

SM3A.4

Mid-Infrared Cross-Comb Spectroscopy Using Sum-Frequency Sampling

Presenter: Mingchen Liu , *California Institute of Technology*

We introduce the cross-comb spectroscopy scheme by sum-frequency sampling of a mid-infrared frequency comb using a near-IR comb with slightly shifted repetition rate. We experimentally demonstrate a 300-nm instantaneous comb-resolved measurement bandwidth around 4 μm .

Authors: Mingchen Liu, California Institute of Technology / Robert Gray, California Institute of Technology / Arkadev Roy, California Institute of Technology / Alireza Marandi, California Institute of Technology

SM3A.5

Dual-Comb Spectroscopy With Frequency Modulation

Presenter: Zhenhai Wang, *Max-Planck-Institut fur Quantenoptik*

Dual-comb spectroscopy with frequency modulation and synchronous lock-in detection over the entire spectral bandwidth of the combs is demonstrated with absorption and dispersion spectra of C_2H_2 in the 1.5 μm region.

Authors: Zhenhai Wang, Max-Planck-Institut fur Quantenoptik / Xing Chao, Center for Combustion Energy, Department of Energy and Power Engineering, Tsinghua University / Jeong Hyun Huh, Max-Planck-Institut fur Quantenoptik / Edoardo Vicentini, Max-Planck-Institut fur Quantenoptik / Theodor Hänsch, Max-Planck-Institut fur Quantenoptik / Nathalie Picqué, Max-Planck-Institut fur Quantenoptik

SM3A.6

Mid-Infrared Dual-Comb Spectroscopy With GHz Resolution Using Soliton Microcombs

Highlighted Talk

Presenter: Chengying Bao, *Caltech*

Microcomb based dual-comb spectroscopy of methane in the mid-infrared is demonstrated with GHz resolution. This fine resolution is enabled by generating spectrally densified mid-infrared combs via interleaved difference-frequency-generation.

Authors: Chengying Bao, Caltech / Zhiquan Yuan, Caltech / LUE WU, Caltech / Myoung-Gyun Suh, Caltech / Kerry Vahala, Caltech / Qiang Lin, University of Rochester

SM3A.7

Dual-Comb Spectroscopy With Two on-Chip III-v-on-Silicon 1-GHz Mode-Locked Lasers

Presenter: Kasper Van Gasse, *Ghent University-imec*

A dual-comb interferometer with two semiconductor lasers on silicon photonic chips enables an optical resolution of 1 GHz, over a 0.7-THz span. The spectrometer directly and unambiguously samples near-infrared rovibrational transitions without spectral interleaving.

Authors: Kasper Van Gasse, Ghent University-imec / Zaijun Chen, Max Planck Institute of Quantum Optics / Edoardo Vincentini, Max Planck Institute of Quantum Optics / Jeong Hyun Huh, Max Planck Institute of Quantum Optics / Stijn Poelman, Ghent University-imec / Zhechao Wang, Ghent University-imec / Gunther Roelkens, Ghent University-imec / Theodor Hänsch, Max Planck Institute of Quantum Optics / Bart Kuyken, Max Planck Institute of Quantum Optics / Nathalie Picqué, Max Planck Institute of Quantum Optics

SM30

Emerging Topics in Optical Sensing and Biomarker Detection

Presenter: Erik Emmons , *US Army CCDC CBC*

SM30.1

Ultra-Sensitive and Selective Detection of DNA and Protein Biomarkers Using Frequency-Locked Microtoroid Optical Resonators

Invited

Presenter: Judith Su , *University of Arizona*

We use frequency-locked microtoroid optical resonators to detect protein and DNA biomarkers at attomolar to femtomolar concentrations, depending on the target. We measure binding affinities and validate our results against existing technologies.

Authors: Judith Su, University of Arizona

SM30.2

(Withdrawn) Monitoring Nanoscale Amyloid Interactions With Topology of Laser Modes

Presenter: Chaoyang Gong , *Nanyang Technological University*

Here we report a novel approach to study nanoscale biomolecular changes by imaging the topological transformation of laser modes through amplified light-molecule interactions in a Fabry–Pérot microcavity.

Authors: Chaoyang Gong, Nanyang Technological University / Zhen Qiao, Nanyang Technological University / YU-CHENG CHEN, Nanyang Technological University

SM30.3

Thin-Film Thermophoresis in Photonic Band Gap Fibers for Sub-NanoMolar Raman Sensing Sensitivity

Presenter: Emily Storey , *University of Toronto*

We present sub-nanomolar Raman detection of nanoparticles, without SERS, enabled by thin-film thermophoresis via photonic bandgap confinement. We achieve sensitivity-of-detection at 0.240 nM, an enhancement of over 8 orders of magnitude.

Authors: Basil Eleftheriades, University of Toronto / Emily Storey, University of Toronto / Amr Helmy, University of Toronto

SM30.4

Single Molecule Detection of Fluorophores “Turned-on” by Corrosion Reactions

Presenter: Anuj Saini , *Case Western Reserve University*

Real-time, single-molecule “turn on” of resazurin by the corrosion of iron was detected by a modern fluorescence microscope to overcome the previous limitations of corrosion detection, opening up a new spatiotemporal regime for studying corrosion.

Authors: Anuj Saini, Case Western Reserve University / Hannah Messenger, Case Western Reserve University / Lydia Kisley, Case Western Reserve University

SM30.5

The Light Cage - Integrated on-Chip Spectroscopy Using a Nano-Printed Hollow Core Waveguide

Presenter: Jisoo Kim , *Leibniz Institute of Photonic Technology*

We present a novel platform- the nano-printed optofluidic light cage - that allows for strong light-liquid interactions across centimetre distances via the antiresonant effect. In accordance with simulations we show liquid-based spectroscopic experiments.

Authors: Jisoo Kim, Leibniz Institute of Photonic Technology / Bumjoon Jang, Leibniz Institute of Photonic Technology / Julian Gargiulo, Nanoinstitute Munich / Johannes Bürger, Nanoinstitute Munich / Jiangbo Zhao, Leibniz Institute of Photonic Technology / Swaathi Uppendar, University of Stuttgart / Thomas Weiss, University of Stuttgart / Stefan Maier, Nanoinstitute Munich / Markus Schmidt, Leibniz Institute of Photonic Technology

SM30.6

Ghost Resonance Spectroscopy

Presenter: Emroz Khan , *Purdue University*

We show the recently discovered ghost waves, a special class of non-uniform waves in biaxial anisotropic media, can offer a new approach to optical sensing, that employs simple planar geometry and low-cost dielectric materials, and provides a high figure of merit for sensor performance.

Authors:Emroz Khan, Purdue University / Sanjay Debnath, Purdue University / Evgenii Narimanov, Purdue University

SM30.7

Toward Artificial Fingertips Based on GaN Optical Tactile Sensors

Presenter: Nathan Dvorak , *University of Michigan*

A tactile sensor using gallium nitride nanopillar light-emitting diodes is proposed and demonstrated. The sensor can detect the direction, magnitude, and location of an external shear force with sensitivities comparable to the human fingertip.

Authors:Nathan Dvorak, University of Michigan / Kunook Chung, Ulsan National Institute of Science and Technology / Kobie Mueller, University of Michigan / Pei-Cheng Ku, University of Michigan

JM3F

Special Symposium - Super Symposium on Advances in Quantum Technologies: Engineering Nonclassical Light Sources

President: Peter Mosley , *University of Bath*

JM3F.1

(Withdrawn) Photonic Quantum State Engineering in Optical Fiber

Invited

Presenter: Virginia Lorenz , *University of Illinois at Urbana-Champaign*

Quantum applications with photons rely on our ability to engineer photonic quantum states. I will present our work on generating, characterizing, and engineering photonic quantum states in optical fiber for quantum applications.

Authors:Virginia Lorenz, University of Illinois at Urbana-Champaign

JM3F.2

An Efficient Nanophotonic Source of Ultra-Broadband Entangled Photons

Presenter: Usman Javid , *University of Rochester*

We demonstrate ultra-broadband spontaneous parametric down-conversion over a 100 THz bandwidth using an on-chip dispersion-engineered periodically-poled lithium niobate waveguide. The source produces photon-pairs with an unprecedented 13 GHz/mW efficiency and a CAR exceeding 10^5 .

Authors: Usman Javid, University of Rochester / Jingwei Ling, University of Rochester / Jeremy Staffa, University of Rochester / Mingxiao Li, University of Rochester / Yang He, University of Rochester / Qiang Lin, University of Rochester

JM3F.3

(Withdrawn) Integrated Photonics for Generating Entangled Photons

Invited

Presenter: Shayan Mookherjea, *University of California San Diego*

To be provided

Authors: Shayan Mookherjea, *University of California San Diego*

JM3F.4

Integrated Contra-Directional Pump-Reject Filters for Photon-Pairs Sources in Silicon.

Presenter: Abdelrahman Afifi, *University of British Columbia*

We demonstrate a micro-ring resonator photon-pair source integrated with a pump-reject filter using cascaded contra-directional couplers from their through-port, achieving coincidence-to-accidental ratio (CAR) of 125 at an on-chip pair generation rate of 0.4MHz.

Authors: Abdelrahman Afifi, *University of British Columbia* / Sudip Shekhar, *University of British Columbia* / Jeff Young, *University of British Columbia* / Lukas Chrostowski, *University of British Columbia*

JM3F.5

Time-Resolved Detection of Phase-Coherent Biphoton Frequency Combs From Si₃N₄ Microring

Presenter: Karthik Myilswamy, *Purdue University*

We generate a biphoton frequency comb from an integrated 40.4 GHz silicon nitride microring and probe the phase coherence through electro-optic mixing of the frequency bins followed by time-resolved detection of the time-correlation function.

Authors: Karthik Myilswamy, *Purdue University* / Mohammed Al Alshaykh, *Purdue University* / Hsuan-Hao Lu, *Purdue University* / Junqiu Liu, *Ecole Polytechnique Federale de Lausanne* / Tobias Kippenberg, *Ecole Polytechnique Federale de Lausanne* / Andrew Weiner, *Purdue University*

JM3F.6

Spontaneous Parametric Down Conversion in Linearly Uncoupled Resonators

Presenter: Luca Zatti , *University of Pavia*

We study degenerate spontaneous parametric down conversion in a structure composed of two linearly uncoupled resonators, in which the linear properties of the fundamental and second harmonic field can be engineered independently.

Authors: Luca Zatti, University of Pavia / Nicola Bergamasco, University of Pavia / Emma Lomonte, University of Münster / Francesco Lenzini, University of Münster / Wolfram Pernice, University of Münster / Marco Liscidini, University of Pavia

JM3G

Special Symposium - Symposium- Hot topics in THz Photonics: Spintronics and Biophotonics I - Spintronics and Ultrafast Magnetism - New Paradigms for Novel Terahertz Sources and Detectors

Presider: Mathias Vanwolleghem , *IEMN CNRS UMR 8520*

JM3G.1

Exploiting Ultrafast Spintronics for Terahertz Photonics

Invited

Presenter: Tom Seifert , *Freie Universität Berlin*

In this talk, I will highlight recent results of studying spintronic phenomena at terahertz (THz) rates, which holds great promise for next-generation THz photonic applications such as broadband THz generation and detection.

Authors: Tom Seifert, Freie Universität Berlin

JM3G.2

Coherent Polarization Rotation of TeraHertz Spintronic Emitters With in-Plane Uni-Axial Magnetic Anisotropy

Presenter: Geoffrey Lezier , *Univ. Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, UMR 8520-IEMN*

Spintronic TeraHertz emitters using uni-axial anisotropic FeCo/TbCo₂/FeCo ferromagnetic layers allow the polarization control of the THz wave thanks to the Stoner-Wohlfarth coherent rotation of magnetization when submitted to a magnetic field along hard axis.

Authors:Geoffrey Lezier, Univ. Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, UMR 8520-IEMN / Pierre Koleják, Univ. Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, UMR 8520-IEMN / Kamil Postava, VSB-Technical University of Ostrava, Nanotechnology centre and IT4Innovations / Jean-François Lampin, Univ. Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, UMR 8520-IEMN / Mathias Vanwolleghem, Univ. Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, UMR 8520-IEMN / Nicolas Tiercelin, Univ. Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, UMR 8520-IEMN

JM3G.3

THz Susceptibility of Antiferromagnetically Coupled Spins

Invited

Presenter: Alexey Kimel , *Radboud Universiteit Nijmegen*

We will discuss interaction of intense THz pulses with spins in ferri- and antiferromagnetic materials. It will be shown that in the case of multi-sublattice magnets well-known mechanisms of light-matter interaction show up in a counter-intuitive way and novel mechanisms for detection of THz radiation can be suggested.

Authors:Alexey Kimel, Radboud Universiteit Nijmegen

JM3G.4

Efficiency of THz Spintronic Emitters: From Spin-Hall Effect in 3d Metals to Surface States in Topological Insulators

Presenter: Enzo Rongione , *Unité Mixte de Physique, CNRS, Thales, Université Paris-Saclay*

THz spintronics emitters represent today novel sources for broadband emission using nanometer-scaled materials. We present and model the THz spintronic emission based on the spin Hall effect in 3d metals and on the inverse Rashba-Edelstein effect in the optimized topological insulator Bi_{1-x}Sb_x.

Authors:Enzo Rongione, Unité Mixte de Physique, CNRS, Thales, Université Paris-Saclay / Laëticia Baringthon, Unité Mixte de Physique, CNRS, Thales, Université Paris-Saclay / Jacques Hawacker, Laboratoire de Physique de l'Ecole Normale Supérieure, ENS, Université PSL, CNRS, Sorbonne Université, Université de Paris / Thi Huong Dang, Unité Mixte de Physique, CNRS, Thales, Université Paris-Saclay / Patrick Lefèvre, Synchrotron SOLEIL / Nicolas Reyren, Unité Mixte de Physique, CNRS, Thales, Université Paris-Saclay / Romain Lebrun, Unité Mixte de Physique, CNRS, Thales, Université Paris-Saclay / Jean-Marie George, Unité Mixte de Physique, CNRS, Thales, Université Paris-Saclay / Sukhdeep Dhillon, Laboratoire de Physique de l'Ecole Normale Supérieure, ENS, Université PSL, CNRS, Sorbonne Université, Université de Paris / Henri Jaffrès, Unité Mixte de Physique, CNRS, Thales, Université Paris-Saclay

JM3G.5

Collective sub-THz Spin Dynamics in Antiferromagnets at Fields up to 12 T.

Invited

Presenter: Mark Sherwin, *University of California at Santa Barbara*

Spin dynamics in the antiferromagnetic, spin-flop, and paramagnetic phases of antiferromagnets are excited at 0.24 THz. Rabi oscillations dressed by dipolar interactions in the organic radical BDPA-Bz, and pure spin currents from Cr₂O₃, are described.

Authors: Mark Sherwin, University of California at Santa Barbara / C. Wilson, University of California at Santa Barbara / Junxue Li, University of California at Riverside / Ran Cheng, University of California at Riverside / Mark Lohmann, University of California at Riverside / Marzieh Kavand, University of California at Santa Barbara / Wei Yuan, University of California at Riverside / Mohammed Aldosary, King Saud University / Nikolay Agladze, University of California at Santa Barbara / Peng Wei, University of California at Riverside / Devin Edwards, University of California at Santa Barbara / Jessica Clayton, University of California at Santa Barbara / Songi Han, University of California at Santa Barbara / Jing Shi, University of California at Riverside

AM3H

A&TTR Super Topical Review on High Power Laser Technology II: Innovative Technologies for the Next Generation of Ultra-intense Lasers

Presider: Zhaoyang Li, *Osaka Univ Inst of Laser Engineering*

AM3H.1

Zettawatt-Equivalent Ultrashort Pulse Laser System (ZEUS) at the University of Michigan

Invited

Presenter: Igor Jovanovic, *University of Michigan*

The new dual-beamline 3 PW ZEUS facility is under construction at the University of Michigan. Once completed, it will be the highest power laser in the US and a user facility open to international community.

Authors: Igor Jovanovic, University of Michigan

AM3H.2

10 PetaWatt Laser Systems for Extreme Light Applications

Invited

Presenter: Christophe Simon-Boisson , *Thales LAS France*

2 Laser beamlines of 10 PetaWatt each have been built for Extreme Light Infrastructure (ELI) Nuclear Physics pillar in Romania. We report about full energy beam characterization after propagation through the beam transport section.

Authors:Christophe Simon-Boisson, Thales LAS France

AM3H.3

Efficient and Robust Quasi-Parametric Chirped-Pulse Amplification (QPCPA)

Invited

Presenter: Jingui Ma , *Shanghai Jiao Tong University*

We introduce a new Quasi-Parametric Chirped-Pulse Amplification (QPCPA) scheme for intense laser, which can suppress the back conversion significantly through depleting the idler. On one hand, it can support high signal efficiency close to quantum-limit. On the other hand, it is robust against phase mismatch, so it has a broader wavelength bandwidth and a larger temperature tolerance. These characteristics make it a promising method for producing higher peak power lasers.

Authors:Jingui Ma, Shanghai Jiao Tong University

AM3H.4

Intensification of a Focused-Laser More Than One Order of Magnitude Through a Micro-Cone in the Petawatt Regime

Invited

Presenter: Kazuo Tanaka , *I.N.F.L.P.R.*

We found an increase of the initial laser pulse intensity of 8×10^{20} W/cm² by more than 10 times for a micro-cone tip diameter of 5 μ m upon performing two-dimensional particle-in-cell simulations.

Authors:Olimpia Budriga, I.N.F.L.P.R. / Kazuo Tanaka, I.N.F.L.P.R.

13:00 - 17:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

SC352

Short Course - SC352: Introduction to Ultrafast Pulse Shaping--
Principles and Applications

SC378

Short Course - SC378: Introduction to Ultrafast Optics

SC403

Short Course - SC403: NanoCavity Quantum Electrodynamics and Applications

SC475

Short Course - SC475: Metasurface Flat Optics

SC477

Short Course - SC477: LiDAR and Remote Sensing: An Application-Oriented Introduction

14:00 - 15:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - OSA Quantum Optical Science and Technology
Technical Group 20x20 Talks

This special session hosted by the OSA Quantum Optical Science and Technology Technical Group offers a unique platform for individuals to present their research in a creative and concise fashion that differs from the usual oral or poster session. Join us as selected participants from the technical group showcase their research in a presentation of 20 images. Our presenters will talk along to the images in their presentation as each slide advances automatically after just 20 seconds.

14:00 - 18:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

SC410

Short Course - SC410: Finite Element Modeling Methods for Photonics and Optics

15:00 - 16:30 (Pacific Time (US & Canada) DST, UTC - 07:00)

AM4P

Environmental and Atmospheric Sensing II

Presider: David Bomse , *Mesa Photonics, LLC*

Tunable Diode Laser Absorption Spectroscopy Instrument for Flow-Through Measurement of Dissolved Carbon Dioxide in the Ocean

Presenter: Beckett Colson , *Woods Hole Oceanographic Institution*

The measurement of dissolved carbon dioxide is important for understanding many ocean processes. Here we present the design and field deployment of a TDLAS sensor for the measurement of dissolved carbon dioxide.

Authors:Beckett Colson, Woods Hole Oceanographic Institution / Anna Michel, Woods Hole Oceanographic Institution

AM4P.2

Statistical Characterization of Temperature and Pressure Vertical Profiles for the Analysis of Laser Heterodyne Data

Presenter: Monica Flores , *George Washington University*

An analysis of historic pressure and temperature profiles from radiosonde launches for use as Bayesian priors in retrieval of mixing ratios for greenhouse gases (GHGs) from Laser Heterodyne Radiometry (LHR) spectra is reported.

Authors:Monica Flores, George Washington University / David Bomse, Mesa Photonics / Houston Miller, George Washington University

AM4P.3

High-Precision Cavity Ring-Down Measurements of the Oxygen a-Band and 2.06 μm Carbon Dioxide Band in Support of Remote Sensing Applications

Invited

Presenter: Erin Adkins , *National Institute of Standards and Technology (NIST)*

Remote sensing missions rely on high resolution spectroscopic reference data for atmospheric retrievals. Cavity ring-down spectroscopy reference measurements in the O₂ A-Band and the 2.06 μm CO₂ band, supporting NASA's OCO missions, are reported.

Authors:Erin Adkins, National Institute of Standards and Technology (NIST)

AM4P.4

Oxygen Stress Response of Nitrifying Bacteria Monitored With Raman Spectroscopy in Vivo

Presenter: Ann-Kathrin Kniggendorf , *Leibniz University of Hannover*

Raman spectroscopy with cytochrome-c resonant excitation enables the stress monitoring of slow growing bacterial cultures with very low cell counts based on only a few hundred cells per culture and measurement.

Authors:Ann-Kathrin Kniggendorf, Leibniz University of Hannover / Regina Nogueira, Leibniz University of Hannover / Bernhard Roth, Leibniz University of Hannover

AM4P.5

A Double-Pass Cavity-Enhanced Spectrometer With a Polarization Analyzed Readout

Presenter: Jong Chow , *Australian National University*

We present an optical cavity-enhanced spectroscopy technique which uses a polarization analyzed readout for molecular absorption. It has a double-pass cavity configuration for mode self-cleaning and attained a quantum noise-equivalent carbon dioxide absorption sensitivity of $\sim 3 \times 10^{-13} \text{ Hz}^{-1/2} \text{ cm}^{-1}$.

Authors:Yajie Guan, Australian National University / Chathura Bandutunga, Australian National University / Malcolm Gray, Australian National University / Jong Chow, Australian National University

15:00 - 17:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FM4M

Quantum Memory

Presenter: Irina Novikova , *College of William & Mary*

FM4M.1

Telecom-Heralded Entanglement Distribution Between Remote, Multimode Quantum Memories in the Solid State

Highlighted Talk

Presenter: Samuele Grandi , *ICFO*

We demonstrate entanglement between two quantum nodes, where the entanglement is generated by non-degenerate photon pair sources and stored in rare-earth based quantum memories that share a delocalized excitation.

Authors:Samuele Grandi, ICFO / Dario Lago-Rivera, ICFO / Jelena V. Rakonjac, ICFO / Alessandro Seri, ICFO / Hugues de Riedmatten, ICFO

FM4M.2

Multiplexed and Broadband Quantum Storage of Single-Photons at Telecom C-Band

Presenter: Qiang Zhou , *University of Electronic Science and Technology of China*

We prepare five separated 10-GHz atomic frequency combs simultaneously in Er³⁺-doped fiber, then demonstrate temporally- and spectrally-multiplexed storage of telecom-band single-photons up to 1650 modes. Our results pave the way for quantum repeaters with multiplexed and broadband quantum memory.

Authors: Shihai wei, University of Electronic Science and Technology of China / Bo Jing, University of Electronic Science and Technology of China / Xueying Zhang, University of Electronic Science and Technology of China / Heqing Wang, Chinese Academy of Sciences / Hao Li, Chinese Academy of Sciences / Lixing You, Chinese Academy of Sciences / Zhen Wang, Chinese Academy of Sciences / You Wang, University of Electronic Science and Technology of China / Guangwei Deng, University of Electronic Science and Technology of China / Haizhi Song, University of Electronic Science and Technology of China / Daniel Oblak, University of Calgary / Guang-Can Guo, University of Electronic Science and Technology of China / Qiang Zhou, University of Electronic Science and Technology of China

FM4M.3

Coherent Backscattering From Randomly Distributed Ions Inside Crystals

Presenter: Arindam Nandi , *Purdue University*

We observed collective atomic resonances and coherent backscattering of light from rare-earth doped crystals by spatio-spectral tailoring of atomic absorption. The observation enables creation of efficient solid-state subradiant quantum memories and superradiant photon sources.

Authors: Arindam Nandi, Purdue University / Haechan An, Purdue University / Mahdi Hosseini, Purdue University

FM4M.4

Optical Coherence Increase by Diffusion Enhanced Optical Pumping in a Rare-Earth Doped Crystal

Presenter: Philippe Goldner , *Chimie ParisTech*

We demonstrate a new spin polarization mechanism that combines optical pumping with spin diffusion to achieve large spin polarization in ¹⁷¹Yb³⁺:Y₂SiO₅. This is used to increase optical coherence lifetime from 0.3 to 0.8 ms

Authors: Sacha Welinski, Chimie ParisTech / Alban Ferrier, Chimie ParisTech / Philippe Goldner, Chimie ParisTech / Alexey Tiranov, University of Geneva / Moritz Businger, University of Geneva / Mikael Afzelius, University of Geneva

FM4M.5

Shallow Donor Qubits in ZnO for Quantum Memory Applications

Presenter: Christian Zimmermann , *University of Washington*

Neutral shallow donors in ZnO are promising candidates for solid-state spin qubits. Here, we report on the suitability of shallow donor qubit ensembles for quantum memory applications.

Authors:Christian Zimmermann, University of Washington / Vasilis Niaouris, University of Washington / Maria L. Viitaniemi, University of Washington / Kai-Mei C. Fu, University of Washington

FM4M.6

A Polariton Interferometer

Presenter: Pratik Adhikary , *Indian Institute of Technology Kanpur*

We report a novel interferometer, where two dark-state polaritons, stored in a spin-1 atom, interfere. One can thereby measure both optical and atomic phases, in the form of field polarizations and applied magnetic fields.

Authors:Pratik Adhikary, Indian Institute of Technology Kanpur / Suprodip Mondal, Indian Institute of Technology Kanpur / Arif warsi Laskar, Indian Institute of Technology Kanpur / Saikat Ghosh, Indian Institute of Technology Kanpur

FM4M.7

HIGHLY-EFFICIENT ENTANGLEMENT STORAGE of LIGHT in COLD-ATOM QUANTUM MEMORIES

Presenter: Félix HOFFET , *Laboratoire Kastler Brossel*

Highly-efficient entanglement storage in quantum memories is a critical requirement for quantum networks. We present an experiment where we stored single-photon entanglement into two atomic-ensemble based quantum memories with an overall efficiency of 87%.

Authors:Félix HOFFET, Laboratoire Kastler Brossel / Mingtao Cao, Laboratoire Kastler Brossel / Shuwei Qiu, Laboratoire Kastler Brossel / Alexandra Sheremet, Laboratoire Kastler Brossel / Hadriel Mamann, Laboratoire Kastler Brossel / Thomas Nieddu, Laboratoire Kastler Brossel / Julien Laurat, Laboratoire Kastler Brossel

FM4H

Photonics in Cavities and Resonators I

Presenter: Andrea Blanco-Redondo , *Nokia Bell Labs*

FM4H.2

Majorana Bound State Cavities

Presenter: Babak Bahari , *University of Southern California*

We present a new class of topological cavities based on Majorana bound states. These cavities are inherently single-moded and robust to local disorder regardless of the size of the structure.

Authors: Babak Bahari, University of Southern California / Jae-Hyuck Choi, University of Southern California / yuzhou Liu, University of Southern California / Demetrios Christodoulides, University of Central Florida / Mercedeh Khajavikhan, University of Southern California

FM4H.3

Zero-Dispersion Solitons in Microresonators With Octave-Spanning Dispersive Wave Formation

Presenter: Miles Anderson, *Swiss Federal Institute of Technology in Lausanne (EPFL)*

We synthesize an octave-spanning microresonator-based frequency comb, based on a zero-dispersion soliton, existing in the regime of vanishing group-velocity dispersion. The microcomb spans 135 THz, enabled by quasi-phase matched dispersive wave formation.

Authors: Miles Anderson, Swiss Federal Institute of Technology in Lausanne (EPFL) / Grigorii Likhachev, Swiss Federal Institute of Technology in Lausanne (EPFL) / Wenle Weng, Swiss Federal Institute of Technology in Lausanne (EPFL) / Junqiu Liu, Swiss Federal Institute of Technology in Lausanne (EPFL) / Tobias Kippenberg, Swiss Federal Institute of Technology in Lausanne (EPFL)

FM4H.4

Continuous-Wave Electron-Photon Interactions Using Chip-Based High-Q Si₃N₄ Microresonator

Presenter: Yujia Yang, *EPFL*

We observe CW-driven electron-photon interaction using a fiber-integrated high-Q Si₃N₄ microresonator, enabled by strong resonantly enhanced coupling with the confined optical mode.

Authors: Arslan Raja, EPFL / Jan-Wilke Henke, University of Gottingen / Armin Feist, University of Gottingen / Junqiu Liu, EPFL / Germaine Arend, University of Gottingen / Huang Guan hao, EPFL / Jasmin Kappert, University of Gottingen / Rui Wang, EPFL / Ofer Kfir, University of Gottingen / Tobias Kippenberg, EPFL / Claus Ropers, University of Gottingen / Yujia Yang, EPFL

FM4H.5

The Linewidth Enhancement Factor in a Microcavity Brillouin Laser

Presenter: Zhiquan Yuan, *Caltech*

Amplitude-phase coupling can enhance the linewidth of regenerative oscillators and lasers. Here, in Brillouin lasers, the coupling is shown to originate from phase mismatch. Linewidth enhancements as large as 50 times are measured.

Authors: Zhiquan Yuan, Caltech / Heming Wang, Caltech / LUE WU, Caltech / Maodong Gao, Caltech / Kerry Vahala, Caltech

FM4H.6

Universal Flip-Flopping and Self-Symmetrization of Symmetry-Breaking Dynamics in Passive Kerr Resonators

Presenter: Stephane Coen , *The University of Auckland*

We report on how a π -phase defect in a two-mode Kerr cavity leads to flip-flopping dynamics and self-symmetrization, enabling spontaneous symmetry breaking with unprecedented robustness. Experiments performed with homogeneous and localized states confirm our predictions.

Authors:Julien Fatome, CNRS, Université Bourgogne Franche-Comté / Gang Xu, The University of Auckland / Bruno Garbin, Université Paris-Saclay / Nicolas Berti, Université Bourgogne Franche-Comté / Gian-Luca Oppo, University of Strathclyde / Stuart Murdoch, The University of Auckland / Miro Erkintalo, The University of Auckland / Stephane Coen, The University of Auckland

FM4H.7

Real-Time Study of Coexisting States in Laser Cavity Solitons

Presenter: Pierre-Henry Hanzard , *University of Sussex*

We experimentally demonstrate the presence of two coexisting states in Laser Cavity Solitons (LCS) Microcombs. By using the Dispersive Fourier Transform technique, we show the simultaneous presence of both LCS and a background modulation.

Authors:Pierre-Henry Hanzard, University of Sussex / Maxwell Rowley, University of Sussex / Antonio Cutrona, University of Sussex / Sai T. Chu, University of Hong Kong / Brent E. Little, Xi'an Institute of Optics and Precision Mechanics / Roberto Morandotti, INRS-EMT / David Moss, Swinburne University of Technology / Benjamin Wetzels, Université de Limoges / Juan-Sebastian Toterogongora, University of Sussex / Marco Peccianti, University of Sussex / Alessia Pasquazi, University of Sussex

FM4H.1

Kerr-Microresonator Frequency Combs: Designing Light-Light Interactions for on-Chip Precision Metrology

Invited

Presenter: Tara Drake , *University of New Mexico*

Nanofabricated dielectric resonators are a compact and integrable platform for efficient optical frequency comb generation. The rich and complex interactions within these resonators present both challenges and opportunities, including new physics and enhanced comb functionality.

Authors:Tara Drake, University of New Mexico

Spatio-temporal Manipulation and Measurement of Light

Presenter: Aaswath Raman

FM4J.1

Absorption-Based Diamond Spin Microscopy on a Plasmonic Quantum Metasurface

Presenter: Laura Kim, *MIT*

We propose a resonant diamond plasmonic metasurface coupled with nitrogen-vacancy ensembles as a quantum imaging surface and report a sensitivity below $1 \text{ nT/Hz}^{1/2}$ per μm^2 of sensing area.

Authors: Laura Kim, MIT / Hyeonrak Choi, MIT / Matthew Trusheim, MIT / Dirk Englund, MIT

FM4J.2

(Withdrawn) Shaping the Color and Angular Appearance of Plasmonic Metasurfaces With Tailored Disorder

Presenter: Florian Sterl, *4th Physics Institute and Research Center SCoPE, University of Stuttgart*

We investigate quantitatively the impact of structural disorder on the far-field response of plasmonic metasurfaces, using short-range as well as long-range disorder. Fourier-space microscopy results agree well with numerical dipole-dipole-interaction based simulations.

Authors: Florian Sterl, 4th Physics Institute and Research Center SCoPE, University of Stuttgart / Ediz Herkert, 4th Physics Institute and Research Center SCoPE, University of Stuttgart / Steffen Both, 4th Physics Institute and Research Center SCoPE, University of Stuttgart / Thomas Weiss, 4th Physics Institute and Research Center SCoPE, University of Stuttgart / Harald Giessen, 4th Physics Institute and Research Center SCoPE, University of Stuttgart

FM4J.3

Multifunctional Resonant Wavefront-Shaping Meta-Optics

Presenter: Stephanie Malek, *Columbia University*

We experimentally demonstrate systems of nonlocal optical metasurfaces that spatially shape the incident wavefront deliberately and distinctively for multiple independent resonances without altering the wavefront shape of non-resonant light.

Authors: Stephanie Malek, Columbia University / Adam Overvig, Columbia University / Andrea Alù, City University of New York / Nanfang Yu, Columbia University

FM4J.4

Arbitrary Control of Femtosecond Timescale Complex Electrical-Field Transients

Presenter: Lu Chen , *National Institute of Standards and Technology*

A dielectric-metasurface-enabled pulse shaper able to tailor the temporal instantaneous polarization states within a near-infrared femtosecond pulse is demonstrated. Simultaneous complex wavefront shaping has been implemented by exploiting metasurfaces' multi-functionalities within a single-pixel.

Authors: Lu Chen, National Institute of Standards and Technology / Wenqi Zhu, National Institute of Standards and Technology / Junyeob Song, University of Delaware / Pengcheng Huo, Nanjing University / Jared Strait, National Institute of Standards and Technology / Cheng Zhang, National Institute of Standards and Technology / Henri J. Lezec, National Institute of Standards and Technology / Ting Xu, Nanjing University / Amit Agrawal, National Institute of Standards and Technology

FM4J.5

Monolithic Bilayer Metasurface for Multicolor Phase-Amplitude Holography

Presenter: Xiaoyan Huang , *Columbia University*

We propose a monolithic bilayer metasurface platform for phase-amplitude holograms operating at up to three colors, in both visible and infrared regimes.

Authors: Xiaoyan Huang, Columbia University / Nanfang Yu, Columbia University

FM4J.6

Ultra-Thin Reflective Light Modulators Enabled by Electro- Optical Tunable Gap Plasmons

Presenter: Alexander Yulaev , *University of Maryland/PML-NIST*

We demonstrate compact reflective light modulators based on coupling to gap plasmons electro-optically modulated at radiofrequencies. Modulation is enabled by ultra-fast electro-optic organic polymers that pave the way for high-speed spatial control of light fields.

Authors: Alexander Yulaev, University of Maryland/PML-NIST / Christian Haffner, University of Maryland/PML-NIST / Henri J. Lezec, NIST / Vladimir Aksyuk, NIST

FM4J.7

The Ballistic Resonance: Plasmonic Response Across IR With III-v Semiconductors

Presenter: Evan Simmons , *University of Massachusetts Lowell*

We analyze the perspectives of the ballistic resonance to enable plasmonic and hyperbolic optical response of doped III-V semiconductors across the infrared frequency range. We demonstrate, experimentally and theoretically, plasmonic structures between 3-5 μm .

Authors: Evan Simmons, University of Massachusetts Lowell / Aaron Muhowski, University of Texas at Austin / Kun Li, University of Texas at Austin / Dan Wasserman, University of Texas at Austin / Viktor Podolskiy, University of Massachusetts Lowell / Evgenii Narimanov, Purdue University

FM4J.8

Control of Photons With the Effective Magnetic Flux in Synthetic Dimensions With Rings Including GVD

Presenter: Luqi Yuan , *Shanghai Jiao Tong University*

We explore the synthetic space with rings including GVD, where effective magnetic flux is constructed to manipulate photons. We find photons can be precisely controlled in two different designs even with the waveguide dispersion included.

Authors: Luqi Yuan, Shanghai Jiao Tong University / Danying Yu, Shanghai Jiao Tong University / Qingrou Shan, Shanghai Jiao Tong University / Guangzhen Li, Shanghai Jiao Tong University / Xianfeng Chen, Shanghai Jiao Tong University

AM4Q

C UV and Soft X-ray

Presenter: Oleg Khodykin , *KLA Corporation*

AM4Q.1

Light for the Nanoworld – Applications of EUV Compact Sources in Future Lithography and Metrology

Invited

Presenter: Larissa Juschkin , *Forschungszentrum Jülich, KLA Corporation*

Sources of extreme ultraviolet and soft x-ray radiation enable manufacturing and probing nanostructures in 3D with natural contrast, that is crucial for nm-scale lithography, inspection and metrology. This talk highlights imaging applications with laboratory sources.

Authors: Larissa Juschkin, Forschungszentrum Jülich, KLA Corporation

AM4Q.2

GaAs Detector Array for Soft X-ray Beam Position Monitoring in Storage Ring Light Sources

Presenter: Jinghe Liu , *Stony Brook University*

We describe a GaAs detector array for soft-Xray photons with energies above 250 eV designed to operate with power density levels of up to 20 W/mm² to be used in a novel beam position monitor.

Authors:Jinghe Liu, Stony Brook University / Kevin Kucharczyk, Stony Brook University / Ricardo Lutchman, Stony Brook University / Dmitri Donetsky, Stony Brook University / Claudio Mazzoli, Brookhaven National Laboratory / Boris Podobedov, Brookhaven National Laboratory

AM4Q.3

Ultra Close Range Localized Surface Plasmon Coupling With Multiple Quantum Well Towards Photoluminescence Intensity Enhancement of Micro-LED

Presenter: Zaifa Du , *Beijing University Of Technology*

A strategy for the application of localized surface plasmon to Micro-LED is proposed in this paper. The quantum wells region is exposed by direct etching and Ag nanoparticles is used to generate localized surface plasmon.

Authors:Zaifa Du, Beijing University Of Technology / Weiling Guo, Beijing University Of Technology / Le Wang, Beijing University Of Technology / Fangzhu Xiong, Beijing University Of Technology / Penghao Tang, Beijing University Of Technology / Jie Sun, Fuzhou University

AM4Q.4

Demonstration of Tunable High Q Aluminum Nitride on Sapphire Microring Resonator at Green and UV Wavelengths

Presenter: Walter Shin , *University of Michigan*

We demonstrate aluminum nitride on sapphire microring resonators at green and ultraviolet wavelength and measured record high quality factors of 147,000 at 532nm and 25,500 at 369.5nm based on thermo optic-effect.

Authors:Walter Shin, University of Michigan / Yi Sun, University of Michigan / Mohammad Soltani, Raytheon / Zetian Mi, University of Michigan

AM4Q.5

Self-Powered Ultraviolet-Photodetectors Based on Molecular Beam Epitaxy-Grown AlGaN Quantum-Disks Nanowires

Presenter: Chen Huang , *Univ of Science and Technology of China*

We have fabricated the novel ultraviolet-photodetectors using AlGaIn quantum-disks nanowires. The device responds to 254 nm light sensitively and exhibits a high on/off ratio, a large responsivity, and a fast recovery speed under 0 V.

Authors:Chen Huang, Univ of Science and Technology of China / Fangzhou Liang, Univ of Science and Technology of China / Haiding Sun, Univ of Science and Technology of China

AM4Q.6

Recent Progress of High-Efficiency AlGaIn Deep-UV LED

Invited

Presenter: Hideki Hirayama , *RIKEN*

High-efficiency AlGaIn-based deep-ultraviolet light-emitting diodes (deep-UV LEDs) are demonstrated by enhancing light-extraction efficiency (LEE). The external quantum efficiency (EQE) reached to 20.3% by introducing transparent p-type AlGaIn contact layer and highly reflective electrode.

Authors:Hideki Hirayama, *RIKEN*

AM4O

Quantum Networks

Presenter: Stephan Ritter , *TOPTICA Photonics AG*

AM4O.1

European Quantum Internet Alliance – Towards a Quantum Internet

Invited

Presenter: Stephanie Wehner , *Delft University of Technology*

To be provided

Authors:Stephanie Wehner, *Delft University of Technology*

AM4O.2

(Withdrawn) A Quantum Communication Infrastructure for Europe's Digital Decade

Invited

Presenter: Gustav Kalbe , *European Commission*

Launched in 2019, the EuroQCI initiative seeks to build a European quantum communication infrastructure by 2027, and is a collaboration between the European Commission, 26 Member States, and the European Space Agency. Consisting of terrestrial and space-based components, the EuroQCI infrastructure will enable information and data to be transmitted and stored ultra-securely, linking critical assets all over the EU.

Authors: Thomas Skordas, European Commission / Gustav Kalbe, European Commission

AM40.3

Protocols Beyond Just QKD on an Eight-User Quantum Network

Highlighted Talk

Presenter: Siddarth Koduru Joshi , *University of Bristol*

Quantum networks have been limited to QKD. Here we present an 8 user quantum network running 5 different anonymity protocols, digital signatures, authentication transfer (sharing initial authentication keys) and flooding (optimally utilization of resources).

Authors: Siddarth Koduru Joshi, University of Bristol / Zixin Huang, University of Sheffield / Alasdair Fletcher, University of York / Naomi Solomons, University of Bristol / Ittoop Puthoor, Heriot-Watt University / Yoann Pelet, University of Bristol / Djeylan Aktas, University of Bristol / Cosmo Lupo, University of Sheffield / Armanda O. Quintavalle, University of Sheffield / Soeren Wengerowsky, IQOQI-Vienna / Martin Loncaric, RBI / Sebastian Neumann, IQOQI-Vienna / Bo Liu, NUDT / Thomas Scheidl, IQOQI-Vienna / Zeljko Samec, RBI / Laurent Kling, University of Bristol / Alex Qiu, University of Bristol / Erika Andersson, Heriot-Watt University / Stefano Pirandola, University of York / Rupert Ursin, IQOQI-Vienna / Mario Stipcevic, RBI / John Rarity, University of Bristol

AM40.4

A low-Noise Telecom Interface for Silicon-Vacancy Quantum Network Nodes

Presenter: Eric Bersin , *Massachusetts Institute of Technology*

Fiber-based quantum networks employing atomic memories require an interface between visible and infrared photons. We demonstrate low-noise conversion between silicon vacancy wavelengths and the telecom O-band for use in a deployed quantum network.

Authors: Eric Bersin, Massachusetts Institute of Technology / Noel Wan, Massachusetts Institute of Technology / Mihir Bhaskar, Harvard University / David Levonian, Harvard University / Ralf Riedinger, Harvard University / Carsten Langrock, Stanford University / Martin Fejer, Stanford University / Mikhail Lukin, Harvard University / P. Dixon, MIT Lincoln Laboratory / Scott Hamilton, MIT Lincoln Laboratory / Dirk Englund, Massachusetts Institute of Technology

AM40.5

Entanglement Distribution and Routing in a Multi-Node Quantum Network Testbed

Presenter: Chaohan Cui , *The University of Arizona*

We report a field test of distribution and reconfigurable routing of multi-channel entangled photons in a quantum network testbed. Nonlocal dispersion cancellation has been leveraged to maintain high-quality entanglement in the quantum network.

Authors:Chaohan Cui, The University of Arizona / William Horrocks, The University of Arizona / Lauren McCaffrey, The University of Arizona / Vijay Nafria, The University of Arizona / Ivan Djordjevic, The University of Arizona / Zheshen Zhang, The University of Arizona

SM4I

Imaging Techniques/Light Manipulation

Presenter: Yaguo Wang , *University of Texas at Austin*

SM4I.1

LEAD Fluorescence Microscopy Operating at 0.8 Million Frames per Second

Invited

Presenter: Adela Ben-Yakar , *University of Texas at Austin*

We present LEAD (line excitation array detection) microscopy that provides fluorescence imaging at 0.8 million frames-per-second by combining an ultrafast line scanning.

Authors:Adela Ben-Yakar, University of Texas at Austin

SM4I.2

2D Vibrational Exciton Nano-Imaging as a Molecular Ruler of Domain Formation in Self-Assembled Monolayers

Presenter: Thomas Gray , *University of Colorado Boulder*

We develop precision infrared nano-imaging and -spectroscopy to probe vibrational excitons and associated vibrational wavefunction delocalization as a molecular ruler to study order and domains in molecular materials and self-assembled monolayer on the molecular scale.

Authors:Thomas Gray, University of Colorado Boulder / Jun Nishida, University of Colorado Boulder / Samuel Johnson, University of Colorado Boulder / Markus Raschke, University of Colorado Boulder

SM4I.3

Optical Trapping of Low Refractive Index Particles by Dual Vortex Beams

Presenter: Yuichi Kozawa , *Tohoku University*

We present a novel method of optical trapping by a size-controllable dark spot produced by dual vortex beams, which realizes stable manipulation of micrometer size particles with a low refractive index.

Authors: Sho Nakaya, Tohoku University / Yuichi Kozawa, Tohoku University / Yuuki Uesugi, Tohoku University / Shunichi Sato, Tohoku University

SM4I.4

a High Aspect-Ratio Holey Metalens

Presenter: Maryna Meretska , *Harvard University*

We design and fabricate metalenses comprising substrateless ultra-deep via-holes in silicon with aspect ratios exceeding 30:1. Deep holes allow us to circumvent fabrication and fragility constraints which limit the aspect ratios of free-standing meta-atoms.

Authors: Maryna Meretska, Harvard University / Soon Wei Daniel Lim, Harvard University / Federico Capasso, Harvard University

SM4I.5

Jones Matrix Holography With Metasurfaces

Presenter: Aun Zaidi , *Harvard University*

We propose a new class of computer generated holograms whose far fields possess designer-specified polarization response. Using form-birefringent metasurfaces, we demonstrate holograms whose far-fields implement parallel polarization analysis and custom waveplate-like behavior.

Authors: Aun Zaidi, Harvard University / Noah Rubin, Harvard University / Ahmed Dorrah, Harvard University / Zhujun Shi, Harvard University / Federico Capasso, Harvard University

SM4I.6

Spin to Orbit Conversion Based on Intensity Gradient

Presenter: Shuang Huang , *Nankai University*

We verify the optical angular momentum (AM) arising from the gradient of the intensity and also depending on spin through optical trapping experiments and it may also be called spin to orbit conversion.

Authors: Shuang Huang, Nankai University / Zhou Wang, Nankai University / Jia Lv, Nankai University / Guan Zhang, Nankai University / Min Wang, Nankai University / Qian Tian, Nankai University / Chenghou Tu, Nankai University / Yongnan Li, Nankai University / Huitian Wang, Nanjing University

SM4I.7

Optothermal Manipulation of Liquid Droplets

Presenter: Youngsun Kim , *University of Texas at Austin*

Optothermal manipulation of liquid was studied with surfactant-free oil-in-water emulsions. Trapping, assembly, and fusion of pure liquid droplets in an aqueous medium were demonstrated by applying an optothermal stimulus and adjusting medium compositions.

Authors: Youngsun Kim, University of Texas at Austin / Yuebing Zheng, University of Texas at Austin

SM4L

Lithium Niobate Photonics

Presenter: Paul Barclay , *University of Calgary*

SM4L.1

(Withdrawn) Wafer-Scale High-Yield Fabrication of low-Loss Lithium Niobate on Insulator PICs

Presenter: Amir Ghadimi , *CSEM*

Here we present high-yield fabrication of lithium niobate PICs based on 6-inch lithium niobate on insulator wafers and the statistical measurements of hundreds of resonators, demonstrating mean optical quality $>10^6$, corresponding to linear losses $<0.2\text{dB/cm}$.

Authors: Hamed Sattari, CSEM / Jacopo Leo, CSEM / Gregory Choong, CSEM / Olivier Dubochet, CSEM / Steve Lecomte, CSEM / Michel Despont, CSEM / Victor Brasch, CSEM / Amir Ghadimi, CSEM

SM4L.2

High-Efficiency Chirped Grating Couplers on Lithium Niobate on Insulator

Presenter: Shuting Kang , *Nankai University*

Chirped grating couplers on lithium niobate on insulator (LNOI) with state-of-the-art theoretical (experimental) coupling efficiencies of 88.7%/coupler (72.0%/coupler), were realized on z-cut LNOI with an Au reflection layer.

Authors: Shuting Kang, Nankai University / Ru Zhang, Nankai University / Zhenzhong Hao, Nankai University / Di Jia, Nankai University / Feng Gao, Nankai University / Fang Bo, Nankai University / Guoquan Zhang, Nankai University / Jingjun Xu, Nankai University

SM4L.3

Broadband Adiabatic Couplers in Thin-Film Lithium Niobate on Insulator

Presenter: Hung-Pin Chung , *National Central University*

We demonstrate broadband adiabatic couplers using lithium niobate on insulator (LNOI) waveguides with a footprint reduced by 98% relative to bulk LN devices. LNOI couplers with coupling efficiency >95% across telecom S-C-L bands are obtained.

Authors:Yi-Xin Lin, National Central University / Mohammadreza Younesi, Friedrich-Schiller-Universität Jena / Hung-Pin Chung, National Central University / Hua-Kung Chiu, Taiwan Semiconductor Research Institute / Reinhard Geiss, Friedrich-Schiller-Universität Jena / Quan-Hsiang Tseng, National Central University / Frank Setzpfandt, Friedrich-Schiller-Universität Jena / Thomas Pertsch, Friedrich-Schiller-Universität Jena / Yen-Hung Chen, National Central University

SM4L.4

Bidirectional Electro-Optic Conversion Reaching 1% Efficiency With Thin-Film Lithium Niobate

Presenter: Yuntao Xu , *Yale University*

We demonstrate an efficient, bi-directional electro-optic frequency converter based on a hybrid lithium-niobate/superconductor material platform. Through materials and device engineering to mitigate the limiting photorefractive effect, on-chip conversion efficiency of 1% is realized.

Authors:Yuntao Xu, Yale University / Ayed Sayem, Yale University / Linran Fan, Yale University / Chang-Ling Zou, Yale University / Hong Tang, Yale University

SM4L.5

On-Chip Lithium Niobate Optical Parametric Oscillator With Micro-Watts Threshold

Presenter: Juanjuan Lu , *Yale University*

We demonstrate an efficient optical parametric oscillator at the telecom band using a triple-resonant, periodically poled lithium niobate microring resonator, which, to the best of our knowledge, delivers the lowest threshold power ($\sim 30 \mu\text{W}$) for on-chip OPOs so far.

Authors:Juanjuan Lu, Yale University / Ayed Sayem, Yale University / Zheng Gong, Yale University / Joshua Surya, Yale University / Hong Tang, Yale University

SM4L.6

Optical Parametric Oscillator in Thin-Film Lithium Niobate With a 130 μW Threshold

Presenter: Hubert Stokowski , *Stanford University*

We present an integrated optical parametric oscillator in thin-film lithium niobate. Our device is based on a periodically poled racetrack resonator and operates at a telecommunication wavelength with a threshold of 130 μW .

Authors: Hubert Stokowski, Stanford University / Timothy McKenna, Stanford University / Vahid Ansari, Stanford University / Jatadhari Mishra, Stanford University / Marc Jankowski, Stanford University / Christopher Sarabalis, Stanford University / Jason Herrmann, Stanford University / Carsten Langrock, Stanford University / Martin Fejer, Stanford University / Amir Safavi-Naeini, Stanford University

SM4L.7

Fully-Resonant Second Harmonic Generation in Periodically Poled Thin-Film Lithium Niobate

Presenter: Timothy McKenna, *Stanford University*

We demonstrate second harmonic generation in a periodically poled X-cut lithium niobate microresonator with total efficiency greater than 12% and output power greater than 1 mW.

Authors: Timothy McKenna, Stanford University / Hubert Stokowski, Stanford University / Vahid Ansari, Stanford University / Jatadhari Mishra, Stanford University / Marc Jankowski, Stanford University / Christopher Sarabalis, Stanford University / Jason Herrmann, Stanford University / Carsten Langrock, Stanford University / Martin Fejer, Stanford University / Amir Safavi-Naeini, Stanford University

SM4L.8

Photonic-Chip-Based Femtosecond Pulse Generator

Presenter: Mengjie Yu, *Harvard University*

We realize an electro-optic time lens on a lithium niobate photonic chip. By temporally carving a continuous-wave single-frequency laser, we generate a flat-top comb spectrum with 10.5-nm bandwidth and a 30-GHz pulse train with 532-fs duration.

Authors: Mengjie Yu, Harvard University / Christian Reimer, HyperLight corp. / Yoshitomo Okawachi, Columbia University / Prashanta Kharel, HyperLight corp. / Linbo Shao, Harvard University / Di Zhu, Harvard University / Yaowen Hu, Harvard University / Alexander Gaeta, Columbia University / Mian Zhang, HyperLight corp. / Marko Loncar, Harvard University

SM4C

New Approaches to Mode Coupling

Presenter: Ognjen Ilic, *University of Minnesota*

SM4C.1

Design Principles of Apodized Grating Couplers

Presenter: Zhexin Zhao , *Stanford University*

We extend an analytical model for designing apodized grating couplers, considering the constraints on the upper and lower bounds of the scattering strength.

Authors:Zhexin Zhao, Stanford University / Shanhui Fan, Stanford University

SM4C.2

Inverse-Designed Optical Vortex Beam Emitters

Presenter: Alexander White , *Stanford*

We experimentally demonstrate a suite of integrated inverse-designed optical vortex beam emitters. As these emitters are extremely compact, 3x3 um, they are capable of operating over a 60 nm uninterrupted band.

Authors:Alexander White, Stanford / Kiyoul Yang, Stanford / Jelena Vuckovic, Stanford

SM4C.3

Experimental Demonstration of an Integrated Broadband Pixel-Array Structure Generating Two Tunable Orbital-Angular-Momentum Mode Values and Carrying 100-Gbit/s QPSK Data

Highlighted Talk

Presenter: Hao Song , *University of Southern California*

We experimentally demonstrate the OAM beam generation with tunable order of and 3-dB bandwidth of ~9 nm using a pixel-array structure. A 100-Gbit/s quadrature-phase-shift-keying communication link carried by the tunable OAM beam is demonstrated.

Authors:Hao Song, University of Southern California / Huibin Zhou, University of Southern California / kaiheng zou, University of Southern California / Runzhou Zhang, University of Southern California / Kai Pang, University of Southern California / Haoqian Song, University of Southern California / Amir Minoofar, University of Southern California / Xinzhou Su, University of Southern California / Nanzhe Hu, University of Southern California / cong liu, University of Southern California / Robert Bock, R-DEX system / Shlomo Zach, Tel Aviv University / Moshe Tur, Tel Aviv University / Alan Eli Willner, University of Southern California

SM4C.4

Inverse-Designed Optical Link for Chip-to-Chip Communication

Presenter: Kiyoul Yang , *Stanford University*

We experimentally demonstrate a chip-to-chip optical interconnect using inverse-designed silicon photonic circuits. Inverse design optimizes mode-division multiplexing and grating coupler structures in a compact footprint with low insertion loss.

Authors: Kiyoul Yang, Stanford University / Alexander White, Stanford University / Fashid Ashtiani, University of Pennsylvania / Lin Chang, University of California, Santa Barbara / Hao Song, University of Southern California / kaiheng zou, University of Southern California / Huibin Zhou, University of Southern California / Kai Pang, University of Southern California / Geun Ho Ahn, Stanford University / Andy Netherton, University of California, Santa Barbara / Jinhie Lee Skarda, Stanford University / Logan Su, Stanford University / Dries Verduyck, Stanford University / Jean Philippe MacLean, Stanford University / Shahriar Aghaeimeibodi, Stanford University / Alan Eli Willner, University of Southern California / John Bowers, University of California, Santa Barbara / Firooz Aflatouni, University of Pennsylvania / Jelena Vuckovic, Stanford University

SM4C.5

Metallic Grating Couplers – Broadband and Efficient

Presenter: Andreas Messner, *ETH Zurich*

Metallic grating couplers can be extremely broadband and efficient. In this work, we investigate an all-plasmonic fiber-to-chip coupler with a coupling efficiency of -2.7 dB and an optical 3-dB passband of 300 nm.

Authors: Andreas Messner, ETH Zurich / Pascal Jud, ETH Zurich / Joel Winiger, ETH Zurich / Marco Eppenberger, ETH Zurich / Ueli Koch, ETH Zurich / Ping Ma, ETH Zurich / Jasmin Smajic, ETH Zurich / Juerg Leuthold, ETH Zurich

SM4C.6

3D Micro Lenses for Efficient Edge Coupling by Two-Photon Lithography

Presenter: Lifeng Chen, *Sun Yat-Sen University*

We demonstrate 3D nano-fabricated lens coupler designs realizing efficient edge coupling for single mode fiber or laser to photonic integrated chips, results show 1dB loss per facet and more than 100 nm wavelength bandwidth.

Authors: Lifeng Chen, Sun Yat-Sen University / Haozhi Luo, Sun Yat-Sen University / Xinlun Cai, Sun Yat-Sen University

SM4C.7

Low-Loss Bi-Layer Edge Couplers for Blue Light

Presenter: Yiding Lin, *Max Planck Institute of Microstructure Physics*

We report low-loss silicon nitride bi-layer fiber-to-chip edge couplers on 200-mm silicon wafers for visible spectrum photonic circuits. The minimum per-facet coupling loss at $\lambda=488\text{nm}$ was $\sim 2.6\text{dB}$ (TM), and polarization-independent coupling was achieved with $\sim 3.2\text{-dB}$ loss.

Authors: Yiding Lin, Max Planck Institute of Microstructure Physics / Jason C. C. Mak, University of Toronto / Hong Chen, Max Planck Institute of Microstructure Physics / Xin Mu, Max Planck Institute of Microstructure Physics / Andrei Stalmashonak, Max Planck Institute of Microstructure Physics / Youngho Jung, Max Planck Institute of Microstructure Physics / Xianshu Luo, Advanced Micro Foundry Pte Ltd / Patrick Lo, Advanced Micro Foundry Pte Ltd / Wesley Sacher, Max Planck Institute of Microstructure Physics / Joyce Poon, Max Planck Institute of Microstructure Physics

SM4B

Heterogenous Photonic Integration

Presenter: Siddhartha Ghosh, *Northeastern University*

SM4B.1

Nonlinear Frequency Conversion in the Hybrid Silicon Nitride - Lithium Niobate Integrated Platform

Presenter: Mikhail Churaev, *EPFL*

We demonstrate optical frequency comb generation in hybrid high-Q optical microresonators fabricated using direct wafer bonding of photonic Damascene silicon nitride wafer with thin-film lithium niobate-on-insulator (LNOI). The devices enable direct phase control via Pockels effect.

Authors: Mikhail Churaev, EPFL / Annina Riedhauser, IBM Research - Europe / Rui Wang, EPFL / Charles Möhl, IBM Research - Europe / Viacheslav Snigirev, EPFL / Simon Hönl, IBM Research - Europe / Terence Blésin, EPFL / Junqiu Liu, EPFL / Youri Popoff, IBM Research - Europe / Paul Seidler, IBM Research - Europe / Tobias Kippenberg, EPFL

SM4B.2

High-Performance Bias-Drift-Free Modulators Based on Heterogeneous Silicon and Lithium Niobate Platform

Presenter: Shihao Sun, *Sun Yat-Sen University*

we demonstrate high-speed and bias-drift-free Mach-Zehnder modulators based on the heterogeneous silicon and lithium niobate platform and exhibit a low half-wave voltage of 3 V, and electro-optic modulation bandwidth of at least 70 GHz.

Authors: Shihao Sun, Sun Yat-Sen University / Siyuan Yu, Sun Yat-Sen University / Xinlun Cai, Sun Yat-Sen University

SM4B.3

Micro-Transfer Printing for Heterogeneous Silicon Photonic Integrated Circuits

Invited

Presenter: Gunther Roelkens , *Ghent University - imec*

In this paper we describe the use of micro-transfer printing technology for silicon photonics heterogeneous integration, including the integration of GaAs & InP opto-electronic components on passive and active silicon photonics platforms (both silicon-on-insulator-based and SiN-based).

Authors: Gunther Roelkens, Ghent University - imec

SM4B.4

Enhancing SiN Waveguide Optical Nonlinearity via Hybrid GaS Integration

Presenter: Skylar Deckoff-Jones , *MIT*

Gallium sulfide is a van der Waals material with strong optical nonlinearities, while silicon nitride has a small nonlinear index. Here, we demonstrate enhanced all optical Kerr modulation in hybrid silicon nitride/gallium sulfide microring resonators.

Authors: Skylar Deckoff-Jones, MIT / Vincent Pelgrin, Centre de Nanosciences et de Nanotechnologies / Jianhao Zhang, Centre de Nanosciences et de Nanotechnologies / Christian Lafforgue, Centre de Nanosciences et de Nanotechnologies / Lucas Deniel, Centre de Nanosciences et de Nanotechnologies / Sylvain Guerber, STMicroelectronics / Rebeca Ribeiro, Centre de Nanosciences et de Nanotechnologies / Fredric Boeuf, STMicroelectronics / Carlos Alonso-Ramos, Centre de Nanosciences et de Nanotechnologies / Laurent Vivien, Centre de Nanosciences et de Nanotechnologies / Juejun Hu, MIT / Samuel Serna, Bridgewater State University

SM4B.5

Nonvolatile Switching in In_2Se_3 -Silicon Microring Resonators

Presenter: Tiantian Li , *University of Delaware*

We investigate the phase transition in molecular beam epitaxy grown crystalline In_2Se_3 and observed nonvolatile switching in hybrid integrated silicon photonic resonator.

Authors: Tiantian Li, University of Delaware / Yong Wang, University of Delaware / Huadan Xing, University of Delaware / Qiu Li, University of Delaware / Feifan Wang, University of Delaware / Anishkumar Soman, University of Delaware / Stephanie Law, University of Delaware / Tingyi Gu, University of Delaware

SM4B.6

Selective Area Heteroepitaxy of Antiphase Boundary Free GaAs Microridges on on-Axis (001) Si for Silicon Photonics

Presenter: Bei Shi , *University of California Santa Barbara*

Low defect density gallium arsenide microridges were selectively grown on patterned (001) silicon. Antiphase boundaries were eliminated by bending and self-annihilation, enabled by low temperature nucleation and subsequent growth temperature optimization.

Authors:Bei Shi, University of California Santa Barbara / Bowen Song, University of California Santa Barbara / Aidan Taylor, University of California Santa Barbara / Simone Brunelli, University of California Santa Barbara / Jonathan Klamkin, University of California Santa Barbara

SM4B.7

Observation of Stimulated Brillouin Scattering in $\text{Ge}_{25}\text{Sb}_{10}\text{S}_{65}$ Chalcogenide Waveguides

Presenter: jingcui Song , *Sun Yat-Sen University*

We demonstrate stimulated Brillouin scattering in $\text{Ge}_{25}\text{Sb}_{10}\text{S}_{65}$ chalcogenide waveguides. The measured Brillouin shift is 7.443 GHz. A 17.6-dB on-off gain is obtained at 200-mW coupled pump power, corresponding to a Brillouin-gain coefficient of $338 \text{ m}^{-1}\text{W}^{-1}$.

Authors:jingcui Song, Sun Yat-Sen University / Xiaojie Guo, Jinan University / Lei Wan, Jinan University / Mingjie Zhang, Jinan University / Bin Zhang, Sun Yat-Sen University / Zhaohui Li, Sun Yat-Sen University

SM4K

Linewidth Management of Fiber Sources

Presenter: Shibin Jiang , *AdValue Photonics Inc*

SM4K.1

Linewidth Narrowing of High Power Fiber Amplifiers Using Nonlinear Phase Demodulation

Highlighted Talk

Presenter: Gregory Goodno , *Northrop Grumman Space Systems*

Nonlinear phase demodulation was applied to narrow the linewidth of a kilowatt-class polarization maintaining fiber amplifier by 7x past the threshold for stimulated Brillouin scattering.

Authors:Gregory Goodno, Northrop Grumman Space Systems / Joshua Rothenberg, Northrop Grumman Space Systems

SM4K.2

Spectrum Broadening Suppression for kW-Class Narrow Linewidth FBG-Based Fiber Laser

Presenter: Yulun Wu , *Tsinghua University*

Spectral broadening caused by nonlinear effects was analyzed in the narrow linewidth FBG-based fiber laser. Kilowatt-class narrow linewidth fiber lasers were established. The maximum power and power spectral density were 3 kW and 29.3 W/pm.

Authors:Yulun Wu, Tsinghua University / Huang Yusheng, Shenzhen Institutes of Advanced Technology / Wang Zehui, Tsinghua University / Li Dan, Tsinghua University / Xiao Qirong, Tsinghua University / Yan Ping, Tsinghua University / Gong Mali, Tsinghua University

SM4K.3

Non-Polarization-Maintaining Fiber Based Single-Polarization, Single-Frequency Erbium-Doped Distributed-Feedback Laser

Presenter: Wenjuan Sun , *Jiangsu Normal University*

Phase-shifted fiber Bragg grating with high laser-induced birefringence is inscribed in a non-polarization-maintaining Er-doped silica fiber, by a novel femtosecond laser line-by-line direct-writing method. Efficient single-polarization, single-frequency distributed-feedback fiber laser is achieved.

Authors:Wenjuan Sun, Jiangsu Normal University / Yanjiang Yu, Jiangsu Normal University / Jindan Shi, Jiangsu Normal University / Xian Feng, Jiangsu Normal University

SM4K.4

Ultra-Narrow Tunable Dip in the Brillouin Gain Spectrum of Spun Birefringent Fiber

Presenter: Neel Choksi , *University of Toronto*

We report a method of generating an ultra-narrow tunable spectral dip with a bandwidth of ~ 1 MHz in a resonator-free arrangement by using stimulated Brillouin scattering in a spun birefringent fiber.

Authors:Neel Choksi, University of Toronto / Yi Liu, University of Toronto / Rojina Ghasemi, University of Toronto / Li Qian, University of Toronto

SM4K.5

Self-Injection-Locked Dual-Frequency Brillouin Laser Operating CW With a Simple Active Feedback Loop

Presenter: Andrei Fotiadi , *University of Mons*

A simple dual-frequency laser, employing a single ring fiber cavity for self-injection-locking of a semiconductor DFB-laser and generation of stimulated Brillouin scattering, features a 300-Hz-width RF spectrum recorded with the beating between two channels.

Authors: Vasily Spirin, Scientific Research and Advanced Studies Center of Ensenada (CICESE) / Jose Bueno Escobedo, Scientific Research and Advanced Studies Center of Ensenada (CICESE) / Dmitry Korobko, Ulyanovsk State University / Irog Zolotovskii, University of Mons / Andrei Fotiadi, University of Mons

SM4K.6

All-Chalcogenide Single-Mode Brillouin Fiber Laser

Presenter: Mohsen Rezaei, *McGill University*

We demonstrate the first all-chalcogenide Brillouin fiber laser. The laser is composed of an As₂S₃ optical fiber for nonlinear amplification and of an As₂Se₃ optical fiber coupler to form a resonant ring cavity.

Authors: Mohsen Rezaei, McGill University / Martin Rochette, McGill University

SM4K.7

High-Power, Single-Longitudinal-Mode Compound-Ring Thulium-Doped Fiber Laser at 1.7 μm

Presenter: lu Zhang, *Tianjin University*

An efficient high-power single-frequency thulium-doped ring-cavity fiber laser operating at 1720 nm based on cascaded sub-ring cavities all-fiber structures has been proposed and experimentally demonstrated for the first time.

Authors: lu Zhang, Tianjin University / Junxiang Zhang, Tianjin University / Quan Sheng, Tianjin University / Shuai Sun, Tianjin University / Chaodu Shi, Tianjin University / Shijie Fu, University of Arizona / xiaolei bai, Inner Mongolia University / Wei Shi, Tianjin University / Jianquan Yao, Tianjin University

SM4A

Free-space and Underwater Communication

Presenter: Mihaela Dinu, *LGS Innovations LLC*

SM4A.1

a 3.2-Gbps Beam Expanded Robust Uplink WDM OWC System Based on 860-nm and 940-nm VCSELs

Presenter: Zhiyuan Cao, *Tsinghua University*

We proposed an 860-nm and 940-nm commercial VCSELS-based 1.5-meter 3.2-Gbps beam expanded robust uplink wavelength division multiplexing (WDM) system which can ignore collimation of the optical path within an area of 97.65 cm².

Authors:Zhiyuan Cao, Tsinghua University / Shi Zhang, Tsinghua University / Zixian Wei, Tsinghua University / Li Zhang, Tsinghua University / Keming Ma, Tsinghua University / H. Y. Fu, Tsinghua University / Yuhan Dong, Tsinghua University

SM4A.2

Gigabit Indoor Free-Space Optical Communication Enhanced by Dynamic Beam Control

Presenter: Cade Trotter , *Oregon State University*

We present an indoor free space, line-of-sight optical communication system with gigabit bandwidth using an ultra-low power VCSEL diode, which is enhanced by dynamic beam steering and beam shaping for rapid user acquisition.

Authors:Cade Trotter, Oregon State University / Spencer Liverman, Oregon State University / Luc Bouchard, Oregon State University / Hayden Bialek, Oregon State University / Think Nguyen, Oregon State University / Arun Natarajan, Oregon State University / Alan Wang, Oregon State University

SM4A.3

(Withdrawn) a Dynamic Handover Scheme for VLC-Based Bidirectional Attocell Networks

Presenter: Liqiang Wang , *Beijing Univ of Posts & Telecom*

We proposed a dynamic handover scheme based on bidirectional visible light communications channel, which reduced the terminal's handover rate by 45% and increased the throughput by 26% compared with the skipping handover scheme.

Authors:Liqiang Wang, Beijing Univ of Posts & Telecom / Dahai Han, Beijing Univ of Posts & Telecom / Min Zhang, Beijing Univ of Posts & Telecom / Peiyu Jia, Beijing Univ of Posts & Telecom / Jingtao Wu, Beijing Univ of Posts & Telecom / Xiaotian Jiang, Beijing Univ of Posts & Telecom / Jingsuo He, Capital Normal University

SM4A.4

Turbulence-Resistant Free-Space Optical Communication Using Mode Diversity Pre-amplification and Reception

Presenter: Yetian Huang , *Shanghai University*

We experimentally compare the performance with and without employing three-mode diversity reception over a 8-m free-space link under a laboratory-simulated turbulence. Few-mode preamplification is applied to enhance the receiver's sensitivity.

Authors: Yetian Huang, Shanghai University / Hanzi Huang, Shanghai University / Haoshuo Chen, Nokia Bell Labs / Qianwu Zhang, Shanghai University / Yingchun Li, Shanghai University / Jianxiang Wen, Shanghai University / Nicolas Fontaine, Nokia Bell Labs / Roland Ryf, Nokia Bell Labs / Juan Alvarado, CREOL / Rodrigo Amezcua Correa, CREOL / Yingxiong Song, Shanghai University / Min Wang, Shanghai University

SM4A.5

Experimental Investigation on Degradation of an Orbital-Angular-Momentum Beam Passing Through Dynamic Aerosol and Air-Water Interface for Air-to-Water Communications

Presenter: Haoqian Song, *University of Southern California*

We experimentally investigate the degradation of a data-carrying OAM beam passing through dynamic aerosol and non-planar air-water interface and observe an up to -6.5-dB modal crosstalk from OAM -1 to OAM +1 under the effects.

Authors: Haoqian Song, University of Southern California / Runzhou Zhang, University of Southern California / Nanzhe Hu, University of Southern California / Huibin Zhou, University of Southern California / Xinzhou Su, University of Southern California / kaiheng zou, University of Southern California / Kai Pang, University of Southern California / Hao Song, University of Southern California / cong liu, University of Southern California / Brittany Lynn, Space & Naval Warfare Systems Center / Moshe Tur, Tel Aviv University / Alan Eli Willner, University of Southern California

SM4A.6

the Circuit Implementation of Feedforward Equalization for High-Speed Real-Time Visible Light Communication Systems

Presenter: Weishu Xu, *Beijing Univ of Posts & Telecom*

We experimentally demonstrated a 180 Mbps real-time visible light communication link with a low-cost and low-complexity adder-circuit-based feed forward equalizer with achieved extremely low bit error rate at 2.87×10^{-6} over 2.3 m transmission distance.

Authors: Weishu Xu, Beijing Univ of Posts & Telecom / Min Zhang, Beijing Univ of Posts & Telecom / Dahai Han, Beijing Univ of Posts & Telecom / Qiguan Chen, Beijing Univ of Posts & Telecom

SM4A.7

10-Gb/s All-Fiber Beamforming LiFi System via Mode-Coupling Control

Presenter: Yiwen Zhang, *University of Southern California*

By controlling the mode coupling in a multi-mode fiber, we realize an all-fiber and low-cost beamforming transmitter and experimentally demonstrate its application for a 10-Gb/s LiFi system at 1550 nm.

Authors:Yiwen Zhang, University of Southern California / Chao Li, Eindhoven University of Technology / Xuebing Zhang, Eindhoven University of Technology / Jian Cui, Peking University / Juhao Li, Peking University / Lei Zhu, Eindhoven University of Technology / Zilun Li, Sun Yat-sen University / Zizheng Cao, Eindhoven University of Technology / Antonius Marcellus Jozef Koonen, Eindhoven University of Technology / Chia Wei Hsu, University of Southern California

SM4A.8

A White-Lighting WDM-VLC System

Presenter: Chao-Yu Feng, *National Taipei University of Technology*

A white-lighting WDM-VLC system over 20 m free-space distance with 3 m lighting distance is built, adopting an R/G/B triple-light polarization-multiplexing scenario, transmission gratings, and an engineered diffuser with a bi-convex lens as a demonstration.

Authors:Chao-Yu Feng, National Taipei University of Technology / Cing-Ru Chou, National Taipei University of Technology / Yi-Hao Chen, National Taipei University of Technology / Agustina Nainggolan, National Taipei University of Technology / Chung-Yi Li, National Taipei University / Hai-Han Lu, National Taipei University of Technology

SM4N

Precision Molecular Spectroscopy

Presenter: Garwing Truong, *Thorlabs Inc*

SM4N.1

Fiber-Connected 3D Printed Hollow-Core Light Cage for Gas Detection

Presenter: Bumjoon Jang, *Leibniz Institute of Photonic Technology*

The light cage is a 3D nanoprinted hollow-core waveguide which can be used as an integrated light-matter interaction platform. Here we present the fiber-connected version of light cage and demonstrate ammonia gas sensing using tunable diode laser absorption spectroscopy.

Authors:Bumjoon Jang, Leibniz Institute of Photonic Technology / Julian Gargiulo, Ludwig-Maximilians-Universität Munich / Jisoo Kim, Leibniz Institute of Photonic Technology / Johannes Bürger, Ludwig-Maximilians-Universität Munich / Hartmut Lehmann, Leibniz Institute of Photonic Technology / Torsten Wieduwilt, Leibniz Institute of Photonic Technology / Stefan Maier, Ludwig-Maximilians-Universität Munich / Markus Schmidt, Leibniz Institute of Photonic Technology

SM4N.2

Doppler-Free Two-Photon Cavity Ring-Down Spectroscopy of a Molecular Vibrational Overtone Transition

Presenter: Gang Zhao , *National Inst of Standards & Technology*

We demonstrate Doppler-free two-photon cavity ring-down spectroscopy using a narrow linewidth quantum cascade laser locked to a high-finesse cavity. Two-photon absorption of $^{14}\text{N}_2^{16}\text{O}$ at $\nu_0 = 2207.507 \text{ cm}^{-1}$ is reported.

Authors: Gang Zhao, National Inst of Standards & Technology / D. Bailey, National Inst of Standards & Technology / Adam Fleisher, National Inst of Standards & Technology / Joseph Hodges, National Inst of Standards & Technology / Kevin Lehmann, University of Virginia

SM4N.3

Mode-Resolved Cavity-Enhanced Vernier Spectroscopy Using an Interband Cascade Laser Frequency Comb

Presenter: Lukasz Sterczewski , *California Institute of Technology*

We demonstrate a mid-IR mode-resolved Vernier optical frequency comb spectrometer with an interband cascade laser source. The free-running system provides 35 meters of effective path length for monitoring 1-THz-broad spectra at $3.63 \mu\text{m}$.

Authors: Lukasz Sterczewski, California Institute of Technology / Tzu-Ling Chen, California Institute of Technology / Douglas Ober, California Institute of Technology / Charles Markus, California Institute of Technology / Chadwick Canedy, Naval Research Laboratory / Igor Vurgaftman, Naval Research Laboratory / Clifford Frez, California Institute of Technology / Jerry Meyer, Naval Research Laboratory / Mitchio Okumura, California Institute of Technology / Mahmood Bagheri, California Institute of Technology

SM4N.4

Electronic Fingerprint Spectroscopy

Invited

Presenter: Birgitta Bernhardt , *Graz University of Technology*

Ultraviolet dual comb spectroscopy will enable broadband spectroscopic studies of photochemical reactions with an unparalleled relative resolution of up to 10^{-9} . Experimental and simulated studies paving the way for ultraviolet dual comb spectroscopy have been performed.

Authors: Birgitta Bernhardt, Graz University of Technology

SM4N.5

Hollow-Core-Fiber Delivery of Broadband Mid-Infrared Light for Remote Multi-Species Spectroscopy

Presenter: Derryck Reid , *Heriot-Watt University*

High-resolution multi-species spectroscopy is achieved by delivering mid-infrared light through a hollow-core silica fiber. Concentrations of H^{37}Cl , H^{35}Cl , H_2O , CH_4 , $\text{C}_3\text{H}_6\text{O}$ and $\text{C}_3\text{H}_8\text{O}$ are simultaneously obtained by a multi-parameter fit with up to 5-ppb precision.

Authors: Kerr Johnson, Chromacity Ltd. / Pablo Castro-Marin, Heriot-Watt University / Carl Farrell, Chromacity Ltd. / Ian Davidson, University of Southampton / Gregory Jasion, University of Southampton / Natalie Wheeler, University of Southampton / Francesco Poletti, University of Southampton / David Richardson, University of Southampton / Derryck Reid, Heriot-Watt University

SM4N.6

Precision Solar Spectroscopy With Near Infrared Laser Heterodyne Radiometry

Presenter: Connor Fredrick, *University of Colorado at Boulder*

With frequency-comb-calibrated laser heterodyne radiometry, we perform near-quantum-limited solar spectroscopy at 1565 nm. Solar spectral lines are resolved to 1 part in 1400 in 10 minutes of averaging.

Authors: Connor Fredrick, University of Colorado at Boulder / Ryan Terrien, Carleton College / Suvrath Mahadevan, The Pennsylvania State University / Franklyn Quinlan, National Institute of Standards and Technology / Scott Diddams, University of Colorado at Boulder

SM4N.7

QEPAS Sensor Based on the Tracking of the Photoacoustic Induced Frequency Shift of a Tuning Fork Maintained in Self-Sustained Oscillation by Electrical Excitation

Presenter: Antoine Godard, *DPHY, ONERA, Université Paris Saclay*

Oscillator frequency shift induced by the photoacoustic force on a closed-loop electrically excited quartz tuning fork is exploited to carry out QEPAS measurement. We report recent improvements of this new method for background-free gas sensing.

Authors: Maxime Duquesnoy, mirSense / Raphaël Lévy, DPHY, ONERA, Université Paris Saclay / Jean-Michel Melkonian, DPHY, ONERA, Université Paris Saclay / Guillaume Aoust, mirSense / Myriam Raybaut, DPHY, ONERA, Université Paris Saclay / Antoine Godard, DPHY, ONERA, Université Paris Saclay

JM4F

Special Symposium - Symposium- Hot Topics in THz Photonics: Spintronics and Biophotonics II - Terahertz Biophotonics from Fundamental Science to Real Life Applications

Presider: M. Hassan Arbab , *Stony Brook University*

JM4F.1

Scanning Point Terahertz Source Microscopy on Unstained Human Breast Cancer Tissues

Invited

Presenter: Masayoshi Tonouchi , *Osaka University*

We have developed a Scanning Point-Terahertz-Source (SPoTS) microscope and applied it to visualize unstained paraffin-embedded human breast cancer images containing invasive ductal carcinoma (IDC) and ductal carcinoma in situ (DCIS).

Authors:Masayoshi Tonouchi, Osaka University

JM4F.2

(Withdrawn) Photoswitching of Long-Range Vibrational Modes in Orange Carotenoid Protein

Invited

Presenter: Jeffrey McKinney , *University at Buffalo*

To be provided

Authors:Jeffrey McKinney, University at Buffalo

JM4F.3

Acute Burn Assessment Using Terahertz Spectroscopic Feature Extraction and Support Vector Machines

Presenter: Mahmoud Khani , *Stony Brook University*

A hand-held THz-TDS scanner was employed for assessment of the burn injuries in a swine model. The accuracy of hyperspectral burn classification between superficial, partial-thickness, and full-thickness categories using THz spectroscopic features was determined to be 93 percent.

Authors:Mahmoud Khani, Stony Brook University / Omar Osman, Stony Brook University / Zachery Harris, Stony Brook University / Juin-wan Zhou, Stony Brook University / Andrew Chen, Stony Brook University / Adam Singer, Stony Brook University / M. Hassan Arbab, Stony Brook University

JM4F.4

Response of Human Induced Pluripotent Stem Cells to Terahertz Radiation

Presenter: Takehiro Tachizaki , *Tokai University*

Intense terahertz pulses were focused on cultured human induced pluripotent stem cells (hiPSCs). Gene analysis revealed that the genes that were affected by THz irradiation were regulated zinc finger proteins. We also found that the pluripotency were unaffected by intense THz pulses.

Authors:Takehiro Tachizaki, Tokai University / Reiko Sakaguchi, Kyoto University / Shiho Terada, Kyoto University / Ken-ichiro Kamei, Kyoto University / Hideki Hirori, Kyoto University

JM4F.5

Advances in THz in Vivo Imaging of Skin

Invited

Presenter: Emma Pickwell-MacPherson , *University of Warwick*

We have recently performed the first in vivo THz ellipsometry measurements of human skin. Here we will explain the key steps needed to ensure accurate results are obtained and give examples of potential applications.

Authors:Emma Pickwell-MacPherson, University of Warwick

JM4E

Special Symposium - Super Symposium on Advances in Quantum Technologies I

President: Nisan Ozana , *MGH. Harvard Medical School*

JM4E.1

Single-Photon Lidar Used in Extreme Imaging Scenarios

Invited

Presenter: Gerald Buller , *Heriot-Watt University*

The high detection sensitivity and timing resolution afforded by single-photon lidar has made this approach a candidate for a range of challenging applications such as imaging in turbid underwater scenarios and free-space imaging through obscurants.

Authors:Gerald Buller, Heriot-Watt University / Aongus McCarthy, Heriot-Watt University / Rachael Tobin, Heriot-Watt University / Aurora Maccarone, Heriot-Watt University / Ewan Wade, Heriot-Watt University / Ulrich Steinlehner, Heriot-Watt University / Abderrahim Halimi, Heriot-Watt University / Yoann Altmann, Heriot-Watt University

JM4E.2

Generating Large Cluster States of Light for Quantum Information Processing

Invited

Presenter: Ulrik Andersen , *Danmarks Tekniske Universitet*

We present our recent work on generating a two-dimensional continuous variable cluster state of more than 30.000 entangled modes, and on exploiting this state for realizing measurement-based single- and two-mode quantum gates.

Authors: Mikkel Larsen, Danmarks Tekniske Universitet / Jonas Neergaard-Nielsen, Danmarks Tekniske Universitet / Ulrik Andersen, Danmarks Tekniske Universitet

JM4E.3

Driving two-Photon Interference via Classical Control in Quantum Networks

Presenter: Syamsundar De , *Paderborn University*

We introduce a mean to tailor two-photon interference in a network, comprised of multiple time bins, via classical coherence control. Our approach relies on analyzing distinct features of time-bin local and network-wide global two-photon interferences.

Authors: Syamsundar De, Paderborn University / Thomas Nitsche, Paderborn University / Sonja Barkhofen, Paderborn University / Evan Meyer-Scott, Paderborn University / Johannes Tiedau, Paderborn University / Jan Sperling, Paderborn University / Aurél Gábris, Czech Technical University in Prague / Igor Jex, Czech Technical University in Prague / Christine Silberhorn, Paderborn University

JM4E.4

Resolving Partially Coherent Ultrafast Pulses at the Quantum Limit

Presenter: Syamsundar De , *Paderborn University*

We demonstrate the precise measurement of the temporal delay between two partially coherent pulses at the quantum limit by projecting onto appropriate temporal modes. Our results confirm that mode projections are optimal for any degree of coherence.

Authors: Syamsundar De, Paderborn University / Jano Gil-Lopez, Paderborn University / Benjamin Brecht, Paderborn University / Christine Silberhorn, Paderborn University / Luis Lorenzo Sanchez Soto, Universidad Complutense / Zdeněk Hradil, Palacký University / Jaroslav Reháček, Palacký University

JM4E.5

Polarization Sensitive Quantum Optical Coherence Tomography: Birefringence Imaging

Presenter: Vitaly Sukharenko , *The City College of the City University of New York*

Polarization sensitive quantum optical coherence tomography (QOCT) is used to characterize birefringence and path length differences in a flat transparent plastic sample.

Authors: Vitaly Sukharenko, The City College of the City University of New York / Simeon Bikorimana, The City College of the City University of New York / Roger Dorsinville, The City College of the City University of New York

JM4E.6

Multiple Pulse-Mode Bell States Heralded via Entanglement Swapping

Presenter: Sofiane Merkouche , *University of Oregon*

A novel scheme is presented for simultaneous heralding of multiple distinct pulse-mode entangled states via frequency-resolved Bell-state measurements. The heralded states are verified using spectral measurements and two-photon interference.

Authors: Sofiane Merkouche, University of Oregon / Valérian Thiel, University of Oregon / Alex Davis, UPMC-Sorbonne Universités / Brian Smith, University of Oregon

JM4D

Special Symposium - Super Symposium on Photonics Solutions for COVID-19 Challenge I

Presider: Utkarsh Sharma , *Catapult Sky*

JM4D.1

(Withdrawn) Title to be Provided

Invited

Presenter: Laura Lechuga , *Fund. Inst. Catala De Nanociencia i Nano*

To be provided

Authors: Laura Lechuga, Fund. Inst. Catala De Nanociencia i Nano

JM4D.2

Hyperchromatic Structural Color for Perceptually Enhanced Colorimetric Sensing by the Naked Eye

Presenter: Tahmid Hassan Talukdar , *Clemson University*

We report a novel colorimetric sensing paradigm using multi-chromatic light from an RGB laser combined with a structural color sensor for fast, ultra-sensitive, and spatio-temporally resolved detection of surface biomolecules by human eye or smartphone.

Authors: Tahmid Hassan Talukdar, Clemson University / Bria McCoy, Clemson University / Sarah Timmins, Clemson University / Taufiqar Khan, University of North Carolina Charlotte / Judson Ryckman, Clemson University

JM4D.3

Fully Integrated Electronic-Photonic Biosensor for Label-Free Molecular Sensing in Advanced Zero-Change CMOS-SOI Process

Presenter: Christos Adamopoulos, *UC Berkeley*

We demonstrate the world's first fully integrated electronic-photonic label-free molecular sensor in a CMOS 45RFSOI commercial process. Real-time kinetics with 100nm lipid nanoparticles, mimicking SARS-CoV-2 particles, are presented utilizing micro-ring resonators integrated with on-chip electronics.

Authors: Christos Adamopoulos, UC Berkeley / Sidney Buchbinder, UC Berkeley / Panagiotis Zarkos, UC Berkeley / Pavan Bhargava, UC Berkeley / Asmaysinh Gharia, UC Berkeley / Ali Niknejad, UC Berkeley / Vladimir Stojanovic, UC Berkeley

JM4D.4

Photonic Resonator Interferometric Scattering Microscope for Single Molecule Characterization

Presenter: Nantao Li, *UIUC*

We developed photonic resonator interferometric scattering microscopy for the label-free detection of nano-objects at low illumination density using a non-immersion objective. Photonic crystals are utilized as the imaging substrates to enhance the intrinsic scattering signal.

Authors: Nantao Li, UIUC / Taylor Canady, UIUC / Qinglan Huang, UIUC / Brian Cunningham, UIUC

JM4D.5

Versatile Manipulation of Viruses in All-Dielectric Optofluidic Nanocavity Arrays

Presenter: Yuzhi Shi, *Nanyang Technological University*

We develop a nano-optofluidic chip with an all-dielectric nanocavity array for versatile manipulation of single or massive adenoviruses. Viruses can be transported, sorted, and concentrated using the trapping mode where light is trapped inside nanoholes.

Authors: Yuzhi Shi, Nanyang Technological University / Zhenyu Li, Nanyang Technological University / Din Ping Tsai, The Hong Kong Polytechnic University / Yuri Kivshar, Australian National University / Ai Qun Liu, Nanyang Technological University

JM4D.6**An Optical Waveguide-Based Platform for Point-of-Care COVID-19 Testing**

Invited

Presenter: Christopher Myatt , *MBio Diagnostics, Inc.*

LightDeck has developed a platform for optical biosensing, based on planar waveguides. I will cover key features and characteristics for medical diagnostics. I will present data on our tests for COVID.

Authors: Christopher Myatt, MBio Diagnostics, Inc.

AM4G**A&TTR Super Topical Review on High Power Laser Technology III: Advanced Laser Metrology in the Context of High Power, High Energy Laser Facilities**

Presider: Ioan Dancus , *IFIN-HH/ELI-NP*

AM4G.1**Frequency Resolved Optical Switching**

Invited

Presenter: adrien leblanc , *IPP*

We report on a toolbox to generate and characterize the temporal profiles and the CEP of mid-infrared few-cycle laser pulses. Most of the talk will focus on the versatile pulse characterization technique : the FROSt (frequency resolved optical switching).

Authors: adrien leblanc, IPP

AM4G.2**Self-Referenced Spectral Interferometry With Extended Time Excursion**

Invited

Presenter: Thomas Oksenhendler , *iTEOX*

Single-shot high dynamic temporal contrast measurement is a key diagnostic for PW class laser. Self-referenced Spectral Interferometry experimentally demonstrates that it will be the solution, up to 100dB over 60ps, for the full pulse bandwidth.

Authors: Thomas Oksenhendler, iTEOX

AM4G.3

Complete Space-Time Metrology of Ultrashort Laser Pulses With INSIGHT

Invited

Presenter: François Sylla , *SourceLAB SAS*

Spatio Temporal Couplings (STC) are ubiquitous in ultrafast optics. Chirped-pulse amplification (CPA) systems rely massively on using well controlled STC. INSIGHT is a new technique commercially available that enables to measure accurately these couplings.

Authors: François Sylla, SourceLAB SAS / Fabien Quere, SourceLAB SAS

AM4G.4

Controls and Diagnostics for BELLA 1Hz Petawatt Laser

Invited

Presenter: Kei Nakamura , *Lawrence Berkeley National Laboratory*

The control and diagnostics for the BELLA 1 Hz – 1 PW laser will be presented, with emphases on “user aspect” and “diagnostics to provide inputs to simulations.

Authors: Kei Nakamura, Lawrence Berkeley National Laboratory

AM4G.5

At the Core of the Extreme Light Infrastructure: Laser Pulses Metrology

Invited

Presenter: Daniel Ursescu , *ELI-NP*

Extreme Light Infrastructure in Europe concentrates several unique-worldwide laser systems. Their outstanding parameters require creative solutions for laser metrology. In this context, solutions implemented at ELI-NP 10PW peak power laser systems will be presented.

Authors: Daniel Ursescu, ELI-NP

AM4G.6

In Situ Temporal Measurement of High-Intensity Ultrashort Laser Pulses

Invited

Presenter: Miguel Miranda , *Sphere Ultrafast Photonics SA*

We discuss issues that arise when measuring high power ultrashort pulses, compare single shot and scanning approaches, and finally present some recent results of fully on-target pulse characterization using the d-scan technique.

<!--[if !supportLineBreakNewLine]-->

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Authors: Miguel Miranda, Sphere Ultrafast Photonics SA

Tuesday, 11 May

3:00 - 7:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

SC270

Short Course - SC270: High Power Fiber Lasers and Amplifiers

SC455

Short Course - SC455: Integrated Photonics for Quantum Information Science and Technology

SC478

Short Course - SC478: Microresonator based Optical Frequency Comb Sources and Integrated Waveguide Based Supercontinuum Generation

4:00 - 5:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - Meet the OSA Journals Editors

The OSA Publishing journal Editors welcome your questions, ideas, and concerns. Join this online event to learn more about journal acceptance criteria, responding to review requests, addressing reviewer feedback, and other topics of interest. All are welcome!

Special Event - What's Next in Ultrafast Optical Phenomena - Hot Topics at CLEO 2021

Join the OSA Ultrafast Phenomena Technical Group for a panel discussion on Tuesday. Our featured presenters will give their perspectives on the exciting research that will be presented at CLEO 2021. These presentations will be followed by a moderated question and answer session, discussing the highlights in Ultrafast Phenomena at the Conference. This event is an excellent opportunity to hear from experts in the field on exciting new areas in Ultrafast Optical Phenomena. Panelists include Dr. Zsuzsanna Slattery-Major, GSI Helmholtzzentrum für Schwerionenfors, Prof. Julia Mikhailova, Princeton University, Dr. Alicia Palacios, Universidad Autónoma de Madrid, and Prof. Giuseppe Sansone, Albert-Ludwigs-Universität Freiburg.

5:00 - 6:30 (Pacific Time (US & Canada) DST, UTC - 07:00)

STu1J

High Speed Sources and Data Centre Applications

STu1J.1

Infrared Light Power Transmission Limitation of Optical Fibers

Presenter: Mario Ferraro , *University of Rome La Sapienza*

Luminescence from silica defects is associated with a multiphoton absorption mechanism, responsible for strong nonlinear losses in graded-index multimode optical fibers. Our experiments reveal the existence of a fundamental limitation to the power transmission capabilities of optical fibers.

Authors: Mario Ferraro, University of Rome La Sapienza / Fabio Mangini, University of Brescia / Mario Zitelli, University of Rome La Sapienza / Alioune Niang, University of Brescia / Alessandro Tonello, University of Limoges / Vincent Couderc, University of Limoges / Stefan Wabnitz, University of Rome La Sapienza

STu1J.2

Optics for the Cloud: Challenges and Opportunities

Invited

Presenter: Francesca Parmigiani , *Microsoft Research Ltd*

This talk discusses some of the key challenges of designing future disruptive optical technologies for the Cloud, primarily in compute. A glimpse into some opportunities we see in the photonic space will also be covered.

Authors: Francesca Parmigiani, Microsoft Research Ltd / Istvan Haller, Microsoft Research Ltd / Christos Gkantsidis, Microsoft Research Ltd / Hitesh Ballani, Microsoft Research Ltd / Antony Rowstron, Microsoft Research Ltd

STu1J.3

Electrically Controllable Microlaser Combs in Graphene-Fiber Microresonators

Presenter: Chenye Qin , *University of Electronic Science & Technology of China*

Electrically controllable laser frequency combs are achieved in a 10 GHz graphene heterogeneous fiber microcavity. It demonstrates tunable mode-locking states with half-an-octave span and phase noise down to -120 dBc/Hz at 10 kHz.

Authors: Chenye Qin, University of Electronic Science & Technology of China / Kunpeng Jia, Nanjing University / Teng Tan, University of Electronic Science & Technology of China / Yanhong Guo, University of Electronic Science & Technology of China / Hao Zhang, University of Electronic Science & Technology of China / Zhenda Xie, Nanjing University / Yunjiang Rao, University of Electronic Science & Technology of China / Shu-wei Huang, University of Colorado Boulder / Baicheng Yao, University of Electronic Science & Technology of China

STu1J.4

Comb-Locked Telecom-Grade Tunable Laser Using a low-Cost FPGA-Based Lockbox

Presenter: Zitong Feng , *university of southampton*

We frequency locked a commercial ITLA (integrable-tunable-laser-assembly) laser to an optical frequency comb with arbitrary carrier frequency within the telecom L band (1570-1625 nm). We achieved long-term (days) frequency stability below ± 1.5 Hz.

Authors: Zitong Feng, university of southampton / Alex Tourigny-Plante, Universite Laval / Josef Vojtěch, Praha 6 / Jérôme Genest, Universite Laval / David Richardson, university of southampton / Radan Slavik, university of southampton

STu1J.5

2.17 GHz Soliton-Like Harmonic Mode-Locking Generated From an Yb-Doped Fiber Laser With Anomalous Net Dispersion

Presenter: Lei Jin , *University of Tokyo*

We demonstrate a 2.17 GHz harmonically mode-locked Yb-doped fiber laser with low pump power, which has a fundamental frequency of 167 MHz. The RF signal-to-noise ratio was confirmed larger than 60 dB.

Authors: Zihao Zhao, University of Tokyo / Lei Jin, University of Tokyo / Sze Set, University of Tokyo / Shinji Yamashita, University of Tokyo

5:00 - 7:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FTu1N

Quantum Engineering Challenges

Presenter: Peter Mosley , *University of Bath*

FTu1N.1

Modal Crosstalk Suppression Using Digital Multi-Probe Time Reversal Through Free-Space Turbulence and Multimode Fiber

Presenter: Jiapeng Zhao , *Univerisity of Rochester*

We demonstrate that digital multi-probe time reversal can effectively suppress crosstalk for mode-division multiplexing. The performance of multi-probe time-reversal is experimentally characterized over a 340-m free-space link and a 1-km standard multimode fiber.

Authors:Yiyu Zhou, Univerisity of Rochester / Jiapeng Zhao, Univerisity of Rochester / Boris Braverman, University of Ottawa / Runzhou Zhang, University of Sourthern California / Kai Pang, University of Sourthern California / Alexander Fyffe, University of South Florida / Alan Eli Willner, University of Sourthern California / Zhimin Shi, University of South Florida / Robert Boyd, Univerisity of Rochester

FTu1N.2

Adaptive-Optics Enhanced Distribution of Entangled Photons Over Turbulent Free-Space Optical Channels

Presenter: Vijay Nafria , *University of Arizona*

We experimentally demonstrate using of adaptive optics to mitigate atmospheric turbulence effects on the distribution of entangled photons over free-space optical links and provide significantly improved photon-counting rates and biphoton correlations

Authors:Vijay Nafria, University of Arizona

FTu1N.3

Energy-Bandwidth Optimization of Quantum-Enabled Communication Channels

Presenter: Jabir M. V. , *National institute of Standard and Technology*

We introduce new modulation schemes and experimentally verify that they enhance the accuracy of practical quantum measurements and significantly optimize the combined use of energy and bandwidth for long communication alphabets

Authors:Jabir M. V., National institute of Standard and Technology / N. Fajar R. Annafianto, National institute of Standard and Technology / Ivan Burenkov, Joint Quantum Institute / Abdella Battou, National institute of Standard and Technology / Sergey Polyakov, National institute of Standard and Technology

FTu1N.4

On-Chip Optical Filters for Microwave-Optical Quantum Transduction in Thin-Film Lithium Niobate

Presenter: Hana Warner , *Harvard University*

We describe a low-loss on-chip optical filter network designed to separate pump and signal photons in a cavity electro-optic microwave-optical transducer for enhanced transduction performance.

Authors:Jeffrey Holzgrafe, Harvard University / Hana Warner, Harvard University / Di Zhu, Harvard University / Neil Sinclair, Harvard University / Marco Colangelo, Massachusetts Institute of Technology / Emma Batson, Massachusetts Institute of Technology / Amirhassan Shams-Ansari, Harvard University / Yaowen Hu, Harvard University / Karl Berggren, Massachusetts Institute of Technology / Marko Loncar, Harvard University

FTu1N.5

a Programmable Electro-Optic Bell-State Analyzer for Spectrally Distinguishable Photons

Presenter: Navin Lingaraju , *Purdue University*

We demonstrate a Bell-state analyzer that operates directly on frequency mismatch and unambiguously distinguishes two of four Bell states with accuracy exceeding 98%, opening a feasible path to wavelength-multiplexed quantum networks.

Authors:Navin Lingaraju, Purdue University / Hsuan-Hao Lu, Purdue University / Daniel Leaird, Purdue University / Steven Estrella, Freedom Photonics / Joseph Lukens, Oak Ridge National Laboratory / Andrew Weiner, Purdue University

FTu1N.6

Multimode Integrated SU(1,1) Interferometer

Presenter: Polina Sharapova , *University of Paderborn*

We present a frequency multimode integrated SU (1,1) interferometer with a polarization converter and strong signal-idler photon correlations. Phase sensitivity below the shot noise limit is demonstrated, various filtering and seeding strategies are discussed.

Authors:Alessandro Ferreri, University of Paderborn / Matteo Santandrea, University of Paderborn / Michael Stefszky, University of Paderborn / Kai-Hong Luo, University of Paderborn / Harald Herrmann, University of Paderborn / Christine Silberhorn, University of Paderborn / Polina Sharapova, University of Paderborn

FTu1N.7

Performance Analysis of Free-Space Quantum Key Distribution Using Multiple Spatial Modes

Presenter: wenhua he , *University of Arizona*

We present a flat-top focused-beam spatial multiplexing scheme for quantum key distribution. It captures a significant fraction of the multiplexing rate gain in vacuum transmission, and outperforms OAM-bearing modes in turbulence.

Authors:wenhua he, University of Arizona / Saikat Guha, University of Arizona / Jeffrey Shapiro, Massachusetts Institute of Technology / Boulat Bash, University of Arizona

FTu1N.8

Scaling the Discrete Fourier Transform Gate in the Quantum Frequency Processor

Presenter: Hsuan-Hao Lu , *Purdue University*

We show that the d -dimensional discrete Fourier transform can be implemented by adding RF harmonics to the applied modulation in a quantum frequency processor. Implementing the $d=3$ case experimentally, we quantify entanglement and perform full quantum state tomography.

Authors:Hsuan-Hao Lu, Purdue University / Navin Lingaraju, Purdue University / Daniel Leaird, Purdue University / Andrew Weiner, Purdue University / Joseph Lukens, Oak Ridge National Laboratory

FTu1O

Exciton Dynamics in Two-dimensional Semiconductors

Presenter: Kenneth Burch , *Boston College*

FTu10.1

Observation of Bound Excitons Stabilised by the Interaction With a Photonic Resonator

Presenter: Simone De Liberato , *University of Southampton*

We demonstrate that, in cavity-embedded doped quantum wells, strong light- matter interaction can create a bound excitonic state. Such a cavity-stabilised state is spectroscopically observed as a discrete resonance below the ionisation threshold.

Authors:Erika Cortese, University of Southampton / Ngoc Linh Tran, Université Paris-Saclay / Jean-Michel Manceau, Université Paris-Saclay / Adel Bousseksou, Université Paris-Saclay / Iacopo Carusotto, Università di Trento and INO-CNR BEC Center / Giorgio Biasiol, CNR-IOM / Raffaele Colombelli, Université Paris-Saclay / Simone De Liberato, University of Southampton

FTu10.2

Site-Controlled and Optically Accessible Single Spins in van der Waals Heterostructures

Presenter: ARUNABH MUKHERJEE , *University of Rochester*

Single spin arrays can serve as a scalable qubit platform. Here, we report the observation of arrays of single spins which are optically accessible through strain-induced localized positive trions residing in WSe_2/CrI_3 heterostructures.

Authors:ARUNABH MUKHERJEE, University of Rochester / Kamran Shayan, University of Rochester / Lizhong Li, Cornell University / Jie Shan, Cornell University / Kin Fai Mak, Cornell University / A. Vamivakas, University of Rochester

FTu10.3

Highly-Confined Exciton-Polaritons Supported by Monolayer Semiconductors

Presenter: Itai Epstein , *Tel Aviv University*

We predict the existence of a new type of highly-confined exciton-polariton supported by monolayer semiconductors in the visible spectrum, which exhibits two orders-of-magnitudes larger wavelength confinement in comparison to surface-plasmon-polaritons at the same spectral range.

Authors:Itai Epstein, Tel Aviv University / Frank Koppens, ICFO

FTu10.5

Transfer of Trionic Coherence Upon Femtosecond Hole Relaxation in a Single CdSe/ZnSe Quantum Dot

Presenter: Philipp Henzler , *University of Konstanz*

Persistent quantum beats between hot trion states are detected with femtosecond transmission microscopy and manipulated by pump-probe polarizations. Induced absorption into excited biexciton levels reveals transfer of coherence between excited states upon femtosecond hole relaxation.

Authors:Philipp Henzler, University of Konstanz / Matthias Holtkemper, University of Münster / Christian Traum, University of Konstanz / Marcel Erbe, University of Konstanz / Doris Reiter, University of Münster / Tilmann Kuhn, University of Münster / Denis Seletskiy, University of Konstanz / Alfred Leitenstorfer, University of Konstanz

FTu10.6

Time-Resolved ARPES of Excitons in a 2D Semiconductor

Presenter: Julien Madeo , *Okinawa Inst of Science & Technology*

We use a table-top time-resolved ARPES based on a MHz XUV source to directly observe direct and momentum-forbidden excitons in the full first Brillouin zone of WSe₂ monolayer and measure their ultrafast dynamics.

Authors:Julien Madeo, Okinawa Inst of Science & Technology / Michael Man, Okinawa Inst of Science & Technology / Chakradhar Sahoo, Okinawa Inst of Science & Technology / Marshall Campbell, University of Texas at Austin / Vivek Pareek, Okinawa Inst of Science & Technology / E Laine Wong, Okinawa Inst of Science & Technology / Abdullah Al-Mahboob, Okinawa Inst of Science & Technology / Bala Murali Krishna Mariserla, Indian Institute of Technology / Xiaoqin Li, University of Texas at Austin / Tony Heinz, Stanford University / Ting Cao, Stanford University / Keshav Dani, Okinawa Inst of Science & Technology

FTu10.7

Directly Visualization of Excitonic Wavefunction in 2D Semiconductors by Angle Resolved Photoemission Spectroscopy

Presenter: Michael Man , *Okinawa Inst. of Science and Technology*

Using time- and angle-resolved photoemission spectroscopy on a microscopic sample of a 2D semiconductor, we visualized directly the excitonic wavefunction in real- and momentum-space.

Authors:Michael Man, Okinawa Inst. of Science and Technology / Julien Madeo, Okinawa Inst. of Science and Technology / Chakradhar Sahoo, Okinawa Inst. of Science and Technology / Kaichen Xie, University of Washington / Marshall Campbell, The University of Texas at Austin / Vivek Pareek, Okinawa Inst. of Science and Technology / Arka Karmakar, Okinawa Inst. of Science and Technology / E Laine Wong, Okinawa Inst. of Science and Technology / Abdullah Al-Mahboob, Okinawa Inst. of Science and Technology / Nicholas Chan, Okinawa Inst. of Science and Technology / David Bacon, Okinawa Inst. of Science and Technology / Xing Zhu, Okinawa Inst. of Science and Technology / Mohamed Abdelrasoul, Okinawa Inst. of Science and Technology / Xiaoqin Li, The University of Texas at Austin / Tony Heinz, Stanford University / Felipe Jornada, Stanford University / Ting Cao, University of Washington / Keshav Dani, Okinawa Inst. of Science and Technology

FTu10.4

Optical Spectroscopy of Excitonic States in two-Dimensional Semiconductors and Heterostructures

Invited

Presenter: Joshua Lui , *University of California Riverside*

We applied optical spectroscopy to study the excitonic states in two-dimensional transition-metal-dichalcogenide gating devices encapsulated by hexagonal boron nitride. Our research reveals intriguing gate-tunable excitonic behavior in the two-dimensional platforms.

Authors:Joshua Lui, University of California Riverside

FTu1L

High- and Low-Harmonic Generation

Presenter: Alexander Szameit , *Universität Rostock*

FTu1L.1

High Harmonic Generation in Topological Chiral Crystals

Presenter: Prashant Padmanabhan , *Los Alamos National Laboratory*

We demonstrate perturbative optical harmonic generation up to fifth order in the topological chiral crystal RhSi under femtosecond mid-infrared excitation, with particularly strong third harmonic responses that may be linked to Berry curvature contributions.

Authors: Prashant Padmanabhan, Los Alamos National Laboratory / Tyler Cochran, Princeton University / Nicholas Sirica, Los Alamos National Laboratory / Tiema Qian, University of California, Los Angeles / Ni Ni, University of California, Los Angeles / Dmitry Yarotski, Los Alamos National Laboratory / Jian-Xin Zhu, Los Alamos National Laboratory / M. Hasan, Princeton University / Rohit Prasankumar, Los Alamos National Laboratory

FTu1L.2

Chiral Solid-State High-Harmonic Generation and Spectroscopy With Polarization-Tailored Strong Fields

Presenter: Tobias Heinrich , *University of Göttingen*

We generate circularly polarized high harmonics from solids by matching the laser's three-fold symmetries with those of the crystal. The chiral harmonic radiation probes the ferromagnetic surface states formed in magnesium oxide by spontaneous chiral-symmetry-breaking.

Authors: Tobias Heinrich, University of Göttingen / Marco Taucer, National Research Council of Canada and University of Ottawa / Ofer Kfir, University of Göttingen / Paul Corkum, National Research Council of Canada and University of Ottawa / André Staudte, National Research Council of Canada and University of Ottawa / Claus Ropers, University of Göttingen / Murat Sivis, University of Göttingen

FTu1L.3

Ellipticity Controlled High-Order Harmonic Generation in 2D Materials

Presenter: Richard Hollinger , *Friedrich Schiller University Jena*

High harmonic generation (HHG) in a single-atomic-layer non-centrosymmetric semiconductor is investigated experimentally for different driving laser field polarizations. The ellipticity enhanced even-order HHG for certain crystal orientations reveals linked laser and valley polarizations.

Authors: Richard Hollinger, Friedrich Schiller University Jena / Harshitha N.G., Friedrich Schiller University Jena / Viacheslav Korolev, Friedrich Schiller University Jena / Ziyang Gan, Friedrich Schiller University Jena / Antony George, Friedrich Schiller University Jena / Valentina Shumakova, Technical University Vienna / Michael Zuerch, University of California Berkeley / Tobias Vogl, Friedrich Schiller University Jena / Audrius Pugzlys, Technical University Vienna / Andrius Baltuska, Technical University Vienna / Falk Eilenberger, Friedrich Schiller University Jena / Christian Spielmann, Friedrich Schiller University Jena / Andrey Turchanin, Friedrich Schiller University Jena / Daniil Kartashov, Friedrich Schiller University Jena

FTu1L.4

High-Harmonic Generation in Metallic Titanium Nitride

Presenter: Aleksey Korobenko, *University of Ottawa*

We demonstrate that high-harmonics generation (HHG) in metallic titanium nitride outperforms HHG in conventional metals limited by the damage threshold. Metal harmonics can link solid and plasma HHG together, and pave way for XUV generating plasmonics.

Authors: Aleksey Korobenko, University of Ottawa / Soham Saha, Purdue University / Alan Godfrey, University of Ottawa / Marina Gertsvolf, National Research Council / Andrei Naumov, National Research Council / David Villeneuve, National Research Council / Alexandra Boltasseva, Purdue University / Vladimir Shalaev, Purdue University / Paul Corkum, University of Ottawa

FTu1L.5

Generation of Tunable Ultrashort X-ray Pulses and Delta-Pulse Trains in van der Waals Materials

Presenter: Amnon Balanov, *Technion*

<div style="direction: ltr;">We find an X-ray generation mechanism based on van der Waals materials, which promises generation of ultrashort pulses, delta-pulse trains, and monochromatic X-ray radiation, with controllable intensity, directionality, and polarization.</div>

Authors: Amnon Balanov, Technion / Alexey Gorlach, Technion / Ido Kaminer, Technion

FTu1L.6

Enhanced Second-Harmonic Generation in Mie-Resonant MoS₂ Nanodisks

Presenter: Anna Popkova, *Lomonosov Moscow State University*

Enhanced second-harmonic generation in a single MoS₂ nanodisk due to the overlap of Mie resonances at the fundamental wavelength with the C-exciton resonance at the second-harmonic wavelength is observed.

Authors: Anna Popkova, Lomonosov Moscow State University / Ilya Antropov, Lomonosov Moscow State University / Gleb Tselikov, Moscow Institute of Physics and Technology / F. Bedu, Aix Marseille Université / I. Ozerov, Aix Marseille Université / A. Arsenin, Moscow Institute of Physics and Technology / V. Volkov, Moscow Institute of Physics and Technology / V. Bessonov, Lomonosov Moscow State University / A. Fedyanin, Lomonosov Moscow State University

FTu1L.7

Broadband-Tunable Third Harmonic Generation Using Phase-Change Chalcogenides

Presenter: Muliang Zhu , *Georgia Institute of Technology*

We demonstrate a Ge₂Sb₂Te₅ (GST)-based asymmetric Fabry-Perot cavity facilitating broadband continuous tuning of third-harmonic generation (THG) due to the nonvolatile high refractive-index contrast amorphous, semi-crystalline, and crystalline GST phases.

Authors: Muliang Zhu, Georgia Institute of Technology / Sajjad Abdollahramezani, Georgia Institute of Technology / Chentao Li, Emory University / Tianren Fan, Georgia Institute of Technology / Hayk Harutyunyan, Emory University / Ali Adibi, Georgia Institute of Technology

FTu1L.8

Third-Harmonic Generation Enhanced by Topological Corner States in Valley-Hall Dielectric Metasurfaces

Presenter: Sergey Kruk , *Australian National University*

We design numerically, then fabricate and study experimentally optical valley-Hall resonant dielectric metasurfaces placed on a mirror for topology-empowered third-harmonic generation from subwavelength topological edge and corner states.

Authors: Sergey Kruk, Australian National University / Wenlong Gao, Paderborn University / Duk-Yong Choi, Australian National University / Thomas Zentgraf, Paderborn University / Shuang Zhang, University of Birmingham / Yuri Kivshar, Australian National University

FTu1K

Plasma Optics

President: John Nees , *University of Michigan*

FTu1K.1

Sub-Cycle Control of Relativistic Plasma Mirror Dynamics

Presenter: Marie Ouillé , *Laboratoire d'Optique Appliquée*

We report on carrier-envelope phase (CEP) effects on the emission of high-order harmonics and electron beams from plasma mirrors driven by relativistic-intensity near-single-cycle laser pulses at 1 kHz repetition rate.

Authors: Marie Ouillé, Laboratoire d'Optique Appliquée / Jaismeen Kaur, Laboratoire d'Optique Appliquée / Stefan Haessler, Laboratoire d'Optique Appliquée / Zhao Cheng, Laboratoire d'Optique Appliquée / Aline Vernier, Laboratoire d'Optique Appliquée / Jérôme Faure, Laboratoire d'Optique Appliquée / Rodrigo Lopez-Martens, Laboratoire d'Optique Appliquée

FTu1K.2

Simultaneous Measurements of High-Order Harmonics, Accelerated Electrons and Protons Emitted From Relativistic Plasma Mirrors

Presenter: Jaismeen Kaur , *Laboratoire d'Optique Appliquée (LOA), CNRS, Ecole Polytechnique, ENSTA Paris, Institut Polytechnique de Paris, 91120 Palaiseau, France*

We report the first simultaneous measurements of high-harmonic generation, accelerated electron and proton beams generated on relativistic plasma mirrors with controlled scale length using laser pulses with duration tunable from 27 fs to sub-4 fs.

Authors: Jaismeen Kaur, Laboratoire d'Optique Appliquée (LOA), CNRS, Ecole Polytechnique, ENSTA Paris, Institut Polytechnique de Paris, 91120 Palaiseau, France / Dan Levy, Weizmann Institute of Science, Rehovot 76100, Israel / Marie Ouillé, Laboratoire d'Optique Appliquée (LOA), CNRS, Ecole Polytechnique, ENSTA Paris, Institut Polytechnique de Paris, 91120 Palaiseau, France / Igor Andriyash, Laboratoire d'Optique Appliquée (LOA), CNRS, Ecole Polytechnique, ENSTA Paris, Institut Polytechnique de Paris, 91120 Palaiseau, France / Eyal Kroupp, Weizmann Institute of Science, Rehovot 76100, Israel / Victor Malka, Weizmann Institute of Science, Rehovot 76100, Israel / Jérôme Faure, Laboratoire d'Optique Appliquée (LOA), CNRS, Ecole Polytechnique, ENSTA Paris, Institut Polytechnique de Paris, 91120 Palaiseau, France / Stefan Haessler, Laboratoire d'Optique Appliquée (LOA), CNRS, Ecole Polytechnique, ENSTA Paris, Institut Polytechnique de Paris, 91120 Palaiseau, France / Rodrigo Lopez-Martens, Laboratoire d'Optique Appliquée (LOA), CNRS, Ecole Polytechnique, ENSTA Paris, Institut Polytechnique de Paris, 91120 Palaiseau, France

FTu1K.3

(Withdrawn) MeV Proton Acceleration From Ultrathin Targets With 11 fs, 3TW Laser Pulses at Oblique Incidence

Presenter: Karoly Osvay , *University of Szeged*

Protons are accelerated from various target materials having a thickness between 5nm and 9000nm with few cycle, high contrast laser pulses. The cut-off energy is around 1 MeV, independent of the target thickness and material.

Authors:Sargis Ter-Avetisyan, University of Szeged / Parvin Varmazyar, University of Szeged / Joon-Gon Son, University of Szeged / Kwinten Nelissen, ELI-ALPS / Sudipta Mondal, ELI-ALPS / Kahaly Subhendu, ELI-ALPS / Adam Borzsonyi, ELI-ALPS / Janos Csontos, ELI-ALPS / Zsolt Lecz, ELI-ALPS / Arpad Mohacsi, University of Szeged / Tamas Somoskoi, ELI-ALPS / Szabolcs Toth, ELI-ALPS / Laszlo Toth, ELI-ALPS / Martin Matys, Institute of Physics ASCR / Petr Valenta, Institute of Physics ASCR / Sergei Bulanov, Institute of Physics ASCR / Georg Korn, Institute of Physics ASCR / Ales Necas, TAE Technologies / Toshiki Tajima, TAE Technologies / Gerard Mourou, Ecole Polytechnique / Gabor Szabo, ELI-ALPS / Karoly Osvay, University of Szeged

FTu1K.4

High-Power Ultraviolet Vortex Beams Generated From a Relativistic Laser Interacting With an Ultrathin Foil

Presenter: Nicholas Fasano , *Princeton University*

Ultrathin foils irradiated by relativistic circularly polarized lasers emit harmonics in both the transmitted and reflected directions that contain orbital angular momentum. We demonstrate this scheme using ab-initio three-dimensional particle-in-cell simulations.

Authors:Nicholas Fasano, Princeton University / Julia Mikhailova, Princeton University

FTu1K.5

Application of Plasma Optics to Precision Control of Laser Energy Deposition in Laser-Fusion Experiments

Presenter: Pierre Michel , *Lawrence Livermore National Laboratory*

Self-induced plasma gratings are now routinely used in inertial confinement fusion experiments at the National Ignition Facility (NIF) to achieve precise spatio-temporal control of the laser energy deposition directly inside the fusion targets.

Authors:Pierre Michel, Lawrence Livermore National Laboratory / Richard Berger, Lawrence Livermore National Laboratory / Debbie Callahan, Lawrence Livermore National Laboratory / Tom Chapman, Lawrence Livermore National Laboratory / Jean-Michel Di Nicola, Lawrence Livermore National Laboratory / Laurent Divol, Lawrence Livermore National Laboratory / Michael Edwards, Lawrence Livermore National Laboratory / John Heebner, Lawrence Livermore National Laboratory / Otto Landen, Lawrence Livermore National Laboratory / Nuno Lemos, Lawrence Livermore National Laboratory / Brian MacGowan, Lawrence Livermore National Laboratory / Nathan Meezan, Lawrence Livermore National Laboratory / John Moody, Lawrence Livermore National Laboratory / Joe Ralph, Lawrence Livermore National Laboratory / David Strozzi, Lawrence Livermore National Laboratory / Larry Suter, Lawrence Livermore National Laboratory / Richard Town, Lawrence Livermore National Laboratory

FTu1K.7

Measuring the Optical Properties of Ionization Gratings in Air for Control of Femtosecond Lasers

Presenter: Matthew Edwards , *Lawrence Livermore National Laboratory*

Interference between crossed femtosecond lasers can drive spatially varying ionization, producing a high-flux plasma optic. We measure the plasma and optical properties of an ionization grating in air as it redirects a millijoule-scale probe beam.

Authors:Matthew Edwards, Lawrence Livermore National Laboratory / Nicholas Fasano, Princeton University / Nuno Lemos, Lawrence Livermore National Laboratory / Ashwin Singh, University of California Berkeley / Vadim Munirov, University of California Berkeley / Eugene Kur, Lawrence Livermore National Laboratory / Jonathan Wurtele, University of California Berkeley / Julia Mikhailova, Princeton University / Pierre Michel, Lawrence Livermore National Laboratory

FTu1K.8

Slow and Fast Light in Plasma

Presenter: Clément Goyon , *LLNL*

Slow and fast light require precise tailoring of the refractive index of a medium. We present the first experimental demonstration of such control inside plasma, reporting group velocity of light between $0.12c$ and $-0.34c$.

Authors:Clément Goyon, LLNL / Matthew Edwards, LLNL / Tom Chapman, LLNL / Laurent Divol, LLNL / Nuno Lemos, LLNL / G. Williams, LLNL / Derek Mariscal, LLNL / D. Turnbull, LLE / A. Hansen, LLE / Pierre Michel, LLNL

FTu1K.6

Hard X-ray-Optical Transient Grating

Presenter: Pamela Bowlan , *Los Alamos National Lab*

We present hard x-ray-pump, optical-probe transient grating measurements. A split-and-delay line generates an interference pattern; subsequently an optical probe diffracts from the excited sample. Both the x-ray-x-ray delay and the x-ray-optical delay were varied.

Authors:William Peters, Los Alamos National Lab / Travis Jones, Los Alamos National Lab / Sanghoon Song, Linac Coherent Light Source / Matthieu Chollet, Linac Coherent Light Source / Joseph Robinson, Linac Coherent Light Source / Laura Foglia, Elettra-Sincrotrone / Filippo Bencivenga, Elettra-Sincrotrone / Ryan Coffee, Linac Coherent Light Source / Pamela Bowlan, Los Alamos National Lab

FTu1M

Topological Photonics I

FTu1M.1

Topological Plasmonics: Ultrafast Vector Movies of Plasmonic Skyrmions on the Nanoscale

Presenter: Harald Giessen , *Universität Stuttgart*

We introduce a new technique, time-resolved *vector* microscopy, that enables us to compose entire movies on a sub-femtosecond time scale and a 10 nm scale of the electric field vectors of surface plasmon skyrmions.

Authors:Harald Giessen, Universität Stuttgart

FTu1M.2

Non-Reciprocal Thouless Pumping in Nonparaxial Topological Photonics

Presenter: Qing Cheng , *University of Shanghai for Science and Technology*

We firstly report a non-reciprocal photonic topological Thouless pumping, guided by the nonparaxial field evolution of our well-designed waveguide-array simulator. This non-reciprocal pumping would point us a promising direction such as nonparaxial topological photonics.

Authors:Qing Cheng, University of Shanghai for Science and Technology / Huaiqiang Wang, Nanjing University / Yongguan Ke, Sun Yat-Sen University / Yiming Pan, Technion

FTu1M.3

Observation of Coupling Between Topological and Topology-Entailed States

Presenter: Francesco Piccioli , *National Institute of Optics (CNR- INO)*

We construct Topology-Entailed Trivial (TET) states from superpositions of counter-propagating topological interface states. The topological origin of these novel entities and their potential as gateway for the interaction with topologically-protected edge states are illustrated.

Authors:Francesco Piccioli, National Institute of Optics (CNR- INO) / Mark Kremer, Universität Rostock / Lukas Maczewsky, Universität Rostock / Matthias Heinrich, Universität Rostock / Iacopo Carusotto, National Institute of Optics (CNR- INO) / Alexander Szameit, Universität Rostock

FTu1M.4

Direct Quantification of Topological Protection in Symmetry-Protected Photonic Edge States at Telecom Wavelengths

Presenter: Sonakshi Arora , *Delft University of Technology*

Experimental characterization of the electromagnetic vector field in topological photonic crystals featuring the photonic quantum valley Hall effect, using phase-resolving near-field optical microscopy, reveals two orders of magnitude higher robustness compared to a conventional waveguide.

Authors: Sonakshi Arora, Delft University of Technology / Thomas Bauer, Delft University of Technology / René Barczyk, AMOLF / Ewold Verhagen, AMOLF / Laurens Kuipers, Delft University of Technology

FTu1M.5

Higher-Order Topological States in the Extended Two-Dimensional SSH Model and Their Electric Circuit Implementation

Presenter: Nikita Olekhno, *ITMO University*

We demonstrate that couplings between diagonal next-nearest neighbor sites give rise to higher-order topological corner states observed recently in the microwave experiments with coupled resonator arrays realizing two-dimensional Su-Schrieffer-Heeger model.

Authors: Nikita Olekhno, ITMO University / Alina Rozenblit, ITMO University / Valerii Kachin, ITMO University / Oleg Burmistrov, ITMO University / Alexey Dmitriev, ITMO University / Pavel Seregin, ITMO University / Dmitry Zhirihin, ITMO University / Maxim Gorlach, ITMO University

FTu1M.6

Spinful Photonic Higher-Order Topological Insulators in the Presence of Spin-Orbit Coupling

Presenter: Ran Gladstein Gladstone, *Cornell University*

Four spinful photonic C_6 photonic higher-order topological insulators are investigated. We show that two are robust to spin-orbit coupling while two are not. We derive a new invariant to predict this effect on corner states.

Authors: Ran Gladstein Gladstone, Cornell University / Minwoo Jung, Cornell University / Gennady Shvets, Cornell University

FTu1M.7

Multimode Floquet Photonic Topological Insulators

Presenter: Shruti Saiji, *University of Central Florida, CREOL*

We show that it is possible to have a multimode Floquet photonic topological insulator. We show that the use of high order modes introduces new degrees of freedom that can help to realize novel topological phenomena.

Authors: Shruti Saiji, University of Central Florida, CREOL / Miguel Bandres, University of Central Florida, CREOL

FTu1M.8

Observation of Splitting of Charge-2 Weyl Points in 3D Micro-Printed Photonic Crystals

Presenter: Christina Jörg , *The Pennsylvania State University*

We experimentally demonstrate splitting of a charge-2 Weyl point into two charge-1 Weyl points in a 3D micro-printed photonic crystal. We measure its angle-resolved spectrum in the near-infrared via Fourier-transform infrared spectroscopy.

Authors: Christina Jörg, The Pennsylvania State University / Sachin Vaidya, The Pennsylvania State University / Jiho Noh, The Pennsylvania State University / Alexander Cerjan, The Pennsylvania State University / Shyam Augustine, TU Kaiserslautern / Georg von Freymann, TU Kaiserslautern / Mikael Rechtsman, The Pennsylvania State University

ATu1T

QCL

Presenter: Grigorii Sokolovskii , *Ioffe Institute*

ATu1T.1

Turn-on Delay in the mid-Infrared Quantum-Cascade Lasers: Experiment and Numerical Simulations

Presenter: Evgenia Cherotchenko , *Ioffe Institute*

Turn-on delay is measured to be much longer and its pump-current dependence different from theoretical predictions for mid-infrared InP- and InAs-based quantum-cascade lasers. Experiment qualitatively agrees with numerical simulations of rate-equations under non-zero rise-time pumping.

Authors: Evgenia Cherotchenko, Ioffe Institute / Vladislav Dudelev, Ioffe Institute / Dmitry Mikhailov, Ioffe Institute / Sergey Losev, Ioffe Institute / Andrey Babichev, ITMO University / Andrey Gladyshev, ITMO University / Innokenty Novikov, Ioffe Institute / Andrey Lutetskiy, Ioffe Institute / Dmitry Veselov, Ioffe Institute / Sergey Slipchenko, Ioffe Institute / Nikita Pikhtin, Ioffe Institute / Leonid Karachinsky, Ioffe Institute / Dmitry Denisov, ITMO University / Vladimir Kuchinskii, Ioffe Institute / Elena Kognovitskaya, Ioffe Institute / Anton Egorov, ITMO University / Roland Teissier, University of Montpellier / Alexei Baranov, University of Montpellier / Grigorii Sokolovskii, Ioffe Institute

ATu1T.2

(Withdrawn) InAs-Based Quantum Cascade Lasers Grown on Foreign Substrates

Invited

Presenter: Alexei Baranov , *University of Montpellier-CNRS*

To be provided

Authors:Alexei Baranov, University of Montpellier-CNRS

ATu1T.3

Ultra-Fast Tunable ECDL Design for the MIR Region

Presenter: Morten Hoppe , *Sacher Lasertechnik GmbH*

An ultrafast ECDL design based on a MEMS device with optimized curved gain chip at 2020 nm is presented. Results of the characterization and its use for the detection of trace gases are shown.

Authors:Morten Hoppe, Sacher Lasertechnik GmbH / Sebastian Schmidtmann, Sensor Photonics GmbH / Martin Honsberg, Sensor Photonics GmbH / Herve Tatentugem, Sensor Photonics GmbH / Tobias Milde, Sacher Lasertechnik GmbH / Joachim Sacher, Sacher Lasertechnik GmbH / Shanshan Gu-Stoppel, Fraunhofer-Institut für Siliziumtechnologie / Frank Senger, Fraunhofer-Institut für Siliziumtechnologie

ATu1T.4

GeSn Membrane mid-Infrared Photodetectors

Presenter: Mahmoud Atalla , *Polytechnique Montreal*

Fully released $\text{Ge}_{0.83}\text{Sn}_{0.17}$ membranes are utilized in broadband photodetectors with a record wavelength cutoff of 4.6 μm and two orders of magnitude reduction in dark current as compared to as-grown strained epitaxial layers.

Authors:Mahmoud Atalla, Polytechnique Montreal / Simone Assali, Polytechnique Montreal / Anis Attiaoui, Polytechnique Montreal / Cédric Lemieux-Leduc, Polytechnique Montreal / aashish kumar, Polytechnique Montreal / salim abdi, Polytechnique Montreal / Oussama Moutanabbir, Polytechnique Montreal

ATu1T.5

Plasmonic GeSn Photodetectors for Enhanced Photo Detection at 2 μm

Presenter: Hao Zhou , *Nanyang Technological University*

Gold hole-array nanostructure was incorporated into GeSn photodetectors to enhance the optical absorption at 2 μm . The surface plasmon resonance near Au/GeSn interface benefits a two times higher responsivity at 2 μm .

Authors:Hao Zhou, Nanyang Technological University / Lin Zhang, Nanyang Technological University / Shaoteng Wu, Nanyang Technological University / Qimiao Chen, Nanyang Technological University / Bongkwon Son, Nanyang Technological University / Chuan Seng Tan, Nanyang Technological University

ATu1T.6

GaSb-Based Photonic Crystal Surface Emitting Lasers

Invited

Presenter: Leon Shterengas , *Stony Brook University*

Epitaxial regrowth of nano-patterned GaSb-based laser heterostructures was utilized for development of photonic crystal surface emitting lasers (PCSEL) operating in spectral range above 2 μm . The PCSELS generated narrow spectrum output in low divergence beams.

Authors: Leon Shterengas, Stony Brook University / Ruiyan Liu, Stony Brook University / Wonjae Lee, Stony Brook University / Aaron Stein, Brookhaven National Laboratory / Gela Kipshidze, Stony Brook University / Gregory Belenky, Stony Brook University

ATu1S

Quantum Communication

Presider: Jonathan Matthews , *University of Bristol*

ATu1S.1

Entanglement-Based Quantum Communications From CubeSats

Invited

Presenter: Robert Bedington , *SpeQtral*

SpeQtral is commercialising miniaturised entangled photon sources with heritage from the National University of Singapore. First launched into ISS orbit on the 3U CubeSat SpooQy-1, subsequent versions are being developed for full satellite-to-ground QKD missions.

Authors: Robert Bedington, SpeQtral / Alexander Lohrmann, SpeQtral / Chithrabhanu Perumangatt, National University of Singapore / Aitor Villar, SpeQtral / Alexander Ling, National University of Singapore

ATu1S.2

Drone-Based Quantum Key Distribution

Presenter: Samantha Isaac , *University of Illinois*

Current quantum cryptography implementations focus on fiber-based or fixed free-space point-to-point channels. We seek to expand this to quantum communication from mobile platforms. Here, we report progress towards tracking system stabilization and air-to-air signal coupling.

Authors:Samantha Isaac, University of Illinois / Andrew Conrad, University of Illinois / Tahereh Rezaei, Florida Atlantic University / Daniel Sanchez-Rosales, The Ohio State University / Roderick Cochran, The Ohio State University / Akash Gutha, The Ohio State University / Daniel Gauthier, The Ohio State University / Paul Kwiat, University of Illinois

ATu1S.3

Synchronization of Quantum Communication Systems Based on Correlated Photons

Presenter: Christopher Spiess , *Fraunhofer IOF*

High-throughput quantum communication requires precise time tagging of photon detection events. Here we show how residual synchronization jitter as low as <1ps can be accomplished by autonomous correlation tracking of photon pairs, and discuss experimental results in a free-space link.

Authors:Christopher Spiess, Fraunhofer IOF / Sebastian Töpfer, Fraunhofer IOF / Sakshi Sharma, Fraunhofer IOF / Andrej Krzic, Fraunhofer IOF / Gregor Sauer, Fraunhofer IOF / Daniel Rieländer, Fraunhofer IOF / Fabian Steinlechner, Fraunhofer IOF

ATu1S.4

Complete System Integration of Chip-Based Quantum Key Distribution Devices

Highlighted Talk

Presenter: Taofiq Paraiso , *Toshiba Europe Ltd*

We establish the viability of integrated quantum photonics for the wide-scale deployment of quantum key distribution in a complete, standalone chip-based system. The system operates at high-clock rate and distributes quantum secure encryption keys in real-time with high stability over several days.

Authors:Taofiq Paraiso, Toshiba Europe Ltd / Thomas Roger, Toshiba Europe Ltd / Davide Marangon, Toshiba Europe Ltd / Innocenzo de Marco, Toshiba Europe Ltd / Mirko Sanzaro, Toshiba Europe Ltd / Robert Woodward, Toshiba Europe Ltd / James Dynes, Toshiba Europe Ltd / Zhiliang Yuan, Toshiba Europe Ltd / Andrew Shields, Toshiba Europe Ltd

ATu1S.5

Multiplexed Entanglement-Based Quantum Cryptography: Concept and Implementations

Presenter: Martin Bohmann , *IQOQI Vienna*

We introduce a general scheme for increasing secure key rates in entanglement-based cryptography exploiting multiple degrees of freedom. We experimentally exemplify this scheme through spatial and wavelength multiplexing. Scalability of our approach is demonstrated.

Authors: Martin Bohmann, IQOQI Vienna / Evelyn Ortega, IQOQI Vienna / Johannes Pseiner, IQOQI Vienna / Lukas Achatz, IQOQI Vienna / Lukas Bulla, IQOQI Vienna / Krishna Dovzhik, IQOQI Vienna / Rodrigo Shiozaki, IQOQI Vienna / Rupert Ursin, IQOQI Vienna

ATu1S.6

Proof-of-Principle Frequency-Bin Quantum Key Distribution With Biphoton Frequency Combs

Presenter: Murat Sarihan , *University of California, Los Angeles*

We offer a proof-of-principle photon-efficient QKD protocol based on energy-time entangled biphoton frequency combs using entangled frequency-bin pairs as qudits.

Authors: Murat Sarihan, University of California, Los Angeles / KAI-CHI CHANG, University of California, Los Angeles / Xiang Cheng, University of California, Los Angeles / Hiroyuki Tsuda, Keio University / Chee Wei Wong, University of California, Los Angeles

STu1B

Laser Based Emerging Technologies

President: Takashige Omatsu , *Chiba University*

STu1B.1

Unlocking Coherent Control of the Extreme Ultrafast Plasmonic Excitation

Presenter: eyal bahar , *Tel Aviv University*

We experimentally coherent control the extreme ultrafast excitation in plasmonic nanostructures within their coherence lifetime. We predict and demonstrate a significant enhancement of the nonlinearity greater than the nonlinearity induced by a maximally compressed pulse.

Authors: eyal bahar, Tel Aviv University / Uri Arieli, Tel Aviv University / Maayan Vizner Stern, Tel Aviv University / Haim Suchowski, Tel Aviv University

STu1B.2

Monolayer Photonic Micro-Ring of Polystyrene Nanoparticles Fabricated by Optical Vortex Laser Induced Forward Transfer

Presenter: Kei Umesato , *Chiba University*

We demonstrate, for the first time, the fabrication of a monolayer photonic micro-ring formed of polydopamine coated monodisperse polystyrene particles by employing optical vortex induced forward mass transfer technique.

Authors: Kei Umesato, Chiba University / Haruki Kawaguchi, Chiba University / Kanta Takahashi, Chiba University / Katsuhiko Miyamoto, Chiba University / Michinari Kohri, Chiba University / Takashige Omatsu, Chiba University

STu1B.4

(Withdrawn) Biological Chiral Microlaser Driven by Intracavity Chiral Light-Matter Interactions

Presenter: Zhiy Yuan , *Nanyang Technological University EEE*

The first demonstration and theory of biological chiral light-matter interactions enhancement in the stimulated emission was revealed, paving a new road for fundamental research in biophysics and chiral light-matter interactions.

Authors: Zhiy Yuan, Nanyang Technological University EEE / Yunke Zhou, Tsinghua University / Xin Cheng, Nanyang Technological University EEE / YU-CHENG CHEN, Nanyang Technological University EEE

STu1B.5

(Withdrawn) Laser Based Cleaning and in-Situ Verification of bio-Loading for Planetary Protection

Invited

Presenter: Henry Helvajian , *The Aerospace Corporation*

NASA requires that satellites destined for other planets/moons are free of biological matter. We use very low power, high repetition rate UV lasers to destroy biological surface matter and confirm eradication via a spectroscopic signature.

Authors: Andrew Robbins, The Aerospace Corporation / Sean Jergensen, UCLA / Margaret Abraham, The Aerospace Corporation / Henry Helvajian, The Aerospace Corporation

STu1B.6

(Withdrawn) Dipolar Exciton Polaritons in Optical Waveguides

Presenter: Dror Liran , *HUJI*

We measure dipolar interactions in Exciton-Polaritons, realized in waveguides, carried to a near mm distance.

The combination of long-range interactions with fast propagation is unique and offers a promising platform for realizing on-chip *Interacting Photons*.

Authors: Dror Liran, HUJI / Itamar Rosenberg, HUJI / Ronen Rapaport, HUJI / Loren Pfeiffer, Princeton / Kenneth West, Princeton

STu1B.3

(Withdrawn) Combination of Femtosecond Filaments and Plasma Spectroscopy for Remote Isotope Sensing in Solids

Invited

Presenter: Vassilia Zorba , *Lawrence Berkeley National Laboratory*

I will introduce emerging femtosecond laser-induced plasma excitation approaches that are used to enable long-range beam propagation for isotopic and elemental analysis of solids at remote distances.

Authors: Vassilia Zorba, Lawrence Berkeley National Laboratory

STu1H

THz and Mid-IR Lasers

Presider: Dan Wasserman , *University of Texas at Austin*

STu1H.1

(Withdrawn) Development of High-Temperature THz QCLs

Invited

Presenter: Qing Hu , *Massachusetts Institute of Technology*

In this work, by adopting a novel design strategy to achieve a clean 3-level system, we have developed THz QCLs (at ~4 THz) with a maximum operating temperature of 250 K, far exceeding the existing records.

Authors: Qing Hu, Massachusetts Institute of Technology

STu1H.2

Self-Starting Harmonic Combs in THz Quantum Cascade Lasers

Presenter: Andres Forrer , *ETH Zurich*

We report on high temperature, self-starting THz Quantum Cascade Laser *harmonic* frequency combs. Their coherence is assessed by electrical beatnote measurements and a self-mixing technique and their beatnote can be injection-locked to a RF source.

Authors: Andres Forrer, ETH Zurich / Yongrui Wang, Texas A & M University / Mattias Beck, ETH Zurich / Alexey Belyanin, Texas A & M University / Jérôme Faist, ETH Zurich / Giacomo Scalari, ETH Zurich

STu1H.3

All-Mid-Infrared Stabilized Quantum Cascade Laser Frequency Comb With 30-kHz Frequency Stability at 7.7 μm

Presenter: Kenichi Komagata , *Laboratoire Temps-Fréquence*

High-resolution spectroscopy in the mid-infrared requires stable frequency references. A frequency comb emitted by a quantum cascade laser is locked to a molecular transition, demonstrating 30-kHz frequency stability up to 5000-s integration time.

Authors:Kenichi Komagata, Laboratoire Temps-Fréquence / Atif Shehzad, Laboratoire Temps-Fréquence / Marin Hamrouni, Laboratoire Temps-Fréquence / Pierre Jouy, IRsweep AG / Filippos Kapsalidis, Institute for Quantum Electronics / Mehran Shahmohammadi, Institute for Quantum Electronics / Mattias Beck, Institute for Quantum Electronics / Renaud Matthey, Laboratoire Temps-Fréquence / Valentin J. Wittwer, Laboratoire Temps-Fréquence / Jérôme Faist, Institute for Quantum Electronics / Thomas Südmeyer, Laboratoire Temps-Fréquence / Andreas Hugi, IRsweep AG / Stéphane Schilt, Laboratoire Temps-Fréquence

STu1H.4

Chaos Bandwidth in Mid-Infrared Quantum Cascade Photonic Devices With Interband and Intersubband Transitions

Presenter: Olivier Spitz , *Télécom Paris*

We experimentally display temporal chaotic waveforms in the mid-infrared domain with two different types of semiconductor lasers. The generated high-dimensional non-linear dynamics are of prime interest for private communications and physical random number generation.

Authors:Olivier Spitz, Télécom Paris / Jia-Gui Wu, Southwest University / Pierre Didier, Télécom Paris / Daniel Diaz-Thomas, Université de Montpellier / Laurent Cerutti, Université de Montpellier / Alexei Baranov, Université de Montpellier / Grégory Maisons, mirSense / Mathieu Carras, mirSense / Chee Wei Wong, University of California Los Angeles / Frédéric Grillot, Télécom Paris

STu1H.5

Ultra-low Threshold Quantum Cascade Laser

Presenter: Zhixin Wang , *ETH Zurich*

We present a quantum cascade laser operating at 4.3 μm wavelength and exhibiting a threshold current of only 9.5 mA while generating a single-mode maximum power of 0.9 mW at -20 °C in continuous-wave operation.

Authors:Zhixin Wang, ETH Zurich / Filippos Kapsalidis, ETH Zurich / ruijun wang, ETH Zurich / Mattias Beck, ETH Zurich / Giacomo Scalari, ETH Zurich / Jérôme Faist, ETH Zurich

STu1H.6

(Withdrawn) Terahertz Quantum Cascade Laser Operating up to ~ 250 K

Presenter: Ali Khalatpour , *Massachusetts Institute of Technology*

Development of THz QCLs with maximum operating temperature of 250 K will be discussed. This operating temperature enables portable THz imaging systems which can perform real-time imaging with room-temperature THz camera.

Authors:Ali Khalatpour, Massachusetts Institute of Technology / Andrew Paulsen, Massachusetts Institute of Technology / Chris Deimert, University of Waterloo / Sadhvikas Addamane, Sandia National Laboratories / Zbig R. Wasilewski, University of Waterloo / John Reno, Sandia National Laboratories / Qing Hu, Massachusetts Institute of Technology

STu1H.7

Full Mid-Infrared Characterization of InGaSb SESAMs

Presenter: Jonas Heidrich , *ETH Zürich*

We present high-precision (<0.04%) nonlinear reflectivity and pump-probe setups to characterize mid-infrared InGaSb quantum-well-based SESAMs at 2.05 μm . The SESAMs show modulation depths between 1-2.2%, low saturation fluences, low non-saturable losses and fast recovery times.

Authors:Jonas Heidrich, ETH Zürich / Marco Gaulke, ETH Zürich / Behçet Özgür Alaydin, ETH Zürich / Matthias Golling, ETH Zürich / Ajanta Barh, ETH Zürich / Ursula Keller, ETH Zürich

STu1C

Emerging Photonic Materials and Applications

Presider: Jiming Bao , *University of Houston*

STu1C.1

(Withdrawn) Metal Halide Perovskites for Radiation Detectors

Invited

Presenter: Jinsong Huang , *University of North Carolina Chapel Hill*

In this talk, some idea of using metal halide perovskites for radiation detection will be presented, and the recent progress in both monocrystalline and polycrystalline perovskites will be briefed.

Authors:Jinsong Huang, University of North Carolina Chapel Hill

STu1C.2

All-Dielectric Halide Perovskite Metasurfaces With Giant Chirality

Presenter: Giorgio Adamo , *Nanyang Technological University*

We realized all-dielectric halide perovskite metasurfaces with giant chirality. With circular dichroism as high as 16% and excellent luminescence properties, high refractive index halide perovskite metasurfaces rival conventional dielectric platforms for low cost, active metadevices.

Authors:Guankui Long, Nanyang Technological University / Giorgio Adamo, Nanyang Technological University / Jingyi Tian, Nanyang Technological University / Elena Feltri, Nanyang Technological University / Harish Krishnamoorthy, Nanyang Technological University / Maciej Klein, Nanyang Technological University / Cesare Soci, Nanyang Technological University

STu1C.3

Halide-Perovskite Metasurfaces Governed by the Kerker Effect

Presenter: Kseniia Baryshnikova , *ITMO University*

We design and demonstrate dramatic suppression of reflection from MAPbBr₃ halide-perovskite metasurfaces. We employ the Kerker effect and engineer both electric and magnetic Mie resonances in each dielectric metaatom to achieve a broadband performance.

Authors:Kseniia Baryshnikova, ITMO University / Dmitry Gets, ITMO University / Tatiana Liashenko, ITMO University / Anatoly Pushkarev, ITMO University / Ivan Mukhin, ITMO University / Yuri Kivshar, ITMO University / Sergey Makarov, ITMO University

STu1C.4

Thermal Properties of the Trigonal Quaternary Nonlinear Crystals BaGa₂GeS₆ and BaGa₂GeSe₆

Presenter: Shekhar Guha , *US Air Force Research Laboratory*

The uniaxial nonlinear crystals BaGa₂GeS₆ and BaGa₂GeSe₆ are characterized in terms of thermal diffusivity and specific heat over a temperature range of -90 to 250 °C for heat propagation along and perpendicular to the *c*-axis.

Authors:Jean Wei, US Air Force Research Laboratory / Joel Murray, US Air Force Research Laboratory / Valeriy Badikov, Kuban State University / Valentin Petrov, Max Born Institut / Shekhar Guha, US Air Force Research Laboratory

STu1C.5

Enhanced Near Infrared (NIR) Luminescence of Bismuth-Doped Phosphosilicate Fiber Under Liquid Nitrogen Cooling

Presenter: Zhao Qiancheng , *The Hong Kong Polytechnic University*

The spectral properties of Bi-doped phosphosilicate fiber have been investigated at liquid nitrogen temperature (LNT). It is observed that the NIR luminescence of phosphor-related bismuth active center (BAC-P) has been enhanced greatly at LNT.

Authors: Zhao Qiancheng, The Hong Kong Polytechnic University / Qun Hao, Beijing Institute of Technology / Zongru Yang, The Hong Kong Polytechnic University / Jiaqi Qu, The Hong Kong Polytechnic University / Gang-ding Peng, University of New South Wales / Changyuan Yu, The Hong Kong Polytechnic University

STu1C.6

Optical Properties of the Refractory Metals at High Temperatures

Presenter: MANOHAR CHIRUMAMILLA , *Hamburg University of Technology*

We measure and compare the optical properties of thin refractory metal films (TiN, W, Mo and Ir) at temperatures up to 1000 °C. In-situ ellipsometry is used to measure the optical constants. Refractory metals show long-term structural stability at 1000 °C for 120 h.

Authors: MANOHAR CHIRUMAMILLA, Hamburg University of Technology / Mahima Arya, Hamburg University of Technology / Ankita Ganguly, Hamburg University of Technology / Surya Rout, Hamburg University of Technology / Gnanavel Krishnamurthy, Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research / tobias krekeler, Hamburg University of Technology / Martin Ritter, Hamburg University of Technology / Michael Störmer, Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research / alexander petrov, Hamburg University of Technology / Manfred Eich, Hamburg University of Technology

STu1C.7

Survey of Metal Oxides for Coatings of Ultra-Stable Optical Cavities

Presenter: Carmen Menoni , *Colorado State University*

A survey of the optical properties and mechanical loss of metal-oxide thin films is reported in a search for optimum materials for mirror coatings for gravitational wave detectors. Ta₂O₅ and GeO₂ doped with TiO₂ achieve the lowest absorption and mechanical loss with post-processing annealing.

Authors: Carmen Menoni, Colorado State University / Le Yang, Colorado State University / Mariana Fazio, Colorado State University / Gabriele Vajente, California Institute of Technology / Alena Ananjeva, California Institute of Technology / GariLynn Billingsley, California Institute of Technology / Francois Schiettekatte, University of Montreal / Martin Chicoine, University of Montreal / Ashot Markosyan, Stanford University / Riccardo Bassiri, Stanford University / Martin Fejer, Stanford University

STu1C.8

Enhanced Random Lasing Performance of CH₃NH₃PbI₃ Perovskite in AgI Configuration

Presenter: Tsung Sheng Kao , *National Chiao Tung University*

We demonstrate that the random lasing behavior of solution-processed MAPbI₃ perovskites can be improved around 3 times in light intensity enhancement and pumping threshold reduction with the existence of AgI configuration

Authors: Tsung Sheng Kao, National Chiao Tung University / Yu-Heng Hong, National Chiao Tung University / Zhi-Wei Huang, National Chiao Tung University / Hyeyoung Ahn, National Chiao Tung University

STu1F

Microresonators

Presenter: Yasutomo Ota , *University of Tokyo*

STu1F.1

inTegrated Gallium Nitride Microresonators for Broadband Kerr Comb Generation

Presenter: Yanzhen Zheng , *Tsinghua University*

Dispersion engineered gallium nitride (GaN) microring resonators with quality factor exceeding 2 million are fabricated. Broadband Raman-Kerr combs are generated by taking advantage of this high Q GaN microresonator

Authors: Yanzhen Zheng, Tsinghua University / Changzheng Sun, Tsinghua University / Bing Xiong, Tsinghua University / Lai Wang, Tsinghua University / Zhibiao Hao, Tsinghua University / Jian Wang, Tsinghua University / Yanjun Han, Tsinghua University / Hongtao Li, Tsinghua University / Jiadong yu, Tsinghua University / Yi Luo, Tsinghua University

STu1F.2

>30 dB Suppression of Intrinsic Backscattering in Whispering-Gallery-Mode Microresonator

Presenter: Andreas Svela , *Imperial College London*

We demonstrate a technique for suppressing backscattered light in a whispering-gallery-mode resonator by positioning a sub-wavelength-size scatterer within its evanescent field, achieving at least 34 dB suppression compared to the intrinsic backscattering.

Authors: Andreas Svela, Imperial College London / Jonathan Silver, National Physical Laboratory / Leonardo Del Bino, Max Planck Institute for the Science of Light / Shuangyou zhang, Max Planck Institute for the Science of Light / Michael Woodley, Imperial College London / Michael Vanner, Imperial College London / Pascal Del Hays, Max Planck Institute for the Science of Light

STu1F.3

on Demand Control of bus-Cavity Coupling

Presenter: Jakob Hinney , *Columbia University*

We show tuning of the cavity-bus coupling rate by more than 160% by imparting a nonlinear differential parametric gain between the clockwise and counterclockwise propagating modes.

Authors: Jakob Hinney, Columbia University / Andres Gil Molina, Columbia University / Utsav Dave, Columbia University / Xingchen Ji, Columbia University / Tong Lin, Columbia University / Alexander Gaeta, Columbia University / Michal Lipson, Columbia University

STu1F.4

Synthetic Dimension Photonics on a Si CMOS Platform

Presenter: Armandas Balcytis , *Yokohama National University*

We present a dynamically modulated ring resonator on a Si CMOS platform, hosting a synthetic dimension lattice over 180 GHz. Frequency and time domain synthetic band structure was acquired and photonic transport phenomena were explored.

Authors: Armandas Balcytis, Yokohama National University / Tomoki Ozawa, Tohoku University / Yasutomo Ota, The University of Tokyo / Satoshi Iwamoto, The University of Tokyo / Jun Maeda, Yokohama National University / Toshihiko Baba, Yokohama National University

STu1F.5

Generation of Multiple Sharp Fano Resonances Based on a Silicon Nanobeam-Microring Resonator

Presenter: Ruihuan Zhang , *Shanghai Jiao Tong University*

A silicon nanobeam-microring resonator is experimentally demonstrated to generate periodic multiple sharp Fano resonances with an FSR of 8.44 nm. The extinction ratios of the Fano resonances are higher than 11 dB.

Authors: Ruihuan Zhang, Shanghai Jiao Tong University / Yu He, Shanghai Jiao Tong University / Yong Zhang, Shanghai Jiao Tong University / Yikai Su, Shanghai Jiao Tong University

STu1F.6

Coupled-Mode Theory of the Polarization Dynamics Inside a Microring Resonator With a Uniaxial Core

Presenter: Luis Cortes Herrera , *University of Rochester*

We develop a coupled-mode theory for polarization coupling inside a LiNbO₃ microring resonator. We use analytical techniques from quantum mechanics to characterize the polarization dynamics in such a resonator.

Authors: Luis Cortes Herrera, University of Rochester / Xiaotong He, University of Rochester / Jaime Cardenas, University of Rochester / Govind Agrawal, University of Rochester

STu1F.7**Independently Coupled and PZT Controllable Photonic Integrated Three-Resonator Photonic Molecule**

Presenter: Jiawei Wang , *University of California Santa Barbara*

We demonstrate an integrated three-resonator photonic molecule with independent buses and PZT controllable 5.11 million Q Si₃N₄ rings. Independent tuning is demonstrated with full control of resonances and splitting and verified with theory and simulation.

Authors: Jiawei Wang, University of California Santa Barbara / Kaikai Liu, University of California Santa Barbara / Qiancheng Zhao, University of California Santa Barbara / Andrei Isichenko, University of California Santa Barbara / Ryan Rudy, U.S. Army Research Laboratory / Daniel Blumenthal, University of California Santa Barbara

STu1F.8**Enhanced Bio-Photocurrent Generation via Light-Harvesting Protein Microcavity**

Presenter: YU-CHENG CHEN , *Nanyang Technological University*

Biological produced photoelectricity was first enhanced through light-harvesting protein microcavity assemblies. Detailed study between optical resonance and photoelectricity reveals the huge potential of optical cavity in light-harvesting and photon conversions.

Authors: Zhiyi Yuan, Nanyang Technological University / Xin Cheng, Nanyang Technological University / Tsungyu Li, Nanyang Technological University / YU-CHENG CHEN, Nanyang Technological University

STu1D**Generation of Ultrafast Pulses**

Presenter: Hiromitsu Kiriya , *National Inst. Quantum & Rad Sc & Tech*

STu1D.1**Experimental Demonstration of Dynamic Spatiotemporal Structured Beams That Exhibit Two Orbital-Angular-Momenta Simultaneously Using a Kerr Frequency Comb**

Presenter: Kai Pang , *Universit of Southern California*

We experimentally demonstrate the generation of dynamic spatiotemporal structured beams that exhibit two orbital-angular-momenta simultaneously using a Kerr frequency comb. The mode purity of the revolving and rotating LG₃₀ beam is obtained to be ~89%.

Authors:Kai Pang, Universit of Southern California / kaiheng zou, Universit of Southern California / Zhe Zhao, Universit of Southern California / Hao Song, Universit of Southern California / Yiyu Zhou, University of Rochester / maxim karpov, École Polytechnique Fédérale de Lausanne / Murat Yessenov, University of Central Florida / Abbas Shiri, University of Central Florida / Haoqian Song, Universit of Southern California / Runzhou Zhang, Universit of Southern California / Huibin Zhou, Universit of Southern California / Xinzhou Su, Universit of Southern California / Nanzhe Hu, Universit of Southern California / Amir Minoofar, Universit of Southern California / Tobias Kippenberg, École Polytechnique Fédérale de Lausanne / Robert Boyd, University of Rochester / Ayman Abouraddy, University of Central Florida / Moshe Tur, Tel Aviv University / Alan Eli Willner, Universit of Southern California

STu1D.2

(Withdrawn) Composed Axial Spectral Variation of Space-Time Wave Packets

Presenter: Alyssa Allende Motz , *University of Florida, CREOL*

User-determined axial spectral encoding is demonstrated by selective amplitude-modulation in the Fourier plane of space-time wave packets. An analytical model is proposed and is shown to be in good agreement with measured results.

Authors:Alyssa Allende Motz, University of Florida, CREOL / Murat Yessenov, University of Florida, CREOL / Ayman Abouraddy, University of Florida, CREOL

STu1D.3

(Withdrawn) Isochronous Propagation of Space-Time Wave Packets at an Oblique Material Interface

Presenter: Alyssa Allende Motz , *University of Florida, CREOL*

We demonstrate space-time wave packets that accumulate the same group delay after propagating through an indexed material layer, at different incident angles, showing that they traverse the same optical path length over different material thicknesses.

Authors:Alyssa Allende Motz, University of Florida, CREOL / Murat Yessenov, University of Florida, CREOL / Ayman Abouraddy, University of Florida, CREOL

STu1D.4

Polarization Twisting Dual-Pulse Generation

Presenter: Chih Wei Luo , *National Chiao Tung University*

The polarization twisting frequency, helicity, and time delay between two pulses, can be manipulated individually via a modified Michelson interferometer with inserting a pellicle beam splitter into each arm.

Authors:Hao-Keng Wei, National Chiao Tung University / Hironori Ito, Tokyo University of Agriculture and Technology / Kazuhiko Misawa, Tokyo University of Agriculture and Technology / Chih Wei Luo, National Chiao Tung University

STu1D.5

Gain-Assisted Microcomb Dual-Soliton Manipulation

Presenter: Teng Tan , *University of Electronic Science & Technology of China*

By using a 980 nm control laser to excite the erbium doped microsphere resonators, we realized remarkable soliton access range enhancement and counter-propagating dual-soliton manipulation, including fast on-off switch (7MHz) and beat note tuning (up to 52 kHz/mW).

Authors:Teng Tan, University of Electronic Science & Technology of China / Zhongye Yuan, University of Electronic Science & Technology of China / Haojing Chen, Peking University / Hao Zhang, University of Electronic Science & Technology of China / Chenye Qin, University of Electronic Science & Technology of China / Chee Wei Wong, University of California / Yunjiang Rao, University of Electronic Science & Technology of China / Yunfeng Xiao, Peking University / Baicheng Yao, University of Electronic Science & Technology of China

STu1D.6

Femtosecond Tunable Light Source With Variable Repetition Rate and Ultra-High Pulse Contrast Ratio

Presenter: Moritz Floess , *University of Stuttgart*

We demonstrate a novel femtosecond tunable light source based on a synchronously pumped fiber-feedback optical parametric oscillator with variable pulse repetition rate from 640 kHz to 41 MHz with 82 dB temporal pulse contrast ratio.

Authors:Moritz Floess, University of Stuttgart / Tobias Steinle, University of Stuttgart / Ilja Gerhardt, IQST / Harald Giessen, University of Stuttgart

STu1D.7

Genetic Algorithm Optimization for Ultra-Broadband Long-Wave Infrared Seed Pulse Generation

Presenter: Hao Huang , *University of Michigan*

We demonstrate the production of broadband long-wave infrared pulses centered near 10.3 μm using difference-frequency generation. An accompanying simulation shows that genetic algorithm optimization of chirp can significantly increase the spectral bandwidth.

Authors: Hao Huang, University of Michigan / Xuan Xiao, University of Michigan / John Nees, University of Michigan / Igor Jovanovic, University of Michigan

STu1D.8

a Stabilized Doubly Resonant Optical Parametric Oscillator for Strong-Field Applications

Presenter: Han Rao , *Leibniz Universität Hannover*

We show that higher order dispersion allows to significantly increase the self-locking region of doubly resonant parametric oscillator and demonstrate a possibility of its stabilization using sum-frequency generation of signal and pump waves.

Authors: Han Rao, Leibniz Universität Hannover / Christian Dietrich, Leibniz Universität Hannover / José Andrade, Max Born Institute / Ayhan Demircan, Leibniz Universität Hannover / Ihar Babushkin, Leibniz Universität Hannover / Uwe Morgner, Leibniz Universität Hannover

STu1G

Photonic Computing

Presenter: Wei Jiang , *Nanjing University*

STu1G.1

Integrated Photonics for Computing, Interconnects and Sensing

Tutorial

Presenter: Ray Chen , *University of Texas at Austin*

Integrated photonics shows promises in abundant applications, ranging from interconnects, optical computing, Lidar for autonomous cars to biomedical sensing. An open biosensing platform is presented with applicability to early cancer detection including COVID-19 detection.

Authors: Ray Chen, University of Texas at Austin

STu1G.2

Neuron-Like Spiking Derived From Silicon-Based Photonic Crystal Microcavity

Presenter: Jia-Gui Wu , *Southwest University*

We propose a method for neuron-like spiking generation using silicon microcavities, where the spiking speed is about 4 nanosecond and a million times faster than biological neurons. Both experiments and theories were carried out

Authors:Yang Deng, Southwest University / Jaime G. Flor Flores, Fang Lu Mesoscopic Optics and Quantum Electronics Laboratory, / Zehao Wang, Southwest University / Huan Yuan, Southwest University / Jinping Zhang, Southwest University / Jia-Gui Wu, Southwest University / Chee Wei Wong, Fang Lu Mesoscopic Optics and Quantum Electronics Laboratory,

STu1G.3

Optical Generative Adversarial Network Based on Programmable Phase-Change Photonics

Presenter: Changming Wu , *University of Washington*

We demonstrate photonic generative adversarial networks (GANs) based on a phase-change metasurface mode converter (PMMC) array and perform the handwritten-like number generation task. © 2021 The Author(s)

Authors:Changming Wu, University of Washington / Xiaoxuan Yang, Duke University / Heshan Yu, The University of Maryland / Ichiro Takeuchi, The University of Maryland / Yiran Chen, Duke University / Mo Li, University of Washington

STu1G.4

Broadband 5Gb/s Optical RAM Cell Over the C-Band

Presenter: Christos Pappas , *Centre for Interdisciplinary Research and Innovation*

A broadband optical RAM cell comprising a monolithic InP Flip-Flop and a Random Access Gate is experimentally presented with at least 5 Gb/s error-free operation and less than 4.5dB power penalty across the whole C-band.

Authors:Christos Pappas, Centre for Interdisciplinary Research and Innovation / Theodoros Moschos, Centre for Interdisciplinary Research and Innovation / George Mourgias-Alexandris, Centre for Interdisciplinary Research and Innovation / Theoni Alexoudi, Centre for Interdisciplinary Research and Innovation / Christos Vagionas, Centre for Interdisciplinary Research and Innovation / Kamil Gradkowski, Tyndall National Institute / Noreen Nudds, Tyndall National Institute / Peter O'Brien, Tyndall National Institute / Amalia Miliou, Centre for Interdisciplinary Research and Innovation / Nikolaos Pleros, Centre for Interdisciplinary Research and Innovation

STu1G.5

a 5 Gb/s Monolithically Integrated InP SOA-Based Bistable Photonic Waveguide Memory

Presenter: Theodoros Moschos , *Centre for Interdisciplinary Research and Innovation*

We experimentally demonstrate for the first time a simple bistable monolithic integrated InP photonic memory relying on two semiconductor optical amplifiers with traveling waveguide configuration. Proof of principle operation is presented at 5 Gb/s.

Authors:Theodoros Moschos, Centre for Interdisciplinary Research and Innovation / Christos Pappas, Centre for Interdisciplinary Research and Innovation / George Mourgias-Alexandris, Centre for Interdisciplinary Research and Innovation / Theoni Alexoudi, Centre for Interdisciplinary Research and Innovation / Christos Vagionas, Centre for Interdisciplinary Research and Innovation / Amalia Miliou, Centre for Interdisciplinary Research and Innovation / Nikolaos Pleros, Centre for Interdisciplinary Research and Innovation

STu1Q

Hollow Core Fibers

Presenter: Maria Chernysheva , *Leibniz Institute of Photonic Technology*

STu1Q.2

Design and Fabrication of a Single-Mode and Ultra-low Loss Hollow-Core Fiber Based on Kagome-Tubular Hybrid Lattice

Presenter: Jonas Osório , *XLIM Research Insititute*

We propose a hybrid Kagome-tubular lattice hollow-core fiber for ultra-low loss and single-mode operation. The fiber displays a minimum loss of 1.6dB/km at 1050nm and a higher-order modes extinction of 47dB for a 10m-long fiber.

Authors:Foued Amrani, XLIM Research Insititute / Jonas Osório, XLIM Research Insititute / Frédéric Delahaye, XLIM Research Insititute / Fabio Giovanardi, University of Modena / Kostiantyn Vasko, XLIM Research Insititute / Luca Vincetti, University of Modena / Benoit Debord, XLIM Research Insititute / Frédéric Gérôme, XLIM Research Insititute / Fetah Benabid, XLIM Research Insititute

STu1Q.3

Fabrication and Characterization of a Double-Ring Negative-Curvature Hollow-Core Fiber

Presenter: Yuxi Wang , *Nanyang technological university*

We fabricate a novel negative-curvature fiber that consists of two rings of non-touching antiresonant tubes surrounding the central hollow core. The transmission loss of the fiber is lower than that achievable with its single-ring counterpart.

Authors:Yuxi Wang, Nanyang technological university / Muhammad Rosdi abu hassan, Nanyang technological university / Wonkeun Chang, Nanyang technological university

STu1Q.4

Limits of Coupling Efficiency Into Hollow-Core Antiresonant Fibers

Presenter: Eric Rodrigue Numkam Fokoua , *University of Southampton*

We show theoretically that the coupling efficiency between a gaussian beam and the fundamental mode of nested antiresonant hollow-core optical fibers exceeds 97% and depends on the order of the antiresonance window.

Authors:Eric Rodrigue Numkam Fokoua, University of Southampton / Radan Slavik, University of Southampton / David Richardson, University of Southampton / Francesco Poletti, University of Southampton

STu1Q.5

Angled Interconnection Between Standard Single-Mode Fiber and Nested Nodeless Antiresonant Fibers

Presenter: Dmytro Suslov , *Czech Technical University in Prague*

We present angled interconnection between standard single-mode fiber and nested nodeless antiresonant fibers with insertion loss of 0.45 dB and return loss below -60 dB over wide (1450-1650 nm) spectral range.

Authors:Dmytro Suslov, Czech Technical University in Prague / Daniel Dousek, Czech Technical University in Prague / Stanislav Zvánovec, Czech Technical University in Prague / Eric Rodrigue Numkam Fokoua, University of Southampton / Francesco Poletti, University of Southampton / David Richardson, University of Southampton / Matěj Komanec, Czech Technical University in Prague / Radan Slavik, University of Southampton

STu1Q.6

Stability Performance of Active gas-Filled Hollow-Core Anti-Resonant Fiber Laser

Presenter: Yazhou Wang , *Technical University of Denmark*

The stability of infrared gas-filled fiber Raman lasers is investigated for the first time. It reveals that high pulse energy leads to low noise, while the associated high heat release compromises the laser's long-term stability.

Authors:Yazhou Wang, Technical University of Denmark / Abubakar Adamu, Technical University of Denmark / Manoj Dasa, Technical University of Denmark / Jose Antonio-Lopez, University of Central Florida / Md Selim Habib, Florida Polytechnic University / Rodrigo Amezcua Correa, University of Central Florida / Ole Bang, Technical University of Denmark / Christos Markos, Technical University of Denmark

STu1Q.7

Hollow Core Fiber Temperature Sensitivity Reduction via Winding on a Thermally-Insensitive Coil

Presenter: Meng Ding , *University of Southampton*

We demonstrate over 3x lower thermal sensitivity by winding a hollow core fiber on an ultralow thermal expansion material bobbin. A record-low fiber phase thermal sensitivity of 0.9 rad/m/K is demonstrated at room temperature.

Authors: Meng Ding, University of Southampton / Eric Fokoua, University of Southampton / Thomas Bradley, University of Southampton / Francesco Poletti, University of Southampton / David Richardson, University of Southampton / Radan Slavik, University of Southampton

STu1Q.1

Low Latency Transmission in a Hollow Core Fiber Cable

Invited

Presenter: Brian Mangan , *OFS Laboratories*

We present the first field-deployed hollow core fiber (HCF) cable, demonstrating error-free transmission of direct-detection 10Gb/s DWDM signal over multi-km cascaded HCF cable link, enabling a 31% reduction in latency compared to a solid-core fiber.

Authors: Brian Mangan, OFS Laboratories

STu1E

Space Division Multiplexing-based Communication Systems

Presenter: Giovanni Milione , *NEC Laboratories America Inc*

STu1E.1

Performance Impairments due to Inter-Core Crosstalk Dynamics in a 7-Core MCF-Based DMT-Modulated Link

Presenter: Alberto Gatto , *Politecnico di Milano - DEIB*

We investigate inter-core crosstalk impact on DMT-modulated signals in a 7-core fiber with different sources at the same nominal wavelength. We observe beating from relative laser frequency shift leads to time-dependent interference on DMT subcarriers.

Authors: Alberto Gatto, Politecnico di Milano - DEIB / Mariangela Rapisarda, Politecnico di Milano - DEIB / Paola Parolari, Politecnico di Milano - DEIB / Benjamin Puttnam, NICT / Georg Rademacher, NICT / Ruben Luis, NICT / Pierpaolo Boffi, Politecnico di Milano - DEIB

STu1E.2

Dynamic Crosstalk Monitoring of Real-Time Transmission in Multi-Core Fibers Based on Deep Learning

Presenter: maoqi zhang , *HUST*

We propose and experimentally demonstrate a novel dynamic crosstalk monitoring in multi-core fibers based on deep learning, by using asynchronous amplitude histogram (AAH). The mean absolute error (MAE) of crosstalk monitoring is below 0.78 dB.

Authors:maoqi zhang, HUST / kangjie li, HUST / Lin Gan, HUST / Yizhao Chen, HUST / Can Zhao, HUST / Ming Tang, HUST

STu1E.3

Maximising Capacity Through Space Division Multiplexing

Tutorial

Presenter: Chigo Okonkwo , *Technische Universiteit Eindhoven*

To be provided

Authors:Chigo Okonkwo, Technische Universiteit Eindhoven

STu1E.4

Demonstration of Turbulence Mitigation in a 200-Gbit/s Orbital-Angular-Momentum Multiplexed Free-Space Optical Link Using Simple Power Measurements on a Probe Wavelength

Presenter: Nanzhe Hu , *Uninversity of Southern California*

We experimentally demonstrate turbulence mitigation in a 200-Gbit/s OAM-multiplexed free-space optical link with data channels on 1552 nm using simple power measurements on a probe wavelength of 1550 nm without interrupting the data transmission. We observe a crosstalk reduction of up to 25 dB.

Authors:Nanzhe Hu, Uninversity of Southern California / Haoqian Song, Uninversity of Southern California / Runzhou Zhang, Uninversity of Southern California / Huibin Zhou, Uninversity of Southern California / cong liu, Uninversity of Southern California / Xinzhou Su, Uninversity of Southern California / Hao Song, Uninversity of Southern California / Kai Pang, Uninversity of Southern California / kaiheng zou, Uninversity of Southern California / Brittany Lynn, Naval Information Warfare Center Pacific / Moshe Tur, Tel Aviv University / Alan Eli Willner, Uninversity of Southern California

STu1E.5

Experimental Demonstration of Vortex Mode Demultiplexing Using a Concentric-Ring Transformation

Presenter: Jian Wang , *Huazhong University of Science and Technology*

A concentric-ring transformation method is presented to realize high-resolution sorting of vortex modes. We experimentally demonstrate the efficient demultiplexing of vortex modes with a low crosstalk <-12 dB.

Authors: Han Cao, Huazhong University of Science and Technology / Yize Liang, Huazhong University of Science and Technology / Lulu Wang, Huazhong University of Science and Technology / Hongya Wang, Huazhong University of Science and Technology / Jian Wang, Huazhong University of Science and Technology

STu1A

Active Nanophotonic Sensing and Detection

Presider: Nicolas Thomas, Ghent University, INTEC

STu1A.1

Photonic Chip-Based Optical Nanoscopy

Invited

Presenter: Balpreet Ahluwalia, UiT, The Arctic University of Tromsø

A photonic chip-based approach is shown as alternative to conventional super-resolution fluorescence microscopy. By making use of photonic circuits, more compact, cost-effective and higher resolving setups can allow for a wider implementation of these techniques.

Authors: Øystein Ivar Helle, UiT, The Arctic University of Tromsø / Firehun Tsige Dullo, UiT, The Arctic University of Tromsø / Marcel Lahrberg, UiT, The Arctic University of Tromsø / Jean-Claude Tinguely, UiT, The Arctic University of Tromsø / Olav Gaute Hellesø, UiT, The Arctic University of Tromsø / Balpreet Ahluwalia, UiT, The Arctic University of Tromsø

STu1A.2

High-Aspect-Ratio Free-Standing Membrane Waveguides for Mid-Infrared Nanophotonics

Presenter: Marek Vlček, UiT, Dept of Physics and Technology

Nanophotonic devices for optical sensing often display poor evanescent field interaction. We demonstrate a suspended thin-film waveguide with stronger light-analyte interaction than a free-space beam, as verified by detecting acetylene at 2566 nm.

Authors: Marek Vlček, UiT, Dept of Physics and Technology / Anurup Datta, UiT, Dept of Physics and Technology / Sebastián Alberti, UiT, Dept of Physics and Technology / Astrid Aksnes, Norwegian University of Science and Technology / Ganapathy Murugan, University of Southampton / Jana Jágorská, UiT, Dept of Physics and Technology

STu1A.3

Distributed Temperature Sensing Based on φ -OTDR Using Back-Reflection-Enhanced Fiber

Presenter: Malak Galal , *Ecole Polytechnique Federale de Lausanne*

Distributed temperature sensing with 10 dB back-reflection-enhanced fiber is performed based on φ -OTDR. While the temperature sensitivity of such fibers is similar to that of standard single-mode fibers, a 3-times higher temperature resolution is observed.

Authors: Malak Galal, Ecole Polytechnique Federale de Lausanne / Suneetha Sebastian, Ecole Polytechnique Federale de Lausanne / Li Zhang, Ecole Polytechnique Federale de Lausanne / Luc Thévenaz, Ecole Polytechnique Federale de Lausanne

STu1A.4

Integrated Near-Infrared Spectral Sensor Based on Near-Infrared Detector Arrays

Presenter: Kaylee Hakkel , *Eindhoven University of Technology*

We present a spectral sensor based on an integrated array of resonant-cavity-enhanced photodetectors operating in the near-infrared. Prediction models are built directly using the 15 photodetector responses, without the need for spectral reconstruction.

Authors: Kaylee Hakkel, Eindhoven University of Technology / Maurangelo Petruzzella, Eindhoven University of Technology / Fang Ou, Eindhoven University of Technology / Anne van Klinken, Eindhoven University of Technology / Francesco Pagliano, Eindhoven University of Technology / Tianran Liu, Eindhoven University of Technology / Rene van Veldhoven, Eindhoven University of Technology / Andrea Fiore, Eindhoven University of Technology

STu1A.5

Wide-Field Magnetic and Thermal Imaging of Electric Currents Using NV⁻ Centers in Nanodiamond Ensembles

Presenter: Siamak Dadras , *University of Rochester*

Magnetic and thermal microscopy can be performed concurrently to probe physical performance of integrated circuits. We present wide-field imaging of current-induced magnetic and thermal patterns using optically-detected magnetic resonance of NV⁻ centers in nanodiamond ensembles.

Authors: Siamak Dadras, University of Rochester / ARUNABH MUKHERJEE, University of Rochester / Kamran Shayan, University of Rochester / John Tarduno, University of Rochester / A. Vamivakas, University of Rochester

STu1A.6

Photonic Integrated Alumina Waveguide Gratings for far-Field Structured Illumination at UV Wavelengths

Presenter: Chupao Lin , *Ghent University*

We demonstrate far-field UV structured illumination implemented with integrated aluminum oxide (AlO_x) waveguide gratings. Based on simulation and experimental results, we discuss the performances of two AlO_x waveguide gratings operating at $\lambda = 360\text{nm}$.

Authors:Chupao Lin, Ghent University / Juan Santo-Domingo Peñaranda, Ghent University / Jolien Dendooven, Ghent University / Christophe Detavernier, Ghent University / David Schaubroeck, Ghent University / Nicolas Thomas, Ghent University

STu1A.7

Low-Loss Nanoslot Waveguides for Sensing Fabricated in a CMOS Foundry

Presenter: Todd Stievater , *US Naval Research Laboratory*

We demonstrate propagation loss as low as 0.3 dB/cm and high-fidelity sensing in foundry-fabricated silicon nitride nanoslot waveguides designed for wavelengths between 700 nm and 1600 nm.

Authors:Nathan Tyndall, US Naval Research Laboratory / Dmitry Kozak, US Naval Research Laboratory / Marcel Pruessner, US Naval Research Laboratory / Peter Goetz, US Naval Research Laboratory / William Rabinovich, US Naval Research Laboratory / Todd Stievater, US Naval Research Laboratory / Michael Bryan, University of Rochester / Ethan Luta, University of Rochester / Benjamin Miller, University of Rochester / Nicholas Fahrenkopf, SUNY Polytechnic Institute / Alin Antohe, SUNY Polytechnic Institute

JTu1P

Special Symposium - Symposium- Emerging Materials for Light Emission and Non-volatile Photonic Memories I: Light Emission

Presenter: Sascha Feldmann , *University of Cambridge*

JTu1P.1

Perovskite Quantum Dot LEDs

Invited

Presenter: Edward Sargent , *University of Toronto*

I will discuss advances in light-emitting diodes enabled by the synthesis and surface-management of novel perovskite quantum dots.

Authors:Edward Sargent, University of Toronto

JTu1P.2

Perovskite Scintillators: Emission at High Energy Excitations

Presenter: Francesco Maddalena , *CNRS International - NTU - Thales Research Alliance*

Here we report the emission properties of perovskite quantum dots and two-dimensional perovskites under high energy excitation from X-, gamma-ray, alpha particle and thermal neutron, aimed towards fast-timed imaging and particle detection applications.

Authors: Francesco Maddalena, CNRS International - NTU - Thales Research Alliance / Aozhen Xie, CNRS International - NTU - Thales Research Alliance / Marcin Witkowski, Nicolaus Copernicus Univ. in Torun / Michal Makowski, Nicolaus Copernicus Univ. in Torun / Winicjusz Drozdowski, Nicolaus Copernicus Univ. in Torun / Stuart Springham, Nanyang Technological University / Philippe Coquet, CNRS International - NTU - Thales Research Alliance / Benoit Mahler, Université Claude Bernard Lyon 1 / Christophe Dujardin, Université Claude Bernard Lyon 1 / Muhammad Birowosuto, CNRS International - NTU - Thales Research Alliance / Cuong Dang, CNRS International - NTU - Thales Research Alliance

JTu1P.3

Broadband Directional Control of Thermal Emission

Presenter: Jin Xu , *University of California, Los Angeles*

We experimentally realize broadband directional thermal emitters by introducing two subwavelength photonic structures consisting of multiple oxides that exhibit epsilon-near-zero (ENZ) regions at long-wave infrared wavelengths.

Authors: Jin Xu, University of California, Los Angeles / Aaswath Raman, University of California, Los Angeles

JTu1P.4

Perovskite Based Hyperbolic Metamaterials: a New Avenue in Perovskite Photonics

Presenter: Supratim Basak , *Tel-Aviv University*

Hyperbolic metamaterials (HMMs) exhibiting direct-transition from *type-I* to *type-II* in the mid-visible region are realized for the first time. These devices are characterized using angle resolved transmission and reflection measurements with excellent agreement with simulations.

Authors: Supratim Basak, Tel-Aviv University / Ofer Bar-On, Tel-Aviv University / Jacob Scheuer, Tel-Aviv University

JTu1P.5

Boosting Fluorescence-Based Chiral Sensing With Nanophotonics

Presenter: Ershad Mohammadi , *Eindhoven University of Technology*

The handedness of chiral molecules can be detected in their circularly polarized fluorescence, which is typically very weak. Here, we propose dielectric nanophotonics to increase both the fluorescence intensity and polarization contrast.

Authors: Ershad Mohammadi, Eindhoven University of Technology / Raziman Thottungal Valapu, Eindhoven University of Technology / Alberto G. Curto, Eindhoven University of Technology

JTu1P.6

Bespoke Light-Matter Interactions in Halide Perovskites From First Principles Calculations

Invited

Presenter: Linn Leppert, *University of Twente*

Halide perovskites are a chemically and electronically diverse class of compounds with applications ranging from solar cells to X-ray scintillators. I will discuss our computational approach for tuning excited state properties in these versatile materials.

Authors: Linn Leppert, University of Twente

JTu1I

Special Symposium - Symposium- Micro-Photonic Positioning, Navigation and Timing I

President: Andrey Matsko, *JPL*

JTu1I.1

Photonic Systems Engineering: a Structured Approach to Positioning, Navigation and Timing Using Microresonators

Invited

Presenter: Ying Lia Li, *UCL*

Optical microresonator gyroscopes, accelerometers and frequency combs are ideally suited for positioning, navigation and timing (PNT) applications. Using the example of a microresonator accelerometer, I present a systems engineering approach to PNT commercialisation.

Authors: Ying Lia Li, UCL

JTu1I.2

A Chip-Based Brillouin Laser Gyroscope With Earth-Rotation-Rate Sensitivity

Invited

Presenter: Kerry Vahala, *California Institute of Technology*

The physical principles of a chip-based Brillouin laser gyroscope are reviewed. The device can resolve sinusoidal rotations with amplitude as low as 5 degrees/hour and is also used to detect the Earth's rotation.

Authors: Kerry Vahala, California Institute of Technology / Yu Hung Lai, California Institute of Technology / Myoung-Gyun Suh, California Institute of Technology / Boqiang Shen, California Institute of Technology

JTu11.3

Integrated Ultra-Narrow Linewidth Ultra-Stable Brillouin Lasers and Their Application to PNT Applications

Invited

Presenter: Daniel Blumenthal, *University of California Santa Barbara*

We describe a new class of photonic integrated ultra-narrow linewidth, ultra-stable Brillouin laser that enables precision spectrally-pure lasers at the chip-scale and their use in atomic clocks, quantum sensing, and optical gyros.

Authors: Daniel Blumenthal, *University of California Santa Barbara*

JTu11.4

Integrated Optomechanical Sensing for Semiconductor Metrology

Invited

Presenter: Andrea Fiore, *Eindhoven University of Technology*

In this talk we will present recent process on the integration of nano-opto-electro-mechanical sensors with photonic circuits and optical read-out, showing a route towards fully-integrated optical sensing

Authors: Andrea Fiore, *Eindhoven University of Technology* / Federico Galeotti, *Eindhoven University of Technology* / Tianran Liu, *Eindhoven University of Technology* / Maurangelo Petruzzella, *Eindhoven University of Technology* / Ivana Seršić Vollenbroek, *Eindhoven University of Technology* / Gustav Lindgren, *Eindhoven University of Technology* / Francesco Pagliano, *Eindhoven University of Technology* / Frank van Otten, *Eindhoven University of Technology* / Rene van Veldhoven, *Eindhoven University of Technology* / Vadim Pogoretskii, *Eindhoven University of Technology* / Yuqing Jiao, *Eindhoven University of Technology* / Abbas Mohtashami, *Netherlands Organisation for Applied Scientific Research TNO* / Hamed Sadeghian, *Eindhoven University of Technology* / Rob van der Heijden, *Eindhoven University of Technology*

JTu11.5

Chip-Scale Optomechanics for Precision Navigation

Invited

Presenter: Jaime G. Flor Flores, *UCLA*

Laser-driven optomechanical transduction has enabled precision measurements at the thermodynamical limits. Here we present measurements of laser-driven silicon optomechanical oscillators in force-acceleration sensing at $\text{mg}/\text{Hz}^{1/2}$ -levels for inertial navigation, supported by our theory and device nanofabrication.

We'll be uploading the recorded video by this evening. If the recorded video upload window is not available, we'll send you a link to the recording -- if you can help upload into the CLEO server, it would make the session run more smoothly. Thank you for the patience and look forward,

Authors: Chee Wei Wong, UCLA / Talha Yerebakan, UCLA / James McMillan, UCLA / Andrey Matsko, UCLA / Jaime G. Flor Flores, UCLA

JTu11.6

Miniature High Performance Gyroscopes With Crystalline WGM Resonators

Invited

Presenter: Lute Maleki , *OEwaves, Inc.*

Several groups around the world have been striving to achieve performance similar to fiber gyros and laser gyros in miniature form factors. At OEwaves we have demonstrated that ultra-high quality factor and exceptional transparency of whispering gallery mode resonators fabricated with crystalline material can be put to advantage to realize miniature high performance gyros.

Authors: Lute Maleki, OEwaves, Inc.

JTu1R

Special Symposium - Super Symposium on Photonics Solutions for COVID-19 Challenge II

Presider: Emily Gibson , *University of Colorado Denver*

JTu1R.1

Using Quantum Mechanics to Detect COVID-19 Disease

Invited

Presenter: Marlan Scully , *Texas A&M University*

In general quantum biophotonics is a hot topic and various examples will be given. As a case in point, some time ago we used quantum coherence (FAST CARS) to detect anthrax [PNAS (2002); Science (2007)]. For the past months we have been researching the application of, e.g., quantum coherence and quantum entanglement to detect COVID-19 antibodies [APL (2020)] and map the surface of a single COVID-19 virus [PNAS (2020)] using FAST CARS with Enhanced Resolution (FASTER CARS).

Authors: Marlan Scully, Texas A&M University

JTu1R.2

Biophotonics - a Game Changer in Covid-19 Diagnostics

Invited

Presenter: Juergen Popp, *Friedrich-Schiller-Universität Jena*

<p style="margin: 0px 48px;">We will introduce two promising SARS-CoV2-diagnostic tools with specially tailored sampling approaches which are focussed on I) fast bead-based approach for direct pathogen detection and II) characterization of the host response applying Raman spectroscopic techniques.</p>

Authors: Juergen Popp, Friedrich-Schiller-Universität Jena

JTu1R.3

(Withdrawn) COVID-19 Detection in Air Using Micro-Fabricated Whispering Gallery Mode Ring Resonators

Presenter: Jaime da Silva, *Southern Methodist University*

A detection approach for the SARS-CoV-2 virus in air using an optical ring resonator is presented. The aim is to detect a single airborne virus particle and quantify the resulting WGM shift.

Authors: Jaime da Silva, Southern Methodist University / Elie Salameh, Southern Methodist University / Danyal Ahsanullah, Southern Methodist University / Prasanna Rangarajan, Southern Methodist University / Kevin Brenner, Southern Methodist University / Bruce Gnade, Southern Methodist University / Volkan Ötügen, Southern Methodist University / Dominique Fourquette, Southern Methodist University

JTu1R.4

Tracking of Individual Nano-Objects Inside Hollow Core Fibers on the Example SARS-CoV-2

Presenter: Ronny Förster, *Leibniz Institute of Photonic Technology*

We tracked unlabeled SARS-CoV-2 viruses inside a hollow core optical fiber by elastic light scattering. The simultaneous confinement of particles and light leads to intense scattering, long trajectories and consequently a precise nanoparticle tracking analysis.

Authors:Ronny Förster, Leibniz Institute of Photonic Technology / Torsten Wieduwilt, Leibniz Institute of Photonic Technology / Mona Nissen, Leibniz Institute of Photonic Technology / Markus Schmidt, Leibniz Institute of Photonic Technology

JTu1R.5

Direct Observation of Blood Clots in COVID-19 Patients by High-Throughput Imaging and AI

Invited

Presenter: Keisuke Goda , *University of Tokyo*

Blood clotting is one of the leading causes of death in COVID-19. Here we demonstrate high-throughput imaging and deep-learning-based analysis of blood clots circulating in the blood of COVID-19 patients for early detection of thrombosis.

Authors:Yuqi Zhou, University of Tokyo / Masako Nishikawa, University of Tokyo / Tinghui Xiao, University of Tokyo / Hiroshi Kanno, University of Tokyo / Yutaka Yatomi, University of Tokyo / Keisuke Goda, University of Tokyo

7:00 - 7:20 (Pacific Time (US & Canada) DST, UTC - 07:00)

Exhibit Hall Event - Technology Showcase: A Comprehensive Simulation Environment for Active and Passive Photonic Component Design

Photon Design: This presentation will introduce you to Photon Design's innovative simulation tools for the design of photonic components including silicon photonics, AWGs and other waveguide components, semiconductor lasers, optical modulators, as well as complete photonic integrated circuits. Speaker: Dominic Gallagher, Photon Design, UK

7:20 - 7:40 (Pacific Time (US & Canada) DST, UTC - 07:00)

Exhibit Hall Event - Technology Showcase: AIM Photonics Integrated Silicon Photonic Chip Fabrication and Test, Assembly & Packaging Offerings

AIM Photonics: Join us for the latest updates in electronic-photonic design automation, multi project wafer platform offering, as well as test, assembly, and packaging. Learn how this PIC ecosystem enables quick turn photonic development through proof of concept, validation, qualification, and commercialization under one national institute, ensuring manufacturing readiness for years to come. Speaker: David Hame, AIM Photonics, USA

7:40 - 8:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Exhibit Hall Event - Technology Showcase: New Interoperable Software Platform for the Design of Photonic Devices

VPIphotonics: As a leader in photonic design automation for components, systems and networks, we will introduce a new interoperable software platform for the design of photonic devices, empowering researchers to explore new designs for photonic integrated circuit (PIC) passive components and optical fibers. This new platform streamlines the migration of device-level simulation data into a circuit-level simulator for the design and optimization of PICs. We will give an overview of the new platform and describe how it fits into our current ecosystem of photonic design and simulation tools. Speakers: Chris Maloney and Eugene Sokolov, VPIphotonics, USA

8:00 - 9:45 (Pacific Time (US & Canada) DST, UTC - 07:00)

FTu2K

Thermal Effects in Nano-optics for Thermal Radiation

Presenter: Peter Catrysse , *Stanford University*

FTu2K.1

Picometric Ballistic (non-Brownian) Thermal Movements in Photonic Nanostructures

Presenter: Tongjun Liu , *University of Southampton*

Components of photonic nanostructures exhibit picometric thermal movements affecting their optical properties. We report the first observation of ballistic (non-Brownian) thermal motion of a microcantilever, at timescales shorter than those of the erratic Brownian regime.

Authors: Tongjun Liu, University of Southampton / Jun-Yu Ou, University of Southampton / Kevin MacDonald, University of Southampton / Nikolay Zheludev, University of Southampton

FTu2K.2

(Withdrawn) Photothermal Response of Single Gold Nanoparticles Through Hyperspectral Imaging Anti-Stokes Thermometry

Presenter: Mariano Barella , *CIBION - CONICET*

We present an implementation of anti-Stokes thermometry that is potentially applicable to any nanoparticle with detectable photoluminescence, requires no assumption or previous characterization of the nanoparticle, and delivers the photothermal coefficient of the nanoscopic system.

Authors: Mariano Barella, CIBION - CONICET / Ianina Violi, CIBION - CONICET / Julian Gargiulo, Ludwig-Maximilians-Universität München / Luciana Martinez, CIBION - CONICET / Florian Goschin, Ludwig-Maximilians-Universität München / Victoria Guglielmotti, UNSAM / Diego Pallarola, UNSAM / Sebastian Schlücker, University of Duisburg-Essen / Mauricio Pilo-Pais, University of Fribourg / Guillermo Acuna, University of Fribourg / Stefan Maier, Ludwig-Maximilians-Universität München / Emiliano Cortes, Ludwig-Maximilians-Universität München / Fernando Stefani, CIBION - CONICET

FTu2K.3

(Withdrawn) Thermal Effects - an Alternative Mechanism for Plasmon-Assisted Photocatalysis

Presenter: Yonatan Sivan , *Ben-Gurion University*

We show that the claims in some of the most famous papers on the topic of plasmon-assisted photocatalysis are extremely unlikely to be correct and that the faster reactions are likely the result of heating.

Authors: Yonatan Dubi, Ben-Gurion University / Joshua Baraban, Ben-Gurion University / Ieng-Wai Un, Ben-Gurion University / Yonatan Sivan, Ben-Gurion University

FTu2K.4

Analysis of Dissipation Mechanisms and Thermal Dynamics in Nanophotonic Resonators Using Thermo-Optical Effect

Presenter: MingKang Wang , *NIST*

We present a robust method to distinguish the absorption loss from other loss mechanisms in a nanophotonic resonator by characterizing its thermo-optical nonlinearity. Using this method, we analyze ten modes of drastically different quality-factors.

Authors: MingKang Wang, NIST / Diego Perez-Morelo, NIST / Vladimir Aksyuk, NIST

FTu2K.5

Optothermal Generation and Manipulation of Plasmons in Atomically Thin Films

Presenter: Eduardo Dias , *ICFO - The Institute of Photonic Sciences*

We demonstrate the ability of graphene and thin metal films to undergo ultrafast photothermal optical modulation under pump-probe conditions, with depths as large as >70% over a wide spectral range.

Authors: Eduardo Dias, ICFO - The Institute of Photonic Sciences / Renwen Yu, ICFO - The Institute of Photonic Sciences / Javier García de Abajo, ICFO - The Institute of Photonic Sciences

FTu2K.6

Solution-Processed Plasmonic Surfaces as Optical Components for Infrared Thermography

Presenter: Jyotirmoy Mandal , *University of California, Los Angeles*

Plasmonic nanoparticle-coated metal substrates, created with common materials and scalable fabrication techniques, yield solar absorptance and LWIR reflectance comparable to yields of standard germanium-based optics used in thermography, but at a fraction of the cost.

Authors: Jyotirmoy Mandal, University of California, Los Angeles / John Brewer, University of California, Los Angeles / Sagar Mandal, Independent Researcher / Aaswath Raman, University of California, Los Angeles

FTu2K.7

Impact of Nonlocality on Polar Nanophotonics

Presenter: Christopher Gubbin , *University of Southampton*

In nanoscale polar resonators local theories of the optical response can break down. Here we develop theories to understand these effects, demonstrating novel phononphoton interactions with applications in mid-infrared nanophotonics and optoelectronics.

Authors: Christopher Gubbin, University of Southampton / Simone De Liberato, University of Southampton

8:00 - 10:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FTu2N

Integrated Quantum Photonics

Presenter: Sonia Buckley , *National Inst of Standards & Technology*

FTu2N.1

Integrated Quantum Optics: Photon Pairs and Beyond

Tutorial

Presenter: John Sipe , *University of Toronto*

We present a tutorial overview of the quantum nonlinear optics of integrated optical structures, and consider the challenges and opportunities that arise in the generation of non-classical states of light in such devices.

Authors: John Sipe, University of Toronto

FTu2N.2

Near-Ideal Heralded Single Photons in Silicon

Presenter: Stefano Signorini , *University of Trento*

Single photons for quantum computing should be pure, indistinguishable and available in a large amount on the same chip. By using pump-delayed intermodal spontaneous four wave mixing we demonstrated the first source of heralded single photons meeting all these requirements on a silicon chip.

Authors: Stefano Signorini, University of Trento / Stefano Paesani, University of Bristol / Massimo Borghi, University of Trento / Alexandre Mainos, University of Bristol / Lorenzo Pavesi, University of Trento / Anthony Laing, University of Bristol

FTu2N.3

Integration of a Visible-Telecom PPKTP Photon Pair Source With Silicon Integrated Photonics

Presenter: Vijay Soorya Shunmuga Sundaram , *Rochester Institute of Technology*

We demonstrate integration of periodically-poled KTP waveguides generating visible-telecom wavelength photon pairs with Photonic Integrated Circuits, bridging visibly-accessed quantum technologies and telecom infrastructure. High pair rates, heralding and telecom-filterless operation are demonstrated.

Authors: Vijay Soorya Shunmuga Sundaram, Rochester Institute of Technology / Evan Manfreda, Rochester Institute of Technology / Todd Hawthorne, AdvR Inc. / Tony Roberts, AdvR Inc. / Thomas Palone, Rochester Institute of Technology / Venkatesh Deenadayalan, Rochester Institute of Technology / Chamithri Adikarige, Rochester Institute of Technology / Mario Ciminelli, Rochester Institute of Technology / Phil Battle, AdvR Inc. / John Serafini, Rochester Institute of Technology / Gregory Howland, Rochester Institute of Technology / Stefan Preble, Rochester Institute of Technology

FTu2N.4

Suppression of Nonlinear Parasitic Processes in Linearly Uncoupled Silicon Resonators

Presenter: Federico Sabattoli , *University of Pavia*

We report on the suppression of nonlinear parasitic processes affecting dual-pump spontaneous four-wave mixing in ring resonators. We measure an enhancement of over 10^4 in the signal-to-noise ratio with respect to conventional ring resonators.

Authors: Federico Sabattoli, University of Pavia / Houssein El Dirani, ST Microelectronics / Laurène Youssef, LMT CNRS / Francesco Garrisi, University of Pavia / Davide Grassani, University of Pavia / Camille Petit-Etienne, LMT CNRS / Erwine Pargon, LMT CNRS / John Sipe, University of Toronto / Marco Liscidini, University of Pavia / Corrado Sciancalepore, SOITEC SA / Daniele Bajoni, University of Pavia / Matteo Galli, University of Pavia

FTu2N.5

Two-Photon Quantum Walks in Su-Schrieffer-Heeger Lattices

Presenter: Friederike Klauck, *Universität Rostock*

We experimentally study quantum correlations in two-photon quantum walks at the edges of Su-Schrieffer-Heeger waveguide lattices. In these systems, topological protection serves to systematically enhance the broadening of the state compared to the trivial edge.

Authors: Friederike Klauck, Universität Rostock / Matthias Heinrich, Universität Rostock / Alexander Szameit, Universität Rostock

FTu2L

Non-Hermitian Photonics

Presider: Christelle Monat

FTu2L.1

Nonlinear Control of PT-Symmetry and Topological States

Presenter: Shiqi Xia, *Teda College of Nankai University*

We demonstrate that optical nonlinearity can effectively modulate the loss of a topological defect waveguide in a non-Hermitian photonic lattice, leading to switching between PT and non-PT-symmetric regimes and control of topological zero modes.

Authors: Shiqi Xia, Teda College of Nankai University / Dimitrios Kaltsas, University of Crete / Daohong Song, Teda College of Nankai University / Ioannis Komis, University of Crete / Jingjun Xu, Nankai University / Alexander Szameit, Universität Rostock / Hrvoje Buljan, Nankai University / Konstantinos Makris, University of Crete / Zhigang Chen, Teda College of Nankai University

FTu2L.2

Towards a Common Path Photonic Emulator for Dynamically Encircling an Exceptional Point

Presenter: Hadiseh Nasari , *University of Southern California*

We report on the first implementation of a photonic emulator platform upon which dynamic encirclement of an exceptional point can be observed. Using two polarization states, an omnipolarizer is realized based on chiral mode conversion.

Authors:Hadiseh Nasari, University of Southern California / Gisela Lopez-Galmiche, University of Central Florida / Helena E. Lopez Aviles, University of Central Florida / Absar Ulhassan, University of Central Florida / Alexander Schumer, Vienna University of Technology / Patrick L. LiKamWa, University of Central Florida / Mercedeh Khajavikhan, University of Southern California / Demetrios Christodoulides, University of Central Florida

FTu2L.3

Exceptional Point Dispersion Engineering

Presenter: Ali Eshaghian Dorche , *Georgia Institute of Technology*

Exceptional point in a passive coupled optical microresonator structure is studied for dispersion engineering. Combined with oscillating coupling coefficients in the coupled-resonator architecture, periodic exceptional points are formed for better dispersion management.

Authors:Ali Eshaghian Dorche, Georgia Institute of Technology / Mohammad Ali Miri, Queens College of the City University of New York / Ali Asghar Eftekhar, Georgia Institute of Technology / Ali Adibi, Georgia Institute of Technology

FTu2L.4

Exceptional Points in a Time-Delayed Anti-Parity-Time Symmetric System

Presenter: Andrew Wilkey , *IUPUI*

We report on the experimental realization of an anti-PT symmetric system in a pair of time-delay coupled semiconductor lasers, and via numerical and analytical modeling investigate the properties of exceptional points in it.

Authors:Andrew Wilkey, IUPUI / Yogesh Joglekar, IUPUI / Gautam Vemuri, IUPUI

FTu2L.5

Observation of the Fermi Pasta Ulam Recurrences Multiple Symmetry Breakings Triggered by Optical Fiber Losses

Presenter: Guillaume Vanderhaegen , *PhLAM - CNRS*

We experimentally investigate the influence of optical fiber loss on the dynamics of the FPU process. We show that the symmetry of the FPU process can be broken several times by tuning the fiber loss value.

Authors:Guillaume Vanderhaegen, PhLAM - CNRS / Pascal Szriftgiser, PhLAM - CNRS / alexandre kudlinski, PhLAM - CNRS / Matteo Conforti, PhLAM - CNRS / Stefano Trillo, University of Ferrara / Arnaud Mussot, PhLAM - CNRS

FTu2L.6**Laser Cooling of Ytterbium-Doped Silica Glass by More Than 6 Kelvin**

Presenter: Arash Mafi , *University of New Mexico*

We report nearly an order of magnitude improvement over the lowest temperature achieved in laser-cooling of Yb-doped silica glass. The 6K cooling relative to the ambient temperature was achieved by pumping the sample at 1035nm.

Authors:Mostafa Peysokhan, University of New Mexico / Saeid Rostami, University of New Mexico / Esmaeil Mobini, University of New Mexico / Alexander Albrecht, University of New Mexico / Stefan Kuhn, Fraunhofer Institute for Applied Optics and Precision Engineering / Sigrun Hein, Fraunhofer Institute for Applied Optics and Precision Engineering / Christian Hupel, Fraunhofer Institute for Applied Optics and Precision Engineering / Johannes Nold, Fraunhofer Institute for Applied Optics and Precision Engineering / Nicoletta Haarlammert, Fraunhofer Institute for Applied Optics and Precision Engineering / Thomas Schreiber, Fraunhofer Institute for Applied Optics and Precision Engineering / Ramona Eberhardt, Fraunhofer Institute for Applied Optics and Precision Engineering / Angel Flores, Air Force Research Laboratory / Andreas Tünnermann, Fraunhofer Institute for Applied Optics and Precision Engineering / Mansoor Sheik-Bahae, University of New Mexico / Arash Mafi, University of New Mexico

FTu2L.7**Gain Induced Topological Response via Tailored Long-Range Interactions**

Presenter: Yuzhou Liu , *University of Southern California*

We report on the first observation of a gain-induced topological response in a photonic lattice exhibiting asymmetric long-range interactions enabled by unidirectional microrings under pumping. This new platform is used to implement the Haldane lattice.

Authors:Yuzhou Liu, University of Southern California / Pawel Jung, University of Central Florida, CREOL / Midya Parto, University of Central Florida, CREOL / Demetrios Christodoulides, University of Central Florida, CREOL / Mercedeh Khajavikhan, University of Southern California

FTu2L.8**Walk-off Induced Dissipative Quadratic Solitons in Degenerate Optical Parametric Oscillators**

Presenter: Arkadev Roy , *California Institute of Technology*

We demonstrate quadratic soliton formation in a synchronously pumped degenerate optical parametric oscillator displaying significant pulse compression leading to the formation of femtosecond pulses at half-harmonic from picosecond pump pulses.

Authors: Arkadev Roy, California Institute of Technology / Rajveer Nehra, California Institute of Technology / Saman Jahani, California Institute of Technology / Luis Ledezma, California Institute of Technology / Carsten Langrock, Stanford University / Martin Fejer, Stanford University / Alireza Marandi, California Institute of Technology

FTu2J

THz and Frequency Comb Photonics

Presider: Matthias Heinrich, *University of Rostock*

FTu2J.1

Time-Domain Integration of Terahertz Pulses

Presenter: Alessandro Tomasino, *INRS-EMT*

We report on the time-domain integration of terahertz pulses obtained via the tight confinement of the radiation in a tapered two-wire waveguide. Both simulation and experimental results prove the time integration capability of this structure

Authors: Alessandro Tomasino, INRS-EMT / Giacomo Balistreri, INRS-EMT / Junliang Dong, INRS-EMT / Aycan Yurtsever, INRS-EMT / Salvatore Stivala, University of Palermo / Jose Azana, INRS-EMT / Roberto Morandotti, INRS-EMT

FTu2J.2

Terahertz Generation From Curved Two-Color Filaments Induced by 2D Airy Wave Packets

Presenter: Anastasios Koulouklidis, *IESL, FORTH*

We report on THz generation from curved filaments produced by 2D Airy wave packets. Due to the curvature of the plasma channel, non-concentric THz beams with different polarizations are generated.

Authors: Anastasios Koulouklidis, IESL, FORTH / Dimitris Mansour, IESL, FORTH / Dimitris Papazoglou, IESL, FORTH / Stelios Tzortzakis, IESL, FORTH

FTu2J.3

Overcoming the Manley-Rowe Limit for CW Terahertz Generation in Q-Engineered Multimodal Cavity

Presenter: Yannick Salamin, *Massachusetts Institute of Technology*

We present a method to overcome the Manley-Rowe limit in a Q -factor engineered multimodal nonlinear cavity. Cascading nonlinear processes enable continuous-wave terahertz generation with a theoretical conversion efficiency of 98.8%.

Authors: Yannick Salamin, Massachusetts Institute of Technology / Charles Roques-Carmes, Massachusetts Institute of Technology / Zin Lin, Massachusetts Institute of Technology / Steven Johnson, Massachusetts Institute of Technology / Marin Soljačić, Massachusetts Institute of Technology

FTu2J.4

Ultrafast THz Self-Action Graphene Based Modulators

Presenter: Anastasios Koulouklidis , *IESL, FORTH*

We demonstrate an ultrafast self-induced terahertz absorption modulator operating at 2.3 THz. A modulation of 50 dB is observed in the absorption when the THz field strength increases from 145 to 654 kV/cm.

Authors: Anastasios Koulouklidis, IESL, FORTH / Eudokia Kyriakou, IESL, FORTH / Christina Daskalaki, IESL, FORTH / Muhammed Said Ergoktas, University of Manchester / Anna Tasolamprou, IESL, FORTH / Maria Kafesaki, IESL, FORTH / Coskun Kocabas, University of Manchester / Stelios Tzortzakis, IESL, FORTH

FTu2J.5

Phase-Matching-Free Two-Color Terahertz Emission From Quasi-2D Media

Presenter: Juan Sebastian Toterogongora , *EPic Laboratory, University of Sussex*

We provide the first demonstration of two-color optical rectification from semiconductors in an extreme absorption regime. The THz generation is free from phase-matching constraints due to the confinement of the interaction within a 25-atomic-layer region.

Authors: Juan Sebastian Toterogongora, EPic Laboratory, University of Sussex / Luke Peters, EPic Laboratory, University of Sussex / Jacob Tunesi, EPic Laboratory, University of Sussex / Vittorio Cecconi, EPic Laboratory, University of Sussex / matteo clerici, University of Glasgow / Alessia Pasquazi, EPic Laboratory, University of Sussex / Marco Peccianti, EPic Laboratory, University of Sussex

FTu2J.6

Carrier-Envelope Phase Dependence of High-Harmonics Generated With a Frequency Comb

Presenter: Daniel Lesko , *University of Colorado Boulder*

Utilizing a robust few-cycle Er: fiber comb source, we demonstrate solid state HHG in ZnO at 100 MHz. We measure the carrier-envelope phase dependence of the UV harmonic generation with >85 dB of dynamic range.

Authors: Daniel Lesko, University of Colorado Boulder / Thomas Allison, Stony Brook University / Scott Diddams, NIST

FTu2J.7

Toward a Tunable VUV Frequency Comb for ^{229m}Th Nuclear Spectroscopy

Presenter: Chuankun Zhang, *National Institute of Standards and Technology*

We constructed a Yb: fiber frequency comb for the generation of a vacuum-ultraviolet frequency comb via 7th harmonic generation. The spectral coverage and the noise performance of this comb are tailored for probing the ^{229m}Th nuclear transition.

Authors: Chuankun Zhang, National Institute of Standards and Technology / Peng Li, IMRA America, Inc. / Jie Jiang, IMRA America, Inc. / Lars von der Wense, National Institute of Standards and Technology / Martin Fermann, IMRA America, Inc. / Jun Ye, National Institute of Standards and Technology

FTu2J.8

Octave-Spanning Dissipative Kerr Soliton Frequency Comb in an AlN Microring Resonator

Presenter: Haizhong Weng, *Trinity College Dublin*

An octave-spanning Kerr soliton comb (1100-2300 nm) is successfully demonstrated in an AlN microring resonator, with a record single soliton step of ~67 pm (8 GHz), at an on-chip power of 350 mW.

Authors: Haizhong Weng, Trinity College Dublin / Jia liu, Huazhong University of Science and Technology / Adnan Ali Afridi, Trinity College Dublin / Jing Li, Trinity College Dublin / Jiangnan Dai, Huazhong University of Science and Technology / Yi Zhang, Huazhong University of Science and Technology / Qiaoyin Lu, Huazhong University of Science and Technology / John Donegan, Trinity College Dublin / weihua guo, Huazhong University of Science and Technology

FTu2O

High-repetition-rate HHG and XFEL Sources

Presenter: Eric Cunningham, *SLAC National Accelerator Laboratory*

FTu2O.1

High-Flux Table-top Hard X-ray Source Driven by Femtosecond mid-Infrared Pulses at a 1 kHz Repetition Rate

Presenter: Azize Koç , *Max-Born-Institute*

Femtosecond X-ray pulses at 8 keV are generated at a 1 kHz repetition rate with a flux of up to 1.5×10^{12} photons/s. A multiple-stage optical parametric chirped-pulse amplifier (OPCPA) serves as driver providing 80 fs pulses at a center wavelength of 5 μm .

Authors: Azize Koç, Max-Born-Institute / Christoph Hauf, Max-Born-Institute / Michael Woerner, Max-Born-Institute / Lorenz von Grafenstein, Max-Born-Institute / Dennis Ueberschaer, Max-Born-Institute / Martin Bock, Max-Born-Institute / Uwe Griebner, Max-Born-Institute / Thomas Elsaesser, Max-Born-Institute

FTu20.2

a High-Repetition Rate Attosecond Pulse Source for Time-Resolved Coincidence Spectroscopy and Nanoscale Imaging

Presenter: Cord Arnold , *Lunds Universitet*

We present a high-repetition rate, attosecond light source, emitting controlled short trains of attosecond pulses. We apply this source to the study of photoionization of atoms using a 3D photoelectron/ion coincidence spectrometer.

Authors: Cord Arnold, Lunds Universitet / Sara Mikaelsson, Lunds Universitet / Jan Vogelsang, Lunds Universitet / Chen Guo, Lunds Universitet / Ivan Sytceвич, Lunds Universitet / Anne-Lise Viotti, Lunds Universitet / Fabian Langer, Lunds Universitet / Yu-Chen Cheng, Lunds Universitet / Saikat Nandi, Lunds Universitet / Anna Olofsson, Lunds Universitet / Robin Weissenbilder, Lunds Universitet / Johan Mauritsson, Lunds Universitet / Anne L'huillier, Lunds Universitet / Mathieu Gisselbrecht, Lunds Universitet

FTu20.3

Comparison of 100-kHz Near-IR and Mid-IR Driven High-Harmonic Generation in the Water Window

Presenter: Pierre-Alexis Chevreuil , *ETH Zurich*

We report the generation of water window harmonics (283-543 eV) with a 0.8- μm driver at 100 kHz repetition rate, and compare the results with high-harmonic generation at 2.2 μm .

Authors: Pierre-Alexis Chevreuil, ETH Zurich / Stefan Hrisafov, ETH Zurich / Fabian Brunner, ETH Zurich / Justinas Pupeikis, ETH Zurich / Christopher Phillips, ETH Zurich / Lukas Gallmann, ETH Zurich / Ursula Keller, ETH Zurich

FTu20.4

Attosecond Metrology at Seeded Free-Electron Lasers

Invited

Presenter: Giuseppe Sansone , *Albert-Ludwigs-Universität Freiburg*

I will introduce the challenges connected to the temporal characterization of attosecond waveforms at the free-electron laser FERMI and I will present experimental results on the first demonstration of programmable attosecond pulse trains.

Authors:Giuseppe Sansone, Albert-Ludwigs-Universität Freiburg

FTu20.5

Flash2020+: the New High Repetition Rate Coherent Soft X-ray Facility

Presenter: Enrico Allaria , *Deutsches Elektronen Synchrotron DESY*

With the ongoing upgrades FLASH2020+ will extend capabilities of existing Free-Electron-Lasers. Combining a superconducting electron-beam accelerator with a new external seeding scheme, FLASH2020+ will provide up to 1 MHz repetition rate highly coherent pulses.

Authors:Enrico Allaria, Deutsches Elektronen Synchrotron DESY / Martin Beye, Deutsches Elektronen Synchrotron DESY / Ingmar Hartl, Deutsches Elektronen Synchrotron DESY / Mehdi Mohammad Kazemi, Deutsches Elektronen Synchrotron DESY / Tino Lang, Deutsches Elektronen Synchrotron DESY / Lucas Schaper, Deutsches Elektronen Synchrotron DESY / Siegfried Schreiber, Deutsches Elektronen Synchrotron DESY

FTu20.6

Nonlinear Shaped Laser Pulses in the LCLS-II Photoinjector

Presenter: Nicole Neveu , *SLAC*

We present a novel nonlinear laser shaping technique to increase X-ray Free Electron Laser brightness and preliminary results estimate an improvement of 25% in emittance relative to the standard configuration of the LCLS-II.

Authors:Nicole Neveu, SLAC / Randy Lemons, SLAC / Joseph Duris, SLAC / Yuantao Ding, SLAC / Agostino Marinelli, SLAC / Christopher Mayes, SLAC / Charles Durfee, Colorado School of Mines / Sergio Carbajo, SLAC

FTu20.7

Femtosecond Slicing for the MHz Repetition Rate LCLS-II Free Electron Laser

Presenter: Joseph Duris , *SLAC*

We present a method to control the temporal profile of the LCLS-II X-ray free-electron laser by selectively heating parts of the electron beam with a spectrally shaped laser.

Authors:Joseph Duris, SLAC / Randy Lemons, SLAC / Zhen Zhang, SLAC / Yuantao Ding, SLAC / Agostino Marinelli, SLAC / Sergio Carbajo, SLAC

Metsurfaces and Wavefronts

Presider: Jie Gao , *Missouri Univ of Science & Technology*

FTu2M.1

Compact Incoherent Spatial Frequency Filtering Enabled by Metasurface Engineering

Presenter: Dean Hazineh , *Harvard*

A single-lens implementation of optoelectronic spatial frequency filtering for incoherent illumination is demonstrated utilizing metasurface engineering. By inverse-designing the phase on the metasurface, arbitrarily structured 2D filters are realized for depth-invariant, broadband operation.

Authors: Dean Hazineh, Harvard / Qi Guo, Harvard / Zhujun Shi, Harvard / Yao-Wei Huang, Harvard / Todd Zickler, Harvard / Federico Capasso, Harvard

FTu2M.2

Vectorial Holography and Polarization-Maintaining Metasurfaces

Presenter: Qinghua Song , *Université Cote d'Azur*

In this presentation, we will present a general method on the realization of vectorial holograms for polarization maintaining properties with unlimited bandwidth. We will also introduce a doublet metasurface design to compensate the angular dispersion.

Authors: Qinghua Song, Université Cote d'Azur / Samira Khadir, Université Cote d'Azur / Stéphane Vézian, Université Cote d'Azur / Benjamin Damilano, Université Cote d'Azur / Philippe de Mierry, Université Cote d'Azur / Virginie Brandli, Université Cote d'Azur / Sébastien Chenot, Université Cote d'Azur / Patrice Genevet, Université Cote d'Azur

FTu2M.3

Triple-Helix Tractor Beam Generation With a Dielectric Metasurface Pancharatnam-Berry Phase Hologram

Presenter: Jasper Cadusch , *University of Melbourne*

We present a silicon-based Pancharatnam-Berry (PB) phase metasurface hologram that produces a triple-helix solenoid tractor beam from a Gaussian input beam. Our metasurface has a >90% diffraction efficiency and >75% transmission. © 2020 The Authors

Authors: Jasper Cadusch, University of Melbourne / Dandan Wen, University of Melbourne / Jiajun Meng, University of Melbourne / Kenneth Crozier, University of Melbourne

FTu2M.4

Cascaded Metasurface Holograms for Optical Secret Sharing

Presenter: Thomas Zentgraf , *Paderborn University*

We demonstrate an all-optical solution for secret sharing based on metasurface holography. Metasurfaces are used as separable shares that reconstruct a secret after combination. The inherent alignment sensitivity can be used to build optical rulers.

Authors: Thomas Zentgraf, Paderborn University / Philip Georgi, Paderborn University / Wei Qunshuo, Beijing Institute of Technology / Basudeb Sain, Paderborn University / Christian Schlickriede, Paderborn University / Yongtian Wang, Beijing Institute of Technology / Lingling Huang, Beijing Institute of Technology

FTu2M.5

Color Splitting Micro-Metalenses for High-Sensitivity Color Image Sensors

Presenter: Masashi Miyata , *NTT Device Technology Labs*

We demonstrate polarization-independent micro-metalenses that sort primary colors within a high-density-pixel footprint. We also show their potential applicability to high-sensitivity color image sensors.

Authors: Masashi Miyata, NTT Device Technology Labs / Naru Nemoto, NTT Device Technology Labs / Kota Shikama, NTT Device Technology Labs / Fumihide Kobayashi, NTT Device Technology Labs / Toshikazu Hashimoto, NTT Device Technology Labs

FTu2M.6

Terahertz Achromatic in Airy Beams and Focusing

Presenter: Qing Cheng , *University of Shanghai for Science and Technology*

We design and fabricate a metasurface composed of silicon posts for the terahertz frequencies in transmission mode, and we experimentally demonstrate achromatic Airy beams and achromatic focusing.

Authors: Qing Cheng, University of Shanghai for Science and Technology / Ling Ma, University of Shanghai for Science and Technology / Juncheng Wang, University of Shanghai for Science and Technology / Songlin Zhuang, University of Shanghai for Science and Technology

FTu2M.7

Analysis of 56 Physically Unclonable Silicon Photonic Moiré Quasicrystal Interferometers

Presenter: Farhan Bin Tarik , *Clemson University*

We verify the uniqueness and unclonability of fifty-six optical devices of the exact same design, fabricated from silicon photonic moiré quasicrystal interferometers. Such structures show promise for cryptographic applications such as hardware authentication and identification.

Authors: Farhan Bin Tarik, Clemson University / Azadeh Famili, Clemson University / Yingjie Lao, Clemson University / Judson Ryckman, Clemson University

FTu2M.8**Designing Arbitrarily Large Metasurfaces Using Inverse Mapping Technique**

Presenter: Mahdad Mansouree , *University of Massachusetts Amherst*

We introduce an inverse mapping technique to design efficient large-scale metasurfaces. A small metasurface is optimized using adjoint optimization, a design map is obtained using the optimization data and used for designing efficient large-scale metasurfaces.

Authors: Mahdad Mansouree, University of Massachusetts Amherst / Andrew McClung, University of Massachusetts Amherst / Amir Arbabi, University of Massachusetts Amherst

ATu2T**THz Sources and Applications**

Presenter: Edik Rafailov , *Aston University*

ATu2T.1**Quantum Engineering of Broadband Quantum Cascade THz Lasers Operating as Fully Stabilized Optical Frequency Comb Synthesizers**

Invited

Presenter: Miriam Vitiello , *Scuola Normale Superiore di Pisa*

This talk will review recent developments in engineering and devising novel highly efficient broadband QCL resonators, behaving as frequency combs at Terahertz frequencies, with record optical powers per mode and record dynamic range , with a special emphasis on novel integrated architectures.

Authors: Miriam Vitiello, Scuola Normale Superiore di Pisa

ATu2T.2**Compact Terahertz Imaging and Spectroscopic Systems Enabled by Quantum Dot Transceivers**

Invited

Presenter: Andrei Gorodetsky , *University of Birmingham*

InAs-GaAs quantum-dot based photoconductive antennas match perfectly with compact quantum-dot semiconductor lasers as pump sources, to open up the perspectives for terahertz pulsed and CW spectroscopy and imaging in ultra-compact room-temperature operating environment.

Authors: Andrei Gorodetsky, University of Birmingham

ATu2T.3**High Spectral Purity Chip-Scale Tunable THz Radiation Source**

Presenter: Wenting Wang , *University of California Los Angeles*

Broadly tunable THz radiation is generated at room temperature after injecting the tunable optical parametric oscillation emitted from a microresonator into a bias-free photomixer. The radiated THz wave features Hz-level linewidth and frequency stability.

Authors:Wenting Wang, University of California Los Angeles / Ping-Keng Lu, University of California Los Angeles / Abhinav Kumar Vinod, University of California Los Angeles / James McMillan, University of California Los Angeles / Mingbin Yu, State Key lab of functional materials for informatics / Dim-Lee Kwong, Institute of Microelectronics / Mona Jarrahi, University of California Los Angeles / Chee Wei Wong, University of California Los Angeles

ATu2T.4**On-Chip Multi-Layer THz Power Generation With Beamforming Capability**

Presenter: Hooman Saeedi , *Princeton University*

We propose a novel on-chip multi-layer coupled oscillator scheme to generate THz power using industry standard 65-nm CMOS process. The scalable architecture enables to generate 14 dBm EIRP in a lensless setup with beamforming capability of ± 30 degrees at 416 GHz.

Authors:Hooman Saeedi, Princeton University / Suresh Venkatesh, Princeton University / Xuyang Lu, Princeton University / Kaushik Sengupta, Princeton University

ATu2T.5**Terahertz Quantum Cascade Amplifier With Optical Threshold**

Presenter: Michael Jaidl , *TU Wien Photonics Institute*

A Terahertz optical amplifier based on a Quantum Cascade laser structure with a lossy double-metal cavity is demonstrated. Amplification appears only above a certain threshold and an amplification of ~ 17 dB is achieved.

Authors:Martin Kainz, TU Wien Photonics Institute / Michael Jaidl, TU Wien Photonics Institute / Benedikt Limbacher, TU Wien Photonics Institute / Dominik Theiner, TU Wien Photonics Institute / Miriam Giparakis, TU Wien / Maximilian Beiser, TU Wien / Aaron Andrews, TU Wien / Gottfried Strasser, TU Wien / Karl Unterrainer, TU Wien Photonics Institute

ATu2T.6**InP Integrated Photonic Circuit for Terahertz Spectroscopy up to 4.1 THz Bandwidth Based on Sampled Grating Lasers**

Presenter: Moon-Hyeok Lee , *Fraunhofer Heinrich Hertz Institute*

We present a photonic integrated circuit (PIC) for terahertz spectroscopy up to 4.1 THz comprising two SG DBR lasers and passive building blocks. The PIC has been realized on the HHI InP generic foundry platform.

Authors: Moon-Hyeok Lee, Fraunhofer Heinrich Hertz Institute / Simon Nellen, Fraunhofer Heinrich Hertz Institute / Francisco Soares, Soares Photonics / Martin Moehrle, Fraunhofer Heinrich Hertz Institute / Wolfgang Rehbein, Fraunhofer Heinrich Hertz Institute / Moritz Baier, Fraunhofer Heinrich Hertz Institute / Martin Schell, Fraunhofer Heinrich Hertz Institute

ATu2S

Quantum Sensing

Presenter: Ying-Ju Wang, *ColdQuanta*

ATu2S.1

Quantum Sensing From Lab to Market: the Example of Qnami ProteusQ

Invited

Presenter: Mathieu Munsch, *Qnami*

Science is experiencing a quantum revolution with astonishing potential for innovation. We present here a new quantum microscope based on NV center technology and show how it's already used today to advance research in materials science and spintronics. We review challenges specific to developing quantum technologies and highlight further opportunities in quantum sensing.

Authors: Mathieu Munsch, Qnami

ATu2S.2

Rydberg Atom Sensors: SI Traceability, Phase Detection, and Other Unique and Unforeseen Applications

Invited

Presenter: Christopher Holloway, *National Institute of Standards and Technology (NIST)*

NIST and other groups have made great progress in the development of Rydberg atom-based RF E-field sensors. Various applications are beginning to emerge: SI-traceable E-field probes, power-sensors, voltage standards, BBR detection, receivers for communication signals, and many other applications.

Authors: Christopher Holloway, National Institute of Standards and Technology (NIST)

ATu2S.3

(Withdrawn) Mid-Infrared Optical Coherence Tomography in the Frequency Domain With Undetected Photons

Presenter: Sven Ramelow , *Humboldt Universität zu Berlin*

Mid-infrared OCT with entangled photons can make mid-IR sources and detectors obsolete and thus reduce complexity, footprint and price: with our proof-of-concept at 3.8 μm we demonstrate 10 μm depth-resolution and shot-noise limited 69 dB/s SNRs.

Authors: Aron Vanselow, Humboldt Universität zu Berlin / Helen M Chrzanowski, Humboldt Universität zu Berlin / Paul Kaufmann, Humboldt Universität zu Berlin / Ivan Zorin, Research Center for Non-Destructive Testing GmbH / Bettina Heise, Research Center for Non-Destructive Testing GmbH / Sven Ramelow, Humboldt Universität zu Berlin

ATu2S.4

Widefield Super-Sensitive Phase Imaging Using NOON State Illumination

Presenter: Robin Camphausen , *ICFO*

We present a widefield quantum polarised light microscope, illuminating with a NOON state ($N=2$) and imaging using a SPAD array camera. Compared to classical imaging we show that sensitivity improves by a factor of 1.31.

Authors: Robin Camphausen, ICFO / Álvaro Cuevas, ICFO / Valerio Pruneri, ICFO

ATu2S.5

Quantum Dot Single-Photon Emission Coupled Into Single-Mode Fibers With 3D Printed Micro-Objectives

Presenter: Ksenia Weber , *University of Stuttgart*

We demonstrate the on-chip integration of a deterministically fabricated quantum dot micro-lens, a 3D-printed micro-objective and a single-mode fiber-coupler. The resulting quantum device has a broadband photon extraction efficiency with a coupling efficiency of 22%.

Authors: Lucas Bremer, Technische Universität Berlin / Ksenia Weber, University of Stuttgart / Sarah Fischbach, Technische Universität Berlin / Simon Thiele, University of Stuttgart / Marco Schmidt, Technische Universität Berlin / Arsenty Kaganskiy, Technische Universität Berlin / Sven Rodt, Technische Universität Berlin / Alois Herkommer, University of Stuttgart / Marc Sartison, University of Stuttgart / Simone Portalupi, University of Stuttgart / Peter Michler, University of Stuttgart / Harald Giessen, University of Stuttgart / Stephan Reitzenstein, Technische Universität Berlin

STu2G

Integrated Microcombs

Presenter: Jaime Cardenas , *University of Rochester*

STu2G.1

Octave-Spanning Lithium Niobate Soliton Microcombs

Highlighted Talk

Presenter: Yang He , *University of Rochester*

We report lithium niobate soliton microcombs with spectral bandwidths exceeding one octave and spanning 125~THz to 268~THz.

Authors:Yang He, University of Rochester / Raymond Lopez-Rios, University of Rochester / Qifan Yang, California Institute of Technology / Jingwei Ling, University of Rochester / Mingxiao Li, University of Rochester / Kerry Vahala, California Institute of Technology / Qiang Lin, University of Rochester

STu2G.2

High-Efficiency and Broadband Electro-Optic Frequency Combs Using Coupled Lithium-Niobate Microresonators

Presenter: Yaowen Hu , *Harvard University*

We demonstrate an electro-optic frequency comb source, based on coupled lithium niobate microresonators, with a factor of 100× higher pump-to-comb conversion efficiency (30%) and 2.4× broader optical bandwidth (117 nm), as compared to the previous broadest electro-optic frequency comb.

Authors:Yaowen Hu, Harvard University / Mengjie Yu, Harvard University / Brandon Buscaino, Stanford University / Neil Sinclair, Harvard University / Di Zhu, Harvard University / Amirhassan Shams-Ansari, Harvard University / Linbo Shao, Harvard University / Mian Zhang, HyperLight Corp. / Joseph Kahn, Stanford University / Marko Loncar, Harvard University

STu2G.3

Raman-Kerr Combs in High-Q Chalcogenide Microresonators Coupled to Silicon Waveguides

Presenter: Philippe Jean , *Laval University*

We report the observation of Kerr frequency combs and Raman lasing in a high- Q ($Q>1.5e6$) $As_{20}S_{80}$ microresonator monolithically integrated with silicon-on-insulator waveguide.

Authors:Philippe Jean, Laval University / Alexandre Douaud, Laval University / Sophie Larochelle, Laval University / Younès Messaddeq, Laval University / Wei Shi, Laval University

STu2G.4

Mode-Locked Dark-Pulse Kerr Combs in Normal-Dispersion AlGaAs-on-Insulator Microresonators

Presenter: Haowen Shu , *Peking University*

We demonstrate dark-pulse Kerr combs from a high-Q Al_{0.2}Ga_{0.8}As-on-insulator microresonator with normal dispersion. Low-noise combs are achieved for the first time at room temperature in this efficient platform, with low pump power of <5 mW.

Authors:Haowen Shu, Peking University / Bitao Shen, Peking University / Lin Chang, University of California, Santa Barbara / Weiqiang Xie, University of California, Santa Barbara / Jun Qin, Peking University / Ming Jin, Peking University / Xuguang Zhang, Peking University / Xingjun Wang, Peking University / John Bowers, University of California, Santa Barbara

STu2G.5

Efficient Passive Signal Linewidth Narrowing by Q-Engineered $\chi^{(2)}$ Parametric Oscillators

Presenter: Dorde Gluhovic , *Boston University*

We extend our proposal of efficient passive "noise eaters" based on Q-engineered Kerr OPOs to $\chi^{(2)}$ systems, which could approach 100% conversion efficiency. We show that existing state-of-the-art integrated devices can implement significant passive signal linewidth narrowing using this concept.

Authors:Dorde Gluhovic, Boston University / MANUJ KUMAR SINGH, Boston University / Cale Gentry, University of Colorado Boulder / Milos Popovic, Boston University

STu2G.6

Formation, Persistence and Statistics of Rogue Events in Microresonators

Presenter: Abhinav Vinod , *University of California Los Angeles*

We utilize a novel buffered time-lens architecture, panoramic-reconstruction temporal imaging (PARTI), to record long evolution portraits capturing the formation of rogue events. Further, we analyze the statistics of these events with regard to their persistence.

Authors:Abhinav Vinod, University of California Los Angeles / Wenting Wang, University of California Los Angeles / Futai Hu, University of California Los Angeles / Xinghe Jiang, University of California Los Angeles / Bowen Li, University of Colorado, Boulder / Chee Wei Wong, University of California Los Angeles

STu2G.7

Ultra-low Power Wavelength Conversion via Four-Wave Mixing in a Ge_{11.5}As₂₄Se_{64.5} Chalcogenide Microring Resonator

Presenter: Wei Jiang , *Corning Inc*

We demonstrate ultra-low power wavelength conversion via four-wave mixing in a $\text{Ge}_{11.5}\text{As}_{24}\text{Se}_{64.5}$ microring resonator with 20- μm radius. The results show conversion efficiency of -33.7 dB with only 63.8 μW pump power.

Authors: Wei Jiang, Corning Inc / Kangmei Li, Corning Inc / Xin Gai, City University of Hong Kong / Daniel Nolan, Corning Inc / Paulo Dainese, Corning Inc

STu2C

Nanophotonic Light Emitters on Chip

Presenter: Marina Radulaski , *University of California Davis*

STu2C.1

Phosphor-Free III-Nitride red Micro-Light Emitting Diodes for Display Applications

Presenter: Barsha Jain , *New Jersey Institute of Technology*

In this study, we report highly stable phosphor-free InGaN/AlGaIn spontaneously formed core-shell nanowire red micro-light emitting diodes (μLEDs) with $30 \times 30 \mu\text{m}^2$ mesa area directly grown on Si (111) substrates using molecular beam epitaxy.

Authors: Barsha Jain, New Jersey Institute of Technology / Ravi Teja Velpula, New Jersey Institute of Technology / Hieu Nguyen, New Jersey Institute of Technology

STu2C.2

Demonstration of Flexible DUV Light Emitting Diodes Through Formation of Nanowires With Inverse-Taper

Presenter: Bryan Melanson , *Rochester Institute of Technology*

AlGaIn nanowires with a novel "inverse taper" profile were fabricated and shown to allow for high-yield liftoff of nanowire arrays in a flexible medium, allowing for creation of flexible nanowire LEDs emitting at 270 nm.

Authors: Bryan Melanson, Rochester Institute of Technology / Matthew Hartensveld, Rochester Institute of Technology / Cheng Liu, Rochester Institute of Technology / Jing Zhang, Rochester Institute of Technology

STu2C.3

Electrically-Operated Buried-Heterostructure Nanocavity Laser With sub-20 μA Threshold Current

Presenter: Aurimas Sakanas , *Technical University of Denmark*

We demonstrate a lateral-current injection photonic crystal laser bonded to a Si-platform and comprising buried heterostructure InGaAsP/InGaAlAs quantum wells. The laser operates CW at room-temperature near 1550 nm with a threshold current of 19 μ A.

Authors: Aurimas Sakanas, Technical University of Denmark / Andrey Marchevsky, Technical University of Denmark / Evangelos Dimopoulos, Technical University of Denmark / Meng Xiong, Technical University of Denmark / Yi Yu, Technical University of Denmark / Kristoffer Mathiesen, Technical University of Denmark / Elizaveta Semenova, Technical University of Denmark / Jesper Mork, Technical University of Denmark / Kresten Yvind, Technical University of Denmark

STu2C.4

On-Chip Erbium-Doped Lithium-Niobate Microring Lasers

Presenter: qiang Luo , *NanKai University*

1550-nm continuous lasers with ~ 20 μ W threshold and stable performance were realized in erbium-doped integrated lithium niobate microrings with loaded quality factors higher than one million.

Authors: qiang Luo, NanKai University / Chen Yang, NanKai University / Ru Zhang, NanKai University / Zhenzhong Hao, NanKai University / Dahuai Zheng, NanKai University / Hongde Liu, NanKai University / Shiguo Liu, NanKai University / Fang Bo, NanKai University / Yongfa Kong, NanKai University / Guoquan Zhang, NanKai University / Jingjun Xu, NanKai University

STu2C.5

Integrated Perovskite Light Emitters

Invited

Presenter: Anna Lena Giesecke , *AMO GmbH*

Metal-halide perovskites are ideal candidates for optoelectronic on-chip devices. In this talk we will demonstrate our latest achievements in integration of perovskite light emitters into Back-end-of-line compatible photonic platforms (Si₃N₄).

Authors: Anna Lena Giesecke, AMO GmbH / Piotr Cegielski, AMO GmbH / Maik Lütticke, AMO GmbH / Stephan Suckow, AMO GmbH / Manuel Runkel, Lehrstuhl fuer Elektronische Bauelemente / Thomas Riedl, Lehrstuhl fuer Elektronische Bauelemente / Max Lemme, AMO GmbH

STu2C.6

Microcavity Lasers Directly Grown on Silicon

Presenter: Zhaoyu Zhang , *Chinese University of Hong Kong, Shenzhen*

Monolithic integration of ultra-compact III-V light sources on silicon is promising for the Si-based on-chip optical interconnects. Here, we present quantum dots microcavity lasers monolithically grown on silicon with ultra-low energy consumption.

Authors:Haochuan Li, Chinese University of Hong Kong, Shenzhen / Taojie Zhou, Chinese University of Hong Kong, Shenzhen / Zhan Zhang, Chinese University of Hong Kong, Shenzhen / Mingchu Tang, University College London / Siming Chen, University College London / Huiyun Liu, University College London / Zhaoyu Zhang, Chinese University of Hong Kong, Shenzhen

STu2C.7

Single-Mode Topological Valley-Hall Lasing Controlled by the Degree of Asymmetry at Telecommunication Wavelength

Presenter: wanwoo noh , *University of California Berkeley*

We report single-mode lasing of valley-Hall ring cavities. The degree of asymmetry in a honeycomb photonic crystal governs light confinement regimes in the valley-Hall cavity and enables efficient single-mode operation despite multiple modes.

Authors:wanwoo noh, University of California Berkeley / Hadiseh Nasari, University of California Berkeley / Hwi-min Kim, University of California Berkeley / Quynh Le-van, University of California Berkeley / Zhetao Jia, University of California Berkeley / Chi-hsin Huang, UC San Diego / Boubacar Kanté, University of California Berkeley

STu2H

Optomechanics

Presenter: Siddhartha Ghosh , *Northeastern University*

STu2H.1

Diamond Cavity Optomechanics: Interfacing Photons, Phonons, and Spins

Invited

Presenter: Paul Barclay , *University of Calgary*

Diamond cavity optomechanical devices allow coherent manipulation of phonons, enabling storage and switching of light via its coupling to highly coherent mechanical resonances. This photon-phonon interface also allows control of diamond spin quantum memories.

Authors:Paul Barclay, University of Calgary

STu2H.2

Quantum Optomechanics With Millimeter Wave Photons

Presenter: Bradley Hauer , *NIST Boulder*

We present a new millimeter wave optomechanical cavity intended to increase the vacuum optomechanical coupling rate towards the regime of single-photon quantum optomechanics.

Authors:Bradley Hauer, NIST Boulder / Katarina Cicak, NIST Boulder / Florent Lecocq, NIST Boulder / Raymond Simmonds, NIST Boulder / Jose Aumentado, NIST Boulder / John Teufel, NIST Boulder

STu2H.3

Topological Phonon Transport in an Optomechanical System

Presenter: Hengjiang Ren , *California Institute of Technology*

We report the observation of topological phonon transport within a optomechanical crystal structure. Using spatially resolved optical read-out, we detect thermal phonons in a 0.325-0.34 GHz band traveling along a topological edge channel, with substantial reduction in backscattering.

Authors:Hengjiang Ren, California Institute of Technology / Tirth Shah, Max Planck Institute for the Science of Light / Hannes Pfeifer, Max Planck Institute for the Science of Light / Christian Brendel, Max Planck Institute for the Science of Light / Vittorio Peano, Max Planck Institute for the Science of Light / Florian Marquardt, Max Planck Institute for the Science of Light / Oskar Painter, California Institute of Technology

STu2H.4

Piezo-Optomechanical Actuation of Nanobeam Resonators for Microwave-to-Optical Transduction

Presenter: BISWARUP GUHA , *NIST*

We demonstrate three methods for microwave actuation of GaAs nanobeam piezo-optomechanical resonators, based on IDTs, piezoelectric resonators, and micro-antenna probes. Potential applications of these devices range from bi-directional microwave-to-optical conversion to optomechanical thermometry.

Authors:BISWARUP GUHA, NIST / Marcelo Wu, University of Maryland / Jin Dong Song, KIST / Krishna Balram, University of Bristol / Kartik Srinivasan, NIST

STu2H.5

Integrated Discrete-Time Surface Acoustic Wave Photonic Radio-Frequency Filters With Arbitrary Tap Weights

Presenter: Moshe Katzman , *Bar-Ilan University*

Integrated, discrete time microwave filters are realized in surface acoustic wave photonics over standard silicon on insulator. The magnitude and phase of each tap are adjusted independently. Twelve-tap filters with 5 MHz bandwidth are demonstrated.

Authors: Moshe Katzman, Bar-Ilan University / Dvir Munk, Bar-Ilan University / Maayan Priel, Bar-Ilan University / Etai Grunwald, Bar-Ilan University / Mirit Hen, Bar-Ilan University / Avi Zadok, Bar-Ilan University

STu2H.6

Brillouin Detection of a Complete GHz Mechanical Band Gap

Presenter: Omar Florez , *Catalan Institute of Nanoscience and Nanotechnology (ICN2)*

We measure a full mechanical gap in the GHz regime for a 2D phononic crystal over the entire Brillouin zone using the noninvasive Brillouin light scattering technique. © 2020 The Author(s).

Authors: Omar Florez, Catalan Institute of Nanoscience and Nanotechnology (ICN2) / Guillermo Arregui, Catalan Institute of Nanoscience and Nanotechnology (ICN2) / Jordi Gomis Bresco, Catalan Institute of Nanoscience and Nanotechnology (ICN2) / Marcus Albrechtsen, Technical University of Denmark / Soren Stobbe, Technical University of Denmark / Clivia Stomayor Torres, Catalan Institute of Nanoscience and Nanotechnology (ICN2) / Pedro Garcia, Catalan Institute of Nanoscience and Nanotechnology (ICN2)

STu2H.7

Fluctuations and Correlations of Transmission Eigenchannels Within Diffusive Media

Presenter: Nicholas Bender , *Yale University*

We experimentally and numerically study the fluctuations and correlations of transmission eigenchannel profiles in diffusive media. We find that high-transmission profiles exhibit low realization-to-realization fluctuations and significant correlations exist between low-transmission profiles.

Authors: Nicholas Bender, Yale University / Alexey Yamilov, Missouri University of Science and Technology / Hasan Yilmaz, Yale University / Hui Cao, Yale University

STu2E

Beam Combining and Frequency Combs

Presenter: Ticijana Ban , *Institut za Fiziku*

STu2E.1

Coherent Combining of Ultrashort Pulse Fiber Lasers – Towards Multi-TW Peak and Multi-kW Average Powers

Tutorial

Presenter: Almantas Galvanauskas, *University of Michigan*

Coherent combining of multiple fiber lasers in space, time, and spectral domain overcomes power, energy, and pulse duration limitations of individual fiber lasers, enabling development of ultrashort pulse lasers with 10s of terawatts of peak and multiple kilowatts of average power for the next-generation laser plasma accelerators, and other advanced applications. This talk will review key technical innovations and the progress of coherent combining of femtosecond fiber lasers.

Authors: Almantas Galvanauskas, University of Michigan

STu2E.2

Design and Operation of Coherent Pulse Stacking Amplification as a Deep Recurrent Neural Network

Presenter: Mathew Whittlesey, *University of Michigan*

We show equivalence of coherent pulse stacking system to a deep recurrent neural network, and experimentally demonstrate real-time learning on stacking cavities and input pulses, necessary for high fidelity coherent temporal combining with ~100 pulses.

Authors: Hanzhang Pei, University of Michigan / Mathew Whittlesey, University of Michigan / Qiang Du, Lawrence Berkeley National Lab / Almantas Galvanauskas, University of Michigan

STu2E.3

2 μm all-Fiber Frequency Comb Providing Single Cycle Pulses and a 2-Octave Spectrum

Presenter: Sida Xing, *NIST*

We present a Tm: fiber frequency comb emitting 6.8 fs pulses centered at 1930 nm with 100 MHz repetition rate, 215 kW peak power and 374 mW average power. The output spectrum covers two octaves.

Authors: Sida Xing, NIST / Daniel Lesko, NIST / Alexander Lind, NIST / Scott Diddams, NIST

STu2E.4

Single-Cavity Dual-Comb Yb:CaF₂ Laser Pumped by a Single-Mode Laser Diode

Presenter: Daniel Koenen, *ETH Zurich*

We present a polarization-multiplexed Yb:CaF₂ dual-comb laser with 100-fs pulses at 161-MHz repetition-rate and 115-mW average power per comb pumped by a single-mode diode. We measure a high stability of the 1.15-kHz repetition-rate difference.

Authors: Daniel Koenen, ETH Zurich / Benjamin Willenberg, ETH Zurich / Justinas Pupeikis, ETH Zurich / Sandro Camenzind, ETH Zurich / Christopher Phillips, ETH Zurich / Ursula Keller, ETH Zurich

STu2E.5

Complete SESAM Characterization via Equivalent Time Sampling Using a Free-Running Dual-Comb Laser

Presenter: Alexander Nussbaum-Lapping, *ETH Zurich*

Through pump-probe measurements with a free-running dual-comb laser, we demonstrate the validity range of a two time constant dynamical model for SESAM dynamics, and use it to show the fluence dependence of the time constants.

Authors: Alexander Nussbaum-Lapping, ETH Zurich / Justinas Pupeikis, ETH Zurich / Benjamin Willenberg, ETH Zurich / Christopher Phillips, ETH Zurich / Ursula Keller, ETH Zurich

STu2Q

Large-Scale Photonic Integration

Presenter: Martin Cryan, *University of Bristol*

STu2Q.1

Silicon Photonic MEMS Phase Shifter With μ s Time Constant Built on a Foundry Platform

Presenter: Pierre Edinger, *KTH Royal Institute of Technology*

MEMS enable low power tuners in silicon photonics, but existing phase shifters lack in range, speed, and loss. We implement a 2π phase shifter with a 1.54 μ s time constant and 0.5 dB insertion loss in IMEC's iSiPP50G platform.

Authors: Pierre Edinger, KTH Royal Institute of Technology / Kristofer Kristinsson, KTH Royal Institute of Technology / Carlos Errando-Herranz, KTH Royal Institute of Technology / Alain Takabayashi, EPFL / Hamed Sattari, EPFL / Niels Quack, EPFL / Peter Verheyen, IMEC / Wim Bogaerts, Ghent University / Kristinn Gylfason, KTH Royal Institute of Technology

STu2Q.2

High-Yield, Wafer-Scale Fabrication of Ultralow-Loss, Dispersion-Engineered Silicon Nitride Photonic Circuits

Presenter: Junqiu Liu , *Ecole Polytechnique Federale de Lausanne*

For widespread applications of nonlinear photonic integrated circuits, ultralow optical losses and high fabrication throughput are required. Here, we present a CMOS fabrication technique for photonic microresonators with mean quality factors exceeding 30 millions and wafer-level yield.

Authors:Junqiu Liu, Ecole Polytechnique Federale de Lausanne / Guanhao Huang, Ecole Polytechnique Federale de Lausanne / Rui Wang, Ecole Polytechnique Federale de Lausanne / Jijun He, Ecole Polytechnique Federale de Lausanne / Arslan Raja, Ecole Polytechnique Federale de Lausanne / Tianyi Liu, Ecole Polytechnique Federale de Lausanne / Nils Johan Engelsen, Ecole Polytechnique Federale de Lausanne / Tobias Kippenberg, Ecole Polytechnique Federale de Lausanne

STu2Q.3

Foundry-Processed Optomechanical Mach-Zehnder Interferometers

Presenter: Marcel Pruessner , *US Naval Research Laboratory*

We demonstrate foundry-processed optomechanical Mach-Zehnder interferometers using standard process development kit components and a post-process release. Measurements show clear optical phase shifting. Pump-probe experiments demonstrate all-optical excitation and readout of mechanical resonances.

Authors:Marcel Pruessner, US Naval Research Laboratory / Dmitry Kozak, US Naval Research Laboratory / Nathan Tyndall, US Naval Research Laboratory / Todd Stievater, US Naval Research Laboratory / William Rabinovich, US Naval Research Laboratory

STu2Q.4

3D Printed Interconnects of Photonic Waveguides

Presenter: Johnny Moughames , *Institut FEMTO-ST*

We present scalable 3D photonic waveguide interconnects fabricated using two-photon polymerization. Interconnects comprise optical waveguide couplers with 1.2 μ m diameter, and we characterize numerous branching topologies. Finally, we demonstrate a 225 input and 529 output interconnect.

Authors:Johnny Moughames, Institut FEMTO-ST / Xavier Porte, FEMTO-ST / Maxime Jacquot, FEMTO-ST / Muamer Kadic, FEMTO-ST / Laurent Larger, FEMTO-ST / Daniel Brunner, FEMTO-ST

STu2Q.5

Large-Scale Optical Switches Based on Silicon Photonics

Invited

Presenter: Keijiro Suzuki , *National Institute of Advanced Industrial Science and Technology (AIST)*

We review our recent research progress of strictly non-blocking multi-port optical switches, focusing on optical and electrical packaging technologies based on flip-chip bonding and the detailed characteristics. Moreover, we discuss further improvements in switching performances.

Authors:Keijiro Suzuki, National Institute of Advanced Industrial Science and Technology (AIST) / Ryotaro Konoike, National Institute of Advanced Industrial Science and Technology (AIST) / Shu Namiki, National Institute of Advanced Industrial Science and Technology (AIST) / Hitoshi Kawashima, National Institute of Advanced Industrial Science and Technology (AIST) / Kazuhiro Ikeda, National Institute of Advanced Industrial Science and Technology (AIST)

STu2Q.6

PAM4 Transmission Experiment and Scalability Simulations on Multi-Wavelength Selective Crossbar Switch

Presenter: Akhilesh Khope , *University of California Santa Barbara*

We demonstrate a multi-wavelength selective crossbar switch with up to two wavelength switching capability per crosspoint. The switch has a mean path loss of 2.43 dB. We demonstrate an error free high speed PAM 4 transmission at 111.16 Gbps. We also report bounds on the port count of the switch.

Authors:Akhilesh Khope, University of California Santa Barbara / Songtao Liu, University of California Santa Barbara / Zeyu Zhang, University of California Santa Barbara / Andy Netherton, University of California Santa Barbara / Rebecca Hwang, University of California Santa Barbara / Aaron Wissing, University of California Santa Barbara / Jesus Perez, University of California Santa Barbara / Franklin Tang, University of California Santa Barbara / Clint Schow, University of California Santa Barbara / Roger Helkey, University of California Santa Barbara / Rod C Alferness, University of California Santa Barbara / Adel Saleh, University of California Santa Barbara / John Bowers, University of California Santa Barbara

STu2Q.7

InP Monolithically Integrated 1×8 Broadcast and Select Polarization Insensitive Switch for Optical Switching Systems

Presenter: Aref Rasoulzadehzali , *TUe*

For the first time we have designed and demonstrated polarization insensitive, high gain and broadband 1×8 broadcast and select switch suitable for optical packet switching system based on bulk SOAs integrated with passive elements.

Authors:Aref Rasoulzadehzali, TUe / Netsanet Tessema, TUe / Kristif Prifti, TUe / Steven Kleijn, Smart Photonics / Luc Augustin, Smart Photonics / Ripalta Stabile, TUe / Nicola Calabretta, TUe

Novel Communication Techniques and Devices

Presider: Magnus Karlsson , *Chalmers Tekniska Högskola*

STu2B.1

Bio-Inspired Photonics and Microwave Photonics for Dynamic and Smart RF Systems

Invited

Presenter: Mable Fok , *University of Georgia*

Bio-inspired and microwave photonics offer dynamic, natural, and effective solutions to tackle critical challenges in emerging RF systems. This paper discusses several small-scale bio-inspired and dynamic microwave photonic technologies to facilitate the advancement of RF systems.

Authors:Mable Fok, University of Georgia / Qidi Liu, University of Georgia

STu2B.2

Subcarrier Intensity Modulation for Turbulent Underwater Optical Wireless Communications

Presenter: Egecan Guler , *The University of Edinburgh*

This paper experimentally demonstrates the resilience of subcarrier intensity modulated underwater optical wireless communications to turbulence compared to amplitude modulation schemes. 1.2 Gbps transmission rate is demonstrated within FEC limit in underwater turbulence.

Authors:Egecan Guler, The University of Edinburgh / Callum Geldard, The University of Edinburgh / Alexander Hamilton, UK Defence Science and Technology Laboratory (Dstl) / Wasii Popoola, The University of Edinburgh

STu2B.3

Real-Time Experimental Demonstration of Timestamped Digitised Radio Over Switched Optical Ethernet Fronthaul

Presenter: Tongyun Li , *University of Cambridge*

This paper experimentally demonstrates a novel digitised RF service transmission with data compression over switched 10Gbps optical Ethernet fronthaul showing low latency ($<2.4\mu\text{s}$), high transmission efficiency ($\sim 1/3$ that of CPRI) and wide dynamic range (40dB).

Authors:Tongyun Li, University of Cambridge / Lu Bai, University of Cambridge / Jingyun Zhang, University of Cambridge / Andrew Moore, University of Cambridge / Ian White, University of Cambridge / Richard Penty, University of Cambridge

STu2B.4

Polarization-Splitter-Rotator-Free Dual-Polarization Coherent Receiver With a Single Optical Hybrid

Presenter: Go Soma , *the University of Tokyo*

We propose and demonstrate a dual-polarization (DP) homodyne coherent receiver with a single optical hybrid without any polarization splitter-rotator. Using a proof-of-concept device fabricated on InP, DP quadrature phase-shift keying signal is retrieved successfully.

Authors:Go Soma, the University of Tokyo / Shota Ishimura, KDDI Research, Inc. / Ryota Tanomura, the University of Tokyo / Taichiro Fukui, the University of Tokyo / Ito Maiko, the University of Tokyo / Yoshiaki Nakano, the University of Tokyo / Takuo Tanemura, the University of Tokyo

STu2B.5

Error-Free Kerr Comb-Driven SiP Microdisk Transmitter

Presenter: Asher Novick , *Columbia University*

We demonstrate the first SiP microdisk modulated Kerr comb source with BER better than $1E-9$ up to 16 Gb/s/ λ . The modulated lines span 44.3 nm bandwidth, paving the path to a comb-driven integrated SiP transmitter.

Authors:Asher Novick, Columbia University / Anthony Rizzo, Columbia University / Vignesh Gopal, Columbia University / Stuart Duadlin, Columbia University / Vaishnavi Murthy, Columbia University / Maarten Hattink, Columbia University / Yu-Han Hung, Columbia University / Yoshitomo Okawachi, Columbia University / Bok Young Kim, Columbia University / Xingchen Ji, Columbia University / Alexander Gaeta, Columbia University / Michal Lipson, Columbia University / Keren Bergman, Columbia University

STu2B.6

Progress and Challenges of Plasmonics for Efficient and High-Speed Optical Communications

Invited

Presenter: Claudia Hoessbacher , *Polariton Technologies Ltd*

We present the ultra-high bandwidth plasmonics platform that enables efficient electro-optic modulation at micrometer scale. Applications in optical communications are discussed.

Authors:Claudia Hoessbacher, Polariton Technologies Ltd / Benedikt Baeuerle, Polariton Technologies Ltd / Eva De Leo, Polariton Technologies Ltd / Nino Del Medico, Polariton Technologies Ltd / Hamit Duran, Polariton Technologies Ltd / Nicholas Guesken, Polariton Technologies Ltd / Patrick Habegger, Polariton Technologies Ltd / Wolfgang Heni, Polariton Technologies Ltd / Norbert Meier, Polariton Technologies Ltd

STu2F

Seeing Through Obstructions and Turbulence

Presenter: Eric Zhang , *IBM T. J. Watson Research Center*

STu2F.1

Non-Line-of-Sight Imaging With Picosecond Optical-Gated Single Photon Detection

Presenter: Shenyu Zhu , *Stevens Institute of Technology*

We demonstrated a non-line-of-sight imaging and tracking system with picosecond optical-gated single photon detection. It sees through obscuration while achieving high resolution NLOS 3D imaging and position retrieval.

Authors: Shenyu Zhu, Stevens Institute of Technology / Yong Meng Sua, Stevens Institute of Technology / Patrick Rehan, Stevens Institute of Technology / Yu-Ping Huang, Stevens Institute of Technology

STu2F.2

Simultaneous Imaging and Localization in a Heavily Scattering Random Medium With Speckle Data From a Moving Object

Presenter: Ryan Hastings , *Purdue University*

Recorded speckle from a moving object hidden in a heavily scattering random medium is used to determine positions and coherently image at high resolution and through an amount of scatter limited only by detector noise.

Authors: Ryan Hastings, Purdue University / Brian Bentz, Sandia National Laboratories / Dergan Lin, Purdue University / Kevin Webb, Purdue University

STu2F.3

Compressive Spectroscopic Long-Wave Infrared Imaging

Presenter: Jake Charsley , *Heriot-Watt University*

We report compressive spectroscopic imaging from 7–12 μm with a 4 cm^{-1} optical resolution, sampled at 25% of the Nyquist rate. Compressed measurements of plastics are presented with 640×512 pixels observed and reconstructed simultaneously.

Authors: Jake Charsley, Heriot-Watt University / Marius Rutkauskas, Heriot-Watt University / Yoann Altmann, Heriot-Watt University / Margaret Smith, University of Glasgow / Christina Young, University of Glasgow / Derryck Reid, Heriot-Watt University

STu2F.4

Demonstration of a Real-Time Orbital Angular Momentum (OAM) Sensor for Probing Variable Density Fog Clouds

Presenter: Kunjian Dai , *Clemson University*

This paper introduces a sensor for interrogating dynamic propagation environments for real-time detection of time-varying beams with OAM. As an example, a rotating variable fog distribution is created and sensed for induced changes in OAM.

Authors:Kunjian Dai, Clemson University / Keith Miller, Clemson University / Richard Watkins, Clemson University / Aristide Dogariu, University of Central Florida / Eric Johnson, Clemson University

STu2F.5

Rotation Measurement Using Spatially Incoherent Light and the Rotational Doppler Shift

Presenter: Alex Anderson , *University of Colorado at Boulder*

We measure the rotational Doppler shift from a spinning target illuminated with spatially and temporally incoherent light. This demonstrates that a well-defined orbital angular momentum spectrum is not required to observe a rotational Doppler shift.

Authors:Alex Anderson, University of Colorado at Boulder / Elizabeth Strong, University of Colorado at Boulder / Brendan Heffernan, University of Colorado at Boulder / Mark Siemens, University of Denver / Gregory Rieker, University of Colorado at Boulder / Juliet Gopinath, University of Colorado at Boulder

STu2F.6

Experimental Demonstration of Turbulence-Resilient Object Reconstruction by Optoelectronic Mixing of Sequentially Transmitted Pairs of Laguerre-Gaussian Modes

Presenter: Nanzhe Hu , *Uninversity of Southern California*

We experimentally demonstrate turbulence-resilient object reconstruction by optoelectronic mixing of sequentially transmitted pairs of Laguerre-Gaussian (LG) modes to measure the object's LG modal signature. The reconstructed object exhibits resilience to turbulence with D/r_0 up to 4.5.

Authors:Nanzhe Hu, Uninversity of Southern California / Runzhou Zhang, Uninversity of Southern California / Haoqian Song, Uninversity of Southern California / Jing Du, Huazhong University of Science and Technology / Xinzhou Su, Uninversity of Southern California / Huibin Zhou, Uninversity of Southern California / Hao Song, Uninversity of Southern California / Kai Pang, Uninversity of Southern California / kaiheng zou, Uninversity of Southern California / Amir Minoofar, Uninversity of Southern California / Moshe Tur, Tel Aviv University / Alan Eli Willner, Uninversity of Southern California

STu2F.7

Quantitative Phase Contrast Imaging Using Guided-Mode Resonator Devices

Presenter: Anqi Ji , *Stanford University*

We showcase the application of resonant flat optical elements as insertable angular filters that facilitate phase contrast imaging. With high accuracy direct angular filtering, quantitative phase contrast imaging is achieved akin to Fourier optics approaches.

Authors:Anqi Ji, Stanford University / Jung-Hwan Song, Stanford University / Pieter Kik, CREOL / David Miller, Stanford University / Mark Brongersma, Stanford University

STu2F.8

Polymer Optical Fibre Bend Sensor Based on Eccentric Bragg Gratings

Presenter: Lennart Leffers , *Gottfried Wilhelm Leibniz University Hanover*

We present a novel bend sensor based on eccentric fibre Bragg gratings in multimode graded-index polymer optical fibres. Dependent on number, position and depth of the gratings, 1D and 3D bend measurements are demonstrated.

Authors:Lennart Leffers, Gottfried Wilhelm Leibniz University Hanover / Julia Locmelis, Gottfried Wilhelm Leibniz University Hanover / Kort Bremer, Gottfried Wilhelm Leibniz University Hanover / Bernhard Roth, Gottfried Wilhelm Leibniz University Hanover / Ludger Overmeyer, Gottfried Wilhelm Leibniz University Hanover

STu2A

Applications of Optical Interferometry

Presenter: Tara Liebisch , *Physikalisch-Technische Bundesanstalt*

STu2A.1

Demonstration of an rf Electrometer Based on EIT Spectroscopy of Non-Resonantly Dressed Rydberg Atoms

Presenter: Lingyun Chai , *University of Virginia*

We present a self-calibrating, broadband technique for characterizing rf-fields. The method is based on electromagnetically induced transparency, exploiting non-linear mixing of rf and DC fields through non-resonant Rydberg dressing in a room temperature Rubidium cell.

Authors:Lingyun Chai, University of Virginia / Robert Jones, University of Virginia

STu2A.2

Application of Refractive-Index-Sensing Optical Frequency Comb for Biosensing of Antigen-Antibody Reaction

Presenter: Takeshi Yasui , *Tokushima University*

We combined a refractive-index-sensing optical comb with biotin surface modification for biosensing of avidin. A repetition frequency signal of optical comb is read out as a sensor signal of antigen-antibody reaction.

Authors: Takuya Nakahara, Tokushima University / Ryo Oe, Tokushima University / Taira Kajisa, Tokushima University / Shuji Taue, Kochi University of Technology / Takeo Minamikawa, Tokushima University / Takeshi Yasui, Tokushima University

STu2A.3

Optical Metrology for Gravitational Wave Observatories and Geophysics

Invited

Presenter: Felipe Guzman , *Texas A&M University*

Decades of efforts by the scientific community in advancing optical metrology enable exquisite, unprecedented displacement sensitivities that make our scientific endeavors possible. Examples from the gravitational-wave and geodesy communities are briefly presented in this paper.

Authors: Felipe Guzman, Texas A&M University

STu2A.4

Temperature-Insensitive Delay-Line Fiber Interferometer

Presenter: Bo Shi , *University of Southampton*

We propose and demonstrate a Mach-Zehnder interferometer made of a combination of hollow core and standard fibers with over 1000 times smaller temperature sensitivity than interferometers made of standard fiber only.

Authors: Bo Shi, University of Southampton / Giuseppe Marra, National Physical Laboratory / Zitong Feng, University of Southampton / Hesham Sakr, University of Southampton / John Hays, University of Southampton / Eric Fokoua, University of Southampton / Francesco Poletti, University of Southampton / David Richardson, University of Southampton / Radan Slavik, University of Southampton

STu2A.5

Ultrafast High-Sensitivity Characterization of Refractive Index Transients Induced by Plasmas or Kerr Effect Using Cross-Polarized Common-Path Temporal Interferometry

Presenter: Zan Nie , *UCLA*

A cross-polarized common-path temporal interferometer using balanced detection was developed for measuring refractive index transients due to plasmas or Kerr effect with a sensitivity of 0.5 mrad and a temporal resolution of 10 fs.

Authors:Zan Nie, UCLA / Kenneth Marsh, UCLA / Noa Nambu, UCLA / Chen-Kang Huang, UCLA / Chan Joshi, UCLA

STu2A.6

Nanometric Precision Metrology Based on Hybrid Spectrally-Resolved and Homodyne Interferometry via a Single Soliton Microcomb

Presenter: Hao Liu , *University of California Los Angeles*

We present ultra-precision distance measurement based on spectral interferometer via single soliton microcomb generated in Si₃N₄ microresonator. We demonstrate 3-nm repeatability over a 23-mm non-ambiguity range via homodyne interferometry, over 1000s long-term stability.

Authors:Hao Liu, University of California Los Angeles / Yoon-Soo Jang, Korea research Institute of Standards and Science / Jinghui Yang, National Institute of Standards and Technology / Mingbin Yu, Shanghai Institute of Microsystem And Information Technology / Dim-Lee Kwong, A*STAR / Chee Wei Wong, University of California Los Angeles

STu2A.7

Limits of Resolution for Sensors Based on Correlated Frequency Combs

Presenter: Jean-Claude Diels , *University of New Mexico*

Sensors based on dual combs of identical repetition rate exhibit quantum limited sensitivity because they are correlated when generated in the same cavity. Dispersion enhancement is demonstrated without a significant noise increase (Petermann factor).

Authors:Luke Horstman, University of New Mexico / Ning Hsu, University of New Mexico / James Hendrie, University of New Mexico / Jean-Claude Diels, University of New Mexico

STu2D

Low Noise Optical and Microwave Sources

Presenter: Pierre-François Cohadon , *Laboratoire Kastler Brossel*

STu2D.1

Transfer Oscillator Technique for 10 GHz Generation With Ultra-Low Phase Noise < -100 dBc/Hz at 1 Hz Offset

Presenter: Nicholas Nardelli , *NIST*

We generate 10 GHz microwave signals from an optical reference cavity using the transfer oscillator scheme with a free-running optical frequency comb. We demonstrate phase noise < -100 dBc/Hz at 1 Hz frequency offset from the carrier.

Authors: Nicholas Nardelli, NIST / Tara Fortier, NIST / Marco Pomponio, NIST / Esther Baumann, NIST / Craig Nelson, NIST / Thomas Schibli, University of Colorado Boulder / Archita Hati, NIST

STu2D.2

Fiber-Integrated Supercontinuum With a 20 GHz Resonant Electro-Optic Frequency Comb

Presenter: Pooja Sekhar , *University of Colorado Boulder*

We employ an efficient 1550 nm resonant waveguide-type electro-optic comb generator with PM nonlinear fiber optics to generate 50 fs pulses and 500 nm broad supercontinuum at 20 GHz.

Authors: Pooja Sekhar, University of Colorado Boulder / Connor Fredrick, University of Colorado Boulder / Stephanie Leifer, Jet Propulsion Laboratory, California Institute of Technology / Scott Diddams, University of Colorado Boulder

STu2D.3

An Ultralow Phase Noise 300 GHz Wave Based on Optical Frequency Division via an Integrated Dissipative Kerr Soliton Comb

Presenter: Antoine Rolland , *IMRA America Inc.*

We demonstrate low phase noise 300 GHz wave generation through optical frequency division using an integrated dissipative Kerr soliton. The obtained phase noise at 10 kHz Fourier frequency, measured with a devised system, is -100 dBc/Hz.

Authors: Tomohiro Tetsumoto, IMRA America Inc. / Tadao Nagatsuma, Osaka University / Martin Fermann, IMRA America Inc. / Gabriele Navickaite, Ligentec SA / Michael Geiselmann, Ligentec SA / Antoine Rolland, IMRA America Inc.

STu2D.4

(Withdrawn) Balanced Photodetection With Photocurrent Pulse Shaping for low Phase Noise Microwave Extraction From Combs

Presenter: Minji Hyun , *Korea Advanced Inst of Science & Tech*

We demonstrate microwave extraction method from optical frequency combs by photocurrent shaping with balanced p-i-n photodetector. We found that phase noise floor can be improved by 8-dB (reaching -162 dBc/Hz) compared to single photodiode system.

Authors: Minji Hyun, Korea Advanced Inst of Science & Tech / Jungwon Kim, Korea Advanced Inst of Science & Tech

STu2D.5

Emergence of Laser Cavity-Solitons in a Microresonator-Filtered Fiber Laser

Presenter: Maxwell Rowley , *University of Sussex*

The parameter space, defined by simple global controls, is probed in a microresonator-filtered fiber laser. We identify a distinct region that clearly admits solitons and we investigate the role of slow nonlinearities in their emergence. © 2020 The Author(s)

Authors:Maxwell Rowley, University of Sussex / Pierre-Henry Hanzard, University of Sussex / Antonio Cutrona, University of Sussex / Sai T. Chu, University of Hong Kong / Brent E. Little, Xi'an Institute of Optics and Precision Mechanics / Roberto Morandotti, INRS-EMT / David Moss, Swinburne institute of technology / Juan-Sebastian Toterogongora, University of Sussex / Marco Peccianti, University of Sussex / Alessia Pasquazi, University of Sussex

STu2D.6

On Spectral Purity of a Soliton Microcomb as a Function of Pump Detuning and Mode Temperature

Presenter: Tomohiro Tetsumoto , *IMRA America Inc.*

We improve spectral purity of a repetition frequency of a 300 GHz soliton microcomb by 44 times down to frequency stability as low as 1.5×10^{-9} in empirically-driven experimental conditions that we describe in this work.

Authors:Tomohiro Tetsumoto, IMRA America Inc. / Jie Jiang, IMRA America Inc. / Martin Fermann, IMRA America Inc. / Gabriele Navickaite, Ligentec SA / Michael Geiselmann, Ligentec SA / Antoine Rolland, IMRA America Inc.

STu2D.7

Gigahertz Supercontinuum Comb Generation by two-Pulse Bound State

Presenter: Shijie Chen , *Peking University*

We theoretically and experimentally demonstrate the gigahertz supercontinuum combs generated by a two-pulse bound state. The repetition rate is about 18.75 GHz and the combs extend over 270 nm.

Authors:Shijie Chen, Peking University / Renlai Zhou, Naval University of Engineering / Xuanyi Liu, Tsinghua University / H. Y. Fu, Tsinghua University / Qian Li, Peking University

STu2D.8

Near-Infrared 10-GHz Astrocomb With Mode Identification

Presenter: Yuk Shan Cheng , *Heriot-Watt University*

We present a 10-GHz astrocomb spanning 1.15–1.8 μm and based on a spectrally broadened degenerate optical parametric oscillator. Absolute mode identification is provided by a Fourier-transform spectrometer cross-calibrated to the comb-mode spacing.

Authors:Yuk Shan Cheng, Heriot-Watt University / Dong Xiao, National Astronomical Observatory of China / Richard McCracken, Heriot-Watt University / Derryck Reid, Heriot-Watt University

JTu2I

Special Symposium - Symposium- Micro-Photonic Positioning, Navigation and Timing II

President: Francesco Dell Olio , *Politecnico di Bari*

JTu2I.1

Parity-Time Symmetric Ring Laser Gyroscopes

Invited

Presenter: Mercedeh Khajavikhan , *University of Southern California*

To be provided

Authors:Mercedeh Khajavikhan, University of Southern California

JTu2I.3

Membrane-Based Optomechanical Accelerometry

Presenter: Aman Agrawal , *University of Arizona*

Optomechanical accelerometers promise quantum-limited readout, high bandwidth, self-calibration and radiation-pressure stabilization. We present a simple, scalable platform that enables these benefits with sub- μg sensitivity and kHz bandwidth, based on a pair of vertically integrated SiN membranes.

Authors:Aman Agrawal, University of Arizona / Mitul Dey Chowdhury, University of Arizona / Christian Pluchar, University of Arizona / Dalziel Wilson, University of Arizona

JTu2I.4

a High Accuracy Cavity Optomechanical Accelerometer With Electro-Optic Frequency Comb Readout

Presenter: David Long , *NIST*

A cavity optomechanical accelerometer based upon a Fabry-Pérot geometry is demonstrated. Electro-optic frequency combs are employed as a rapid and high accuracy method to interrogate a cavity mode and elucidate the corresponding acceleration.

Authors:David Long, NIST / Benjamin Reschovsky, NIST / Feng Zhou, NIST / Yiliang Bao, NIST / Ramgopal Madugani, NIST / Richard Allen, NIST / Jason Gorman, NIST / Thomas LeBrun, NIST

JTu2I.5

Anti-Parity-Time-Symmetric Integrated Optical Gyroscopes

Presenter: Martino De Carlo , *Politecnico di Bari*

Parity-time-symmetric optical gyroscopes are gaining interest for the enhanced sensitivity shown by exceptional points. The real splitting of anti-PT-symmetric gyroscopes is more reliable for stability and readout scheme than the complex splitting of parity-time-symmetric gyroscopes.

Authors:Martino De Carlo, Politecnico di Bari / Francesco De Leonardis, Politecnico di Bari / Vittorio M. N. Passaro, Politecnico di Bari

JTu2I.6

Thermodynamical Bounds and Noise of Cavity Optomechanical Acceleration Sensing

Presenter: Talha Yerebakan , *UCLA*

We present the theoretical formulation of the fundamental limits for force sensing in optomechanical accelerometers, and matched them into the design space. Finally, we analyze the performance of a fabricated device closely approaching this bounds.

Authors:Talha Yerebakan, UCLA / Jaime Flor Flores, UCLA / Yongjun Huang, UCLA / Wenting Wang, UCLA / Jia-Gui Wu, UCLA / Chee Wei Wong, UCLA

JTu2I.2

Integrated Photonics for Next-Generation Optical Clocks

Invited

Presenter: Zachary Newman , *National Institute of Standards and Technology (NIST)*

In this talk, I discuss a handful of microfabricated and integrated photonic devices for miniaturized optical atomic clocks. Technologies for both vapor cell and cold-atom clocks will be presented.

Authors:Zachary Newman, National Institute of Standards and Technology (NIST)

Special Symposium - Super Symposium on Photonics Solutions for COVID-19 Challenge III

Presider: Tilman Schmoll , *Carl Zeiss Meditec Inc*

JTu2R.1

Portable UV-C Disinfection Methods

Invited

Presenter: Andrea Armani , *USC*

UV-C disinfection in healthcare was popularized due to antibiotic resistant bacteria, but the approach became more well-known during the current COVID-19 pandemic. This presentation will discuss a recently developed, constructed, and validated portable UV-C system.

Authors:Andrea Armani, USC

JTu2R.2

Accelerated Grassroots Innovation: Insights From the MIT COVID-19 Challenge

Invited

Presenter: Freddy Nguyen , *Massachusetts Institute of Technology*

The MIT COVID-19 Challenge's channelled the world's best and brightest towards solving the greatest global COVID-19 challenge by hosting 7 weekend virtual innovation sprints bringing multi-disciplinary stakeholders to define impactful problems, and develop viable solutions.

Authors:Freddy Nguyen, Massachusetts Institute of Technology

JTu2R.3

Purcell-Enhanced UV Sources

Presenter: Avner Shultzman , *Technion*

UV lamps are of increasing importance for safe virus disinfection. Here we propose a novel concept for UV sources based on a stack of phosphor-nanolayers, designed to maximize the output emission through photonic local-density-of-states engineering.

Authors:Avner Shultzman, Technion / Ohad Segal, Technion / Yaniv Kurman, Technion / Ido Kaminer, Technion

JTu2R.4

High Contrast Reporter Cleavage Detection for Enhancing Porous Silicon Sensor Sensitivity

Presenter: Michael Dubrovsky , *SiPhox Inc.*

We show the first experimental implementation of biosensing using high contrast reporter cleavage detection (HCRCD). HCRCD makes use of dramatic signal amplification caused by cleavage of high-contrast nanoparticle labeled reporters instead of the capture of low-index biomolecules.

Authors:Michael Dubrovsky, SiPhox Inc. / RABEB LAYOUNI, Vanderbilt University / Mengdi Bao, RIT / Haejun Chung, Massachusetts Institute of Technology / Ke Du, RIT / Svetlana V. Boriskina, Massachusetts Institute of Technology / Sharon Weiss, Vanderbilt University / Diedrik Vermeulen, SiPhox Inc.

JTu2R.5

ENZYME ACTIVITY DIAGNOSTICS of SARS INFECTION BASED on FOERSTER RESONANCE ENERGY TRANSFER

Invited

Presenter: Frauke Rininsland , *Mesa Photonics*

More accurate COVID tests are urgently needed. To meet this need, a rapid on-site test using tongue scrape lysate was developed that detects cleavage of a FRET peptide specifically recognized by a SARS protease.

Authors:Frauke Rininsland, Mesa Photonics / Daniel Kane, Mesa Photonics

JTu2P

Special Symposium - Symposium- Emerging Materials for Light Emission and Non-volatile Photonic Memories II - Non-volatile Photonic Memories

Presider: Christos Vagionas , *Aristotle University of Thessaloniki*

JTu2P.1

Non-Volatile Silicon Photonic Switches Based on Phase Change Materials

Invited

Presenter: Arka Majumdar , *University of Washington*

We report nonvolatile electrically reconfigurable photonic switches using PCM-clad waveguides and microrings actuated by in-situ silicon PIN heaters. High extinction ratio (~15 dB), near-zero extra loss, and high cyclability (> 3000) are demonstrated.

Authors:Arka Majumdar, University of Washington

JTu2P.2

Integrated Nonvolatile Phase-Shifter Based on Electrically Reconfigurable Low-Loss Phase-Change Materials

Presenter: Carlos Rios Ocampo , *Massachusetts Institute of Technology*

We demonstrate a nonvolatile, small-form-factor (20 mm) phase-shifter based on low-loss phase-change materials ($\text{Ge}_2\text{Sb}_2\text{Se}_4\text{Te}_1$ and Sb_2Se_3) on SOI waveguides. We achieve continuous optical phase modulation and an MZI switch with 30 dB extinction ratio.

Authors: Carlos Rios Ocampo, Massachusetts Institute of Technology / Juejun Hu, Massachusetts Institute of Technology

JTu2P.3

Electrical Switching of Nonvolatile Phase-Change Materials for Integrated Photonics: a Comparison

Presenter: Jiajiu Zheng , *University of Washington*

We compare electrical switching of nonvolatile phase-change materials for integrated photonics with graphene, ITO, and silicon p-i-n heaters. Graphene heaters exhibit the best heating and overall performance with high switching speed (~ 80 MHz) and energy efficiency (6.6 aJ/nm^3).

Authors: Jiajiu Zheng, University of Washington / Zhuoran Fang, University of Washington / Shifeng Zhu, University of Washington / Peipeng Xu, Ningbo University / Scott Dunham, University of Washington / Arka Majumdar, University of Washington

JTu2P.4

Volatile and non-Volatile Optical Weights in Photonic Neuromorphic Computing

Invited

Presenter: Bert Offrein , *IBM Research GmbH*

To enhance the performance and power efficiency of neuromorphic computing systems, new signal processing concepts are required. We will discuss neural network building blocks, technology requirements as well as several photonic signal processing examples.

Authors: Bert Offrein, IBM Research GmbH

JTu2P.5

(Withdrawn) Tunable Metasurfaces Based on Phase-Change Materials: the Potential of Thermal Scanning Probes for Ultra-Small Designs

Presenter: Ann-Katrin Michel , *ETH Zurich*

We adapt a thermal scanning probe lithography method to pattern chalcogenide-based metasurfaces with ultra-small feature sizes. This switching technique could enable new optical functionalities, ranging from effective-medium design to the control over individual meta-atoms.

Authors: Ann-Katrin Michel, ETH Zurich / Sebastian Meyer, RWTH Aachen University / Nicolas Essing, RWTH Aachen University / Nolan Lassaline, ETH Zurich / Carin Lightner, ETH Zurich / Samuel Bisig, Heidelberg Instruments Nano / David J. Norris, ETH Zurich / Dmitry N Chigrin, RWTH Aachen University

JTu2P.6

Phase-Change Material Micro-Displays

Presenter: Omid Hemmatyar , *Georgia Institute of Technology*

Here, we leverage Mie scattering resonances supported by an all-dielectric metasurface made of phase-change material GeSe₃ nanopillars to demonstrate nanoscale high-saturation color switching.

Authors: Omid Hemmatyar, Georgia Institute of Technology / Sajjad Abdollahramezani, Georgia Institute of Technology / Tyler Brown, Georgia Institute of Technology / Ali Adibi, Georgia Institute of Technology

8:00 - 13:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - Arthur Ashkin Memorial Symposium

This special memorial symposium will describe and honor the contributions of Arthur Ashkin. ♦
Organizers: ♦ Gary Bjorklund, Bjorklund Enterprises, USA ♦ Steve Harris, Stanford University, USA ♦
Presenters: ♦ Aline Ashkin, USA ♦ John Bjorkholm, Bell Labs, USA ♦ Gary Bjorklund, Bjorklund Enterprises, USA ♦ Steve Block, Stanford University, USA ♦ Gary Boyd, Nokia Bell Labs, USA ♦ Bob Byer, Stanford University, USA ♦ Steve Chu, Stanford University, USA ♦ Joe Dziedzic, Bell Labs, USA ♦ Rene Essiambre, Nokia Bell Labs, USA ♦ Steve Harris, Stanford University, USA ♦ Erich Ippen, MIT, USA ♦ Elizabeth Rogan, The Optical Society, USA ♦ Erik Schäffer, University of Tübingen, Germany ♦ Roger Stolen, Clemson University, USA

9:00 - 11:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - Advancing Mid-Managers Summit

Millions of people have watched the TV show “Mr. Rogers’ Neighborhood,” delighting in how its gentle host used stories, dialogue, interaction, and kindness to inspire children and adults alike to change the world. Mr. Rogers employed simple yet powerful techniques to create memorable lessons that have stayed with people for generations. There are some remarkable parallels between his goals and those shared by managers at all levels as they set goals, adapt to changes, and support their people and organizations along the way. After all, truly effective managers know teams and companies thrive when people are encouraged, challenged, and—most importantly—treated with kindness. Join us for this interactive session hosted by the OSA Booth.

10:00 - 11:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - Successfully Navigate an OSA Virtual Meeting

The post-COVID world has new challenges in regards to virtual meetings – are you prepared? Listen to Isaiah Hankel, Cheeky Scientist, help guide you through the different platforms OSA uses and how you can effectively network and get the most out of your meeting experience.

Special Event - The Brightest Light Initiative: Update on the U.S. Strategy for Intense Ultrafast Lasers

The U.S. intense ultrafast laser community is pursuing a community strategy to prioritize research and build new facilities. Join the session to learn about progress over the past year and plans to invigorate U.S. research in this exciting field. ♦ Speakers: ♦ Félicie Albert, LLNL ♦ Jon Zuegel, LLE ♦ Roger Falcone, UC Berkeley ♦ Hosted by OSA

10:00 - 12:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - Workshop: How can optics contribute towards addressing future pandemics: from advanced developments to challenges and limitations?

12:00 - 14:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

JTu3A

Joint Poster Session I

JTu3A.1

**Carrier Dynamics in Nitrogen-Doped Graphene Under THz Radiation
(</home/eposters/poster/?id=3522491>)**

Presenter: roozbeh Anvari , *Queen's university*

Nitrogen is a common impurity in graphene. We combine density functional tight binding theory and a density matrix formalism to calculate the effect of nitrogen doping on the linear and nonlinear carrier dynamics in graphene

Authors: roozbeh Anvari, Queen's university / Marc Dignam, Queen's university

JTu3A.3

Group Theory Guided Symmetry Coupling Between Cylindrical Vector Beams and Localized Surface Plasmon Resonances (</home/eposters/poster/?id=3518787>)

Presenter: Bo Xu , *University of Colorado Boulder*

This paper reports a rigorous group theoretical method to selectively excite dark mode plasmons of any axially symmetric structures with cylindrical vector beams, based on symmetry analysis of the single V-point cylindrical vector beams basis.

Authors: Bo Xu, University of Colorado Boulder / Brendan Heffernan, University of Colorado Boulder / Kyuyoung Bae, University of Colorado Boulder / Mark Siemens, University of Denver / Juliet Gopinath, University of Colorado Boulder / Wounghang Park, University of Colorado Boulder

JTu3A.4

Localized and Propagating Modes on Coupled Nanoridge Array Metasurfaces (</home/eposters/poster/?id=3521700>)

Presenter: Milan Palei , *University of Notre Dame*

Arrays of coupled nanorod are fabricated and characterized via wavelength-dependent ellipsometry. Coupling between nanoridges, controlled by the nanoridge spacing, alters the modal dispersion.

Authors: Milan Palei, University of Notre Dame / John Haug, University of Notre Dame / Anjan Goswami, University of Notre Dame / Joshua Shrout, University of Notre Dame / Paul Bohn, University of Notre Dame / Evgenii Narimanov, Purdue University / Anthony Hoffman, University of Notre Dame

JTu3A.5

Free-Electron Interactions With Designed van der Waals Materials: Novel Source of Lensed X-ray Radiation (</home/eposters/poster/?id=3523044>)

Presenter: xihang shi , *Technion - Israel Institute of Technology*

We propose two novel X-ray generation schemes based on free electron interactions with van der Waals materials, in which the crystal geometry is shaped to create intrinsic lensing of the generated X-rays.

Authors:xihang shi, Technion - Israel Institute of Technolog / Michael Shentcis, Technion - Israel Institute of Technolog / Javier García de Abajo, The Barcelona Institute of Science and Technology / Ido Kaminer, Technion - Israel Institute of Technolog

JTu3A.6

Far-Subwavelength Spatial Resolution Using Relative Motion in Structured Illumination (/home/eposters/poster/?id=3523461)

Presenter: Ryan Hastings , *Purdue University*

Far-subwavelength spatial resolution based on relative motion between a structured field and an object with far-field intensity measurements is proposed, supported with numerical simulations, and demonstrated with speckle from random media to sense microstructure.

Authors:Vivek Raghuram, Purdue University / Ryan Hastings, Purdue University / Kevin Webb, Purdue University

JTu3A.7

Fundamental Limits to the Excitation of Polaritons in Thin Films (/home/eposters/poster/?id=3524965)

Presenter: Eduardo Dias , *ICFO-The Institute of Photonic Sciences*

We quantify the coupling strength between light and 2D polaritons in thin films, using point and line scatterers, and find universal constraints that limit its fundamental maximum allowed values.

Authors:Eduardo Dias, ICFO-The Institute of Photonic Sciences / Javier García de Abajo, ICFO-The Institute of Photonic Sciences

JTu3A.8

Photonic Modulation Using Antimony-Trisulphide Phase Change Huygens Metasurfaces (/home/eposters/poster/?id=3525508)

Presenter: Siddharth Padmanabha , *Tulane University*

We design switchable antimony trisulfide (Sb_2S_3) Huygens metasurfaces for optical modulation. Simulation results show near 2π phase modulation with $\sim 15\text{dB}$ amplitude modulation optimizable by spectral resonance tuning at near infrared wavelengths. Experimental verification is in progress.

Authors:Siddharth Padmanabha, Tulane University / Isaac Oguntoye, Tulane University / Jesse Frantz, US Naval Research Laboratory / Jason Myers, US Naval Research Laboratory / Robel Bekele, University Research Foundation / Anthony Clabeau, University Research Foundation / Matthew Escarra, Tulane University

JTu3A.9

An Optical Parametric Amplifier for Seeding Femtosecond Fe:ZnSe Lasers at 4.1 μm (/home/eposters/poster/?id=3531667)

Presenter: Alphonse Marra , *University of Central Florida*

Mid-infrared pulses with 200 nJ energy and 200 nm bandwidth were generated at 4.1 μm and 60 kHz repetition rate. The highly-stable LiGaS₂-based Optical Parametric Amplifier was pumped by a turn-key, commercially available Yb:KGW laser.

Authors:Alphonse Marra, University of Central Florida / Jialin Li, University of Central Florida / David Smerina, University of Central Florida / Fangjie Zhou, University of Central Florida / Yi Wu, University of Central Florida / Zenghu Chang, University of Central Florida

JTu3A.10

Zettawatt Equivalent Ultrashort Pulse Laser System: an NSF Mid-Scale Facility for Laser-Driven Science in the QED Regime (/home/eposters/poster/?id=3525458)

Presenter: John Nees , *University of Michigan*

Zettawatt Equivalent Ultrashort pulse laser System (Zeus): The National Science Foundation's mid-scale 3PW laser facility for exploration of relativistic plasmas, nonlinear quantum electrodynamics, and other extreme high-field phenomena is described.

Authors:John Nees, University of Michigan / Anatoly Maksimchuk, University of Michigan / Galina Kalinchenko, University of Michigan / Bixue Hou, University of Michigan / Yong Ma, University of Michigan / Paul Campbell, University of Michigan / Andrew McKelvey, University of Michigan / Louise Willingale, University of Michigan / Igor Jovanovic, University of Michigan / Carolyn Kuranz, University of Michigan / Alexander Thomas, University of Michigan / Karl Krushelnick, University of Michigan

JTu3A.11

Spatial Imaging of Minority Charge Carrier Lifetimes of Semiconductors Using Digital Light Processing and Compressed Sensing (/home/eposters/poster/?id=3520860)

Presenter: Aidas Baltusis , *University of Surrey*

We propose and investigate a novel, rapid method for contactless spatial imaging of minority charge carrier lifetimes based on compressed sensing. The proposed method demonstrates an order of magnitude potential increase in imaging speeds.

Authors:Aidas Baltusis, University of Surrey / George Koutsourakis, National Physical Laboratory / Sebastian Wood, National Physical Laboratory / Stephen Sweeney, University of Surrey

JTu3A.12

Colour Tunable Graded Index Refractory Metal-Oxide Metamaterials (/home/e posters/poster/?id=3525530)

Presenter: Josh Perkins , *University of Alberta*

We present refractory metal-oxide metamaterials realized using annealing techniques that exhibit vibrant colour arising from the subwavelength graded refractive index structure which can be realized across large lateral dimensions for data storage and sensing applications.

Authors: Josh Perkins, University of Alberta / Behrad Gholipour, University of Alberta

JTu3A.13

THz Generation in Organic Crystal BNA at MHz Repetition Rates (/home/e posters/poster/?id=3531866)

Presenter: Samira Mansourzadeh , *Ruhr Universität Bochum*

We investigate average power scaling at MHz repetition rate and thermal behavior of THz generation in the organic crystal BNA for the first time, reaching an average power of 380 μ W at 10% duty cycle.

Authors: Samira Mansourzadeh, Ruhr Universität Bochum / Tim Vogel, Ruhr Universität Bochum / Mostafa Shalaby, Swiss Terahertz Research-Zurich / Frank Wulf, Ruhr Universität Bochum / Clara Saraceno, Ruhr Universität Bochum

JTu3A.14

Ghost Imaging Counterfactually (/home/e posters/poster/?id=3513714)

Presenter: Jonte Hance , *University of Bristol*

We have developed a protocol for ghost imaging that is always counterfactual - while imaging an object, no light interacts with it. This provides both better visibility/SNR and less absorbed intensity than ghost imaging.

Authors: Jonte Hance, University of Bristol / John Rarity, University of Bristol

JTu3A.15

Surface-Enhanced Raman Spectroscopy for Detection of Threat Chemicals With Portable Raman Spectrometers (/home/e posters/poster/?id=3526858)

Presenter: Erik Emmons , *US Army CCDC CBC*

We are demonstrating surface-enhanced Raman spectroscopy using compact Raman spectrometers for field detection of trace-level threat materials. The goal is to improve limits-of-detection for realistic threat materials.

Authors: Erik Emmons, US Army CCDC CBC / Ashish Tripathi, US Army CCDC CBC / Jason Guicheteau, US Army CCDC CBC

JTu3A.16

Single-Shot Dual-Wavelength Polarized Microscope to Detect Malaria-Infected Erythrocytes via Birefringence Response (</home/eposters/poster/?id=3532012>)

Presenter: MARIA LOPERA, *Universidad EAFIT*

The implementation of a dual-wavelength polarized microscope to obtain the birefringence response of Malaria-infected Erythrocytes is presented. By retrieving the dichroism images of blood samples, those containing the Plasmodium parasite can be detected.

Authors: Carlos Trujillo, Universidad EAFIT / MARIA LOPERA, Universidad EAFIT / Adriana Pabón, Universidad de Antioquia

JTu3A.17

Squeezed State Generation in a Dual-Pumped Integrated Microring Resonator: the Effects of Parasitic Processes (</home/eposters/poster/?id=3519579>)

Presenter: Hossein Seifoory, *University of Toronto*

We theoretically investigate the effects of parasitic quantum nonlinear optical processes on the generation of squeezed light in a dual-pumped integrated microring resonator coupled to a waveguide.

Authors: Hossein Seifoory, University of Toronto / Zachary Vernon, Xanadu / Dylan Mahler, Xanadu / Matteo Menotti, Xanadu / John Sipe, University of Toronto

JTu3A.18

Development of Low Noise III-v Digital Alloys for Improved Photodetection (</home/eposters/poster/?id=3520922>)

Presenter: Sheikh Ahmed, *University of Virginia*

A detailed theoretical investigation of the underlying physics of low noise III-V digital alloy APDs is presented here. Based on our investigations, the criteria for developing low noise digital alloys are proposed.

Authors: Sheikh Ahmed, University of Virginia / Jiyuan Zheng, University of Chicago / Yaohua Tan, Synopsys / Joe Campbell, University of Virginia / Avik Ghosh, University of Virginia

JTu3A.19

Valley-Polarization in Biased Bilayer Graphene Using Circularly Polarized Light (</home/eposters/poster/?id=3522008>)

Presenter: Alex Friedlan, *Queen's University*

We theoretically examine valley-polarization induced in biased bilayer graphene using circularly polarized light. We find that a very strong valley-polarization can be achieved (>97%) with careful choice of bias and pulse frequency.

Authors:Alex Friedlan, Queen's University / Marc Dignam, Queen's University

JTu3A.21

UV Laser Pulse Trains for Raman Spectroscopy (/home/eposters/poster/?id=3519379)

Presenter: Dustin Swanson , *University of Maryland*

The theoretical framework for Raman spectroscopy using a UV probe laser pulse train consisting of multi femtosecond pulses is developed. We show selective excitation of a single Raman mode by tuning the pulse parameters.

Authors:Dustin Swanson, University of Maryland / Phillip Sprangle, University of Maryland

JTu3A.22

Echoes in Unidirectionally Rotating Molecules (/home/eposters/poster/?id=3519760)

Presenter: Long Xu , *The Weizmann Institute of Science*

Molecular unidirectional rotation echoes have been induced using a pair of time-delayed polarization-twisted ultrashort laser pulses. The echoes are imaged using Coulomb explosion-based technique, and the experimental findings are supported by a detailed theoretical analysis.

Authors:Long Xu, The Weizmann Institute of Science / Ilia Tutunnikov, The Weizmann Institute of Science / Lianrong Zhou, East China Normal University / Kang Lin, East China Normal University / Junjie Qiang, East China Normal University / Peifen Lu, East China Normal University / Yehiam Prior, The Weizmann Institute of Science / Ilya Averbukh, The Weizmann Institute of Science / Jian Wu, East China Normal University

JTu3A.23

Polarization-Resolved Measurement of Nonlinear Thomson Scattering From Elliptically Polarized Light (/home/eposters/poster/?id=3523363)

Presenter: Colton Fruhling , *University of Nebraska*

Measurements of first and second harmonic radiation from nonlinear Thomson scattered light as a function of laser polarization ellipticity are reported. Polarization-resolved patterns were observed and connected to the underlying electron motion, confirming half-century old theoretical predictions.

Authors:Colton Fruhling, University of Nebraska / Christoph Schulzke, Brigham Young University / Mahonri Romero, Brigham Young University / Junzhi Wang, University of Nebraska / Michael Ware, Brigham Young University / justin peatross, Brigham Young University / Donald Umstadter, University of Nebraska

JTu3A.24

Arrival Time Monitor for Sub-10 fs Soft X-ray and 800 nm Optical Pulses (/home/eposters/poster/?id=3531742)

Presenter: Isa Muhammad, SLAC

We develop an Arrival Time Monitor (ATM) achieving high sensitivity for soft X-ray pulses in low-fluence conditions. The ATM cross-correlates ultrashort X-ray with 800nm laser pulses using a new multi-layer target designed and grown in-house to achieve optimal sensitivity.

Authors:Isa Muhammad, SLAC / Benson Frimpong, SLAC / Joseph Daafour, SLAC / Xiaoqing Xu, Stanford University / Peter Walter, SLAC / James Cryan, SLAC / Thomas Wolf, SLAC / James Glowonia, SLAC / Joseph Robinson, SLAC / Stefan Droste, SLAC / Giacomo Coslovich, SLAC

JTu3A.26

Efficient Broadly Tunable Waveguide Lasers in Yb³⁺:CaF₂ Produced by Deep Diamond Saw Dicing (/home/eposters/poster/?id=3525138)

Presenter: Pavel Loiko, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie

High-aspect-ratio ridge waveguides (propagation losses: 0.13±0.05 dB/cm) were fabricated in Yb³⁺:CaF₂ by diamond-saw-dicing. The waveguide laser generated 723 mW at 1029-1051 nm with a slope efficiency of 76.0%; wavelength tuning between 1009-1072 nm was achieved.

Authors:Pavel Loiko, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie / Ludovic Gauthier-Manuel, FEMTO-ST Institute / Gurvan Brasse, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie / Alain Braud, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie / Abdelmjid Benayad, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie / Patrice Camy, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie

JTu3A.27

Extreme Absorption in the Bulk of Dielectrics With Femtosecond Bessel Pulses (/home/eposters/poster/?id=3525185)

Presenter: Kazem Ardaneh , *Femto-st*

High absorption and high energy density deposition are experimentally measured during illumination of dielectrics by femtosecond Bessel pulses. Using particle-in-cell simulations, we explain this process by resonance absorption on a nanoscale plasma rod.

Authors:Kazem Ardaneh, Femto-st / Remi Meyer, Femto-st / Benoit Morel, Femto-st / Remo Giust, Femto-st / Francois Courvoisier, Femto-st

JTu3A.28

Physical Unclonable Functions Based on Holographic Microstructures on Silver (/home/eposters/poster/?id=3523030)

Presenter: ANGELIKI ANASTASIOU , *University of Patras*

We demonstrate the utilization of Computer-Generated Holograms engraved on silver surface with a nanosecond infrared fiber laser as ultra-strong optical PUFs. The reconstructed images represented through a few distinctive features could create robust authentication keys.

Authors:ANGELIKI ANASTASIOU, University of Patras / Evangelia Zacharaki, University of Patras / Anastasios Tsakas, University of Patras / Konstantinos Moustakas, University of Patras / Dimitris Alexandropoulos, University of Patras

JTu3A.29

Room-Temperature Near-Infrared Electroluminescence in *n*-Type GaAs Unipolar MicroLEDs (/home/eposters/poster/?id=3525368)

Presenter: Bejoys Jacob , *International Iberian Nanotechnology Lab*

We report the first observation of pronounced light emission (~806 nm) from the active AlAs/GaAs/AlAs double barrier quantum well of unipolar (electron-transporting) microLEDs. This paves the way for a new class of *n*-type optoelectronic micro-nanodevices.

Authors:Bejoys Jacob, International Iberian Nanotechnology Lab / Jerome Borme, International Iberian Nanotechnology Lab / Jose Figueiredo, Universidade de Lisboa / Bruno Romeira, International Iberian Nanotechnology Lab

JTu3A.30

CLONETS-DS – Clock Network Services-Design Study Strategy and Innovation for Clock Services Over Optical-Fibre Networks in Europe (/home/eposters/poster/?id=3522846)

Presenter: Josef Vojtech , *CESNET*

Long-haul time and frequency transfer methods over optical fibres have evolved rapidly demonstrating excellent performance. CLONETS-DS is a European Union-funded research and innovation action facilitating the vision of a sustainable, pan-European network for time and frequency dissemination.

Authors:Josef Vojtech, CESNET / Lada Altmannova, CESNET / Vladimir Smotlacha, CESNET / Radek Velc, CESNET / Rudolf Vohnout, CESNET / Harald Schnatz, PTB / Tara Liebisch, PTB / Vincenzo Capone, GEANT VERENIGING / Tryfon Chiotis, GEANT VERENIGING / Guy Roberts, GEANT VERENIGING / Domenico Vicinanza, GEANT VERENIGING / Artur Binczewski, PSNC / Wojbor Bogacki, PSNC / Krzysztof Turza, PSNC / Paul-Eric Pottie, LNE-SYRTE / Philip Tuckey, LNE-SYRTE / Davide Calonico, INRIM / Ronald Holzwarth, Menlo Systems / Benjamin Sprenger, Menlo Systems / Ondrej Cip, ISI CAS / Lenka Pravidova, ISI CAS / Simon Rerucha, ISI CAS / Javier Diaz Alonso, Uni Granada / Eduardo Ros Vidal, Uni Granada / Trinidad Garcia, Seven Solutions / Jan Kodet, TU Munich / Ulrich Schreiber, TU Munich / Jurgen Kusche, University of Bonn / Dieter Meschede, University of Bonn / Stefan Schroder, University of Bonn / Simon Stellmer, University of Bonn / Pawel Nogas, Piktime Systems / Robert Urbaniak, Piktime Systems / Przemyslaw Krehlik, AGH Uni / Lukasz Sliwczynski, AGH Uni / Anne Amy-Klein, LPL USPN / Nicolas Quintin, RENATER / Alwyn Seeds, UCL / Bruno Desruelle, Muquans / Jean Lautier-Gaud, Muquans / Vincent Menoret, Muquans / Martin Rabault, Muquans

JTu3A.31

Computer Generated Holograms for in-Vivo Optogenetic Neural Stimulation (/home/e posters/poster/?id=3525795)

Presenter: Anastasios Tsakas , *University of Patras*

A novel design method for the in-vivo optogenetic photostimulation of neurons is presented. The method accounts for the brain tissue scattering effects for the holographic illumination of neurons.

Authors:Anastasios Tsakas, University of Patras / Dimitris Ampeliotis, University of Patras / Dimitris Alexandropoulos, University of Patras

JTu3A.32

Machine Learning Assisted Management of Photonic Switching Systems (/home/e posters/poster/?id=3531811)

Presenter: Ihtesham Khan , *Politecnico di Torino*

We propose a machine learning based approach to predict control signals for a photonic switching system.

This solution is topology and technology agnostic and it can be employed in real-time switch control planes.

Authors:Ihtesham Khan, Politecnico di Torino / Muhammad Masood, Politecnico di Torino / lorenzo tunesi, Politecnico di Torino / Paolo Bardella, Politecnico di Torino / enrico ghillino, Synopsys, Inc. / andrea carena, Politecnico di Torino / vittorio curri, Politecnico di Torino

JTu3A.34

Linear Optical Quantum Information Processing via Stacked Micro-Ring Resonators (/home/eposters/poster/?id=3518819)

Presenter: Matteo Pennacchietti, *Institute for Quantum Computing*

Here we propose an architecture for path encoded photonic quantum information processing based on micro-ring resonators. This scheme increases on-chip component density and more naturally incorporates error mitigation, when compared to the Mach-Zehnder Interferometer approach.

Authors: Matteo Pennacchietti, Institute for Quantum Computing / Alexander Tait, National Institute of Standards and Technology / Bhavin Shastri, Queen's University

JTu3A.36

Echoes in a Single Quantum Kerr-Nonlinear Oscillator (/home/eposters/poster/?id=3521947)

Presenter: Ilia Tutunnikov, *Weizmann Institute of Science*

We theoretically study the echo phenomenon in a single impulsively excited ("kicked") Kerr-nonlinear oscillator. These echoes may be useful for studying decoherence processes in a number of systems related to quantum information processing.

Authors: Ilia Tutunnikov, Weizmann Institute of Science / K. Rajitha, Weizmann Institute of Science / Ilya Averbukh, Weizmann Institute of Science

JTu3A.37

Dipolar Interactions in Bilayers of Indirect Excitons (/home/eposters/poster/?id=3521324)

Presenter: Darius Choksy, *University of California San Diego*

We studied both experimentally and theoretically attractive dipolar interaction in bilayers of indirect excitons (IXs) with built-in dipole moments and found monotonic IX energy reduction with density and spatial attraction between IX clouds.

Authors: Darius Choksy, University of California San Diego / Chao Xu, University of California San Diego / Michael Fogler, University of California San Diego / Leonid Butov, University of California San Diego / Justin Norman, University of California: Santa Barbara / Arthur Gossard, University of California: Santa Barbara

JTu3A.38

Demonstration of Corner States in Photonic Square-Root Higher-Order Topological Insulators (/home/eposters/poster/?id=3523332)

Presenter: Wenchao Yan, *Nankai University*

We experimentally demonstrate the square-root higher-order topological insulators, unveiling two kinds of corner states that reside in different band gaps of a photonic super-honeycomb lattice established with photorefractive cw-laser-writing.

Authors: Wenchao Yan, Nankai University / Shiqi Xia, Nankai University / Xiuying Liu, Nankai University / Yuqing Xie, Nankai University / Liqin Tang, Nankai University / Daohong Song, Nankai University / Jingjun Xu, Nankai University / Zhigang Chen, Nankai University

JTu3A.39

Time-Resolved Measurement of Power Transfer in Plasma Amplifier Experiments on NIF (</home/eposters/poster/?id=3532044>)

Presenter: Patrick Poole , *Lawrence Livermore National Laboratory*

Beam combination via an ion wave plasma optic is discussed, including measurement of the power transfer (pump depletion and seed amplification) for several seed pulse durations and total pump energies, with accompanying simulation studies.

Authors: Patrick Poole, Lawrence Livermore National Laboratory / Robert Kirkwood, Lawrence Livermore National Laboratory / Scott Wilks, Lawrence Livermore National Laboratory / Tom Chapman, Lawrence Livermore National Laboratory / Dan Kalantar, Lawrence Livermore National Laboratory / Matthew Edwards, Lawrence Livermore National Laboratory / Pierre Michel, Lawrence Livermore National Laboratory / Laurent Divol, Lawrence Livermore National Laboratory / Jeff Bude, Lawrence Livermore National Laboratory / Brent Blue, Lawrence Livermore National Laboratory / Kevin Fournier, Lawrence Livermore National Laboratory / Bruno Van Wonterghem, Lawrence Livermore National Laboratory / Nat Fisch, Princeton Plasma Physics Laboratory / Peter Norreys, University of Oxford / Wojciech Rozmus, University of Alberta

JTu3A.40

Terahertz Waves Polarization Rotation in Unaligned Single-Wall Carbon Nanotubes (</home/eposters/poster/?id=3492948>)

Presenter: Anatoly Kvitsinskiy , *ITMO University*

Faraday effect modulation in carbon nanotubes was experimental studied in range 0.2–0.8 THz with a weak magnetic field. A change of 15° in an azimuth, and of 10° in an ellipticity angle was achieved.

Authors: Anatoly Kvitsinskiy, ITMO University / Petr Demchenko, ITMO University / Mikhail Novoselov, ITMO University / Ilya Anoshkin, ITMO University / Kirill Bogdanov, ITMO University / Alexander Baranov, ITMO University / Mikhail Khodzitsky, ITMO University

JTu3A.41

Generation of Spatiotemporal Optical Vortex With Partial Temporal Coherence (</home/eposters/poster/?id=3522073>)

Presenter: Yimin Zang , *University of Dayton*

We demonstrate both theoretically and experimentally, the generation of spatiotemporal optical vortices using a light source with partial temporal coherence, which could serve as a cheaper source for generating such vortices.

Authors:Yimin Zang, University of Dayton / Amal Mirando, University of Dayton / Andy Chong, University of Dayton

JTu3A.42

Investigation of the Plume Generated in LIBS Process Induced by a ps UV Laser (/home/eposters/poster/?id=3524741)

Presenter: Ali Rastegari , *University of New Mexico*

The plume produced by a ps UV laser is analyzed, with the aim of understanding the ultra-narrow (isotopically resolvable) re-absorption lines that we observed with this type of irradiation.

Authors:Ali Rastegari, University of New Mexico / Jean-Claude Diels, University of New Mexico

JTu3A.43

Managing Backscattering Noise in Sagnac-Loop Twin-Field Quantum Key Distribution (/home/eposters/poster/?id=3524537)

Presenter: Reem Mandil , *University of Toronto*

We propose a signal patterning technique to mitigate backscattering and optimize secure key rates for Sagnac twin-field QKD systems. Simulation results based on experimentally-measured backscattering coefficient yield positive key rates for 250km using APD detectors.

Authors:Reem Mandil, University of Toronto / Li Qian, University of Toronto / Hoi-Kwong Lo, University of Toronto

JTu3A.44

Free-Form Broadband Flat Lens for F-Number and Numerical Aperture Decoupling (/home/eposters/poster/?id=3524691)

Presenter: Monjurul Meem , *University of Utah*

The f-number ($f\#$) and numerical aperture (NA) of a conventional lens are inherently coupled. We demonstrate a free-form broadband flat lens that de-couples the $f\#$ and NA.

Authors:Monjurul Meem, University of Utah / Apratim Majumder, University of Utah / Sourangsu Banerji, University of Utah / Berardi Sensale-Rodriguez, University of Utah / Rajesh Menon, University of Utah

JTu3A.45

Quantum State Tomography at the Tsierlson Bound (/home/eposters/poster/?id=3523527)

Presenter: Gautam Kavuri , *University of Colorado*

We compare the results of linear and maximum likelihood tomography for a polarization-entangled photon pair source that is close to the Tsirelson bound. We introduce a new density matrix representation to better make this comparison.

Authors:Gautam Kavuri, University of Colorado / Michael Mazurek, University of Colorado / Martin Stevens, National Institute of Standards and Technology / Richard Mirin, National Institute of Standards and Technology / Sae Woo Nam, National Institute of Standards and Technology / Lynden Shalm, National Institute of Standards and Technology

JTu3A.46

Coherent Manipulation of Finite-Energy Gottesman-Kitaev-Preskill-Qubit Graph States (</home/eposters/poster/?id=3531511>)

Presenter: Kaushik Seshadreesan , *University of Arizona*

We present an exact description of graph states composed of finite-energy Gottesman-Kitaev-Preskill qubits, and determine rules for their transformation under Steane error correction and fusion operations that can be used to grow large graph states.

Authors:Kaushik Seshadreesan, University of Arizona / Prajit Dhara, University of Arizona / Ashlesha Patil, University of Arizona / Liang Jiang, University of Chicago / Saikat Guha, University of Arizona

JTu3A.48

a Self-Oscillating Phase Conjugate Resonator as an Optical Frequency Comb (</home/eposters/poster/?id=3523554>)

Presenter: Zhifan Zhou , *University of Maryland*

We demonstrate a phase conjugate resonator with a forward-propagating four-wave mixing process that oscillates with the build-up of spontaneous emission. The oscillation exhibits frequency comb properties: equal frequency spacing and phase coherence among different components.

Authors:Zhifan Zhou, University of Maryland / Jie Zhao, University of Maryland / Rory Spiers, University of Maryland / Nicholas Brewer, University of Maryland / Meng-Chang Wu, University of Maryland / Paul Lett, University of Maryland

JTu3A.49

Twisted Bilayer Dielectric Photonic Crystal Slabs (</home/eposters/poster/?id=3523921>)

Presenter: Haoning Tang , *Harvard University*

We design twisted bilayer photonic crystal slabs that introduce Moiré flat-bands and localized modes. The flat-bands have a quality factor of 10^6 and a high density-of-states of $0.967 \text{ THz}^{-1} \mu\text{m}^{-1}$.

Authors:Haoning Tang, Harvard University / Fan Du, Harvard University / Stephen Carr, Brown University / Clayton DeVault, Harvard University / Eric Mazur, Harvard University

JTu3A.50

Stress Tuning and Enhancement of Optical Nonlinearity in an Organic Crystal (/home/eposters/poster/?id=3523519)

Presenter: Peter Moroshkin , *Brown University*

$\chi^{(2)}$ is critical to applications, but its value is material-limited. We report on stress tuning and dramatical enhancement of $\chi^{(2)}$ in an organic crystal, harvesting the molecular deformation and charge redistribution associated with its plasticity.

Authors:Peter Moroshkin, Brown University / Akshay Nagar, Brown University / Meng-Ju Yu, Brown University / Bin Cai, University of Shanghai for Science and Technology / Jimmy Xu, Brown University

JTu3A.51

Infrared Beam Steering Device Based on InAsSb/(Al)GaInSb Heterostructure (/home/eposters/poster/?id=3519842)

Presenter: Jinghe Liu , *Stony Brook University*

We describe an nBp structure comprised of waveguide with gratings for electronic steering a 10.6- μm laser and show that a 0.06 change of the refractive index by carrier injection leads to a 3.5° steering angle.

Authors:Jinghe Liu, Stony Brook University / Kevin Kucharczyk, Stony Brook University / Dmitri Donetsky, Stony Brook University / Gela Kipshidze, Stony Brook University / Gregory Belenky, Stony Brook University / Stefan Svensson, US Army Research Laboratory

JTu3A.52

Optical Signal Processing Performance Dependence on Non-Ideal MZI Operation in a Tapped-Delay-Line (/home/eposters/poster/?id=3522533)

Presenter: Fatemeh Alishahi , *University of Southern California*

An optical tapped-delay-line based on a cascade of MZI under non-ideal operation is simulated. The effect of different non-ideal conditions on FIR filtering metrics and analog or digital signal qualities is investigated.

Authors:Fatemeh Alishahi, University of Southern California / Ahmad Fallahpour, University of Southern California / kaiheng zou, University of Southern California / Amir Minoofar, University of Southern California / cong liu, University of Southern California / Huibin Zhou, University of Southern California / Jonathan Habif, Information sciences Institute / Moshe Tur, Tel Aviv University / Alan Eli Willner, University of Southern California

JTu3A.53

Point-of-Care SERS Sensing of Illicit Drug Residue Using in-Situ Growth Silver Nanoparticles on Diatomaceous Photonic Crystals (/home/eposters/poster/?id=3523824)

Presenter: Alan Wang , *Oregon State University*

Point-of-care sensing of illicit drug residue is demonstrated with a portable Raman spectrometer using in-situ growth silver nanoparticles on diatomaceous photonic crystals. By chemometric analyses, we achieved ultra-sensitive detection of fentanyl in tap water.

Authors:Boxin Zhang, Oregon State University / Xingwei Hou, Oregon State University / Alan Wang, Oregon State University

JTu3A.54

Generating Single Photon Pulses From a Quantum dot Using a Continuous Wave Laser and an Electro-Optic Modulator (/home/eposters/poster/?id=3522685)

Presenter: Paul Anderson , *University of Waterloo*

We report the generation of single-photon pulses from an InAsP quantum dot utilizing a CW diode laser and a fiber electro-optic modulator as a pump in lieu of a pulsed picosecond Ti:Sapphire laser.

Authors:Paul Anderson, University of Waterloo / Divya Bharadwaj, University of Waterloo / Rubayet Al Maruf, University of Waterloo / Michal Bajcsy, University of Waterloo

JTu3A.55

Hidden Four-Mode Entanglement in a Single-Pass Stimulated FWM (/home/eposters/poster/?id=3524095)

Presenter: Raul Rincon Celis , *Universidade de Sao Paulo*

We present a hidden entanglement between four-modes generated by a single-pass stimulated FWM. Considering the seed at the AntiStokes channel and colinear propagation inside a cell of rubidium 85, we describe the entanglement between 2 bipartitions of individual sidebands, a behavior commonly hidden

Authors:Raul Rincon Celis, Universidade de Sao Paulo / Alvaro Montaña, Universidade de Sao Paulo / Paulo Nussenzveig, Universidade de Sao Paulo / Marcelo Martinelli, Universidade de Sao Paulo / Hans Marin, Universidade de Sao Paulo

JTu3A.56

All-Optical Atomic Simulator on a Nonlinear Photonic Chip (/home/eposters/poster/?id=3524302)

Presenter: Ivan Burenkov , *Joint Quantum Institute*

We show how quantum-compatible photonic devices such as ultrafast optical switch and efficient frequency transducer can be implemented using three-wave mixing processes in a 1D array of nonlinear waveguides evanescently coupled to nearest neighbors.

Authors:Ivan Burenkov, Joint Quantum Institute / Irina Novikova, College of William & Mary / Olga Tikhonova, Lomonosov Moscow State University / Sergey Polyakov, NIST

JTu3A.57

Optimization of Broadband Λ -Type Quantum Memory Using Gaussian Pulses (/home/eposters/poster/?id=3525315)

Presenter: Kai Shinbrough , *Univ of Illinois at Urbana-Champaign*

We optimize the efficiency of broadband Λ -type quantum memories under the restriction of Gaussian-shape optical fields. We demonstrate an experimentally-simple path to enhancing memory efficiency over a wide range of broadband memory parameters.

Authors:Kai Shinbrough, Univ of Illinois at Urbana-Champaign / Benjamin Hunt, Univ of Illinois at Urbana-Champaign / Virginia Lorenz, Univ of Illinois at Urbana-Champaign

JTu3A.58

Infinite Asymptotic Degeneracy and Subwavelength Three-Dimensional far-Field Localization in Spherical Structures (/home/eposters/poster/?id=3525749)

Presenter: Asaf Farhi , *Technion*

We show that spherical structures have an infinite-asymptotic-eigenpermittivity degeneracy. We then consider the possibility that the time reversal of the field emitted by atomic/molecular-transition current will spatially correlate with it, leading to strong light-matter interaction.

Authors:Asaf Farhi, Technion

JTu3A.59

**Coupling of Electromagnetic Field to Phonons in Helical Structures
(/home/eposters/poster/?id=3525783)**

Presenter: Asaf Farhi , *Creol*

Using a vibrational and eigenfunction analyses we show that phonons in a helical structure exhibit delocalized response and selectivity in frequency. We also examine the eigenpermittivities and density of electromagnetic states in proximity to such a structure.

Authors:Asaf Farhi, Creol / Aristide Dogariu, Creol

JTu3A.61

Controlled Phase Gate of Spin Qubits in Two Quantum-Dot Single-Photon Emitters (/home/eposters/poster/?id=3531668)

Presenter: JUHYEON KIM , *University of Michigan*

We show that a controlled phase gate on two laterally positioned quantum dots can be achieved using the long-range Coulomb coupling. The permanent dipole moment in piezoelectric quantum dots can significantly enhance the coupling.

Authors:JUHYEON KIM, University of Michigan / Zachary Croft, University of Michigan / Duncan Steel, University of Michigan / Pei-Cheng Ku, University of Michigan

JTu3A.62

**Measuring Luttinger Parameters Directly From Quasiparticle Dynamics
(/home/eposters/poster/?id=3526352)**

Presenter: James O'Hara , *Department of Physics, UCSB*

High-order sideband generation (HSG) is sensitive to dynamic phases, which electrons and holes accumulate when accelerating through a III-V semiconductor. This sensitivity can be exploited to reconstruct the effective Hamiltonian through HSG polarimetry.

Authors:James O'Hara, Department of Physics, UCSB / Joseph Costello, Department of Physics, UCSB / Qile Wu, Department of Physics, UCSB / Kenneth West, Princeton University / Loren Pfeiffer, Princeton University / Mark Sherwin, Department of Physics, UCSB

JTu3A.63

**Maximizing the Efficiency of $\chi^{(2)}$ Processes in Microresonators
(/home/eposters/poster/?id=3523736)**

Presenter: Yun Zhao , *Columbia University*

We perform a study of conversion efficiency in microresonator-based second-harmonic and difference-frequency generation. High conversion efficiencies can be achieved only at specified pump power and detunings and perfect phase matching is not a necessary condition.

Authors:Yun Zhao, Columbia University / Jae Jang, Columbia University / Yoshitomo Okawachi, Columbia University / Alexander Gaeta, Columbia University

JTu3A.64

Dielectric Metasurfaces Made of Vertically Oriented Germanium Ellipses (/home/eposters/poster/?id=3523985)

Presenter: Sylvain Gennaro , *Sandia National laboratories*

In this work, we investigate the linear optical response of a dielectric metasurface made of vertically-oriented germanium ellipses deposited on walls of a micron-scale cubic silicon nitride unit cell support matrix.

Authors:Sylvain Gennaro, Sandia National laboratories / Michael Goldflam, Sandia National laboratories / David Bruce Burckel, Sandia National laboratories / Jeong Jeeyoon, Kangwon National University / Michael Sinclair, Sandia National laboratories / Igal Brener, Sandia National laboratories

JTu3A.65

Artificial Birefringence With Moving Metasurfaces (/home/eposters/poster/?id=3524053)

Presenter: Nasim Mohammadi Estakhri , *Chapman University*

We theoretically characterize a compact optical polarizer consisting of two cascaded metasurfaces. The relative movement of the metasurfaces is tailored to create an artificial birefringence effect which is utilized to design optical waveplates.

Authors:Nasim Mohammadi Estakhri, Chapman University / Nader Engheta, University of Pennsylvania

JTu3A.66

Analytical Expression of Raman Induced Soliton Self-Frequency Shift (/home/eposters/poster/?id=3524166)

Presenter: Robi Kormokar , *McGill University*

We derive an analytical expression that predicts the Raman-induced frequency shift experienced by a soliton. By including fiber losses, dispersion slope, and self-steepening, the resulting expression is a high-order extension of Gordon's formula.

Authors:Robi Kormokar, McGill University / Md Hosne Shamim, McGill University / Martin Rochette, McGill University

JTu3A.68

**Nanoparticle Trapping in Symmetry-Breaking System
(/home/eposters/poster/?id=3524745)**

Presenter: Sen Yang, *Vanderbilt University*

We propose an all-dielectric nanotweezer for low laser power optical trapping combined with negligible heating effect. A new way to harness the self-induced back-action (SIBA) force is also presented.

Authors: Sen Yang, Vanderbilt University / Chuchuan Hong, Vanderbilt University / Yuxi Jiang, Vanderbilt University / Justus Ndukaife, Vanderbilt University

JTu3A.69

Optoelectronic Readout of STT-RAM Memory Cells Using Plasmon Drag Effect (/home/eposters/poster/?id=3524750)

Presenter: Parinaz Sadri Moshkenani, *University of California Irvine*

An optoelectronic readout method for reading the state of STT-RAM cells based on plasmon drag effect is proposed. Our simulations show that the proposed scheme can achieve up to 29.6 Gbit/sec readout speed.

Authors: Parinaz Sadri Moshkenani, University of California Irvine / Mohammad Wahiduzzaman Khan, University of California Irvine / Md Shafiqul Islam, University of California Irvine / Dan Shi, Beijing University of Posts and Telecommunications / Eric Montoya, University of California Irvine / Ilya Krivorotov, University of California Irvine / Nader Bagherzadeh, University of California Irvine / Ozdal Boyraz, University of California Irvine

JTu3A.70

Pulsewidth Dependence of the Effective Nonlinear Refractive Index of Air in the Atmosphere (/home/eposters/poster/?id=3525501)

Presenter: Natalia Múnera, *University of Central Florida*

The ultrafast response function of air is used to predict the pulsewidth dependence of $n_{2,eff}$ from our measurements in the near and mid-infrared. We predict $n_{2,eff}$ in the atmosphere, showing agreement with multiple literature measurements

Authors: Natalia Múnera, University of Central Florida / Salimeh Tofighi, University of Central Florida / David Hagan, University of Central Florida / Eric Van Stryland, University of Central Florida

JTu3A.71

Nonlinear Optical Properties of Functionalized Aza-Borondipyrromethene Chromophores (/home/eposters/poster/?id=3525549)

Presenter: Hao-Jung Chang, *University of Central Florida*

We report the nonlinear-optical properties of functionalized aza-borondipyrromethene chromophores in the near infrared. The fluorescence efficiencies are low, and they exhibit excited-state absorption and two-photon absorption at these wavelengths.

Authors:Hao-Jung Chang, University of Central Florida / Mykhailo Bondar, University of Central Florida / Sylvain David, The École normale supérieure de Lyon / Olivier Maury, The École normale supérieure de Lyon / Gerard Berginc, Thales Las / Andraud Chantal, The École normale supérieure de Lyon / David Hagan, University of Central Florida / Eric Van Stryland, University of Central Florida

JTu3A.72

Simulation of Quantum Gibbs States Using Epsilon-Near-Zero Materials and Classical Light (</home/eposters/poster/?id=3525825>)

Presenter: Jacob Leamer , *Tulane University*

We present theoretical methods for simulating the evolution of quantum Gibbs states using classical light and epsilon-near-zero materials, which allow for easy measurement of the statistical information of the simulated system.

Authors:Jacob Leamer, Tulane University / Wenlei Zhang, Tulane University / Ravi Saripalli, Tulane University / Ryan Glasser, Tulane University / Denys Bondar, Tulane University

JTu3A.73

Faithful Simulation of the XY Hamiltonian With Laser Networks (</home/eposters/poster/?id=3525838>)

Presenter: Mostafa Honari-Latifpour , *City University of New York*

We introduce a Lyapunov function for a network of dissipatively coupled lasers and show that this cost function reduces to the classical XY Hamiltonian in the large gain limit.

Authors:Mostafa Honari-Latifpour, City University of New York / Mohammad Ali Miri, City University of New York

JTu3A.74

Using Plasma Structures to Control the Polarization of High-Intensity Laser Beams (</home/eposters/poster/?id=3528035>)

Presenter: Eugene Kur , *Lawrence Livermore National Laboratory*

Overlapped laser beams in plasma interact via the density grating they generate. We demonstrate how to use this phenomenon to control the polarization of high-intensity laser beams that would damage traditional optical elements.

Authors:Eugene Kur, Lawrence Livermore National Laboratory / Malcolm Lazarow, University of California, Berkeley / Jonathan Wurtele, University of California, Berkeley / Laurent Divol, Lawrence Livermore National Laboratory / Tom Chapman, Lawrence Livermore National Laboratory / Pierre Michel, Lawrence Livermore National Laboratory

JTu3A.75

a Deep Learning Approach to Explore the Mutual Coupling Effects in Metasurfaces (/home/eposters/poster/?id=3531019)

Presenter: *sensong an , University of Massachusetts Lowell*

We propose a deep learning approach that predicts the performance of meta-atoms placed among different neighbors. It provides a fast way to explore the impact of mutual coupling to metasurfaces' performance and conduct further optimizations.

Authors:sensong an, University of Massachusetts Lowell / bowen zheng, University of Massachusetts Lowell / Mikhail Shalaginov, Massachusetts Institute of Technology / hong tang, University of Massachusetts Lowell / hang li, University of Massachusetts Lowell / mohammad haerinia, University of Massachusetts Lowell / yunxi dong, University of Massachusetts Lowell / Anuradha Agarwal, Massachusetts Institute of Technology / clara Rivero-Baleine, Lockheed Martin Corporation / Myungkoo kang, CREOL, University of Central Florida / Kathleen Richardson, CREOL, University of Central Florida / Tian Gu, Massachusetts Institute of Technology / Juejun Hu, Massachusetts Institute of Technology / clayton fowler, University of Massachusetts Lowell / hualiang zhang, University of Massachusetts Lowell

JTu3A.76

Localized Field Enhancements and Anapoles in Subwavelength-Engineered Silicon Nanodisks (/home/eposters/poster/?id=3531846)

Presenter: *Farhan Bin Tarik , Clemson University*

We report the design and characterization of sub-wavelength engineered all-dielectric silicon nanodisks supporting localized field enhancements and anapoles in the near infra-red and verify the presence of the resonant mode through polarization resolved reflectance measurements.

Authors:Farhan Bin Tarik, Clemson University / Saddam Gafsi, Clemson University / Cody Nelson, Clemson University / Judson Ryckman, Clemson University

JTu3A.77

Critical Coupling of a Single Metallic Nanoantenna Under Focused Illumination (/home/eposters/poster/?id=3532018)

Presenter: *Sylvain Gennaro , Sandia National labs*

In this work, we investigate the critical coupling of a single gold disk antenna with a focused beam by evaluating its absorption and scattering using spectral interferometry microscopy.

Authors:Sylvain Gennaro, Sandia National labs / Tyler Roschuk, Imperial College London / Stefan Maier, Nanoinstitut Munich, Ludwig-Maximilians-Universitat Munchen / Rupert Oulton, Imperial College London

JTu3A.78

Fabrication of Photonic Crystal Surface Emitting Lasers (PCSEs) by Epitaxial Regrowth (/home/eposters/poster/?id=3521497)

Presenter: Kevin Reilly , *University of New Mexico*

Epitaxial regrowth is investigated as a method of PCSEL fabrication and is compared to non-regrowth methods. The influence of regrowth to photonic crystal morphology is explored and optically pumped and electrically injected devices are demonstrated.

Authors:Kevin Reilly, University of New Mexico / Akhil Kalapala, The University of Texas at Arlington / Alex Song, Stanford University / Thomas Rotter, University of New Mexico / Zhonghe Liu, The University of Texas at Arlington / Emma Renteria, University of New Mexico / Shanhui Fan, Stanford University / Weidong Zhou, The University of Texas at Arlington / Ganesh Balakrishnan, University of New Mexico

JTu3A.79

Single-Shot Method for Determination of Detonation Energy Using the Sedov Blast Model in Laser Ablation Plasmas (/home/eposters/poster/?id=3523268)

Presenter: Patrick Skrodzki , *University of Michigan, Ann Arbor*

We demonstrate a novel single-shot approach to determine the detonation energy of laser-induced plasmas. The method employs a double-pulse shadowgraphy scheme coupled with analysis of shock expansion rates using the Sedov blast model.

Authors:Patrick Skrodzki, University of Michigan, Ann Arbor / Lauren Nagel, University of Michigan, Ann Arbor / Lauren Finney, University of Michigan, Ann Arbor / Milos Burger, University of Michigan, Ann Arbor / Robert Nawara, University of Michigan, Ann Arbor / John Nees, University of Michigan, Ann Arbor / Igor Jovanovic, University of Michigan, Ann Arbor

JTu3A.80

Dissipative Dynamics of Chirped-Pulse Kerr Resonators (/home/eposters/poster/?id=3523994)

Presenter: Xue Dong , *University of Rochester*

Here we investigate the unique dissipative properties of chirped-pulse solitons in normal dispersion Kerr resonators. Chirped pulses are stable despite >90% round-trip loss and the required drive power has a beneficial insensitivity to cavity losses.

Authors:Xue Dong, University of Rochester / Christopher Spiess, University of Rochester / Victor Bucklew, University of Rochester / William Renninger, University of Rochester

JTu3A.81

Tailoring the Multipolar Content at Tight Focus Using Cylindrical Vector Beams With Orbital Angular (</home/eposters/poster/?id=3524663>)

Presenter: Brendan Heffernan , *University of Colorado, Boulder*

We demonstrate that the polarization and phase degrees of freedom of paraxial laser beams can be used to tailor their multipolar content under tight-focusing conditions. This has applications in controlling the scattering conditions from particles.

Authors:Brendan Heffernan, University of Colorado, Boulder / Bo Xu, University of Colorado, Boulder / Kyuyoung Bae, University of Colorado, Boulder / Mark Siemens, University of Denver / Wounjhang Park, University of Colorado, Boulder / Juliet Gopinath, University of Colorado, Boulder

JTu3A.82

Light by Design: Engineering 2D Optical Fields in Inhomogeneous Media (</home/eposters/poster/?id=3525487>)

Presenter: Yousuf Aborahama , *University of Toronto*

We provide a generalized theoretical framework for designing optical fields with arbitrarily chosen intensity and phase patterns inside an inhomogeneous media. We demonstrate the capabilities of our formulation by generating two exotic beam patterns.

Authors:Yousuf Aborahama, University of Toronto / Mo Mojahedi, University of Toronto

JTu3A.83

Optical Vortex Memory (</home/eposters/poster/?id=3525859>)

Presenter: Mahdi Eshaghi , *CREOL*

We demonstrate that, upon interaction with different randomly scattering media, vortex beams maintain a certain memory of initial properties. We describe the extent of this memory in relation to variance and spatial correlation of randomness.

Authors:Mahdi Eshaghi, CREOL / Aristide Dogariu, CREOL

JTu3A.84

Electrically-Driven Linear Optical Isolation in a Lithium Niobate Nanophotonic Platform (</home/eposters/poster/?id=3524578>)

Presenter: Oğulcan Örsel , *University of Illinois*

We experimentally demonstrate magnet-less linear optical isolation enabled via acousto-optic interaction in a lithium niobate nanophotonic platform. The system leverages non-reciprocal mode splitting of optical modes in a ring resonator induced by traveling acoustic waves.

Authors: Donggyu Sohn, University of Illinois / Oğulcan Örsel, University of Illinois / Gaurav Bahl, University of Illinois

JTu3A.85

**Ultra-High Q Silica Microcavity Fabrication Using Conventional Photolithography Combined With Chemo-Mechanical Polishing
(/home/e posters/poster/?id=3525099)**

Presenter: Shahin Honari , *University of Victoria*

We fabricated ultrahigh Q silica microdisks using conventional photolithography followed by chemo-mechanical polishing. Through this procedure, optical quality factor exceeding one hundred million was obtained.

Authors: Shahin Honari, University of Victoria / Sanaul Haque, University of Victoria / Tao Lu, University of Victoria

JTu3A.86

**Arrays of Microplasma-Assisted Atomic Layer Deposition and Etching Free Patterning of Ga₂O₃ Thin Film With Flexible DUV Photodetector
(/home/e posters/poster/?id=3530779)**

Presenter: Jinhong Kim , *University of Illinois Urbana Champaign*

Microplasma arrays assisted atomic layer deposition (MALD) have been used to deposit gallium oxide (Ga₂O₃) thin film on the rigid and flexible substrate in order to fabricate deep-ultraviolet (DUV) photodetector under 254 nm illumination.

Authors: Jinhong Kim, University of Illinois Urbana Champaign / Andrey Mironov, University of Illinois Urbana Champaign / Dane Sievers, University of Illinois Urbana Champaign / Sung-jin Park, University of Illinois Urbana Champaign / J. Gary Eden, University of Illinois Urbana Champaign

JTu3A.87

**Emerging Materials Based Electro-Optic Phase Modulators
(/home/e posters/poster/?id=3530901)**

Presenter: Rubab Amin , *The George Washington University*

We conduct an *ab-initio* analysis of modulator performance based on heterogeneously integrating emerging materials validating a small modal cross section availed by plasmonic modes which enables high-performance operation, physically realized by arguments on charge-distribution.

Authors:Rubab Amin, The George Washington University / Rishi Maiti, The George Washington University / Jacob Khurgin, Johns Hopkins University / Volker Sorger, The George Washington University

JTu3A.88

Graphene Optoelectronic Artificial Intelligence Accelerators (/home/eposters/poster/?id=3531714)

Presenter: Ruiyang Chen , *University of Utah*

We present a graphene-based optoelectronic artificial intelligence accelerator using spatial light modulators and photodetectors, design a method of performing accurate calculations using imperfect components, and show the system capability of accelerating a few representative algorithms.

Authors:Weilu Gao, University of Utah / Cunxi Yu, University of Utah / Ruiyang Chen, University of Utah

JTu3A.89

Monolithic Indium Phosphide Dual Laser Photonic Integrated Circuit for Remote Sensing Lidar (/home/eposters/poster/?id=3523438)

Presenter: Joseph Fridlander , *University of California Santa Barbara*

A dual laser indium phosphide photonic integrated circuit for remote sensing lidar was realized. A twentyfold improvement in the long-term frequency stability of the master laser was demonstrated using an on-chip phase modulator.

Authors:Joseph Fridlander, University of California Santa Barbara / Fengqiao Sang, University of California Santa Barbara / Victoria Rosborough, University of California Santa Barbara / Simone Brunelli, University of California Santa Barbara / Jeffrey Chen, NASA / Kenji Numata, NASA / Stephan Kawa, NASA / Mark Stephen, NASA / Larry Coldren, University of California Santa Barbara / Jonathan klamkin, University of California Santa Barbara

JTu3A.90

Effect of Strain in WS₂ Monolayer Integrated Excitonic Photodetector (/home/eposters/poster/?id=3523567)

Presenter: Chandraman Patil , *George Washington University*

We investigate the effect of local non-homogeneous strain on WS_2 monolayer when integrated on a SiN photonic waveguide showing a strong spectral responsivity(80mA/W) at exciton wavelength(620nm) and shift of ~10nm in photodetector device.

Authors:Chandraman Patil, George Washington University / Volker Sorger, George Washington University / Rishi Maiti, George Washington University

JTu3A.91

Design and Testing of High-Index Liquid-Core Waveguides for Single Particle Sensing (/home/eposters/poster/?id=3523696)

Presenter: Joel Wright , *Brigham Young University*

Fluidic microchannels filled with high-index ZnI_2 salt solution enable optimized particle fluorescence collection. We describe their design for efficient interfacing with solid-core excitation waveguides and their improved performance in comparison with leaky mode waveguide approaches.

Authors:Joel Wright, Brigham Young University / Gopikrishnan Gopalakrishnan Meena, Univeristy of California, Santa Cruz / Holger Schmidt, Univeristy of California, Santa Cruz / Aaron Hawkins, Brigham Young University

JTu3A.92

Hybrid Guiding in a Multi-Mode Slab Waveguide (/home/eposters/poster/?id=3523887)

Presenter: Abbas Shiri , *University of Central Florida, CREOL*

We demonstrate the hybrid guidance of a pulsed field endowed with precise spatio-temporal structure in a 25-mm-long multi-mode thin-film waveguide. Group delay measurements confirm that the modal indices can be tuned independently of the waveguide parameters.

Authors:Abbas Shiri, University of Central Florida, CREOL / Ayman Abouraddy, University of Central Florida, CREOL

JTu3A.93

Enhanced Supercontinuum From a Dispersion-Varying Fiber (/home/eposters/poster/?id=3524473)

Presenter: Imtiaz Alamgir , *McGill University*

We experimentally demonstrate that a supercontinuum becomes further broadened by using a dispersion varying nonlinear medium. Compared to constant dispersion designs, a power enhancement of 4.3 dB and bandwidth extension of 262 nm are obtained

Authors:Imtiaz Alamgir, McGill University / Md Hosne Shamim, McGill University / Wagner Correr, Laval University / Younès Messaddeq, Laval University / Martin Rochette, McGill University

JTu3A.94

High-Resolution, High-Sensitivity Time-Stretch Spectroscopy Based on Optical Sampling by Cavity Tuning (/home/eposters/poster/?id=3524475)

Presenter: Lingze Duan , *University of Alabama in Huntsville*

We report experimental demonstration of sub-GHz spectral resolution and 10^{-18} -J power sensitivity with a time-wavelength optical sampling spectrometer based on optical sampling by laser cavity tuning.

Authors:Srikamal Soundararajan, University of Alabama in Huntsville / Lingze Duan, University of Alabama in Huntsville

JTu3A.95

Automatically Mapping the Stable Regions of Frequency Combs in Microresonators (/home/eposters/poster/?id=3525080)

Presenter: Logan Courtright , *University of Maryland, Baltimore County*

It has been difficult to determine the experimental parameter space where stable frequency combs can be obtained in microresonators. We describe an automatic computer algorithm that accomplishes this task.

Authors:Logan Courtright, University of Maryland, Baltimore County / Zhen Qi, University of Maryland, Baltimore County / Thomas Carruthers, University of Maryland, Baltimore County / Curtis Menyuk, University of Maryland, Baltimore County

JTu3A.96

Edge-Resolved Transient Imaging (/home/eposters/poster/?id=3525646)

Presenter: charles saunders , *Boston University*

We demonstrate 2.5-dimensional, 180-degree field-of-view non-line-of-sight reconstructions of large-scale scenes using time-correlated single-photon detection and pulsed illumination along an arc at a small opening where a vertical wall edge meets a floor plane.

Authors:charles saunders, Boston University / Joshua Rapp, Boston University / Julián Tachella, Heriot-Watt University / John Murray-Bruce, Boston University / Yoann Altmann, Heriot-Watt University / Jean-Yves Tournet, University of Toulouse / Stephen McLaughlin, Heriot-Watt University / Robin Dawson, Charles Stark Draper Laboratory / Franco Wong, Massachusetts Institute of Technology / Vivek Goyal, Boston University

JTu3A.97

Vascular Injury in Lung Vessels Post-Radiation: a Dose and Time Response Case Study (/home/eposters/poster/?id=3530401)

Presenter: soudeh mostaghimi , *University of Wisconsin Milwaukee*

3D vasculature of non-irradiated and irradiated lungs was extracted, 60 and 90 days after radiation using optical Cryo-imaging. Quantitative measurements show that the number of terminal points and vessel diameter, volume, and terminal points decreases.

Authors: soudeh mostaghimi, University of Wisconsin Milwaukee / Shima Mehrvar, Abbvie Inc. / Farnaz Foomani, University of Wisconsin Milwaukee / Jayashree Narayanan, Medical College of Wisconsin / Amadou Camara, Medical College of Wisconsin / Brian Fish, Medical College of Wisconsin / Meetha Medhora, Medical College of Wisconsin / Mahsa Ranji, Florida Atlantic University

JTu3A.99

Electro-Optic Two-Mode Squeezing Using Graphene Periodic Layers (/home/eposters/poster/?id=3520327)

Presenter: Montasir Qasymeh , *Abu Dhabi University*

A novel electro-optic scheme is proposed to achieve hybrid (microwave and optical) two-mode squeezing. The proposed structure comprises periodic graphene layers, electrically biased by microwave signal and illuminated by two optical fields.

Authors: Montasir Qasymeh, Abu Dhabi University / Hichem Eleuch, University of Sharjah

JTu3A.100

Collimation Effect in Strongly Modulated Anisotropic Photonic Crystals With Near-Zero Refractive Indices (/home/eposters/poster/?id=3521483)

Presenter: Saeid Jamilan , *Michigan Technological University*

A strongly modulated photonic crystal with rectangular lattice was designed to realize the collimation effect for diverging waves entering the crystal at frequencies, providing near-zero refractive indices at unidirectional transmission.

Authors: Saeid Jamilan, Michigan Technological University / Elena Semouchkina, Michigan Technological University

JTu3A.102

Robustness of Dual-Pump-Induced Ultrahigh Repetition Rate Pulse Trains Against Input Power Fluctuations (/home/eposters/poster/?id=3524667)

Presenter: Aku Antikainen , *Boston University*

We demonstrate numerically that the temporal and spectral coherence of a pulse train generated through dual-color pumping a fiber can be maintained even in the presence of pump power fluctuations on the order of 5%.

Authors: Aku Antikainen, Boston University / Govind Agrawal, University of Rochester

JTu3A.103

Embedded Eigenstate in a Single Resonator for Sensing (/home/eposters/poster/?id=3524924)

Presenter: Jacobsen Jacobsen , *Technical University of Denmark*

Embedded eigenstates have been shown in periodic arrays or in structures with extreme material properties. Here, we experimentally demonstrate a compact embedded eigenstate supported by suitable boundary conditions, enabling advanced sensing applications.

Authors:Jacobsen Jacobsen, Technical University of Denmark / Alex Krasnok, Advanced Science Research Center, City University of New York / Samel Arslanagić, Technical University of Denmark / Andrei Lavrinenko, Technical University of Denmark / Andrea Alù, Advanced Science Research Center, City University of New York

JTu3A.104

Two-Beam Coupling at the Epsilon-Near-Zero Wavelength in Indium Tin Oxide (/home/eposters/poster/?id=3525245)

Presenter: Jared Wahlstrand , *NIST*

Two-beam coupling enables tailoring of the optical nonlinearity in hot electron based nonlinear materials. Polarization- and chirp-dependent pump-probe measurements in indium tin oxide are found to be in good agreement with theory.

Authors:Jagannath Paul, NIST / Mario Miscuglio, George Washington University / Yaliang Gui, George Washington University / Volker Sorger, George Washington University / Jared Wahlstrand, NIST

JTu3A.105

Dynamically Controlled Spatio-Temporal Filamentation of Orbital Angular Momentum Light in Water (/home/eposters/poster/?id=3525585)

Presenter: Keith Miller , *Clemson University*

We demonstrate a new route for a systematic, dynamical, high-speed, spatio-temporal control of femtosecond light filamentation in water and, more generally, other maritime environments that can be precisely controlled on a pulse by pulse basis.

Authors:Keith Miller, Clemson University / Justin Free, Clemson University / Kunjian Dai, Clemson University / Dmitrii Tsvetkov, Duke University / Pavel Terekhov, Duke University / Natalia M. Litchinitser, Duke University / Eric Johnson, Clemson University

JTu3A.106

Artificial Intelligence Assisted Optimization and Prediction of Absorption of Metasurfaces for Hot-Electron Generation (/home/eposters/poster/?id=3525823)

Presenter: Raktim Sarma , *Sandia National Labs*

We use artificial intelligence techniques such as the genetic algorithm and convolutional neural networks for optimization and prediction of absorption spectra of plasmonic metasurfaces for enhancing hot-electron generation. The predictions of our algorithms agree well to experimental results.

Authors:Raktim Sarma, Sandia National Labs / Michael Goldflam, Sandia National Labs / Emily Donahue, Sandia National Labs / Abigail Pribisova, Sandia National Labs / Sylvain Gennaro, Sandia National Labs / Jeremy Wright, Sandia National Labs / Igal Brener, Sandia National Labs / Jayson Briscoe, Sandia National Labs

JTu3A.107

Study of Optical Forces Induced by Graphene Plasmonic Resonators on Nanoparticles Near Their ENZ Frequencies (/home/eposters/poster/?id=3531726)

Presenter: Puspita Paul , *State University of New York at Buffalo*

We demonstrate that optical forces induced by graphene plasmonic resonators on nanoparticles of Lorentz model materials are significantly larger than forces on dielectric nanoparticles. Such optical forces also exhibit intriguing characteristics around the ENZ frequencies.

Authors:Puspita Paul, State University of New York at Buffalo / Peter Liu, State University of New York at Buffalo

JTu3A.108

Laser Diodes as Reliable Pump Source for Space-Borne Methane Remote Sensing Lidar System (/home/eposters/poster/?id=3516731)

Presenter: Karl Haeusler , *Ferdinand Braun Institut*

Laser diode minibars for QCW pumping Nd:YAG at 63 W were developed for the satellite MERLIN and subjected to accelerated life test. Evaluating 320 single emitters indicates a reliability of 99.99% during the mission lifetime.

Authors:Karl Haeusler, Ferdinand Braun Institut / Ralf Staske, Ferdinand Braun Institut / Andre Maassdorf, Ferdinand Braun Institut / Peter Ressel, Ferdinand Braun Institut / Christoph Stoelmacker, Ferdinand Braun Institut / Guenther Traenkle, Ferdinand Braun Institut / Paul Crump, Ferdinand Braun Institut

JTu3A.109

Nanosecond 2.73- μ m Parametric Source for Pumping LWIR OPCPA (/home/eposters/poster/?id=3522436)

Presenter: Xuan Xiao , *University of Michigan*

A 31-mJ, 9.6-ns, 2.73- μm parametric source is demonstrated, producing a supergaussian spatial profile with $M^2=2.8$. The source is further sliced to 1-ns pulses, providing favorable characteristics for LWIR OPCPA pumping.

Authors:Xuan Xiao, University of Michigan / John Nees, University of Michigan / Hao Huang, University of Michigan / Igor Jovanovic, University of Michigan

JTu3A.110

Machine Learning Analysis of 2×1 VCSEL Array Coherence and Imaginary Coupling Coefficient (/home/eposters/poster/?id=3524305)

Presenter: Pawel Strzebonski , *University of Illinois, Urbana-Champaign*

Machine learning is used to estimate the coherent-coupling power enhancement from 2×1 VCSEL arrays and serves to identify coherent non-Hermitian operation.

Authors:Pawel Strzebonski, University of Illinois, Urbana-Champaign / William North, University of Illinois, Urbana-Champaign / Nusrat Jahan, University of Illinois, Urbana-Champaign / Kent Choquette, University of Illinois, Urbana-Champaign

JTu3A.111

A Fiber-Based Dual-Color Infrared Pulse Source With Tunable 12-60 THz Frequency Separation (/home/eposters/poster/?id=3524550)

Presenter: Aku Antikainen , *Boston University*

We provide a numerical proof-of-concept demonstration of a widely tunable all-fiber dual-color pulse source in the infrared. The pulse source is based on intermodal Raman scattering and soliton trapping in a dispersion compensating fiber.

Authors:Aku Antikainen, Boston University / Siddharth Ramachandran, Boston University

JTu3A.112

All-Fiber Modelocked Laser Using Chalcogenide Based Nonlinear Multimode Interference Saturable Absorber (/home/eposters/poster/?id=3527331)

Presenter: Arslan Anjum , *McGill University*

We present an all-fiber saturable absorber based on multimode interference (MMI-SA) in a chalcogenide fiber. Results show the nonlinear saturation profile, and mode-locking upon insertion of the MMI-SA in a thulium-doped fiber laser cavity.

Authors:Arslan Anjum, McGill University / Martin Rochette, McGill University

JTu3A.113

High-Power, Narrow-Band PPLN Non-Resonant Optical Parametric Oscillator (/home/eposters/poster/?id=3531550)

Presenter: Valentin Petrov , *Max Born Institute for Nonlinear Optics and Ultrafast Spectroscopy*

We report on power scaling of a PPLN non-resonant optical parametric oscillator reaching an average output power of 8.63 W at 35 kHz with spectral bandwidths not exceeding 2 nm for both signal and idler.

Authors: Li Wang, Max Born Institute for Nonlinear Optics and Ultrafast Spectroscopy / Weidong Chen, Max Born Institute for Nonlinear Optics and Ultrafast Spectroscopy / André Schirrmacher, CANLAS GmbH / Edlef Büttner, APE Angewandte Physik & Elektronik GmbH / Andrey Boyko, Research Laboratory of Quantum Optics Technology / Ning Ye, Key Laboratory of Optoelectronic Materials Chemistry and Physics, Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences / Ge Zhang, Key Laboratory of Optoelectronic Materials Chemistry and Physics, Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences / Valentin Petrov, Max Born Institute for Nonlinear Optics and Ultrafast Spectroscopy

JTu3A.114

Self-Illuminated and Self-Synchronized Image Up-Conversion System by SHG Based on a Passively Q-Switched Laser With an Intra-Cavity Telescopic Configuration (/home/eposters/poster/?id=3532086)

Presenter: Juan Capmany, *Universidad Miguel Hernandez de Elche*

We present a Self-illuminated and Self-synchronized Image Up-conversion system that uses SHG in a passively Q-Switched $\text{Nd}^{3+}:\text{YVO}_4 + \text{V}^{3+}:\text{YAG}$ laser at 1342 nm with an intra-cavity telescopic configuration to simultaneously achieve enhanced conversion and resolution

Authors: Juan Capmany, Universidad Miguel Hernandez de Elche / Adrian Torregrosa, Universidad Miguel Hernandez de Elche / Haroldo Maestre, Universidad Miguel Hernandez de Elche / Maria Luisa Rico, Universidad de Alicante

JTu3A.115

Manifold Learning for Reducing the Design Complexity of Photonic Nanostructures (/home/eposters/poster/?id=3524003)

Presenter: Mohammadreza Zandehshahvar, *Georgia Institute of Technology*

We present a new manifold-learning-based approach to reduce the geometric complexity of the inverse design of photonic nanostructures and show how this approach can provide valuable insight about the underlying physics of their operation.

Authors: Mohammadreza Zandehshahvar, Georgia Institute of Technology / Yashar Kiarashi, Georgia Institute of Technology / Muliang Zhu, Georgia Institute of Technology / Hossein Maleki, Georgia Institute of Technology / Tyler Brown, Georgia Institute of Technology / Ali Adibi, Georgia Institute of Technology

JTu3A.116

Optimization of the Light Coupling Between Metalens and Photonic Crystal Resonators for Robust on-Chip Microsystems (/home/eposters/poster/?id=3524060)

Presenter: Yahui Xiao , *University of Delaware*

We designed an on-chip transformative optics microsystem with integrated metalens for robust and highly efficient light coupling into a photonic crystal cavity.

Authors:Yahui Xiao, University of Delaware / Zi Wang, University of Delaware / Feifan Wang, University of Delaware / Hwaseob Lee, University of Delaware / Thomas Kananen, University of Delaware / Tingyi Gu, University of Delaware

JTu3A.117

Controllable Pure Dephasing Pathways in Single Site-Controlled Pyramidal Quantum Dot – Nanocavity System (/home/eposters/poster/?id=3524482)

Presenter: Jiahui Huang , *University of California, Los Angeles*

We demonstrate the controllable exciton-cavity mode interaction mediated by pure dephasing in a single site-controlled quantum dot-nanocavity system. With varying detuning, Purcell enhanced dynamics and phonon-assisted cavity feeding sequentially dominate the exciton-cavity mode interaction.

Authors:Jiahui Huang, University of California, Los Angeles / Wei Liu, University of California, Los Angeles / Alessio Miranda, École Polytechnique Fédérale de Lausanne / Benjamin Dwir, École Polytechnique Fédérale de Lausanne / Alok Rudra, École Polytechnique Fédérale de Lausanne / Elyahou Kapon, École Polytechnique Fédérale de Lausanne / Chee Wei Wong, University of California, Los Angeles

JTu3A.118

Anomalous Dispersion in Blue Wavelength Range in Vertically Coupled III-Nitride Waveguides (/home/eposters/poster/?id=3531225)

Presenter: Pallabi Das , *IIT Bombay*

In this paper, we present dispersion engineering in vertically coupled III-nitride (GaN/AlN/GaN) waveguides for short (blue) wavelengths. Peak anomalous dispersion $\approx 1.83 \times 10^5$ ps/nm–km is achieved by tuning the geometric parameters and thereby coupling strength of the waveguides.

Authors:Pallabi Das, IIT Bombay / Kasturi Saha, IIT Bombay / Siddharth Tallur, IIT Bombay

JTu3A.119

Photonics in Extreme Environments: High Energy Radiation-Induced Optical Response in Silicon Waveguides (/home/eposters/poster/?id=3531443)

Presenter: Landen Ryder , *Vanderbilt University*

The radiation-induced optical response of a silicon waveguide is investigated and important implications for experimental testing techniques are reported. A computationally efficient approach to accurately estimate the radiation-induced response using perturbation theory is also reported.

Authors: Landen Ryder, Vanderbilt University / Robert Reed, Vanderbilt University / Sharon Weiss, Vanderbilt University

JTu3A.120

A Deep Mixture Density Network for on-Demand Inverse Design of Thin Film Reflectors (/home/eposters/poster/?id=3531600)

Presenter: Rohit Unni , *University of Texas at Austin*

We report a mixture density neural network trained for on-demand inverse design of thin film reflectors, able to retrieve accurate designs and independently reproduce conventional design methods based on physical principles.

Authors: Rohit Unni, University of Texas at Austin / Kan Yao, University of Texas at Austin / Yuebing Zheng, University of Texas at Austin

JTu3A.121

Spontaneous Polarization and Surface Charge Distribution of ZnO From Surface Photovoltage Spectroscopy (/home/eposters/poster/?id=3531619)

Presenter: Yury Turkulets , *Ben Gurion University of the Negev*

Surface charge distribution and spontaneous polarization charge are obtained experimentally using a proposed method based on surface photovoltage spectroscopy and photoluminescence. Our results provide a comprehensive charge characterization of the polar faces of ZnO.

Authors: Yury Turkulets, Ben Gurion University of the Negev / Ilan Shalish, Ben Gurion University of the Negev

JTu3A.122

On-Chip Si₃N₄ Spatial Heterodyne Fourier Transform Spectrometer for the Optical Window in Biological Tissue (/home/eposters/poster/?id=3518585)

Presenter: Kyoung Min Yoo , *University of Texas at Austin*

We designed and demonstrated an on-chip Fourier transform spectrometer on Si₃N₄-on-SiO₂ using an array of Mach-Zehnder interferometers (MZIs) for $\lambda=600\sim 1000$ nm. The retrieval of an input spectrum is demonstrated by the interconnect simulation.

Authors: Kyoung Min Yoo, University of Texas at Austin / Ray Chen, University of Texas at Austin

JTu3A.123

Dynamic Entanglement and Photon Antibunching Using Near-Field-Excited Quantum Emitters (/home/e posters/poster/?id=3520418)

Presenter: Geoffrey Keating , *University of Dublin, Trinity College*

We numerically demonstrate strongly-driven, dynamic entanglement of quantum emitters using time-varying, sub-diffracted light from a near-field transducer. Using cavity-free environments, a controlled-NOT quantum logic operation is performed and ultrafast, single-photon emission is demonstrated.

Authors: Frank Bello, University of Dublin, Trinity College / Nuttawut Kongsuwan, Thailand Center of Excellence in Physics / Geoffrey Keating, University of Dublin, Trinity College / John Donegan, University of Dublin, Trinity College / Ortwin Hess, University of Dublin, Trinity College

JTu3A.124

Wavelength-Division Multiplexed Optical Cryptocurrency (/home/e posters/poster/?id=3520678)

Presenter: Sunil Pai , *Stanford University*

We propose an optical proof-of-work scheme that feeds data encoded into wavelength-division multiplexed modes through a programmable photonic network. We verify robustness by modeling network dispersion, allowing for energy-efficient optical alternatives to current cryptocurrency security schemes

Authors: Sunil Pai, Stanford University / Nathnael Abebe, Stanford University / Michael Dubrovsky, PoWx / Rebecca Hwang, Stanford University / maxim karpov, École polytechnique fédérale de Lausanne / Bogdan Penkovsky, PoWx / David Miller, Stanford University / Olav Solgaard, Stanford University

JTu3A.125

Silicon Photonic Optical-Electrical-Optical Modulator Neuron Verilog-a Model (/home/e posters/poster/?id=3523266)

Presenter: Hector Rubio , *Rochester Institute of Technology*

An Optical-Electrical-Optical silicon photonic neuron is modeled using Verilog-A. The neuron realizes nonlinear activation without electrical amplification. The model (using experimental data) enables the implementation of scalable deep silicon photonic neural networks.

Authors: Hector Rubio, Rochester Institute of Technology / Matthew van Niekerk, Rochester Institute of Technology / Stefan Preble, Rochester Institute of Technology

JTu3A.126

Wide Optical and RF Bandwidth Thin Film Lithium Niobate Modulator on Silicon (/home/e posters/poster/?id=3523369)

Presenter: Swapnajit Chakravarty , *Imec USA*

We propose a bonding interface fabrication tolerant silicon nitride capped thin film lithium niobate on silicon modulator that operates with RF bandwidths >200 GHz in C- and O- bands and V_p L 4V-cm and 3V-cm respectively

Authors:Swapnajit Chakravarty, Imec USA / Reza Safian, Imec USA / Leimeng Zhuang, Imec USA

JTu3A.127

Coupled Multicore Fibers for Dual-Point Refractive Index Measurements (/home/eposters/poster/?id=3525319)

Presenter: Daniel May-Arrijoja , *Centro de Investigaciones en Optica AC*

Simultaneous measurement of refractive index (RI) in liquids is demonstrating by using multicore fibers to spectrally encode the intensity changes observed when the fiber tip is immersed in the tested liquid.

Authors:Natanael Cuando-Espitia, Universidad de Guanajuato / Miguel Fuentes-Fuentes, Centro de Investigaciones en Optica AC / Daniel May-Arrijoja, Centro de Investigaciones en Optica AC / Ivan Hernandez-Romano, Universidad de Guanajuato / Rodolfo Martínez-Manuel, Centro de Investigaciones en Optica AC / Miguel Torres-Cisneros, Universidad de Guanajuato

JTu3A.128

Finesse-Enhanced Measurement of Thermal Capillary-Waves at Liquid-Phase Boundaries (/home/eposters/poster/?id=3525564)

Presenter: Mark Douvidzon , *Technion – Israel Institute of Technolog*

We report on a device, that optically interrogates capillary. Our resolution scales with wavelength divided by cavity finesse and achieves angstrom scale resolution. We show preliminary results in distinguishing between viscosities

Authors:Elad Haber, Technion – Israel Institute of Technolog / Mark Douvidzon, Technion – Israel Institute of Technolog / Tal Carmon, Tel Aviv University

JTu3A.129

Receiver IQ Imbalance and Skew Compensation by Frequency Domain 4x2MIMO Equalizer (/home/eposters/poster/?id=3531653)

Presenter: Liang Junpeng , *ZTE Corporation*

We propose a frequency domain 4x2 multi-input and multi-output (MIMO) equalizer for long-haul transmission systems, which can compensate receiver IQ imbalance and skew with lower computational complexity than time domain 4x2 MIMO

Authors:Liang Junpeng, ZTE Corporation / Wang Weiming, ZTE Corporation

JTu3A.130

Analysis of a VLC Link Under Lighting Conditions in an Indoor Scenario (/home/eposters/poster/?id=3531684)

Presenter: DAVID FARFAN , *Federal University of Technology – Paraná*

Visible light communication transmits data through light-emitting diodes. In this work a commercial lamp consisting of 7 white LEDs is employed in the demonstration of data transmission, obeying the recommended lighting requirement for an indoor scenario.

Authors:DAVID FARFAN, Federal University of Technology – Paraná / FERNANDO TOSTA, Federal University of Technology – Paraná / PAULO DE TARSO NEVES JR, Federal University of Technology – Paraná / ALEXANDRE POHL, Federal University of Technology – Paraná

JTu3A.131

Fiber Interferometers for Time-Domain Quantum Optics (/home/eposters/poster/?id=3519397)

Presenter: Benjamin MacLellan , *Institut National de la Recherche Scientifique*

A novel method for stabilizing fiber interferometers based on frequency- and polarization-multiplexing enables unambiguous phase retrieval, long-term stability, and phase-independent performance. These capabilities allow for precise manipulation of time-bin quantum states in a low-complexity setup.

Authors:Benjamin MacLellan, Institut National de la Recherche Scientifique / Piotr Roztocki, Institut National de la Recherche Scientifique / Mehedi Islam, Institut National de la Recherche Scientifique / Christian Reimer, HyperLight Corporation / Bennet Fischer, Institut National de la Recherche Scientifique / Stefania Sciara, Institut National de la Recherche Scientifique / Robin Helsten, Institut National de la Recherche Scientifique / Yoann Jestin, Institut National de la Recherche Scientifique / Alfonso Cino, University of Palermo / Sai T. Chu, City University of Hong Kong / Brent E. Little, Xi'an Institute of Optics and Precision Mechanics / David Moss, Swinburne University of Technology / Michael Kues, Leibniz University of Hannover / Roberto Morandotti, Institut National de la Recherche Scientifique

JTu3A.132

Velocity Random Walk and Dynamic Range of Laser-Driven Precision Optomechanical Inertial Accelerometers (/home/eposters/poster/?id=3524409)

Presenter: Jaime Flor Flores , *University of California Los Angeles*

Here we present a full study and characterization of our fabricated precision optomechanical accelerometer with an $8.2 \mu\text{g}/\text{Hz}^{1/2}$ VRW and $50.9 \mu\text{g}/\text{Hz}$ bias stability, with innovative RF readout, suitable for inertial applications.

Authors: Jaime Flor Flores, University of California Los Angeles / Yongjun Huang, University of Electronic Science and Technology of China / Talha Yerebakan, University of California Los Angeles / Wenting Wang, University of California Los Angeles / Jia-Gui Wu, University of California Los Angeles / Chee Wei Wong, University of California Los Angeles

JTu3A.134

Classical Filters in Integrated Waveguides With Coupled Sagnac Loop Reflectors (</home/eposters/poster/?id=3526365>)

Presenter: David Moss, *Swinburne University of Technology*

We present theoretical designs of high performance Butterworth, Bessel, Chebyshev, and elliptic filters in integrated silicon photonic nanowire resonators using mode interference in three parallel waveguide coupled Sagnac loop reflectors.

Authors: Hamed Arianfard, Swinburne University of Technology / Jiayang Wu, Swinburne University of Technology / David Moss, Swinburne University of Technology / Saulius Juodkazis, Swinburne University of Technology

JTu3A.135

Triangular Silicon Carbide Nanophotonic Devices for Quantum Simulators (</home/eposters/poster/?id=3524511>)

Presenter: Sridhar Majety, *University of California Davis*

We explore applications of silicon carbide photonics in quantum simulation. We design a low-loss triangular photonic crystal molecule with embedded color centers, and explore the formation of hybridized light-matter states in this system.

Authors: Sridhar Majety, University of California Davis / Victoria Norman, University of California Davis / Liang Li, University of California Davis / Miranda Bell, University of California Davis / Pranta Saha, University of California Davis / Marina Radulaski, University of California Davis

JTu3A.136

Filamentation-Free Self-Compression of LWIR Pulses in a CO₂ Gas-Filled Multi-Pass Cell: a Numerical Study (</home/eposters/poster/?id=3523907>)

Presenter: Michael Hastings, *University of Arizona*

Pulse self-compression is demonstrated numerically for 10.3 μm pulses in a gas-filled multi-pass cell. The cell is filled with the $^{13}\text{CO}_2$ isotope, which exhibits a shifted absorption spectrum from the $^{12}\text{CO}_2$ laser gain medium.

Authors: Michael Hastings, University of Arizona / Paris Panagiotopoulos, University of Arizona / Victor Hasson, University of Arizona / Miroslav Kolesik, University of Arizona / Jerome Moloney, University of Arizona

JTu3A.137

Experimental Measurement of Phase Distributions in Disordered Systems (/home/e posters/poster/?id=3524635)

Presenter: Sandip Mondal, *Tata Institute of Fundamental Research*

The phase distributions of Anderson localized modes are measured in 2D disordered photonic crystals, using single-shot interferograms. The distribution closely follows the theoretical prediction.

Authors: Sandip Mondal, Tata Institute of Fundamental Research / Randhir Kumar, Tata Institute of Fundamental Research / Martin Kamp, Lehrstuhl für Technische Physik, Universität Würzburg / Kedar Khare, Indian Institute of Technology Delhi / Sushil Mujumdar, Tata Institute of Fundamental Research

JTu3A.138

Sampling sub-THz Phase Noise in Frequency Microcombs via Fiber Interferometry (/home/e posters/poster/?id=3497572)

Presenter: Wenting Wang, *University of California Los Angeles*

We characterized the phase jitter of frequency microcomb with μrad phase resolution through fiber interferometry. The measured phase fluctuation PSD and integrated phase jitter are $2.588 \text{ mrad}^2/\text{Hz}$ at 10 kHz and 0.126 rad at 100 μs .

Authors: Wenting Wang, University of California Los Angeles / Xinghe Jiang, University of California Los Angeles / Abhinav Kumar Vinod, University of California Los Angeles / Xinzhou Su, USC / Jinghui Yang, NIST / Mingbin Yu, State Key lab of functional materials for informatics / Dim-Lee Kwong, Institute of Microelectronics / Chee Wei Wong, University of California Los Angeles

JTu3A.139

High Reliability and Advanced Manufacturing of 6x25 Gb/s Uncooled Directly Modulated CWDM Lasers for 5G Wireless (/home/e posters/poster/?id=3524297)

Presenter: Jack Jia-Sheng Huang, *Source Photonics*

In this paper, we present highly reliable 6-channel CWDM of 25G DFB lasers that exhibit low threshold current, high bandwidth, and excellent eye pattern for uncooled operations of -40 to 85 °C. Robust reliability is demonstrated to guarantee stable operations for 5G mobile.

Authors: Jack Jia-Sheng Huang, Source Photonics / S.C. Huang, Source Photonics / NiYeh Wu, Source Photonics / Deo Yu, Source Photonics / C.K. Wang, Source Photonics / Ansel Chen, Source Photonics / David Klotzkin, Source Photonics / Yu-Heng Jan, Source Photonics / ChunKo Chen, Source Photonics / H.S. Chen, Source Photonics / Emin Chou, Source Photonics

JTu3A.140

Spectral Mode Analysis of Non-Hermitian Phased Microcavity Laser Array (/home/eposters/poster/?id=3524407)

Presenter: William North, *University of Illinois*

A coupled 2x1 microcavity laser array is experimentally investigated. We show that the spectral mode profile can identify the coherent region and is consistent with the coupled power enhancement.

Authors: William North, University of Illinois / Nusrat Jahan, University of Illinois / Pawel Strzebonski, University of Illinois / Kent Choquette, University of Illinois

JTu3A.141

New Approach to Mode Locking of High-Energy-Pulse Fibre Lasers (/home/eposters/poster/?id=3531041)

Presenter: Sergey Kobtsev, *Novosibirsk State University*

A new mode locking fibre laser configuration is proposed that delivers record-high energy (150 nJ) of short linearly polarised pulses (~ 200 ns) without external amplification. It is further shown that elongation of the laser cavity with a standard PM-fibre.

Authors: Sergey Kobtsev, Novosibirsk State University / Boris Nyushkov, Novosibirsk State University / Serge Smirnov, Novosibirsk State University / Aleksey Ivanenko, Novosibirsk State University

JTu3A.142

Reflective Fourier Ptychographic Microscopy Using the Scheimpflug Scheme (/home/eposters/poster/?id=3517567)

Presenter: Mojde Hasanzade, *Universitetet i Sorost-Norge*

We report a new approach for reflection mode Fourier ptychographic microscopy using the Scheimpflug geometry. Successful recovery of a USA resolution target is shown with $2NA_{obj}$ synthetic aperture. © 2020 The Authors.

Authors: Mojde Hasanzade, Universitetet i Sorost-Norge / Nazabat Hussain, Universitetet i Sorost-Norge / Dag Werner Breiby, Norwegian University of Science and Technology (NTNU) / Muhammad Nadeem Akram, Universitetet i Sorost-Norge

JTu3A.143

Ultrafast Mode-Locked Fiber Laser Employing New Scheme of Cr-Doped Fiber and Reduced Graphene Oxide (/home/eposters/poster/?id=3523194)

Presenter: Chia-Ming Liu , *National Chung Hsing University*

The 1400-nm ultrafast mode-locked Cr-doped fiber lasers employing new scheme as optical gain and reduced graphene-oxide as saturable absorber is demonstrated for the first time. The output pulse width, average output power, and repetition rate were 118-fs, 2.95-mW, and 15.9-MHz, respectively.

Authors: Chia-Ming Liu, National Chung Hsing University / Chun-Nien Liu, National Chung Hsing University / Heng-Yi Su, National Chung Hsing University / Vincent Hsiao, National Chi Nan University / Nan-Kuang Chen, Liaocheng University / Chao-Yung Yeh, Metal Industries Research and Development Center / Sheng-Lung Huang, National Taiwan University / Wood-HI Cheng, National Chung Hsing University

JTu3A.144

High-Power Broadband Single-Mode ASE Source Near 2 μ m Based on Thulium-Doped Fiber (/home/eposters/poster/?id=3523233)

Presenter: Ian Sun , *OFS Fitel*

We demonstrate a thulium doped fiber amplified spontaneous emission sources pumped by a Raman fiber laser at 1579 nm and 1693 nm. A single mode, maximum output power of 550 mW at the center wavelength of 1880 nm with FWHM of 140 nm has been achieved. © 2020 The Author(s)

Authors: Ian Sun, OFS Fitel / Farooq Khan, OFS Fitel / Joanna Ng, OFS Fitel / Jeffrey Nicholson, OFS Fitel

JTu3A.145

MEMS Photonic Networks for Parallelized Matrix Multiplication Using Wavelength-Division Multiplexing (/home/eposters/poster/?id=3525587)

Presenter: Sunil Pai , *Stanford University*

We study dispersion models and design variations for programmable MEMS photonic networks to analyze scalability of parallel matrix-vector multiplication, which is a core element of commercially viable and energy-efficient photonic neural network accelerator chips.

Authors: Sunil Pai, Stanford University / Nathnael Abebe, Stanford University / Rebecca Hwang, Stanford University / David Miller, Stanford University / Olav Solgaard, Stanford University

JTu3A.146

on-Chip Reconfigurable Inverse-Designed Nanophotonic Devices Based on Phase-Change Materials (/home/eposters/poster/?id=3531201)

Presenter: Sikang Yang, *Huazhong University of Science and Technology*

We propose an on-chip reconfigurable nanophotonic device platform to dynamically implement inverse-designed devices with different functions by programming the state of the phase-change materials, four power splitters and one wavelength multiplexer are demonstrated.

Authors: Sikang Yang, Huazhong University of Science and Technology / Jing Luan, Huazhong University of Science and Technology / Deming Liu, Huazhong University of Science and Technology / Minming Zhang, Huazhong University of Science and Technology

JTu3A.147

Dual-Comb gas Detection Using Single Optical Reference Error Correction (/home/eposters/poster/?id=3522524)

Presenter: Haoyang Yu, *Tsinghua University*

We present a simplified single optical reference error correction method for dual-comb gas detection. Standard deviation of measured $H^{13}C^{14}N$ transmittance spectrum is merely 1% compared to conventional method over 4 THz spectral range.

Authors: Haoyang Yu, Tsinghua University / Qian Zhou, Tsinghua University / Xinghui Li, Tsinghua University / Xiaohao Wang, Tsinghua University / Guan hao Wu, Tsinghua University / Kai Ni, Tsinghua University

JTu3A.148

Highly Sensitive Compact Optical Magnetometer on the Basis of an Atomic Clock (/home/eposters/poster/?id=3531045)

Presenter: Sergey Kobtsev, *Novosibirsk State University*

We demonstrate the possibility of a compact optical magnetometer reaching sensitivities down to $270 \text{ pT/Hz}^{1/2}$ within a 10-Hz bandwidth. It is further shown how to design such a device on the basis of a standard atomic clock.

Authors: Sergey Kobtsev, Novosibirsk State University / Valerii Andryuskov, Novosibirsk State University / Daba Radnatarov, Novosibirsk State University

JTu3A.149

SLASOPS: Proposing a New Method of Delivering Two-Laser Asynchronous Optical Sampling Using a Single Laser (/home/eposters/poster/?id=3486493)

Presenter: David Bajek , *Heriot-Watt University*

We propose SL-ASOPS – Single Laser Asynchronous Optical Sampling; the theory of performing fast two-laser style asynchronous optical sampling, using only one laser, halving the costs and complexity for applications from metrology to life sciences.

Authors:David Bajek, Heriot-Watt University / Richard McCracken, Heriot-Watt University / Maria Ana Cataluna, Heriot-Watt University

JTu3A.150

OSBERT: Towards Megahertz Scan Rates Using Optical Sampling by Electronic Repetition-Rate Tuning (/home/eposters/poster/?id=3521175)

Presenter: David Bajek , *Heriot-Watt University*

We present OSBERT – Optical Sampling By Electronic Repetition-Rate Tuning. OSBERT is a novel optical sampling technique whose potential is shown to approach highly competitive megahertz scan rates, using a single mode-locked two-section laser diode.

Authors:David Bajek, Heriot-Watt University / Maria Ana Cataluna, Heriot-Watt University

JTu3A.152

Another Ultra-Fast Phenomena, Superluminal Propagation of Pulse, and its Application (/home/eposters/poster/?id=3521398)

Presenter: Zi hua Zhang , *Beijing Univ of Posts & Telecom*

The ultra fast phenomenon, superluminal transmission of light pulse , was proposed. Its velocity faster than the infinite was proved in theory and experiment based on two kinds of epistemologies, New application of Laser also discussed.

Authors:Zi hua Zhang, Beijing Univ of Posts & Telecom / Zhang Huaan, Beijing Univ of Posts & Telecom

JTu3A.153

Exploring Field Correlation Measurements on the Electromagnetic Ground State in non-Local Regime (/home/eposters/poster/?id=3525370)

Presenter: Francesca Settembrini , *ETH Zurich*

In the terahertz range, electric field correlations on the electromagnetic ground state have been measured exploiting electrooptic sampling and femtosecond pulses. We investigate the dependence of these correlations on the probed space-time volume.

Authors: Francesca Settembrini, ETH Zurich / Alexa Herter, ETH Zurich / Ileana Benea-Chelmus, Harvard University / Frieder Lindel, Albert-Ludwigs-Universität Freiburg / Giacomo Scalari, ETH Zurich / Jérôme Faist, ETH Zurich

JTu3A.154

Quantum Random Number Generation Combining Intensity Fluctuations With Phase Fluctuations of a DFB Laser (/home/eposters/poster/?id=3522578)

Presenter: Jian Wang, *WNLO&HUST*

We demonstrate a quantum random number generation (QRNG) scheme combining intensity fluctuations with phase fluctuations of a DFB laser. We experimentally verify the best phase difference of the unbalanced Mach-Zehnder interferometer (uMZI) for the best QRNG performance.

Authors: Shunkai Xiang, *WNLO&HUST* / Jian Wang, *WNLO&HUST*

JTu3A.155

Quantum State Tomography With Feed-Forward - Towards Embedding Feed-Forward in Quantum Computation (/home/eposters/poster/?id=3531227)

Presenter: Leonid Vidro, *HUJI*

We have performed 2-photon Quantum State Tomography by embedding a Pockels cell in a feed forward configuration into a scheme for creating linear cluster states - a first step towards implementing feed-forward in quantum computation.

Authors: Leonid Vidro, *HUJI* / Hagai Eisenberg, *HUJI*

JTu3A.156

Single-Shot Broadband White Light Imaging Through Scattering Layers via Speckle Cross-Correlations (/home/eposters/poster/?id=3516869)

Presenter: Wei Li, *Xidian University*

A method for imaging through scattering media under a 300nm-bandwidth white-light illumination from a single-shot speckle is demonstrated. This approach, involving a cross-correlation operation, is free from ambiguities and is robust to noise.

Authors: Wei Li, *Xidian University* / Jietao Liu, *Xidian University* / Wenhai Liang, *Xidian University* / Lixian Liu, *Xidian University* / Bingjian Wang, *Xidian University* / Xiaopeng Shao, *Xidian University*

JTu3A.158

Correlation Effects in Double-Quantum Multidimensional Coherent Spectroscopy (/home/eposters/poster/?id=3523748)

Presenter: Bachana Lomsadze , *Santa Clara University*

We investigate the correlation effects in double-quantum 2D spectroscopy by solving the optical Bloch equations. We also explain the discrepancies between the experimental results reported by multiple groups.

Authors:Bachana Lomsadze, Santa Clara University / Steven Cundiff, University of Michigan

JTu3A.159

Generation of a Nearly-Monocycle Optical Pulse in the Near-Infrared Region and Its Application to Mass Spectrometry (/home/eposters/poster/?id=3524630)

Presenter: Totaro Imasaka , *Kyushu University*

We report on the generation of an octave-spanning (600-1400 nm) nearly-monocycle (1.1 cycle) ultrashort optical pulse (3.2 fs) in the near-infrared region by the Fourier synthesis of two spectrally-broadened pulses at 800 and 1200 nm.

Authors:Yuta Nakano, Kyushu University / Tomoko Imasaka, Kyushu University / Totaro Imasaka, Kyushu University

JTu3A.160

Focusing and Accelerating Light With the Same Flat Lens (/home/eposters/poster/?id=3531528)

Presenter: Tahmid Hassan Talukdar , *Clemson University*

We demonstrate how a simple 1D flat lens can be utilized to not only focus light but to generate non-paraxial accelerating beams. We further report how illumination angle and wavelength degrees of freedom allow dynamic transition between these two functionalities.

Authors:Tahmid Hassan Talukdar, Clemson University / Judson Ryckman, Clemson University

JTu3A.161

Control of VCSEL Polarization via Built-in Gratings (/home/eposters/poster/?id=3531678)

Presenter: Pingping Qiu , *Chinese Academy of Sciences*

Polarization control of VCSEL via built-in gratings is demonstrated. Compared with the devices without gratings, the VCSEL with built-in gratings exhibits a higher orthogonal polarization suppression ratio (>18 dB) up to thermal rollover.

Authors: Pingping Qiu, Chinese Academy of Sciences / Bo Wu, Beijing University of Technology / Pan Fu, Beijing University of Technology / Ming Li, Chinese Academy of Sciences / Yiyang Xie, Beijing University of Technology / Qiang Kan, Chinese Academy of Sciences

JTu3A.162

Bending-Insensitive Broadband-Guiding Anti-Resonant Hollow-Core Fiber at Two-Micron (/home/e posters/poster/?id=3522912)

Presenter: Muhammad Rosdi Abu Hassan , *Nanyang Technological University*

We report a bending-insensitive anti-resonance hollow-core fiber that guides in the two-micron region. The fiber can be bent to a radius as small as 2 cm with the bending-induced loss of <0.53 dB/m.

Authors: Muhammad Rosdi Abu Hassan, Nanyang Technological University / Yuxi Wang, Nanyang Technological University / Wonkeun Chang, Nanyang Technological University

JTu3A.163

on-Chip Universal and Scalable Silicon-Based Mode-Order Converters by Depositing Tapered Metal Layers (/home/e posters/poster/?id=3531273)

Presenter: Yin Xu , *Jiangnan University*

We develop a universal and scalable silicon-based mode-order conversion scheme that can realize the mode-order conversion from fundamental mode to arbitrary higher-order mode in a compact size (conversion length <3 μm) with bandwidth > 200 nm.

Authors: Yin Xu, Jiangnan University / Luping Liu, Jiangnan University / Xin Hu, Hangzhou Dianzi University / Yue Dong, Jiangnan University / Bo Zhang, Jiangnan University / Yi Ni, Jiangnan University

JTu3A.164

Preventing the Breakdown of Photoconductive Terahertz Emitter at High Bias-Field Operation (/home/e posters/poster/?id=3531442)

Presenter: Abhishek Singh , *Helmholtz-Zentrum Dresden-Rossendorf*

The efficiency of photoconductive terahertz emitters is improved by increasing the operating bias field and preventing the breakdown. We can apply ~ 120 kV/cm bias field by using external resistances in series to the emitter.

Authors: Malte Welsch, Helmholtz-Zentrum Dresden-Rossendorf / Abhishek Singh, Helmholtz-Zentrum Dresden-Rossendorf / Stephan Winnerl, Helmholtz-Zentrum Dresden-Rossendorf / Alexej Pashkin, Helmholtz-Zentrum Dresden-Rossendorf / Ming Xu, Xi'an University of Technology / Mengxia Li, Xi'an University of Technology / Manfred Helm, Helmholtz-Zentrum Dresden-Rossendorf / Harald Schneider, Helmholtz-Zentrum Dresden-Rossendorf

JTu3A.165

Isolating Solitons From the Resonant Continuous Wave by Using Nonlinear Fourier Transform (</home/eposters/poster/?id=3519569>)

Presenter: Yutian Wang, *Huazhong University of Science and Technology*

Pure solitons are isolated from the resonant continuous wave background arising in a fiber laser by utilizing nonlinear Fourier transform, which is great helpful to investigate the soliton interaction correctly.

Authors: Yutian Wang, Huazhong University of Science and Technology / Songnian FU, Guangdong University of Technology / Chi Zhang, Huazhong University of Science and Technology / Xiahui Tang, Huazhong University of Science and Technology / Jian Kong, Kunshan Shunke Laser Technology Co., Ltd. / Ju Han Lee, University of Seoul / Luming Zhao, Huazhong University of Science and Technology

JTu3A.166

On Scattering-Induce Fading in Underwater FSO Links for Clear Ocean and Coastal Waters (</home/eposters/poster/?id=3523231>)

Presenter: Pedro Salcedo Serrano, *Universidad de Málaga*

We propose a novel probability density function to describe statistically the effect of scattering-induced fading in underwater FSO links for clear ocean and coastal waters, achieving a coefficient of determination R^2 above 0.9

Authors: Pedro Salcedo Serrano, Universidad de Málaga / Ruben Boluda-Ruiz, Universidad de Málaga / José María Garrido-Balsells, Universidad de Málaga / Antonio García-Zambrana, Universidad de Málaga

JTu3A.167

QCSE and Carrier Blocking in P-Modulation Doped InAs/InGaAs Quantum Dots (</home/eposters/poster/?id=3531050>)

Presenter: Joe Mahoney, *Cardiff University*

The quantum confined Stark effect in InAs/InGaAs QDs using an undoped and p-modulation doped active region was investigated. Doping potentially offers more than a 3x increase in figure of merit modulator performance up to 100 °C.

Authors: Joe Mahoney, Cardiff University / Peter Smowton, Cardiff University / Benjamin Maglio, Cardiff University / ydia Jarvis, Cardiff University / Mingchu Tang, UCL / Huiyun Liu, UCL / Nicolas Abadia, Cardiff University

JTu3A.168

Panda-Type Few-Mode Fiber Enabled Microwave Photonic Filter With Reconfigurable Finite Impulse Response (/home/eposters/poster/?id=3531137)

Presenter: Yao Zhang, *Huazhong University of Sci. and Tech.*

We demonstrate multiple-dimensional division multiplexing enabled microwave photonic filter with the help of Panda-type few-mode fiber. By utilizing the delay between two orthogonal polarizations, the number of taps in finite impulse response can be doubled.

Authors: Yao Zhang, Huazhong University of Sci. and Tech. / Jitao Gao, Huazhong University of Sci. and Tech. / Songnian FU, Guangdong University of Technology / Yuncai Wang, Guangdong University of Technology / Yuwen Qin, Guangdong University of Technology

JTu3A.169

Recognition of OAM State Using CNN Based Deep Learning for OAM Shift Keying FSO System With Pointing Error and Limited Receiving Aperture (/home/eposters/poster/?id=3531800)

Presenter: Biao Gong, *BUPT*

In this paper, we study the performance of OAM shift keying FSO system with pointing error and limited receiving aperture using CNN based demodulator. The results show that the recognition accuracy can reach 98% with pointing error and weak turbulence.

Authors: Biao Gong, BUPT / xing Wang, BUPT / Zhiguo Zhang, BUPT

JTu3A.170

Cryogenic Optical Transitions in $^{77}\text{Se}^+$ Implanted Si for on-Chip Spin-Photon Interfaces (/home/eposters/poster/?id=3524727)

Presenter: Murat Sarihan, *University of California, Los Angeles*

We examine and verify the mid-infrared transitions of $^{77}\text{Se}^+$ deep donors in Silicon. We aim to use implanted Se ions as nuclear-spin/photon interfaces for on-chip quantum repeater structures.

Authors: Murat Sarihan, University of California, Los Angeles / Wei Liu, University of California, Los Angeles / Jiahui Huang, University of California, Los Angeles / Ke Tang, National Institute of Standards and Technology / James McMillan, University of California, Los Angeles / Mark Goorsky, University of California, Los Angeles / Hong-Wen Jiang, University of California, Los Angeles / Joshua Pomeroy, National Institute of Standards and Technology / Chee Wei Wong, University of California, Los Angeles

JTu3A.171

Study on Optical Efficiency of CMOS Image Sensor to High Performance Imaging Devices (/home/eposters/poster/?id=3531775)

Presenter: Hyo jong Cho , *Kyungpook National University*

In this study, we designed the CMOS image sensor and performed optical analysis. As a result, our suggested structure is 19.5% (red), 3.2% (green) and 14.6% (blue) improvements over the reference structure.

Authors: Hyo jong Cho, Kyungpook National University / Yun Seon Do, Kyungpook National University

JTu3A.172

High-Speed Wavelength-Dependent Speckle Generator Applied to Compressive Video Sensing (/home/eposters/poster/?id=3521039)

Presenter: Wanxin Shi , *Beijing National Research Center for Information Science and Technology*

A high-speed wavelength-dependent speckle generator with the refreshing rate up to 100MHz is proposed. This can be used for compressive video sensing for recovering high-speed moving scenes from one blurred image.

Authors: Wanxin Shi, Beijing National Research Center for Information Science and Technology / Chengyang Hu, Beijing National Research Center for Information Science and Technology / Sigang Yang, Beijing National Research Center for Information Science and Technology / Minghua Chen, Beijing National Research Center for Information Science and Technology / Hongwei Chen, Beijing National Research Center for Information Science and Technology

JTu3A.173

Erbium-Doped Dual Wavelength Fiber Laser Interferometric Proximity Sensor With ± 16 nm Measurement Accuracy (/home/eposters/poster/?id=3522972)

Presenter: Zhen Tian , *Beijing University of Posts and Telecommunications (BUPT)*

An erbium-doped fiber ring laser proximity sensor with a high accuracy of ± 16 nm when the output power difference between the dual lasing wavelengths is smaller than 3 dB around 1560 nm wavelength was demonstrated.

Authors:Zhen Tian, Beijing University of Posts and Telecommunications (BUPT) / Nan-Kuang Chen, Liaocheng University / Perry Ping Shum, Southern University of Science and Technology / Cheng-Kai Yao, Liaocheng University / Liqiang Zhang, Liaocheng University / Yicun Yao, Liaocheng University / Shijie Ren, Liaocheng University / Kenneth T. V. Grattan, City, University of London / Qiang Wu, Northumbria University

JTu3A.174

Ultrafast Dynamics of Coherent Optical Phonons and Phonon-Polaritons in a LiNbO_3 Crystal Observed by Reflective Pump-Probe Spectroscopy Based on Electro-Optic Sampling (</home/eposters/poster/?id=3522683>)

Presenter: Aizitiaili Abulikemu , *University of Tsukuba*

Ultrafast dynamics of low-frequency phonon polariton *A*-mode, longitudinal-optic (LO) modes, transverse-optic (TO) modes, and low and high-frequency *E*-modes in *x*-cut lithium niobate crystal have been studied using reflection-type pump-probe spectroscopy with an electro-optic sampling technique.

Authors:Aizitiaili Abulikemu, University of Tsukuba / Takumi Fukuda, University of Tsukuba / Muneaki Hase, University of Tsukuba

JTu3A.175

Coupling Scaling for High-Efficient Cnoidal Wave Generation in Microresonators (</home/eposters/poster/?id=3521601>)

Presenter: Pei-Hsun Wang , *National Central University*

We model the threshold and efficiency of microcombs by scaling the cavity coupling with the Lugiato-Lefever equation (LLE) and the traveling wave theory. Stable cnoidal waves with efficiency $\geq 40\%$ are analytically identified at over-coupling.

Authors:Pei-Hsun Wang, National Central University / Kuan-Lin Chiang, National Central University

JTu3A.176

Fiber-Optic Displacement Sensor With 4 nm Resolution ($\sim \lambda/400$) at 1550 nm Using off-Axis Interferometer (</home/eposters/poster/?id=3522652>)

Presenter: Zhen Tian , *Beijing University of Posts and Telecommunications (BUPT)*

A fiber-optic displacement sensor with $\sim\lambda/400$ spatial resolution, at an operating wavelength of ~ 1550 nm, using an off-axis fiber interferometer and achieving the best displacement resolution of 4-nm in the optical domain has been demonstrated.

Authors:Zhen Tian, Beijing University of Posts and Telecommunications (BUPT) / Nan-Kuang Chen, Liaocheng University / Perry Ping Shum, Southern University of Science and Technology / Lina Suo, Liaocheng University / Yicun Yao, Liaocheng University / Liqiang Zhang, Liaocheng University / Kenneth T. V. Grattan, City, University of London / B. M. Azizur Rahman, City, University of London / Raman Kashyap, Polytechnique Montreal

JTu3A.177

Dwell Time and Spin Relaxation Probability of Rb Atoms on Anti-Spin-Relaxation Coatings (</home/eposters/poster/?id=3524253>)

Presenter: Kanta Asakawa , *Tokyo University of Agriculture and Technology*

The scattering of Rb atoms on paraffin coatings was studied. The results showed that the increase of surface dwell time by cooling from 305 to 123 K is smaller than 2.3×10^{-6} s.

Authors:Kanta Asakawa, Tokyo University of Agriculture and Technology / Yutaro Tanaka, Tokyo University of Agriculture and Technology / Kenta Uemura, Tokyo University of Agriculture and Technology / Norihiro Matsuzaka, Tokyo University of Agriculture and Technology / Kunihiro Nishikawa, Tokyo University of Agriculture and Technology / Yuki Oguma, Tokyo University of Agriculture and Technology / Hiroaki Usui, Tokyo University of Agriculture and Technology / Atsushi Hatakeyama, Tokyo University of Agriculture and Technology

JTu3A.178

Investigation of Multi-Layer-Wall Hollow-Core Negative Curvature Fiber (</home/eposters/poster/?id=3524926>)

Presenter: Shibo Yan , *Beijing Jiaotong University*

We investigate the characteristics of NCFs with multi-layer-wall, and explain the change of equivalent wall-thickness with different other-material-region thicknesses and indices. We also measure the THz NCFs in a THz-TDS system for verification.

Authors:Shibo Yan, Beijing Jiaotong University / shuqin Lou, Beijing Jiaotong University / Guozhong Zhao, Capital Normal University / Jiaoyan Guo, Capital Normal University / Shuai Yang, Beijing Jiaotong University / Xinzhi Sheng, Beijing Jiaotong University

JTu3A.179

Nonmetallic Broadband Visible-Light Absorbers With Polarization and Incident Angle Insensitivity (</home/eposters/poster/?id=3523103>)

Presenter: Yue Yu , *The Chinese University of Hong Kong*

We proposed nonmetallic broadband visible-light absorbers based on alternating SiO₂/InAs thin films on SiO₂ substrate, where average absorption of 97% in 300–850 nm could be achieved with insensitivity to light polarization and incident angles.

Authors: Yue Yu, The Chinese University of Hong Kong / Zejie Yu, The Chinese University of Hong Kong / Xiankai Sun, The Chinese University of Hong Kong

JTu3A.180

Time-Dependent Side Channels in Quantum Key Distribution (/home/eposters/poster/?id=3531946)

Presenter: Amita Gnanapandithan, *University of Toronto*

Time-dependent side channels pose a security risk for quantum key distribution (QKD). We apply a numerical security proof technique to study such a side-channel, which we identify in a common source implementation for measurement-device-independent QKD employing Faraday mirrors.

Authors: Amita Gnanapandithan, University of Toronto / Eli Bourassa, University of Toronto / Li Qian, University of Toronto / Hoi-Kwong Lo, University of Toronto

13:00 - 17:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

SC376

Short Course - SC376: Plasmonics and Mie-tronics

SC438

Short Course - SC438: Photonic Metamaterials

15:00 - 16:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - Discussion of Seminal Papers and Outlook: From Statistical Ray Optics to the Physics of Solar Cells

Join the OSA Photonic Metamaterials Technical Group for this special session featuring Prof. Eli Yablonovitch from the University of California, Berkeley. Prof. Yablonovitch will be discussing his seminal paper "Statistical Ray Optics" (JOSA, 1982) and will provide insights into what controls the voltage of a solar cell.

17:00 - 18:30 (Pacific Time (US & Canada) DST, UTC - 07:00)

STu4A

Applications of Multimode and Multicore Fibers

STu4A.1

“Multimode Fiber Applications”

Invited

Presenter: Demetri Psaltis , *Ecole Polytechnique Federale de Lausanne*

Multimode fibers have been used in a variety of new applications including mode division multiplexing in optical communications, imaging, lasers, laser ablation and spectroscopy. We will discuss how the computational imaging techniques have made it possible to harness the large number of spatial degrees of freedom available in a multimode fiber.

Authors: Demetri Psaltis, *Ecole Polytechnique Federale de Lausanne*

STu4A.2

Image Reconstruction and Enhancement Through Wavelength-Sensitive Speckle Multiplexing and Deconvolution

Presenter: Zhao Wang , *Univ of Electronic Science & Tech China*

Partially spatially coherent illumination from multimode fiber is proposed for imaging through opacity based on deconvolution algorithm. The image quality is greatly enhanced by multiplexing the speckle or the reconstructed images from different illuminating wavelengths.

Authors: Zhao Wang, *Univ of Electronic Science & Tech China* / Rui Ma, *Shenzhen University* / Yong Zhang, *Univ of Electronic Science & Tech China* / Yang Zhu, *Univ of Electronic Science & Tech China* / Jun Liu, *Shenzhen University* / Yaron Bromberg, *Hebrew University of Jerusalem* / Wei Li Zhang, *Univ of Electronic Science & Tech China*

STu4A.3

Visible Spectrum Multicore Fibers With 10 and 16 Cores

Presenter: M. Saeed Sharif Azadeh , *Max Planck Institute of Microstructure Physics*

We demonstrate 10- and 16-core multicore fibers with all cores operating in a single-mode with <0.06 dB/m of loss in the visible spectrum. These fibers address emerging applications requiring spatial division multiplexing in the visible spectrum.

Authors: M. Saeed Sharif Azadeh, *Max Planck Institute of Microstructure Physics* / Andrei Stalmashonak, *Max Planck Institute of Microstructure Physics* / Kevin Bennet, *Corning Research and Development Corporation* / Fu-Der Chen, *Max Planck Institute of Microstructure Physics* / Wesley Sacher, *Max Planck Institute of Microstructure Physics* / Joyce Poon, *Max Planck Institute of Microstructure Physics*

STu4A.4

Efficient 976 nm Laser Based on an all-Solid and Large-Mode-Area Multicore Yb-Doped Fiber

Presenter: Huizi Li , *Nanyang Technological University*

We present an efficient 976 nm laser from an all-solid Ytterbium-doped multicore fiber. Based on the large core-to-cladding area ratio and wavelength selective bending technique, 25 W output power is achieved with 46% slope efficiency.

Authors: Huizi Li, Nanyang Technological University / Sidharthan Raghuraman, Nanyang Technological University / Shaoxiang Chen, Nanyang Technological University / Jichao Zang, Nanyang Technological University / Amiel Ishaaya, Ben-Gurion University of the Negev / Seongwoo Yoo, Nanyang Technological University

STu4A.5

Phase-Locked and Mode-Locked Multicore Photonic Crystal Fiber Laser With Saturable Absorber

Presenter: Tomonari Kawamura , *The University of Electro-Communications*

Phase-locked and mode-locked 7-core multicore photonic crystal fiber laser was demonstrated using a semiconductor saturable absorber for the first time. High energy 333 nJ, 42.4 MHz pulses were generated with a 14.1 W average power.

Authors: Tomonari Kawamura, The University of Electro-Communications / Akira Shirakawa, The University of Electro-Communications

17:00 - 19:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FTu4G

Quantum States Creation, Amplification and Attenuation

Presenter: Jeff Lundeen , *University of Ottawa*

FTu4G.1

Quantum Computational Advantage Using Photons

Invited

Presenter: Chaoyang Lu , *Univ of Science and Technology of China*

We implemented boson sampling (an intermediate model of quantum computing, a strong candidate for demonstrating quantum computational advantage and refuting Extended Church Turing Thesis) with up to 76 photon clicks after a 100-mode interferometer.

Authors: Chaoyang Lu, Univ of Science and Technology of China

FTu4G.2

Encoding Qubit-Qudit States in Photon Polarization and Picosecond Time-Bins

Presenter: Leonid Vidro , *HUJI*

We introduce a qubit-qudit information system realized by two degrees of freedom in a single photon: polarization and picosecond time-bin. We demonstrate creation and reconstruction of states in this framework using quantum state tomography.

Authors: Leonid Vidro, HUJI / Hagai Eisenberg, HUJI

FTu4G.3

on-Chip Generation of Telecommunications-Compatible Ultrafast Time-bin Entangled Qubits

Presenter: Hao Yu , *Institut national de la recherche scientifique*

We demonstrate telecom compatible time-entangled two-photon pairs qubits using an on-chip unbalanced interferometer and spiral waveguide for state preparation/processing and generation, respectively. We show quantum interference and confirm Bell's inequality violation.

Authors: Hao Yu, Institut national de la recherche scientifique / Mario Chemnitz, Institut national de la recherche scientifique / Stefania Sciara, Institut national de la recherche scientifique / Bennet Fischer, Institut national de la recherche scientifique / Benjamin Crockett, Institut national de la recherche scientifique / Piotr Roztock, Institut national de la recherche scientifique / Brent Little, Chinese Academy of Science / Sai T. Chu, City University of Hong Kong / David Moss, Swinburne University of Technology / Jose Azana, Institut national de la recherche scientifique / zhiming wang, University of Science and Technology of China / Roberto Morandotti, Institut national de la recherche scientifique

FTu4G.4

Noiseless Attenuation of Nonclassical States of Light

Presenter: Saurabh Shringarpure , *University of Maryland Baltimore County*

Attenuating a quantum state using a beam splitter will introduce noise and decoherence. Here we show that heralding techniques can be used to attenuate number states or Schrödinger cat states without any noise or decoherence.

Authors: Saurabh Shringarpure, University of Maryland Baltimore County / Cory Nunn, University of Maryland Baltimore County / Todd Pittman, University of Maryland Baltimore County / James Franson, University of Maryland Baltimore County

FTu4G.5

Experimental Noiseless Attenuation With Heralding on Zero Photons

Presenter: Cory Nunn , *UMBC*

Heralded noiseless attenuation is theoretically achievable with linear optics and an uncommon measurement of zero photons in an auxiliary mode. We review this phenomenon and describe experimental progress toward demonstrating it in two physical systems.

Authors: Cory Nunn, UMBC / James Franson, UMBC / Todd Pittman, UMBC

FTu4G.6

Noiseless Linear Amplification for Multi-Photon States

Invited

Presenter: Timothy Ralph, *University of Queensland*

We present a new technique for heralded noiseless linear amplification of quantum states using linear optics which can amplify larger states with higher fidelity and probability of success than previous methods.

Authors: Timothy Ralph, *University of Queensland* / Matthew Winnel, *University of Queensland* / Nedasadat Hosseinidehaj, *University of Queensland*

FTu4I

Quantum Materials Studied by Novel Ultrafast Spectroscopy and Microscopy

Presenter: Joshua Lui, *UC Riverside*

FTu4I.1

Helicity-Resolved Pump-Probe Observation of Biexciton Fine Structures in Monolayer Molybdenum Ditelluride

Presenter: Jiacheng Tang, *Tsinghua University*

A series of biexciton fine structures were directly observed in monolayer MoTe₂ through helicity-resolved resonant pump-probe spectroscopy, in good agreement with our theoretical calculations of transient absorption spectra by solving the four-body Bethe-Salpeter Equation.

Authors: Jiacheng Tang, *Tsinghua University* / Hao Sun, *Tsinghua University* / Qiyao Zhang, *Tsinghua University* / Xingcan Dai, *Tsinghua University* / Zhen Wang, *Tsinghua University* / Cun-Zheng Ning, *Tsinghua University*

FTu4I.2

Femtosecond Nano-Videography of Interlayer Charge Transfer in van der Waals Heterostructures

Presenter: Martin Zizlsperger, *University of Regensburg*

Tunneling between atomic layers strongly changes the polarizability of electron-hole pairs in van der Waals heterobilayers. By monitoring this dynamics with a near-field microscope, we record subcycle nano-movies of local tunneling processes even in insulators

Authors: Martin Zizlsperger, University of Regensburg / Markus Plankl, University of Regensburg / Paulo Faria Junior, University of Regensburg / Fabian Mooshammer, University of Regensburg / Tom Siday, University of Regensburg / Fabian Sandner, University of Regensburg / Felix Schiegl, University of Regensburg / Simon Maier, University of Regensburg / Markus Huber, University of Regensburg / Martin Gmitra, University of Regensburg / Jaroslav Fabian, University of Regensburg / Jessica Boland, University of Manchester / Tyler Cocker, Michigan State University / Rupert Huber, University of Regensburg

FTu4I.3

Nano-Imaging the Few-fs Coherent Dynamics of Graphene

Presenter: Wenjin Luo , *University of Colorado Boulder*

We demonstrate coherent spatio-temporal nano-imaging of graphene and its plasmonic nano-structures in four-wave mixing through adiabatic plasmonic nanofocusing. We resolve nanoscale heterogeneity and ultrafast dephasing affected by weakly screened carrier-carrier scattering.

Authors: Wenjin Luo, University of Colorado Boulder / Tao Jiang, University of Colorado Boulder / Vasily Kravtsov, ITMO University / Mikhail Tokman, Russian Academy of Sciences / Alexey Belyaninand, Texas A&M University / Markus Raschke, University of Colorado Boulder

FTu4I.4

Nanosecond Dynamics in Intrinsic Topological Insulator Revealed by Time-Resolved Optical Reflectivity

Invited

Presenter: Inna Vishik , *University of California Davis*

We show substantial (1000x) slowing of the bulk carrier relaxation time in intrinsic three-dimensional topological insulator $\text{Bi}_{2-x}\text{Sb}_x\text{Se}_3$ as compared to n-type metallic Bi_2Se_3 , using transient pump-probe reflectivity. These dynamics are correlated across fluences and compositions.

Authors: Adam Gross, University of California Davis / Antonio Rossi, Lawrence Berkeley National Lab / Yasen Hou, Massachusetts Institute of Technology / Dong Yu, University of California Davis / Inna Vishik, University of California Davis

FTu4I.5

Ultrafast Heterodyne Infrared Nano-Imaging of Polaron Dynamics in Lead Halide Perovskites

Presenter: Jun Nishida , *University of Colorado*

Ultrafast heterodyne infrared nano-imaging has been developed to reveal nanoscale heterogeneity of polaron formation, dynamics, and polaron-cation coupling in lead halide perovskites, with real space-time mapping of elementary electron-phonon coupling underlying their optoelectronic response.

Authors: Jun Nishida, University of Colorado / Peter Chang, University of Colorado / Jiselle Ye, University of Colorado / Prachi Sharma, University of Colorado / Sean Shaheen, University of Colorado / Markus Raschke, University of Colorado

FTu4I.6

Imaging the Dynamics of 2D Polariton Wavepackets

Presenter: Yaniv Kurman , *Israel Institute of technology*

We use ultra-fast electron microscopy to measure the spatio-temporal dynamics of phonon-polariton wavepackets in a thin hBN sample. The electron probe enables recording the wavepacket formation, propagation, and decay, unveiling intriguing acceleration & deceleration phenomena.

Authors: Yaniv Kurman, Israel Institute of technology / Raphael Dahan, Israel Institute of technology / Hanan Herzig Shenfux, ICFO - Institut de Ciències Fotòniques, The Barcelona Institute of Science and Technology / Kangpeng Wang, Israel Institute of technology / Michael Yannai, Israel Institute of technology / Yuval Adiv, Israel Institute of technology / Ori Reinhardt, Israel Institute of technology / Luiz Tizei, Université Paris-Saclay, CNRS / Steffi Steffi, Université Paris-Saclay, CNRS / Mathieu Kociak, Université Paris-Saclay, CNRS / Frank Koppens, ICFO - Institut de Ciències Fotòniques, The Barcelona Institute of Science and Technology / Ido Kaminer, Israel Institute of technology

FTu4I.7

Tailoring Coulomb Correlations in Twisted WSe₂ Bilayers

Presenter: Philipp Merkl , *University of Regensburg*

Phase-locked few-cycle mid-infrared pulses trace how the twist angle alone renormalizes the binding energy of excitons in twisted WSe₂ homobilayers by a factor of two and tunes their lifetime by a factor of twenty.

Authors: Philipp Merkl, University of Regensburg / Fabian Mooshammer, University of Regensburg / Samuel Brem, Chalmers University of Technology / Anna Girnhuber, University of Regensburg / Kai-Giang Lin, University of Regensburg / Leonard Weigl, University of Regensburg / Chaw-Keong Yong, University of Regensburg / Roland Gillen, Friedrich-Alexander University Erlangen-Nürnberg / Janina Maultzsch, Friedrich-Alexander University Erlangen-Nürnberg / John Lupton, University of Regensburg / Ermin Malic, Chalmers University of Technology / Rupert Huber, University of Regensburg

FTu4E

Photonics in Cavities and Resonators II

Presider: Alireza Marandi , *California Institute of Technology*

FTu4E.1

Dirac Solitons in Optical Microresonators

Highlighted Talk

Presenter: Heming Wang , *California Institute of Technology*

We demonstrate optical Dirac solitons in microresonators by polarization mode coupling. The solitons show unusual properties such as polarization twisting and asymmetrical spectra, and they provide a road-map for visible-band soliton generation in microresonators.

Authors: Heming Wang, California Institute of Technology / Yu-Kun Lu, California Institute of Technology / LUE WU, California Institute of Technology / Dong Yoon Oh, California Institute of Technology / Boqiang Shen, California Institute of Technology / Seung Hoon Lee, California Institute of Technology / Kerry Vahala, California Institute of Technology

FTu4E.2

Nonlinear Optical Response of Metal-Dielectric Nanocavities Resonating in the Near-Infrared

Presenter: Nicolò Maccaferri , *University of Luxembourg*

We study the nonlinear emission of single metal-dielectric nanostructures resonating in the near-infrared. We achieve one order of magnitude higher second-harmonic generation efficiency compared to gold nanostructures with the same geometry and resonant behavior.

Authors: Attilio Zilli, Politecnico di Milano / Tommi Isoniemi, University of Sheffield / Marzia Iarossi, Istituto Italiano di Tecnologia / Marco Finazzi, Politecnico di Milano / Francesco De Angelis, Istituto Italiano di Tecnologia / Michele Celebrano, Politecnico di Milano / Nicolò Maccaferri, University of Luxembourg

FTu4E.3

Dark-Pulse Dynamics and Directional Switching in Photonic-Crystal Ring Resonators

Presenter: Erwan Lucas , *National Institute of Standards and Technology*

Microcomb generation under normal dispersion requires an external phase-matching condition, which we fulfill with a photonic crystal (PhC) in a ring resonator. The bidirectional coupling induced by the PhC leads to a non-trivial direction of propagation and breathing of the nonlinear pulse state.

Authors:Erwan Lucas, National Institute of Standards and Technology / Su-Peng Yu, National Institute of Standards and Technology / Joseph Bush, National Institute of Standards and Technology / Scott Papp, National Institute of Standards and Technology

FTu4E.4

Symmetry Protection Against Mode Crossings in Multimode Photonic Resonator Chains

Presenter: Alexey Tikan, *Institute of Physics, Swiss Federal Institute of Technology Lausanne (EPFL)*

The accessibility of solitons in driven-dissipative photonic dimers drastically varies for different supermode families. We explain the origin of this phenomenon and show its crucial influence on any soliton lattice configuration including topological arrangements.

Authors:Alexey Tikan, Institute of Physics, Swiss Federal Institute of Technology Lausanne (EPFL) / Aleksandr Tusnin, Institute of Physics, Swiss Federal Institute of Technology Lausanne (EPFL) / Johann Riemensberger, Institute of Physics, Swiss Federal Institute of Technology Lausanne (EPFL) / Mikhail Churayev, Institute of Physics, Swiss Federal Institute of Technology Lausanne (EPFL) / Kenichi Komagata, Institute of Physics, Swiss Federal Institute of Technology Lausanne (EPFL) / Xinru Ji, Institute of Physics, Swiss Federal Institute of Technology Lausanne (EPFL) / Rui Wang, Institute of Physics, Swiss Federal Institute of Technology Lausanne (EPFL) / Junqiu Liu, Institute of Physics, Swiss Federal Institute of Technology Lausanne (EPFL) / Tobias Kippenberg, Institute of Physics, Swiss Federal Institute of Technology Lausanne (EPFL)

FTu4E.5

Tunable Kerr Combs in a Normal Dispersion Pulse-Driven Mini-Resonator

Presenter: Stuart Murdoch, *University of Auckland*

Kerr combs are demonstrated in a purely normal dispersion pulse-driven fiber mini-resonator. Though harmonic driving and tunable desynchronization, we are able to control both the spectral extents and line spacing of the output comb.

Authors:Yiqing Xu, University of Auckland / Alexander Sharples, University of Auckland / Julien Fatome, University of Auckland / Stephane Coen, University of Auckland / Miro Erkintalo, University of Auckland / Stuart Murdoch, University of Auckland

FTu4E.6

Soliton Slingshot in Over-Moded Microresonators

Presenter: Teng Tan, *University of Electronic Science & Technology of China*

Leveraging the avoid mode couplings in microsphere resonators, we demonstrated fast soliton slingshot intracavity. Its soliton access range reaches 8 GHz, with success possibility > 90% and single soliton ratio > 60%.

Authors:Teng Tan, University of Electronic Science & Technology of China / Haojing Chen, Peking University / Zhongye Yuan, University of Electronic Science & Technology of China / Yu Yan, Peking University / Qitao Cao, Peking University / Hao Zhang, University of Electronic Science & Technology of China / Juntong Du, University of Electronic Science & Technology of China / Chee Wei Wong, University of California / Yunjiang Rao, University of Electronic Science & Technology of China / Yunfeng Xiao, Peking University / Baicheng Yao, University of Electronic Science & Technology of China

FTu4E.7

Dark- and Bright-Pulse States in Photonic Crystal Ring Resonators

Presenter: Su-Peng Yu , *National Inst of Standards & Technology*

Kerr microresonators with normal dispersion support dark- and bright-pulse states, characterized by either locally vanishing or enhanced intensity. We demonstrate that exciting the photonic-crystal resonator defect mode enables continuous tuning between dark and bright solitons.

Authors:Su-Peng Yu, National Inst of Standards & Technology / Erwan Lucas, National Inst of Standards & Technology / Jizhao Zang, National Inst of Standards & Technology / Scott Papp, National Inst of Standards & Technology

FTu4F

Topological Photonics IV

Presenter: Sander Mann

FTu4F.1

Singularities of Non-Hermitian Systems and Immunoassay Sensing

Invited

Presenter: Abdoulaye Ndao , *Boston University*

We experimentally report new devices based on non-Hermitian systems enabling detection of attomolar anti IgG concentration and quantification of single-cell secretion.

Authors:Abdoulaye Ndao, Boston University

FTu4F.2

Deeply Subwavelength Topological Microscopy

Presenter: Nikitas Papasimakis , *University of Southampton*

We demonstrate experimentally imaging resolution exceeding $\lambda/20$ by a new far-field and label-free approach based on illumination with topologically structured light fields and artificial intelligence. Further improvements promise resolution beyond $\lambda/100$.

Authors:Tanchao Pu, University of Southampton / Jun-Yu Ou, University of Southampton / Guanghui Yuan, Nanyang Technological Univeristy / Edward Rogers, University of Southampton / Nikitas Papasimakis, University of Southampton / Peter J. Smith, University of Southampton / Nikolay Zheludev, University of Southampton

FTu4F.3

Topological Viscous Hall Plasmons in Graphene

Presenter: Wenbo Sun , *Purdue University*

Graphene's viscous Hall fluid is the first candidate for a non-local topological electromagnetic phase of matter. Here, we demonstrate unidirectional topological viscous Hall plasmons and an ultra sub-wavelength topological circulator based on them.

Authors:Wenbo Sun, Purdue University / Todd Van Mechelen, Purdue University / Ashwin Boddeti, Purdue University / Hadiseh Alaeian, Purdue University / Adrian Tepole, Purdue University / Zubin Jacob, Purdue University

FTu4F.4

Fano Resonances in Individual Dielectric Nanoantennas

Presenter: Elizaveta Melik-Gaykazyan , *Australian National University*

We employ azimuthally polarized laser beams to demonstrate experimentally variations of the Fano resonance profiles in the linear spectra of individual AlGaAs nanoantennas and reveal their links to optical bound states in the continuum.

Authors:Elizaveta Melik-Gaykazyan, Australian National University / Kirill Koshelev, Australian National University / Jae-Hyuck Choi, University of Southern California / Sergey Kruk, Australian National University / Andrey Bogdanov, ITMO University / Hong-Gyu Park, Korea University / Yuri Kivshar, Australian National University

FTu4F.5

Radial Bound States in the Continuum

Presenter: Andreas Tittl , *Ludwig-Maximilians-Universität München*

We experimentally demonstrate a new platform for enhanced light-matter interaction and sensing based on radial bound states in the continuum, which are supported in rings of symmetry-broken dielectric resonators with an ultracompact footprint.

Authors: Lucca Kühner, Ludwig-Maximilians-Universität München / Haoran Ren, Ludwig-Maximilians-Universität München / Rodrigo Berté, Ludwig-Maximilians-Universität München / Stefan Maier, Ludwig-Maximilians-Universität München / Yuri Kivshar, Australian National University / Andreas Tittl, Ludwig-Maximilians-Universität München

FTu4F.6

Super-BIC Laser

Highlighted Talk

Presenter: MIN-SOO HWANG, *Korea University*

We demonstrate lasing with ultralow threshold from small-scale dielectric metasurfaces with only $\sim 10 \times 10$ periods operating at a super-BIC regime. Engineered high-Q resonance originates from topological merging of accidental and symmetry-protected bound states in the continuum.

Authors: MIN-SOO HWANG, Korea University / Hoo-Cheol Lee, Korea University / Kyoung-Ho Kim, Chungbuk National University / Kwang-Yong Jeong, Korea University / Soon-Hong Kwon, Chung-Ang University / Kirill Koshelev, Australian National University / Yuri Kivshar, Australian National University / Hong-Gyu Park, Korea University

FTu4J

Ultrafast XUV and X-ray Spectroscopy

Presenter: Julia Mikhailova, *Princeton University*

FTu4J.1

Attosecond and Soft X-ray Time-Resolved Dynamics

Tutorial

Presenter: Stephen Leone, *University of California Berkeley*

High order harmonics are used for molecular and solid-state time-resolved investigations down to attosecond timescales, based on transient absorption, transient reflectivity, four-wave mixing, and diffraction, revealing states of matter, curve crossings, and coherent superpositions.

Authors: Stephen Leone, University of California Berkeley

FTu4J.2

Sub-7-Femtosecond Conical-Intersection Dynamics Probed at the Carbon K-Edge

Presenter: Kristina Zinchenko , *ETHZ*

We present a novel soft X-ray high-harmonic setup and demonstrate the first realization of attosecond transient-absorption spectroscopy at the carbon K-edge, revealing the fastest electronic-relaxation dynamics measured to date.

Authors:Kristina Zinchenko, ETHZ / Fernando Ardana-Lamas, European XFEL GmbH, Schenefeld, Germany / Issaka Seidu, National Research Council of Canada, Ottawa, Canada / Simon Neville, National Research Council of Canada, Ottawa, Canada / Joscelyn van der Veen, National Research Council of Canada, Ottawa, Canada / Valentina Utrio Lanfaloni, ETHZ / Michael Schuurman, National Research Council of Canada, Ottawa, Canada / Hans Jakob Wörner, ETHZ

FTu4J.3

Real-Time Probing of an Atmospheric Photochemical Reaction by Ultrashort EUV Pulses: Nitrous Acid Release From *o*-Nitrophenol

Presenter: Taro Sekikawa , *Hokkaido University*

Photolysis of *o*-nitrophenol, contained in brown carbon in the atmosphere, was investigated by time-resolved photoelectron spectroscopy with EUV light and by theoretical calculations to disentangle all reaction steps from the excitation to the dissociation.

Authors:yuki nitta, Hokkaido University / Oliver Schalk, University of Copenhagen / Hironori Igarashi, Hokkaido University / satoi wada, Hokkaido University / takuro Tsutsumi, Hokkaido University / Kennichiro Saita, Hokkaido University / Tetsuya Taketsugu, Hokkaido University / Taro Sekikawa, Hokkaido University

FTu4J.4

the Effect of Photo-Carrier Doping on the Generation of High Harmonics From MoS₂

Presenter: Christian Heide , *Stanford PULSE Institute*

We report the influence of photo-carrier doping on high-harmonic generation in monolayer MoS₂. The observed decrease in efficiency suggests a strong role for interband transitions in mid-IR driven HHG in this prototypical 2D semiconductor.

Authors:Christian Heide, Stanford PULSE Institute

FTu4J.5

Single Image Measurement of an Isolated Attosecond Pulse

Presenter: Dong Hyuk Ko , *University of Ottawa*

Single image measurement of an attosecond pulse is demonstrated for its complete temporal characterization. To determine the spectrally resolved emission time of the attosecond pulse, we image the dipole modulated by a time-dependent optical grating.

Authors: Dong Hyuk Ko, University of Ottawa / Graham Brown, University of Ottawa / Chunmei Zhang, University of Ottawa / Paul Corkum, University of Ottawa

FTu4H

Imaging with Meta-Optics

Presenter: Junsuk Rho , *Pohang Univ of Science & Technology*

FTu4H.1

Metalens Array With Controllable Angle of View for Compact, Large Field-of-View Microscopy

Presenter: Junjie Hu , *University of California Davis*

We present an innovative metalens array design with a controllable angle of view. Our design leverages the angular dependent transmission of the metastructure, and enables a compact system for large field-of-view microscopic imaging

Authors: Junjie Hu, University of California Davis / Weijian Yang, University of California Davis

FTu4H.2

Electrically Actuated Varifocal Lens Based on a Liquid-Crystal-Encapsulated Semiconductor Metasurface

Presenter: Melissa Bosch , *Cornell University*

An ultrathin electrically controlled varifocal lens based on a liquid crystal encapsulated semiconductor metasurface is demonstrated. Owing to their ultrathin thickness and adaptable design, LC-driven semiconductor metasurfaces offer new prospects for modern imaging technologies.

Authors: Melissa Bosch, Cornell University / Kanghee Won, Samsung Advanced Institute of Technology (SAIT), Samsung Electronics, Co. Ltd / Hong-Seok Lee, Samsung Advanced Institute of Technology (SAIT), Samsung Electronics, Co. Ltd / Maxim Shcherbakov, Cornell University / Gennady Shvets, Cornell University

FTu4H.3

Building Multi-Functional Meta-Optic Systems Through Deep Learning

Presenter: Dayu Zhu , *Georgia Institute of Technology*

We develop a deep learning framework for the design of large-scale, multi-layered, multi-functional meta-optic systems. We demonstrate designed examples of a dual-functional beam generator, an all-optical second-order differentiator, and a space-polarization-wavelength multiplexed hologram.

Authors: Dayu Zhu, Georgia Institute of Technology / Zhaocheng Liu, Georgia Institute of Technology / Lakshmi Raju, Georgia Institute of Technology / Andrew Kim, Georgia Institute of Technology / Wenshan Cai, Georgia Institute of Technology

FTu4H.4

Electrically Switchable Metasurface for Beam Steering Using PEDOT Polymers

Presenter: Julian Karst, *University of Stuttgart*

We present an electrically switchable metasurface for beam steering where we use the conducting polymer PEDOT as an active material. We show intensity-tunable beam diffraction with angles up to 10° , employing an externally applied voltage.

Authors: Julian Karst, University of Stuttgart / Juliane Ratzsch, University of Stuttgart / Jinglin Fu, University of Stuttgart / Monika Ubl, University of Stuttgart / Tobias Pohl, University of Stuttgart / Florian Sterl, University of Stuttgart / Claudia Malacrida, University of Stuttgart / Matthias Wieland, University of Stuttgart / Bernhard Reineke, Paderborn University / Thomas Zentgraf, Paderborn University / Sabine Ludwigs, University of Stuttgart / Mario Hentschel, University of Stuttgart / Harald Giessen, University of Stuttgart

FTu4H.5

Understanding the Limits of Sub-Diffraction Focusing of Light With Photonic Funnel

Presenter: Evan Simmons, *University of Massachusetts Lowell*

We analyze, numerically and experimentally, deep subwavelength focusing of light in new material platform, photonic funnels, implemented at infrared frequencies with semiconductor-based hyperbolic metamaterials, as function of material concentration, geometric profile, and cladding characteristics.

Authors: Evan Simmons, University of Massachusetts Lowell / Kun Li, University of Texas at Austin / Andrew Briggs, University of Texas at Austin / Leland Nordin, University of Texas at Austin / Jiaming Xu, University of Massachusetts Lowell / Dan Wasserman, University of Texas at Austin / Viktor Podolskiy, University of Massachusetts Lowell

FTu4H.6

High-Efficiency Compound Metaoptics for Independent Amplitude and Phase Control

Presenter: Brian Raeker, *University of Michigan*

We demonstrate multi-metasurface devices with high efficiency that provide independent amplitude and phase control across an optical wavefront. Experimental results of metaoptics implementing a three-dimensional point source hologram are reported.

Authors: Brian Raeker, University of Michigan / Hanyu Zheng, Vanderbilt University / You Zhou, City University of New York / Jason Valentine, Vanderbilt University / Anthony Grbic, University of Michigan

FTu4H.7

Optical Metasurfaces for Processing of Amplitude and Phase Images

Presenter: Lukas Wesemann, *The University of Melbourne*

We investigate the utilization of plasmonic resonant waveguide gratings for all-optical image processing in transmission. We experimentally demonstrate edge-detection in amplitude- as well as phase images and contrast enhancement of images of biological samples.

Authors: Lukas Wesemann, The University of Melbourne / Jon Rickett, The University of Melbourne / Jingchao Song, The University of Melbourne / Timothy Davis, The University of Melbourne / Ann Roberts, The University of Melbourne

FTu4H.8

Optical Computation of the Spin Glass Dynamics

Presenter: Marco Leonetti, *Italian Institute of Technology*

Spin Glasses (SG) are paradigmatic models with many applications, while their dynamics is difficult to treat because it is NP-hard. Here we implement the optical simulation of a SG demonstrating a speedup with respect to in-silico simulations.

Authors: Marco Leonetti, Italian Institute of Technology / Erik Hormann, Sapienza University / Luca Leuzzi, CNR / Giorgio Parisi, Sapienza University / Giancarlo Ruocco, Italian Institute of Technology

ATu4L

Machine Learning Enhanced Biological Imaging

Presenter: Utkarsh Sharma, *Catapult Sky*

ATu4L.1

Hyperspectral and Brightfield Imaging Combined With Deep Learning Uncover Hidden Regularities of Colours and Patterns in Biological Cells and Tissues

Invited

Presenter: Ewa Goldys , *University of New South Wales*

Precise quantification of native fluorescent colours of cells and tissue and their morphology patterns allow non-invasive monitoring of biological function at a molecular level, most notably metabolism and its dysregulation. This next-generation methodology opens new options for diagnostics in neurodegeneration and cancer, reproductive medicine and ophthalmology, as well as fundamental biological science.

Authors: Ewa Goldys, University of New South Wales

ATu4L.2

Neural Network-Based Single-Shot Autofocusing of Microscopy Images

Presenter: Luzhe Huang , *University of California, Los Angeles*

Using fluorescence and brightfield microscopy modalities, we demonstrate a deep learning-based offline autofocusing method to blindly autofocus an image that is captured at an unknown out-of-focus distance or on a tilted sample plane.

Authors: Luzhe Huang, University of California, Los Angeles / Yilin Luo, University of California, Los Angeles / Yair Rivenson, University of California, Los Angeles / Aydogan Ozcan, University of California, Los Angeles

ATu4L.3

Deep-Learning Augmented Reflectance Microscopy for Label-Free Multiplexed Cytometry

Presenter: Shiyi Cheng , *Boston University*

We develop a label-free multiplexed cytometry technique based on deep-learning-augmented virtual labeling. We demonstrate accurate single-cell structural phenotypes of cell cycles and multi-parametric single-cell profiling across a large cell population from the multiplexed readouts.

Authors: Shiyi Cheng, Boston University / Sipei Fu, Boston University / Yumi Mun Kim, Boston University / Weiye Song, Boston University / Yunzhe Li, Boston University / Yujia Xue, Boston University / Ji Yi, Boston University / Lei Tian, Boston University

ATu4L.4

AI Enabled Multi-Spectral Autofluorescence Imaging Device for Rapid Detection of Bacteria and Fungus Causing Skin and Soft Tissue Infections

Invited

Presenter: Geethanjali Radhakrishnan , *ADIUVO DIAGNOSTICS PVT LTD*

Skin and soft tissue infections are causing a major health burden requiring point-of-care devices for rapid diagnosis. Here, we present Illuminate, a portable device based on multi-spectral autofluorescence and integrated with AI for rapid detection of pathogens on wounds.

Authors:Geethanjali Radhakrishnan, ADIUVO DIAGNOSTICS PVT LTD

ATu4L.5

Deep Learning-Enabled Coherent Imaging Achieves Early Detection and Classification of Bacteria in Water Samples

Presenter: Hongda Wang , *University of California Los Angeles*

Using deep learning and lensfree holographic imaging, we report early detection and classification of bacterial colonies in water samples. Our system detects 1 colony-forming unit (CFU) per Liter within 9 h of total test time.

Authors:Hongda Wang, University of California Los Angeles / Hatice Koydemir, University of California Los Angeles / Yunzhe Qiu, University of California Los Angeles / Bijie Bai, University of California Los Angeles / Yibo Zhang, University of California Los Angeles / Yiyin Jin, University of California Los Angeles / Sabiha Tok, University of California Los Angeles / Enis Yilmaz, University of California Los Angeles / Esin Gumustekin, University of California Los Angeles / Yair Rivenson, University of California Los Angeles / Aydogan Ozcan, University of California Los Angeles

ATu4L.6

High-Throughput Multimodal FACED Imaging Flow Cytometry

Presenter: Gwinky G. K. Yip , *The University of Hong Kong*

We report a high-throughput, submicron-resolution imaging flow cytometer that allows synchronized single-cell quantitative phase and fluorescence imaging and empowers deep-learning-assisted image-based cell-type classification and cell cycle tracking.

Authors:Gwinky G. K. Yip, The University of Hong Kong / Michelle C. K. Lo, The University of Hong Kong / Kelvin C. M. Lee, The University of Hong Kong / Queenie T. K. Lai, The University of Hong Kong / Kenneth K. Y. Wong, The University of Hong Kong / Kevin Tsia, The University of Hong Kong

ATu4K

Non-conventional Optics and Imaging

Presenter: Daniel Adams , *Colorado School of Mines*

ATu4K.2

Achromatic Broadband Visible Imaging With a 10cm Flat Lens

Presenter: Monjurul Meem , *University of Utah*

We demonstrate 10 cm achromatic flat multilevel diffractive lens with a focal length and thickness of 200mm and 2.4 μm , respectively operating across the entire visible band, which is the largest flat lens ever reported till date.

Authors: Monjurul Meem, University of Utah / Apratim Majumder, University of Utah / Sourangsu Banerji, University of Utah / Berardi Sensale-Rodriguez, University of Utah / Rajesh Menon, University of Utah

ATu4K.3

A Flattened Luneburg Lens for the THz Region

Presenter: Yasith Amarasinghe , *Brown University*

We describe a Luneburg lens modified with quasi-conformal transformation optics. This device offers the possibility for wide-angle beam steering and reception over a broad bandwidth in the terahertz range.

Authors: Yasith Amarasinghe, Brown University / Rajind Mendis, Riverside Research / Rabi Shrestha, Brown University / Hichem Guerboukha, Brown University / Jochen Taiber, Philipps-Universität Marburg / Martin Koch, Philipps-Universität Marburg / Daniel Mittleman, Brown University

ATu4K.4

Xenos Peckii's Compound Eye Structure Inspired Flat Microlens Array for Super-Resolution Imaging

Presenter: Monjurul Meem , *University of Utah*

Inspired by compound eye structures found in insects, we demonstrate an ultrathin arrayed camera enabled by a flat multilevel diffractive microlens array for super-resolution visible imaging, with resolution improvement factor of 1.4 compared to the diffraction limit.

Authors: Monjurul Meem, University of Utah / Apratim Majumder, University of Utah / Sourangsu Banerji, University of Utah / Berardi Sensale-Rodriguez, University of Utah / Rajesh Menon, University of Utah

ATu4K.5

High-Resolution Artificial Compound eye Camera: a Proof-of-Concept Study

Presenter: Sehui Chang , *GIST*

We suggest a new strategy for artificial compound eye camera using tapered fiber bundle. High-resolution imaging from curved microlens array is achieved, with vantages of natural insect eyes: wide field-of-view and infinite depth-of-field.

Authors: Sehui Chang, GIST / Gil Ju Lee, GIST / Young Min Song, GIST

ATu4K.6

Confocal Spatial Frequency Modulation Imaging With Wavelength Domain Modulation

Presenter: John Czerski , *Colorado School of Mines*

We present a novel single element detector imaging scheme in which spatial information is encoded into the spectral content of a broadband source. The technique is confocal when delivered with optical fiber.

Authors: John Czerski, Colorado School of Mines / Daniel Adams, Colorado School of Mines / Jeffrey Field, Colorado State University / Randy Bartels, Colorado School of Mines / Robert Reeves, Lawrence Livermore National Lab / Jeff Squier, Colorado School of Mines

ATu4K.7

High-Performance Akinetic Parallel Light Field Sensor for 3D Imaging

Presenter: Gregory Pandraud , *Ommatidia Lidar*

We present for the first time an akinetic light field sensor with 0.190° FWHM angular resolution and a detection range of > 60m. The work shows the promise of such architecture in metrology and aerospace.

Authors: José Luis Rubio Guivernau, Ommatidia Lidar / Iván Bravo Gonzalo, Ommatidia Lidar / Eduardo Margallo-Balbás, Ommatidia Lidar / Gregory Pandraud, Ommatidia Lidar

ATu4K.1

Recent Advances in Freeform Optics From Design to Manufacture

Invited

Presenter: Jannick Rolland , *University of Rochester*

Freeform optics is an emerging technology that will enable compact and high-performance imaging systems. In this paper, we focus on recent developments in the design and metrology of freeform optical systems.

Authors: Jannick Rolland, University of Rochester / Di Xu, University of Rochester / Romita Chaudhuri, University of Rochester / Rosario Porras-Aguilar, University of North Carolina at Charlotte / John Lambropoulos, University of Rochester / Aaron Bauer, University of Rochester / Daniel Nikolov, University of Rochester

STu4C

Optical Parametric Oscillators and Amplifiers

Presenter: Zhaowei Zhang , *Huazhong Univ. of Science and Technology*

STu4C.1

High-Order Mid-IR Multiphoton Absorption and Nonlinear Refraction in GaP, ZnSe, GaSe, and ZGP Crystals.

Presenter: Taiki Kawamori , *University of Central Florida*

Using Z-scan and femtosecond 2.35- μm pulses, we study high-order nonlinear effects in monocrystals. We find the multiphoton order N varies from $N=6$ (GaP, ZnSe) to $N=4$ (GaSe, ZGP), in accordance with the crystals' bandgaps.

Authors: Taiki Kawamori, University of Central Florida / Peter Schunemann, BAE Systems / Konstantin Vodopyanov, University of Central Florida

STu4C.2

Optical Parametric Amplification With a Spatially-Homogenized Pump Laser

Presenter: Frantisek Batysta , *Lawrence Livermore National Laboratory*

We demonstrate optical parametric amplification using a spatially-homogenized pump beam for the first time and investigate the impact of pump beam angular content on OPA efficiency and bandwidth.

Authors: Frantisek Batysta, Lawrence Livermore National Laboratory / Drew Willard, Lawrence Livermore National Laboratory / Emily Sistrunk, Lawrence Livermore National Laboratory / David Alessi, Lawrence Livermore National Laboratory / Thomas Spinka, Lawrence Livermore National Laboratory / Brendan Reagan, Lawrence Livermore National Laboratory

STu4C.3

High-Brightness Backward Terahertz-Wave Parametric Oscillators for 3D Nondestructive Applications

Invited

Presenter: Hiroaki Minamide , *RIKEN*

We demonstrated novel phase-matching conditions of a tunable backward optical parametric down-conversion generating Terahertz-wave in a periodically poled lithium niobate. The cascading generation and threshold reduction by injection seeding provide high-brightness THz-wave emission.

Authors: Hiroaki Minamide, RIKEN / Kouji Nawata, RIKEN / Yuma Takida, RIKEN / Takashi Notake, RIKEN

STu4C.4

Kerr-Lens Mode-Locked, Synchronously Pumped, Ultra-Broadband Breathing Pulse Optical Parametric Oscillator

Presenter: Jintao fan , *Leibniz University*

Profiting from a breathing pulse design, we demonstrate a Kerr-lens mode-locked non-collinear optical parametric oscillator, which is capable of delivering stable ultrabroadband signal spanning from 628 nm to 890 nm at -10 dB level.

Authors:Jintao fan, Leibniz University / David Zuber, Leibniz University / Robin Mevert, Leibniz University / Tino Lang, Deutsches Elektronen-Synchrotron DESY / Thomas Binhammer, neoLASE GmbH / Uwe Morgner, Leibniz University

STu4C.5

Non-Collinear Optical Parametric Oscillator as Fast Tunable Light Source for Stimulated Raman Scattering

Presenter: Luise Beichert , *Leibniz Univerisät Hannover, Institut für Quantenoptik,*

We present a Non-collinear Optical Parametric Oscillator quickly tunable between 700 and 1030 nm within a few microseconds. It is used for high-speed Stimulated Raman Scattering experiments with up to 100 spectra per second.

Authors:Luise Beichert, Leibniz Univerisät Hannover, Institut für Quantenoptik, / Yuliya Binhammer, Leibniz Univerisät Hannover, Institut für Quantenoptik, / José Andrade, Max-Born-Institut / Uwe Morgner, Leibniz Univerisät Hannover, Institut für Quantenoptik,

STu4C.6

Spectral Broadening in Chirped-Pulse Optical Parametric Oscillators Based on KTiOAsO_4

Presenter: Jiaxing Heng , *Huazhong University Science and Technology*

We report a chirped-pulse optical parametric oscillator based on a KTiOAsO_4 crystal, generating light pulses with a bandwidth of 45.3 THz, twelve times as much as the parametric gain-bandwidth of the nonlinear crystal.

Authors:Jiaxing Heng, Huazhong University Science and Technology / Pei Liu, Huazhong University Science and Technology / Zhaowei Zhang, Huazhong University Science and Technology

STu4C.7

Ultra-Broadband Spontaneous Parametric Down-Conversion From an Aperiodically-Poled Lithium Niobate Superlattice

Presenter: Zi Siang Desmond Toa , *Institute of Materials Research & Engineering*

Ultra-broadband photon pairs from spontaneous parametric down-conversion are important for emerging quantum technologies. Bright ultra-broadband comb-like spectrum spanning ~40 nm around 647 nm signal wavelength from 63.5 mm long aperiodically poled lithium niobate was demonstrated.

Authors:Zi Siang Desmond Toa, Institute of Materials Research & Engineering / Anna Paterova, Institute of Materials Research & Engineering / Leonid Krivitsky, Institute of Materials Research & Engineering

STu4D

Innovative Applications

Presenter: Sungwon Chung , *Neuralink Corporation*

STu4D.1

Deflector for Resolution Enhancement of Head Mounted Displays and Other Visual Systems

Presenter: Jaeyeol Ryu , *Samsung Research*

The resolution of a near eye display is improved by using a liquid crystal (LC) based deflector to tilt light at an angle equivalent to a sub-pixel. Potentially this technology can improve the resolution fourfold.

Authors:Jaeyeol Ryu, Samsung Research / Nikolay Muravev, Samsung R&D Institute Rus / Dmitry Piskunov, Samsung R&D Institute Rus / Mikhail Popov, Samsung R&D Institute Rus / Kyookeun Lee, Samsung Research / Kyusub Kwak, Samsung Research / Myongjo Choi, Samsung Research / James Kim, Samsung Research

STu4D.2

Spatially-Chirped Optical Phased Array Design and its 10-m LiDAR Operation

Presenter: changgyun shin , *Samsung Advanced Institute of Technology*

Novel optical phased array design based on spatially-chirped spacing is presented for solid-state beam steering. Its 128-channel implementation achieved 2.1-dB higher side-mode suppression ratio compared to previous results. 10-m 3D depth imaging was also demonstrated.

Authors:changgyun shin, Samsung Advanced Institute of Technology / dongjae shin, Samsung Advanced Institute of Technology / hyunil byun, Samsung Advanced Institute of Technology / jinmyoung kim, Samsung Advanced Institute of Technology / jisan lee, Samsung Advanced Institute of Technology / changbum lee, Samsung Advanced Institute of Technology / kyung hyun son, Samsung Advanced Institute of Technology / inoh hwang, Samsung Advanced Institute of Technology / dongshik shim, Samsung Advanced Institute of Technology / bongyong jang, Samsung Advanced Institute of Technology / eun kyung lee, Samsung Advanced Institute of Technology / hyuck choo, Samsung Advanced Institute of Technology / kyounggho ha, Samsung Advanced Institute of Technology

STu4D.3

Solving Interdisciplinary Problems With Inverse-Designed Photonics Integrated Circuits

Invited

Presenter: Lin Yang , *Institute of Semiconductors of CAS*

We present latest advances in using the photonics integrated devices and circuits for solving interdisciplinary problems. Especially, we focus on the efficient inverse-design optimization methodology, and ways to promote the circuits in multiple application scenes.

Authors:Hao Jia, Lanzhou University / Shanglin Yang, Institute of Semiconductors of CAS / Lin Yang, Institute of Semiconductors of CAS

STu4D.4

Variable Depth Augmented Reality Display Based on Diffractive Waveguide and Liquid Crystal Varifocal Lens

Presenter: Kyookeun Lee , *Samsung Electronics Co. Ltd.*

We propose an optical see-through variable depth augmented reality display by combining a diffractive waveguide and liquid crystal lens. Depth of virtual images can be controlled up to 4D with a 0.5D step without disturbing ambient images.

Authors:Kyookeun Lee, Samsung Electronics Co. Ltd. / Seungjae Lee, Samsung Electronics Co. Ltd. / Harry Milton, Samsung Electronics Co. Ltd. / Myongjo Choi, Samsung Electronics Co. Ltd. / Kyusub Kwak, Samsung Electronics Co. Ltd. / James Kim, Samsung Electronics Co. Ltd.

STu4D.5

Metasurface Optical Elements for High Performing Augmented/Mixed-Reality Smart Glasses

Presenter: Hyunpil Boo , *University of California, Los Angeles*

We report state-of-the-art metasurface optical elements enabling our high-resolution full color prototype, via various combination of analytical and numerical simulations. Our prototype device has achieved FoV ($>40^\circ$), high output efficiency ($>1\%$), and 1080-pixel resolution.

Authors:Hyunpil Boo, University of California, Los Angeles / Yoo Seung Lee, University of California, Los Angeles / Hangbo Yang, University of California, Los Angeles / Brian Matthews, University of California, Los Angeles / Tom Lee, University of California, Los Angeles / Chee Wei Wong, University of California, Los Angeles

STu4D.6

Characterization of Contactless Integrated Photonic Probes on Silicon Waveguides at Cryogenic Temperatures

Presenter: Zhao Wang, *Tianjin University*

We characterized contactless integrated photonic probes on silicon waveguides in a temperature range from 293 K down to 12 K, and observed the oscillation of admittance and decrease of the sensitivity.

Authors:Zhao Wang, Tianjin University / Haiyi Liu, Tianjin University / Ziyu Zhang, Tianjin University / Kai Zou, Tianjin University / Nan Hu, Tianjin University / Yun Meng, Tianjin University / Liang Xu, Tianjin University / Xiaolong Hu, Tianjin University

STu4D.7

Actuation Bandwidth Extension of an Integrated Piezo-Optomechanical Nanophotonic Device

Presenter: Anat Siddharth, *EPFL*

We demonstrate a novel technique of contour-mode suppression of an integrated MEMS-photonic chip up to the first HBAR mode at 17 MHz. The flattened actuation response is critical to the development of compact LiDAR engine or low-noise frequency-agile laser.

Authors:Anat Siddharth, EPFL / Wenle Weng, EPFL / Grigorii Likhachev, EPFL / Johann Riemensberger, EPFL / Hao Tian, Purdue University / Junqiu Liu, EPFL / sunil bhav, Purdue University / Tobias Kippenberg, EPFL

JTu4B

Special Symposium - Super Symposium on Advances in Quantum Technologies II

President: Alp Sipahigil

JTu4B.1

Optimized Microwave-to-Optical Quantum Transduction

Invited

Presenter: Jelena Vuckovic , *Stanford University*

Inhomogeneities and imperfections in solid state quantum emitter ensembles degrade microwave to optical quantum transduction efficiency. This can be addressed by optimized driving of the system developed by combining open quantum systems solver with adjoint optimization.

Authors:Jelena Vuckovic, Stanford University

JTu4B.2

on-Chip Microwave to Optical Transduction Using Rare Earth Doped Material

Invited

Presenter: Andrei Faraon , *California Institute of Technology*

Rare-earth ions simultaneously coupled to optical and microwave resonators are one of the platforms for realizing efficient microwave to optical quantum transducers. I discuss our group's recent progress towards this goal.

Authors:Andrei Faraon, California Institute of Technology / Jake Rochman, California Institute of Technology / Tian Xie, California Institute of Technology / John Bartholomew, California Institute of Technology

JTu4B.3

Quantum Simulation of 2D Antiferromagnets With Arrays of Individual Rydberg Atoms

Invited

Presenter: Daniel Barredo , *Institut d'Optique,Univ Paris Sud 11*

Rydberg atoms in arrays of optical tweezers are among the most promising platforms for quantum simulation of many body quantum systems [1].

Authors:Daniel Barredo, Institut d'Optique,Univ Paris Sud 11

JTu4B.4

Rydberg Excitons in Cu₂O: From Bulk to Mesoscopic Dimensions

Invited

Presenter: Nobuko Naka , *Kyoto University*

Playgrounds of Rydberg states are not limited to atoms. By reviewing radiative processes of Rydberg excitons in semiconductor Cu_2O , we show that controlling material dimensions is an interesting approach to explore Rydberg physics in solid.

Authors: Nobuko Naka, Kyoto University / Mitsuyoshi Takahata, Kyoto University

Wednesday, 12 May

5:00 - 7:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

JW1A

Joint Poster Session II

JW1A.1

High-Field Charge Transport in InGaAs Nanowires (</home/eposters/poster/?id=3531440>)

Presenter: Rakesh Rana , *Helmholtz-Zentrum Dresden-Rossendorf*

Charge transport in GaAs/InGaAs nanowires is studied using high-field terahertz pulses. With increasing terahertz field, the plasmon resonance redshifts and loses its spectral weight. The results provide evidence for inhomogeneous intervalley scattering across the nanowire.

Authors:Rakesh Rana, Helmholtz-Zentrum Dresden-Rossendorf / Leila Balaghi, Helmholtz-Zentrum Dresden-Rossendorf / Ivan Fotev, Helmholtz-Zentrum Dresden-Rossendorf / Harald Schneider, Helmholtz-Zentrum Dresden-Rossendorf / Manfred Helm, Helmholtz-Zentrum Dresden-Rossendorf / Emmanouil Dimakis, Helmholtz-Zentrum Dresden-Rossendorf / Alexej Pashkin, Helmholtz-Zentrum Dresden-Rossendorf

JW1A.2

Engineering High-Dimensional Entangled States via Discrete-Time Quantum Walks (</home/eposters/poster/?id=3522109>)

Presenter: Taira Giordani , *Univ degli Studi di Roma La Sapienza*

Discrete-time quantum walks (QWs) are versatile platforms in quantum information. In this work we engineer QWs encoded in the angular momentum of single-photon states, to transfer and accumulate entanglement between information carriers of different dimensions.

Authors:Taira Giordani, Univ degli Studi di Roma La Sapienza / Luca Innocenti, Queen's University Belfast / Alessia Suprano, Univ degli Studi di Roma La Sapienza / Emanuele Polino, Univ degli Studi di Roma La Sapienza / Mauro Paternostro, Queen's University Belfast / Nicolò Spagnolo, Univ degli Studi di Roma La Sapienza / Fabio Sciarrino, Univ degli Studi di Roma La Sapienza / Alessandro Ferraro, Queen's University Belfast

JW1A.3

Anti-Bunching of Phase Modulated Frequency-Bin Entangled Photons (</home/eposters/poster/?id=3525822>)

Presenter: Kirthanaa Indumathi , *Institut de Recherche FEMTO-ST*

We introduce a high-brightness and high-visibility source to generate and manipulate high-dimensional frequency-bin entangled photon pairs, using photonic circuit integrable components. We demonstrate, with this source, the antibunching effect in high-dimensional space.

Authors: Kirthanaa Indumathi, Institut de Recherche FEMTO-ST / Thomas Daugey, Institut de Recherche FEMTO-ST / Amelie Piveteau, Institut de Recherche FEMTO-ST / Luca Furfaro, Institut de Recherche FEMTO-ST / mohamed Bourennane, Stockholm University / Jean-Marc Merolla, Institut de Recherche FEMTO-ST

JW1A.4

Giant Raman Wave From SPM Sidelobes in ANDi Fiber (/home/eposters/poster/?id=3520496)

Presenter: Rasmus Hansen , *DTU Photonics*

We couple a supercontinuum with a distributed soliton spectrum into an ANDi fiber and demonstrate the generation of giant SPM waves by inter-pulse Raman scattering, which slowly red-shifts the total spectrum.

Authors: Rasmus Hansen, DTU Photonics / Christian Petersen, DTU Photonics / Ole Bang, DTU Photonics

JW1A.5

Transfer Matrix Method for Kerker-Type Scattering of Metasurface (/home/eposters/poster/?id=3521807)

Presenter: Xia Zhang , *Trinity College Dublin, Ireland*

We experimentally, numerically and semi-analytically study the effect of the substrate on Kerker effect in ultra-thin nanodisk metasurface. A transfer matrix approach successfully explains the experimentally measured reflection dip of a metasurface on SiO₂/Si substrate.

Authors: Xia Zhang, Trinity College Dublin, Ireland

JW1A.6

Soliton Blockade and Symmetry Breaking in Microresonators (/home/eposters/poster/?id=3523137)

Presenter: Zhiwei Fan , *University of Bath*

We report new methods to control the soliton generation in ring microresonators via the soliton blockade and symmetry breaking in the bidirectionally pumped and coupled ring systems.

Authors: Zhiwei Fan, University of Bath / Danila Puzyrev, University of Bath / Magnus Johansson, Linköping University / Dmitry Skryabin, University of Bath

JW1A.8

Wide Gamut, Single-Wafer, Flexible Structural Coloration via wet Chemistry With Resolution Beyond Diffraction Limit (/home/eposters/poster/?id=3523816)

Presenter: Ning Li , *KAUST University*

We demonstrate structural colors with gamut exceeding the red green and blue (RGB) spectrum, on inexpensive, metal-free, and thermal resistant structures with resolution of 127000 dots per inches (DPI) on 4-inch wafers beyond.

Authors: Ning Li, KAUST University / Andrea Fratolocchi, KAUST University

JW1A.9

Dynamic Control of Plasmonic Colors by Voltage Actuation MEMS Cantilevers (/home/eposters/poster/?id=3523897)

Presenter: Zhengli Han , *The Hebrew University of Jerusalem*

We propose a dynamic control of plasmonic colors by using MEMS (micro electro mechanical system) cantilevers. The nano hole structures provide plasmonic colors, while the MEMS cantilevers are built on top to switch the colors.

Authors: Zhengli Han, The Hebrew University of Jerusalem / Christian Frydendahl, The Hebrew University of Jerusalem / Noa Mazurski, The Hebrew University of Jerusalem / Uriel Levy, The Hebrew University of Jerusalem

JW1A.10

Topological Protection Versus Degree of Entanglement of two-Photon Edge States (/home/eposters/poster/?id=3525059)

Presenter: Armando Leija , *Max Born Institute*

We investigate theoretically the physical mechanisms that contribute to the vulnerability of highly entangled two-photon edge states propagating in topological insulator photonic lattices. We present clear guidelines for maximizing entanglement without sacrificing topological protection.

Authors: Armando Leija, Max Born Institute / Konrad Tschernig, Max Born Institute / Kurt Busch, Max Born Institute

JW1A.12

Femtosecond non-Collinear Optical Parametric Oscillator in the Visible (VIS-NOPO) (/home/eposters/poster/?id=3525513)

Presenter: Robin Mevert , *Institute of Quantum Optics*

In this work, we present a femtosecond, fast tunable non-collinear optical parametric oscillator (NOPO) pumped by the third harmonic of a Yb-fiber laser. The NOPO covers nearly the complete visible spectral range from 440-720 nm.

Authors: Robin Mevert, Institute of Quantum Optics / Yuliya Binhammer, Institute of Quantum Optics / Christian Dietrich, Institute of Quantum Optics / José Andrade, Institute of Quantum Optics / Luise Beichert, Institute of Quantum Optics / Thomas Binhammer, neoLase GmbH / Jintao fan, Institute of Quantum Optics / Uwe Morgner, Institute of Quantum Optics

JW1A.13

Dispersive Wave Generation via Intermodal Cross-Phase Modulation (/home/eposters/poster/?id=3525538)

Presenter: Maximilian Timmerkamp, *University of Münster*

We present dispersive wave generation via intermodal cross-phase modulation. The interaction between a higher-order soliton in one transverse mode and an orthogonal, low-intensity mode causes the latter to radiate a dispersive wave.

Authors: Maximilian Timmerkamp, University of Münster / Niklas Lüpken, University of Münster / Ramona Scheibinger, Leibniz Institute of Photonic Technology / Kay Schaarschmidt, Leibniz Institute of Photonic Technology / Markus Schmidt, Leibniz Institute of Photonic Technology / Klaus-J. Boller, University of Twente / Carsten Fallnich, University of Münster

JW1A.14

***in Situ* Measurement of the Cooper Minimum in Argon (/home/eposters/poster/?id=3525875)**

Presenter: Graham Brown, *University of Ottawa*

We simulate a collinear two-color attosecond *in situ* measurement in argon and show that *in situ* techniques measure a variation of the electron group delay around the Cooper minimum.

Authors: Graham Brown, University of Ottawa / Chunmei Zhang, University of Ottawa / Dong Hyuk Ko, University of Ottawa / Paul Corkum, University of Ottawa

JW1A.15

Mechanism and Sensitivity of Fano Resonance Tuning in High-Contrast Gratings (/home/eposters/poster/?id=3531700)

Presenter: Hsin-Yu Yao, *National Tsing Hua University*

An analytical theory for Fano resonance tuning in high-contrast gratings (HCGs) is developed, agreeing well with numerical modeling. We show HCG resonance tuning contains a cooperative contribution from two modes, different from single-mode microresonators.

Authors: Hsin-Yu Yao, National Tsing Hua University / Tsing-Hua Her, The University of North Carolina at Charlotte

JW1A.16

Planar Schottky Photodiode Based on Multilayered 2D GeAs for High-Performance VIS-NIR Broadband Detection (/home/eposters/poster/?id=3519342)

Presenter: Ghada Dushaq, *New York University Abu Dhabi*

we demonstrate a metal-semiconductor-metal Schottky photodiode with asymmetric contact geometries based on multilayered 2D GeAs. Results show low dark current with stable, reproducible, and remarkable broadband spectral response from UV to optical communication wavelengths.

Authors: Mahmoud Rasras, *New York University Abu Dhabi* / Ghada Dushaq, *New York University Abu Dhabi*

JW1A.17

Numerically Accelerated Development Cycle for Ultra-High Finesse Micro-Fabricated Resonators (/home/eposters/poster/?id=3520513)

Presenter: Yizhi Luo, *Yale University*

We show that eigenmode solvers can drastically shorten the development cycle of high finesse micro-Fabry-Pérot resonators. In conjunction with angstrom-level surface metrology, benchmarked simulation yields accurately predict eigenmode profiles and finesse in nonstandard resonator geometries.

Authors: Yizhi Luo, *Yale University* / David Mason, *Yale University* / James Hendrie, *University of Colorado Boulder* / Naijun Jin, *Yale University* / Charles McLemore, *University of Colorado Boulder* / Prashanta Kharel, *Yale University* / Megan Kelleher, *University of Colorado Boulder* / Franklyn Quinlan, *University of Colorado Boulder* / Scott Diddams, *University of Colorado Boulder* / Peter Rakich, *Yale University*

JW1A.18

Physical-Layer Security Using Atmosphere-Limited Line-of-Sight Terahertz Links (/home/eposters/poster/?id=3521000)

Presenter: Zhaoji Fang, *Brown University*

We simulate the properties of atmospheric absorption for a free-space terahertz channel, and propose a method to enable physical-layer security by tuning the carrier frequency relative to a water vapor absorption line.

Authors: Zhaoji Fang, *Brown University* / Daniel Mittleman, *Brown University*

JW1A.19

Influence of Nanoparticle Dimensions on Rabi Splitting Strength (/home/eposters/poster/?id=3521864)

Presenter: Julia Lawless , *Trinity College, University of Dublin*

Strong coupling was detected between single gold nano-bipyramids and monolayer MoS₂. It was demonstrated that the coupling strength increases with nanoparticle size, even without increasing the number of excitons coupled into the system.

Authors: Julia Lawless, Trinity College, University of Dublin / Calin Hrelescu, Trinity College, University of Dublin / Carolyn Elliott, Trinity College, University of Dublin / Lisanne Peters, Trinity College, University of Dublin / Niall McEvoy, Trinity College, University of Dublin / Louise Bradley, Trinity College, University of Dublin

JW1A.20

Accurate Profile Design of Parabolic SNAP Structures Fabricated With a Femtosecond Laser (/home/eposters/poster/?id=3530947)

Presenter: Yu Qi , *Huazhong Univ of Science and Technology*

We demonstrate a new and powerful approach for fabricating the parabolic SNAP structures with a femtosecond laser by tailoring the length of the inscribed lines to match the parabolic profile.

Authors: Yu Qi, Huazhong Univ of Science and Technology / Zhen Zhang, Huazhong Univ of Science and Technology / Xuewen Shu, Huazhong Univ of Science and Technology

JW1A.21

Direct Current Frequency Chirping of Diode Laser Injection Locked to WGMR (/home/eposters/poster/?id=3498008)

Presenter: Oleg Benderov , *MIPT*

We investigate the possibility of frequency chirping of single mode diode laser locked to WGMR via driving current modulation. Maximum frequency deviation of LD locked to WGMR is measured as well as backward wave phase impact on LD linewidth.

Authors: Artem Shitikov, Russian Quantum Center / Oleg Benderov, MIPT / Valery Lobanov, Russian Quantum Center / Nikita Kondratiev, Russian Quantum Center / German Antoshkin, MIPT / Igor Bilenko, Russian Quantum Center

JW1A.22

Visible Wavelength Beam Steering in Silicon Nitride Nanophotonic Phased Arrays With a Supercontinuum Laser (/home/eposters/poster/?id=3520158)

Presenter: Zhenmin Chen , *Peng Cheng Laboratory (PCL)*

In this work, beam steering angle of 65° is achieved on a 32-channel antennas phased array. We demonstrate a wide range of beam steering in visible band with a supercontinuum laser for the first time.

Authors:Zhenmin Chen, Peng Cheng Laboratory (PCL) / hongjie wang, The Chinese University of Hong Kong (CUHK) / Caiming Sun, Peng Cheng Laboratory (PCL) / shupeng Deng, Peng Cheng Laboratory (PCL) / Xinke Tang, Peng Cheng Laboratory (PCL) / Long Zhang, Peng Cheng Laboratory (PCL) / Rui Jiang, Peng Cheng Laboratory (PCL) / Wu Shi, Peng Cheng Laboratory (PCL) / Zhen Chen, Peng Cheng Laboratory (PCL) / Zhongyi Li, Peng Cheng Laboratory (PCL) / Aidong Zhang, Peng Cheng Laboratory (PCL)

JW1A.23

Compact and Broadband Silicon Photonic Multiplexers Based on Fast Adiabatic Structures (/home/eposters/poster/?id=3520724)

Presenter: Kazim Gorgulu , *Koç University*

We present the theory and experimental demonstration for compact integrated spectral multiplexers utilizing fast adiabatic structures. The demonstrated 1x2 multiplexers effectively separate/combine broadband long-pass and short-pass signals, with compact footprint and low loss.

Authors:Kazim Gorgulu, Koç University / Emir Magden, Koç University

JW1A.24

Real-Time Scalable Imaging Through Dynamic Scattering Media at Ultra-low Light Level (/home/eposters/poster/?id=3522659)

Presenter: Yiwei Sun , *Shanghai Jiao Tong University*

We experimentally reconstruct high-quality images through dynamic media using as little as ~ 0.4 photons per pixel by proposed scalable method, which provides guidance on the real-time photon-limited time-varying scattering imaging applications such as in vivo bioimaging.

Authors:Yiwei Sun, Shanghai Jiao Tong University / xiaoyan Wu, Shanghai Jiao Tong University / Jianhong Shi, Shanghai Jiao Tong University / Guihua Zeng, Shanghai Jiao Tong University

JW1A.25

Calibration of Fiber Grating Heavy Metal Ion Sensor Using Artificial Neural Network (/home/eposters/poster/?id=3523468)

Presenter: SOUVIK GHOSH , *City, University of London*

An ultrasensitive hybrid fiber grating sensor has been designed and functionalized with a novel nanocomposite material for selective detection of lead ions in water. Sensor performance is enhanced using an artificial neural network-based calibration process.

Authors:SOUVIK GHOSH, City, University of London / Kasun Dissanayake, City, University of London / Tong Sun, City, University of London / Kenneth Grattan, City, University of London / B. M. Azizur Rahman, City, University of London

JW1A.26

Reciprocating Reflective Double Gratings Based LCOS Waveshaper With Finer Bandwidth Resolution (/home/eposters/poster/?id=3524207)

Presenter: Jingquan Xu , *Huazhong Uni. of Sci. & Tech.*

We demonstrate a LCOS-based waveshaper with reciprocating reflective double gratings as dispersive element. Arbitrary spectrum shaping can be obtained with the minimum filter bandwidth of 1.63 GHz and the bandwidth setting resolution of 240 MHz.

Authors:Jingquan Xu, Huazhong Uni. of Sci. & Tech. / Kexin Chen, Huazhong Uni. of Sci. & Tech. / Yingying Qu, Huazhong Uni. of Sci. & Tech. / Chen Liu, Huazhong Uni. of Sci. & Tech. / Songnian FU, Guangdong University of Technology / Deming Liu, Huazhong Uni. of Sci. & Tech.

JW1A.27

High Efficiency Silicon Nitride Gratings for Fiber-Chip Coupling in 850-900 nm Wavelength (/home/eposters/poster/?id=3525586)

Presenter: Siddharth Nambiar , *CeNSE, IISc*

We demonstrate high-efficiency Silicon Nitride gratings for fiber-chip coupling in 850-900 nm. Experimentally measured peak efficiency is -4.44 dB and -3.4 dB for uniform and apodized gratings, respectively.

Authors:Siddharth Nambiar, CeNSE, IISc / Avijit Chatterjee, CeNSE, IISc / Shankar Selvaraja, CeNSE, IISc

JW1A.28

Hybrid Inhibited-Coupling and Photonic Bandgap Hollow Core Fiber for Telecom Wavelength Range (/home/eposters/poster/?id=3531520)

Presenter: Kostiantyn VASKO , *University of Limoges*

We numerically demonstrate that a hollow-core fiber with a cladding comprised with a first-ring with non-touching tubes surrounded by a photonic bandgap outer-cladding combines low confinement loss, low optical overlap with silica and single modedness.

Authors:Kostiantyn VASKO, University of Limoges / Benoit Debord, University of Limoges / Lorenzo ROSA, University of Modena and Reggio Emilia / Luca Vincetti, University of Modena and Reggio Emilia / Fetah Benabid, University of Limoges

JW1A.29

Direct Attachment of Optical Fibers to Photonic Integrated Circuits With *in Situ* UV Curing (/home/eposters/poster/?id=3531951)

Presenter: Gregory Bond , *Rochester Institute of Technology*

Here we present direct attachment of multiple optical fibers to PIC chips at arbitrary pitches. Each fiber is actively aligned and then “tacked” by directly transmitting UV light down the fiber itself.

Authors:Gregory Bond, Rochester Institute of Technology / Thomas Palone, Rochester Institute of Technology / Matthew van Niekerk, Rochester Institute of Technology / John Serafini, Rochester Institute of Technology / Mario Ciminelli, Rochester Institute of Technology / Michael Fanto, Air Force Research Laboratory / Stefan Preble, Rochester Institute of Technology

JW1A.31

Experimentally Optimizing QKD Rates via Nonlocal Dispersion Compensation (/home/eposters/poster/?id=3518856)

Presenter: Sebastian Neumann , *Austrian Academy of Sciences*

Detection-time uncertainty due to chromatic dispersion in optical fibers decreases key rates of Quantum Key Distribution (QKD). Using nonlocal dispersion compensation, we demonstrate a 37-fold key rate increase of an entanglement-based QKD system.

Authors:Sebastian Neumann, Austrian Academy of Sciences / Domenico Ribezzo, Austrian Academy of Sciences / Martin Bohmann, Austrian Academy of Sciences / Rupert Ursin, Austrian Academy of Sciences

JW1A.32

Multimode Interferometric Biosensor Based on the Evanescent-Wave of Si₃N₄ Rib-Optical Waveguides (/home/eposters/poster/?id=3520626)

Presenter: Hongsik Jung , *Hongik University*

An integrated-optic, evanescent-wave biosensor utilizing a multimode interferometric waveguide based on a Si₃N₄ rib-optical waveguide consisting of the Si/SiO₂/Si₃N₄/SiO₂ stacked structure was described. The changes in the index of an analyte greatly affect the location of interferometric patterns.

Authors:Hongsik Jung, Hongik University

JW1A.33

Near-Unity Efficiency Photonic Hourglass Single-Photon Source (/home/eposters/poster/?id=3525554)

Presenter: Martin Arentoft Jacobsen , *Technical University of Denmark*

We present the “photonic hourglass” structure as a candidate for a highly efficient single-photon source design. We demonstrate a computed spontaneous emission β factor above 0.99, enabled by suppression of the background emission.

Authors: Martin Arentoft Jacobsen, Technical University of Denmark / Benedek Gaál, Technical University of Denmark / Luca Vannucci, Technical University of Denmark / Niels Gregersen, Technical University of Denmark

JW1A.34

Resolving the $^{12}\text{CH}_4$ and $^{13}\text{CH}_4$ Lines of Raman Spectrum (/home/e posters/poster/?id=3531925)

Presenter: Evgeny Popov, *ITMO University*

We demonstrate a method to determine the volume fraction of gaseous isotopologues of methane $^{12}\text{CH}_4$ and $^{13}\text{CH}_4$ in a mixture from a Raman spectrum under spectral overlap and limited resolution.

Authors: Vladimir Vitkin, ITMO University / Anton Kovalev, ITMO University / Konstantin Grigorenko, ITMO University / Valeriya Kurikova, ITMO University / Evgeny Popov, ITMO University / Pavel Loiko, CIMAP, Université de Caen Normandie

JW1A.35

High-Order Mode Mode-Locked Fiber Laser Based on Few-Mode Based SESAM (/home/e posters/poster/?id=3525350)

Presenter: Xianglong Zeng, *Shanghai University*

We experimentally compared the nonlinear saturation absorption characteristic of SESAM with LP01 and LP11 modes, and obtained a mode-locked laser enabling the oscillation of LP11 mode by using few-mode based SA.

Authors: Si Lv, Shanghai University / Lin Teng, Shanghai University / Fan Shi, Nanjing University of Posts and Telecommunications / Yi Huang, Shanghai University / Xianglong Zeng, Shanghai University

JW1A.36

REplica Symmetry Breaking in Brillouin Random Fiber Laser (/home/e posters/poster/?id=3524930)

Presenter: Jilin Zhang, *Shanghai University*

This paper reported the experimental evidence of replica symmetry breaking in a random fiber laser incorporating nonlinear Brillouin gain and distributed Rayleigh random feedback.

Authors: Jilin Zhang, Shanghai University / Zenghuan Qiu, Shanghai University / Zhelan Xiao, Shanghai University / Haoran Xie, Shanghai University / Yikun Jiang, Shanghai University / Fufei Pang, Shanghai University / Liang Zhang, Shanghai University

JW1A.37

**All-Fiber Pulsed Visible Vortex Beam Based on Cherenkov Radiation
(/home/eposters/poster/?id=3525199)**

Presenter: Xianglong Zeng , *Shanghai university*

All-fiber femtosecond visible vortex beam generation is demonstrated by assembling nonlinear frequency conversion and mode selective coupler, which has found potential applications in super-resolution microscopic imaging, optical tweezers and Raman enhancement.

Authors:xuan zhou, Shanghai university / Fan Shi, Nanjing University of Posts and Telecommunications / Jiafeng Lu, Shanghai university / Jie Zhu, Shanghai university / Xianglong Zeng, Shanghai university / Xiaomin Liu, Max Planck Institute for Polymer Research

JW1A.38

Stabilized Fast Light and Superluminal Propagation via Linearly Polarized Brillouin Lasing Oscillation (/home/eposters/poster/?id=3524826)

Presenter: Zhelan Xiao , *Shanghai University*

We experimentally achieved stabilized Brillouin-induced fast light and superluminal propagation in kilometer-long optical fibers by introducing linearly polarized single-longitudinal-mode Stokes lasing resonance.

Authors:Zhelan Xiao, Shanghai University / Zenghuan Qiu, Shanghai University / Jilin Zhang, Shanghai University / Haoran Xie, Shanghai University / Yikun Jiang, Shanghai University / Fufei Pang, Shanghai University / Liang Zhang, Shanghai University

JW1A.39

Spectrally Purified Brillouin Random Fiber Laser via Self-Tracking Dynamic Fiber Grating (/home/eposters/poster/?id=3524823)

Presenter: Zenghuan Qiu , *Shanghai university*

We demonstrated spectral purification of random lasing emission in a Brillouin random fiber laser by employing a self-tracking dynamic fiber grating with unpumped Erbium doped fibers.

Authors:Zenghuan Qiu, Shanghai university / Zhelan Xiao, Shanghai university / Jilin Zhang, Shanghai university / Haoran Xie, Shanghai university / Yikun Jiang, Shanghai university / Fufei Pang, Shanghai university / Liang Zhang, Shanghai university

JW1A.40

**Broadband Polarization Beam Splitter Based on Tilted Subwavelength Gratings on the Si₃N₄/Si Augmented Low Index Guiding Platform
(/home/eposters/poster/?id=3526050)**

Presenter: Can Ozcan , *University of Toronto*

We demonstrate a polarization beam splitter based on the use of subwavelength gratings on an augmented low index waveguide. The design provides <0.65 dB insertion loss and >25 dB extinction ratio with notable fabrication tolerance.

Authors:Can Ozcan, University of Toronto / Mo Mojahedi, University of Toronto / J. Stewart Aitchison, University of Toronto

JW1A.41

Electrical Control of Ultra-Long Spin-Valley Polarization of Trions in Monolayer Molybdenum Ditelluride (/home/eposters/poster/?id=3520758)

Presenter: Qiyao Zhang , *Tsinghua University*

We systematically investigated the electrically-tunable valley polarization mechanism in monolayer MoTe₂ by helicity-resolved photoluminescence and ultrafast pump-probe spectroscopy. We observed an ultra-long trion valley lifetime of over 600 ps, the longest for a 2D material.

Authors:Qiyao Zhang, Tsinghua University / Hao Sun, Tsinghua University / Jiacheng Tang, Tsinghua University / Xingcan Dai, Tsinghua University / Zhen Wang, Tsinghua University / Cun-Zheng Ning, Tsinghua University

JW1A.42

Polarity-Switchable Ultraviolet Photodetector Towards Spectrum-Distinguishable Photodetection (/home/eposters/poster/?id=3520313)

Presenter: Xin Liu , *University of Science and Technology of China*

The design of polarity-switchable ultraviolet photodetector based on photovoltage-counteraction mechanism has been reported for the first time, which successfully distinguished different incident ultraviolet light and corresponding light intensity.

Authors:Xin Liu, University of Science and Technology of China / Danhao Wang, University of Science and Technology of China / Huabin Yu, University of Science and Technology of China / Muhammad Memon, University of Science and Technology of China / Haiding Sun, University of Science and Technology of China

JW1A.43

Laser Grooving Technology Study at Dicing Process in GaN Power Devices WLCSP (/home/eposters/poster/?id=3523105)

Presenter: Yao-Hsing Liu , *National Chiao Tung University*

Chipping free is a dream for GaN Epi wafer sawing process. With current high complexity of wafer technology plus the drive for cost reduction by narrowing the saw street width, it is a challenge which requires huge effort for wafer sawing process to achieve chipping free process.

Authors:Yao-Hsing Liu, National Chiao Tung University

JW1A.44

Picosecond Squeezing at 844 nm With a Periodically Poled LiTaO₃ Waveguide (/home/eposters/poster/?id=3520697)

Presenter: Zicong XU , *the University of Tokyo*

Aiming at quantum enhancement in $<1 \mu\text{m}$, we demonstrate pulsed squeezing with a periodically poled stoichiometric LiTaO₃ waveguide. We confirm anti-squeezing of $>7 \text{ dB}$ and vacuum squeezing of -1.19 dB at 844 nm.

Authors:Zicong XU, the University of Tokyo / Kenichi Oguchi, the University of Tokyo / Yuki Sano, the University of Tokyo / Yoshitaka Taguchi, the University of Tokyo / Kazuhiro Katoh, the University of Tokyo / Yasuyuki Ozeki, the University of Tokyo

JW1A.45

Iridescent Retroreflective Structural Color Based on Micro Concavity Array (/home/eposters/poster/?id=3519109)

Presenter: Joo-Hwan Ko , *GIST*

We present an iridescent retroreflective structural color based on micro concavity array. Inspired by the hummingbird's dynamic iridescent colors, the ultra-thin resonant layer is introduced for a self-grading structural coloration.

Authors:Joo-Hwan Ko, GIST / Young Jin Yoo, GIST / Hyun Myung Kim, GIST / Young Min Song, GIST

JW1A.46

Monolithically Integrated Laser Platform for the mid-Infrared (/home/eposters/poster/?id=3524962)

Presenter: Ruijun Wang , *ETH-Zurich*

We present an active-passive monolithic integration platform developed for the mid-infrared spectral range. The monolithically integrated quantum cascade lasers output optical power up to 550 mW in pulsed operation and 100 mW in continuous-wave operation.

Authors:Ruijun Wang, ETH-Zurich / Zhixin Wang, ETH-Zurich / Emilio Gini, ETH-Zurich / Mattias Beck, ETH-Zurich / Jérôme Faist, ETH-Zurich

JW1A.47

Controlling the Extinction Ratio of Microring Resonators by Perovskite Nonlinearity (/home/eposters/poster/?id=3524781)

Presenter: Feifan Wang , *University of Delaware*

We demonstrate a low power all-optical switch in hybrid silicon resonator at room temperature, utilizing exceptionally high nonlinearity in solution integrated perovskite.

Authors: Feifan Wang, University of Delaware / Lianfeng Zhao, Princeton University / Hwaseob Lee, University of Delaware / Yahui Xiao, University of Delaware / Tiantian Li, University of Delaware / Yixiu Wang, University of Delaware / Anishkumar Soman, University of Delaware / Thomas Kananen, University of Delaware / Xiaoyong Hu, Peking University / Barry P. Rand, Princeton University / Tingyi Gu, University of Delaware

JW1A.48

Experimental Demonstration of a Practical Bidirectional Multiple Access Scheme for VLC Networking (/home/eposters/poster/?id=3521535)

Presenter: Qiguan Chen , *State Key Lab of Info. Photon. & Opt. Co*

Experimental demonstration of a practical multiple access scheme for VLC networking with both optical downlink and uplink. System normalized throughput and user access delay were measured to be feasible for bidirectional VLC networking applications scenario.

Authors: Qiguan Chen, State Key Lab of Info. Photon. & Opt. Co / Min Zhang, State Key Lab of Info. Photon. & Opt. Co / Dahai Han, State Key Lab of Info. Photon. & Opt. Co / Zhiguo Zhang, State Key Lab of Info. Photon. & Opt. Co / Weishu Xu, State Key Lab of Info. Photon. & Opt. Co

JW1A.49

Half-Wave-Plate Based Adaptive Polarization Controller (/home/eposters/poster/?id=3522956)

Presenter: Xuefeng Wang , *Huazhong University of Sci & Technol*

We experimentally demonstrated an endlessly adaptive polarization controller based on a rotatable half-wave-plate on the lithium niobate platform. It is recommended to eliminate the carrier fading in a self-coherent communication system.

Authors: Xuefeng Wang, Huazhong University of Sci & Technol / Yifan Zeng, Huazhong University of Sci & Technol / Ruolin Liao, Huazhong University of Sci & Technol / Li Shen, Huazhong University of Sci & Technol / Can Zhao, Huazhong University of Sci & Technol / Hao Wu, Huazhong University of Sci & Technol / Ming Tang, Huazhong University of Sci & Technol

JW1A.50

Image Restoration of Undersampled Two-Photon Microscopy With Conditional Generative Adversarial Network (/home/eposters/poster/?id=3523218)

Presenter: KA YAN CHAN , *The University of Hong Kong*

We demonstrate the use of conditional generative adversarial network in restoring undersampled two-photon microscopic image. Image resolution and contrast can be substantially improved without noticeable artefacts with a 4-fold increase in imaging speed.

Authors:KA YAN CHAN, The University of Hong Kong / Hongsen He, The University of Hong Kong / W. L. So, The University of Hong Kong / Hiu Ka Fok, The University of Hong Kong / Yu-Xuan Ren, The University of Hong Kong / Cora S. W. Lai, The University of Hong Kong / Kenneth K. Y. Wong, The University of Hong Kong

JW1A.51

Narrow-Linewidth Optical Frequency Comb Reference to a Fiber Delay Line (/home/eposters/poster/?id=3524281)

Presenter: Haochen Tian , *Tianjin University*

A fully-stabilized Er: fiber optical frequency comb referenced to a km-long fiber delay line is presented. The comb mode's fractional frequency stability is at 10^{-12} level in 12.8 ms. The absolute linewidth is 587 Hz.

Authors:Haochen Tian, Tianjin University / Fei Meng, National Institute of Metrology / Baike Lin, National Institute of Metrology / Shiyong Cao, National Institute of Metrology / Zhanjun Fang, National Institute of Metrology / Youjian Song, Tianjin University / Ming-lie Hu, Tianjin University

JW1A.52

A SVM Combined Pixel Accumulation Technique for SPAD Based LiDAR System (/home/eposters/poster/?id=3524634)

Presenter: Hualong Zhang , *Peking University*

We present a flash LiDAR system based on SPAD array and a proposed SVM combined accumulation technique was applied in the system to obviously improve the accuracy of depth image.

Authors:Hualong Zhang, Peking University / Chuanchuan Yang, Peking University / Weizhen Yan, SenseFuture Technologies Co., Ltd / Hao Chen, SenseFuture Technologies Co., Ltd

JW1A.53

Double-Pulse Operation Enhances Brightness of Hybrid Perovskite Light Emitting Transistor (/home/eposters/poster/?id=3525279)

Presenter: Maciej Klein , *Nanyang Technological University*

We report enhancement of the brightness of hybrid perovskite light emitting transistors operated with independent pulsing of drain and gate bias voltages, attributed to compensation of space-charge effects and improved timing of carrier injection. © 2020 The Authors

Authors: Maciej Klein, Nanyang Technological University / Bryan Cheng, Nanyang Technological University / Li Jia, Nanyang Technological University / Annalisa Bruno, Nanyang Technological University / Cesare Soci, Nanyang Technological University

JW1A.54

High-Efficiency Plasmon-Enhanced GeSn Photodetectors Operating at 2 μm (/home/e posters/poster/?id=3530298)

Presenter: Hao Zhou , *Nanyang Technological University*

Au/GeSn grating structure was designed and adopted in GeSn photodetectors to enhance the optical absorption at 2 μm . A 3 \times improvement in responsivity to 0.386 A/W was achieved under TM-polarized illumination.

Authors: Hao Zhou, Nanyang Technological University / Lin Zhang, Nanyang Technological University / Jinchao Tong, Nanyang Technological University / Shaoteng Wu, Nanyang Technological University / Qimiao Chen, Nanyang Technological University / Bongkwon Son, Nanyang Technological University / Dao Hua Zhang, Nanyang Technological University / Chuan Seng Tan, Nanyang Technological University

JW1A.55

FMCW Lidar System Based on Cylindrical Lens-Assisted Integrated Beam Steering (/home/e posters/poster/?id=3524740)

Presenter: Chao Li , *Shanghai Jiao Tong University*

An FMCW (frequency-modulated continuous-wave) Lidar system based on cylindrical lens assisted two-dimensional beam steering is demonstrated. It is tested in ranging experiment for 1m-distance target detection with an FOV of 11.3 $^\circ$ \times 8.1 $^\circ$.

Authors: Chao Li, Shanghai Jiao Tong University / Xianyi Cao, Shanghai Jiao Tong University / Xinwan Li, Shanghai Jiao Tong University / Kan Wu, Shanghai Jiao Tong University / Jianping Chen, Shanghai Jiao Tong University

JW1A.56

Mirror-Symmetric Patterning of Topological Insulator Reverses Photogalvanic Currents (/home/e posters/poster/?id=3525171)

Presenter: Xinxing Sun , *Nanyang Technological University*

Patterning of topological insulator with mirror-symmetric forms of planar chiral design yields photogalvanic currents with opposite directions due to the interplay between the spin-momentum locking and polarization conversion in the pattern.

Authors:Xinxing Sun, Nanyang Technological University / Giorgio Adamo, Nanyang Technological University / Mustafa Eginligil, Nanyang Technological University / Harish Krishnamoorthy, Nanyang Technological University / Nikolay Zheludev, Nanyang Technological University / Cesare Soci, Nanyang Technological University

JW1A.57

Ultra-Flattened and Near-Zero Chromatic Dispersion Control by Chalcogenide all-Solid Hybrid Microstructured Optical Fibers (/home/eposters/poster/?id=3525686)

Presenter: Hoang Tuan Tong , *Toyota Technological Institute*

We demonstrate ultra-flattened (less than 1ps/km.nm) and near-zero chromatic dispersions profiles which can be tailored with high freedom by using our proposed chalcogenide all-solid hybrid microstructure optical fibers.

Authors:Hoang Tuan Tong, Toyota Technological Institute / Hoa Phuoc Trung Nguyen, Toyota Technological Institute / Ayaka Koumura, Toyota Technological Institute / Yasutake Ohishi, Toyota Technological Institute / Takenobu Suzuki, Toyota Technological Institute

JW1A.58

A Novel Gain Modulation Approach for the 2.8 mm Pulsed Er³⁺:ZBLAN Fiber Laser (/home/eposters/poster/?id=3524695)

Presenter: Jun Liu , *Shenzhen University*

By introducing a 1973 nm ASE seeded source as the external modulation element, we obtain a stable ~2.8 μm pulsed output from an Er³⁺:ZBLAN fiber laser without using any traditional intracavity pulse modulation devices.

Authors:Jun Liu, Shenzhen University / Zhiqiang Fang, Shenzhen University

JW1A.59

Phase Noise Reduction of a Dissipative Kerr-Microresonator Soliton Comb by a Sideband Cooling (/home/eposters/poster/?id=3521008)

Presenter: Naoya Kuse , *Tokushima University*

We demonstrate the reduction of the phase noise of a dissipative Kerr-microresonator soliton comb by putting a sideband generated from a pump CW laser to a microresonator, where the thermorefractive noise is mitigated.

Authors:Naoya Kuse, Tokushima University / Kenji Nishimoto, Tokushima University / Takeshi Yasui, Tokushima University / Kaoru Minoshima, University of Electro-Communications

JW1A.60

Modulation of Terahertz Generation in Two-Color Photoionization Verified by the Spectral Broadening (</home/eposters/poster/?id=3521708>)

Presenter: Chen Gong , *Osaka Univeristy*

We studied the evolution of the two-color laser filament emitted THz pulse energy with the influences of the infrared pump energy and air dispersion. The THz modulation induced by additional relative phase is verified by the two-color spectral broadening due to the intensity dependent nonlinearity.

Authors:Chen Gong, Osaka Univeristy / Iwao Kawayama, Osaka Univeristy / Hironaru Murakami, Osaka Univeristy / Takahiro Teramoto, Osaka Univeristy / Masayoshi Tonouchi, Osaka Univeristy

JW1A.61

Cantilever Edge Coupler for Lithium Niobate on Insulator Platform (</home/eposters/poster/?id=3521734>)

Presenter: Lifeng Chen , *Sun Yat-Sen University*

We demonstrate a CMOS compatible cantilever edge coupler design realizing efficient edge coupling for lithium niobate on insulator platform, experimental results show 1.7dB loss per facet.

Authors:Lifeng Chen, Sun Yat-Sen University / Shengqian Gao, Sun Yat-Sen University / Xinlun Cai, Sun Yat-Sen University

JW1A.62

Coarse Wavelength Division (De)Multiplexer Based on Cascaded Topology Optimized Wavelength Filters (</home/eposters/poster/?id=3521832>)

Presenter: Simei Mao , *Tsinghua University*

We propose a coarse wavelength division (de)multiplexer by cascading wavelength filters. Assisted by topology optimization, four compact wavelength filters centered at different wavelengths are designed with less than -0.7 dB insertion loss, respectively.

Authors:Simei Mao, Tsinghua University / Lirong Cheng, Tsinghua University / Caiyue Zhao, Tsinghua University / H. Y. Fu, Tsinghua University

JW1A.63

Graphene Plasmonic Terahertz Lamps (</home/eposters/poster/?id=3531332>)

Presenter: Yuyu Li , *Boston Unviersity*

We investigate the use of graphene plasmonic excitations for current-driven narrowband THz light emission. Device structures designed to promote critical coupling to free-space radiation are shown to be particularly effective for maximizing the output power.

Authors:Yuyu Li, Boston University / Roberto Paiella, Boston University

JW1A.64

SU(1,1) Interferometer by Direct Detection (/home/eposters/poster/?id=3521492)

Presenter: Nan Huo , *Tianjin University*

We study the performance of SU(1,1) interferometer for precision phase measurement with double injection for parametric amplifiers and intensity measurement. This has the advantage of high phase probing intensity to improve absolute phase measurement sensitivity.

Authors:Nan Huo, Tianjin University / Xueshi Guo, Tianjin University / Wen Zhao, Tianjin University / Yunxiao Zhang, Tianjin University / Xiaoying Li, Tianjin University / Zhe-Yu Ou, Tianjin University

JW1A.65

Optical Nano-Metrology of Sub-Wavelength Objects Enabled by Artificial Intelligence (/home/eposters/poster/?id=3522871)

Presenter: Carolina Rendón-Barraza , *Nanyang Technological University*

We experimentally demonstrate that a linear dimension of a sub-wavelength nanoscale object can be measured with an accuracy better than $\lambda/250$ by a deep-learning-enabled examination of its diffraction pattern.

Authors:Carolina Rendón-Barraza, Nanyang Technological University / Eng Aik Chan, Nanyang Technological University / Guanghui Yuan, Nanyang Technological University / Giorgio Adamo, Nanyang Technological University / Tanchao Pu, University of Southampton / Nikolay Zheludev, University of Southampton

JW1A.66

Imaging-Based Laser Barcode for Cellular Phenotyping (/home/eposters/poster/?id=3524109)

Presenter: Randall Ang , *Nanyang Technological University*

An imaging-based cellular laser barcode was developed to analyze complex laser modes generated from single cell lasers. Different cell types from neural differentiate stem cells and sizes were investigated, paving a road for cellular phenotyping.

Authors:Randall Ang, Nanyang Technological University / Zhen Qiao, Nanyang Technological University / YU-CHENG CHEN, Nanyang Technological University

JW1A.67

Backward Pump and Signal Combiner With Negligible Beam Quality Degradation for 5KW-Level Fiber Lasers (/home/eposters/poster/?id=3524787)

Presenter: Yu Liu , *Research Center of Laser Fusion*

A backward (6+1)×1 pump and signal combiner has been presented, which can combine >5kW pump power in brightness-loss operation mode. By optimizing the fabrication technology, the beam quality (M^2) degradation has been controlled to be less than 0.1.

Authors: Yu Liu, Research Center of Laser Fusion / Wenjie Wu, Research Center of Laser Fusion / Shan Huang, Research Center of Laser Fusion / Min Li, Research Center of Laser Fusion / Xi Feng, Research Center of Laser Fusion / Benjian Shen, Research Center of Laser Fusion / Huaqing Song, Research Center of Laser Fusion / Chun Zhang, Research Center of Laser Fusion / Lianghua Xie, Research Center of Laser Fusion / Haokun Li, Research Center of Laser Fusion / Rumao Tao, Research Center of Laser Fusion / Honghuan Lin, Research Center of Laser Fusion / Jianjun Wang, Research Center of Laser Fusion / Feng Jing, Research Center of Laser Fusion

JW1A.68

Self-Referenced Distribution of Millimeter Waves Over 10km Optical Fiber With High Frequency Stability (/home/eposters/poster/?id=3524876)

Presenter: Chunlong Yu , *Beihang University*

We propose a photonic approach for the frequency-stabilized distribution of millimeter waves based on a self-referenced feedback control technique. The implementation is demonstrated over an optical fiber link of 10 km.

Authors: Chunlong Yu, Beihang University / Zhuoyan An, Beihang University / Yihan Li, Beihang University / Hao Guo, Beihang University / Hancheng Tong, Beihang University / Zheng Zheng, Beihang University

JW1A.69

Buildup Dynamics of Multiple-Soliton in Spatiotemporal Mode-Locked Multimode Fiber Lasers (/home/eposters/poster/?id=3525278)

Presenter: Xiaosheng Xiao , *Beijing University of Posts and Telecommunications*

The real-time buildup dynamics of multiple-soliton in spatiotemporal mode-locked fiber lasers are observed. The experimental results indicate that the dynamics vary for different transverse modes, and the multiple-soliton has spatiotemporal structure among the pulses.

Authors: Kewei Liu, Tsinghua University / Xiaosheng Xiao, Beijing University of Posts and Telecommunications / Changxi Yang, Tsinghua University

JW1A.70

A Compact and Tunable Acoustically Induced Mach-Zehnder Interferometer Based on Sandwich-Like Structure With Uniform Diameter (/home/eposters/poster/?id=3529726)

Presenter: Xiaofang Han , *Nankai University*

Through phase matching optimization, an acoustically induced tunable in-fiber Mach-Zehnder interferometer less than 7 cm with 120 μ s switching time based on a sandwich-like structure with uniform diameter was proposed and demonstrated in the experiment.

Authors:Xiaofang Han, Nankai University / Caifen Li, Nankai University / Feng Gao, Nankai University / Xiao Dong, Nankai University / Guoquan Zhang, Nankai University / Jingjun Xu, Nankai University

JW1A.71

Waveguide Superlattice-Based Optical Phased Array: Balancing Superlattice Lobe and Crosstalk Suppression (/home/eposters/poster/?id=3531212)

Presenter: Lemeng Leng , *Nanjing University*

The crucial factors governing the behavior of waveguide superlattice-based optical phased arrays are investigated. The superlattice-induced extra lobes can be minimized with sophisticated supercells while the inter-waveguide crosstalk still needs to be judiciously balanced.

Authors:Lemeng Leng, Nanjing University / Yue Shao, Nanjing University / Guihan Wu, Nanjing University / Wei Jiang, Nanjing University

JW1A.72

Simulating Optical Field Mode Profiles Using Artificial Neural Networks for use in OpenSource Eigenmode Expansion (/home/eposters/poster/?id=3522461)

Presenter: Ian Hammond , *Brigham Young University Provo*

We use artificial neural networks (ANN) to predict the electromagnetic spatial modes of nanophotonic structures, and propose their use to accelerate eigenmode expansion (EME) simulations. A new intuitive open-source EME solver is presented.

Authors:Ian Hammond, Brigham Young University Provo / Ryan Camacho, Brigham Young University Provo / Alec Hammond, Georgia Institute of Technology

JW1A.73

Fock State-Enhanced Expressivity of Quantum Machine Learning Models (/home/eposters/poster/?id=3523385)

Presenter: Beng Yee Gan , *Centre for Quantum Technologies*

We propose quantum classifiers based on encoding classical data onto Fock states using tunable beam-splitter meshes, similar to the boson sampling architecture. We show that higher photon numbers enhance the expressive power of the circuit.

Authors: Beng Yee Gan, Centre for Quantum Technologies / Daniel Leykam, Centre for Quantum Technologies / Dimitris Angelakis, Centre for Quantum Technologies

JW1A.74

Performing Two-Dimensional Differentiation With Gap Plasmon-Based Metasurface (</home/eposters/poster/?id=3523004>)

Presenter: Chenyuan XU , *Wuhan National Lab for Optoelectronics*

We numerically demonstrate spatial differentiation using circular gap-plasmon resonators arranged in a square lattice. The metasurface enables ultrafast analog computing and two-dimensional edge detection for image processing.

Authors: Chenyuan XU, Wuhan National Lab for Optoelectronics / Béatrice Dagens, Centre de Nanosciences et de Nanotechnologies / Xinliang Zhang, Wuhan National Lab for Optoelectronics

JW1A.75

Nanophotonic All-Weather Windows for Energy-Efficient Smart Buildings (</home/eposters/poster/?id=3527964>)

Presenter: Ashish Chowdhary , *IIT Guwahati*

We design electrically switchable all-weather smart windows to actively control portions of transmitted solar radiation. These window glasses outperform industry-standard commercial glasses. Such low-cost nanophotonic systems can significantly reduce global energy needs of air-conditioning systems.

Authors: Ashish Chowdhary, IIT Guwahati / Debabrata Sikdar, IIT Guwahati

JW1A.76

A Compact and Low-Noise Femtosecond Fiber Source Tunable Between 740-1236 nm for Wide Two-Photon Fluorescence Microscopy Applications (</home/eposters/poster/?id=3521699>)

Presenter: LU-TING CHOU , *National Yang-Ming University*

By optimizing fiber-optic nonlinearity and managing the damage threshold, we demonstrated tunable nJ-level femtosecond fiber sources, featuring a full pulse compressibility and low intensity noise, as a promising substitution of Ti:sapphire-based systems for imaging applications.

Authors: LU-TING CHOU, National Yang-Ming University / Dong-Lin Zhong, National Yang-Ming University / Yu-Cheng Liu, National Yang-Ming University / Wei-Zhong Lin, National Yang-Ming University / Chao-Jin Chan, National Yang-Ming University / SHIH-HSUAN CHIA, National Yang-Ming University

JW1A.77

Generation of Sub-Megawatt Peak Power Femtosecond Pulses From a 24MHz Cr:Forsterite Oscillator (</home/eposters/poster/?id=3522781>)

Presenter: HAO-HSUAN HUNG, *Institute of Biophotonics*

Using a 24-MHz Cr:forsterite oscillator and the precisely controlled fiber-optic nonlinearity, we have simultaneously demonstrated sub-megawatt-peak-power femtosecond pulses at 1.3 μ m and compressible blue-shifted octave-spanning spectra.

Authors: HAO-HSUAN HUNG, Institute of Biophotonics / LU-TING CHOU, Institute of Biophotonics / CHAO-HSU WEN, Institute of Biophotonics / Chao-Jin Chan, Institute of Biophotonics / SHIH-HSUAN CHIA, Institute of Biophotonics

JW1A.78

High Coupling-Efficiency Ridge-Waveguide Gratings on Single Crystal Thin-Film Lithium Niobate (TFLN) (</home/eposters/poster/?id=3522794>)

Presenter: Sipan Yang, *Department of Micro-nano Electronics, School of Electronic Information and Electrical Engineering, Shanghai Jiao Tong University*

The uniform ridge-waveguide grating couplers in TFLN are fabricated. All the structures in the device are monolithically patterned by electron-beam lithography. Single coupler exhibits an ultra-high coupling efficiency of -6.5 dB at 1546 nm.

Authors: Sipan Yang, Department of Micro-nano Electronics, School of Electronic Information and Electrical Engineering, Shanghai Jiao Tong University / Jinbin Xu, Center for Advanced Electronic Materials and Devices, Shanghai Jiao Tong University / Liying Wu, Center for Advanced Electronic Materials and Devices, Shanghai Jiao Tong University / Xueling Quan, Center for Advanced Electronic Materials and Devices, Shanghai Jiao Tong University / Xiulan Cheng, Department of Micro-nano Electronics, School of Electronic Information and Electrical Engineering, Shanghai Jiao Tong University

JW1A.80

Reconfigurable Topological Edge State in Valley Photonic Crystals (</home/eposters/poster/?id=3531790>)

Presenter: Yang Liu , *Nankai University*

Abstract: A reconfigurable topological valley photonic crystal (RTVPC) is proposed. By adjusting the refractive index of liquid crystals via an external voltage applied between two parallel metal plates, and the reconfigurable topological boundary state can be achieved.

Authors:Yang Liu, Nankai University / Jiayi Wang, Nankai University / Faheem Hassan, Nankai University / Xinzheng Zhang, Nankai University / Jingjun Xu, Nankai University

JW1A.81

Detection of Near- and far-Field Radiation Pattern of a Silicon-on-Insulator Optical Phase Array (</home/eposters/poster/?id=3520293>)

Presenter: Xiaomin Nie , *Peng Cheng Laboratory*

We experimentally measured the radiation of optical phased arrays fabricated on SOI waveguide platform. By tuning the input laser wavelength, we realized one-dimension beam steering and observed standing-wave patterns in the waveguide antennas.

Authors:Xiaomin Nie, Peng Cheng Laboratory / Caiming Sun, Peng Cheng Laboratory / hongjie wang, Institute of Robotics and Intelligent Manufacturing (IRIM), Chinese University of Hong Kong (CUHK) / Zhenmin Chen, Peng Cheng Laboratory / shupeng Deng, Peng Cheng Laboratory / Aidong Zhang, Peng Cheng Laboratory

JW1A.82

Femtosecond Synchronization of Three Mode-Locked Lasers and a Microwave Oscillator With Multi-Color Timing Detection (</home/eposters/poster/?id=3522682>)

Presenter: Dohyeon Kwon , *Korea Advanced Institute of Science and Technology*

We synchronize three mode-locked lasers and a microwave oscillator with fewfemtosecond residual jitter and drift using phase-locked loops with a single multi-color electrooptic sampling-based timing detector.

Authors:Dohyeon Kwon, Korea Advanced Institute of Science and Technology / Chan-Gi Jeon, Korea Advanced Institute of Science and Technology / Dohyun Kim, Korea Advanced Institute of Science and Technology / Igju Jeon, Korea Advanced Institute of Science and Technology / Jungwon Kim, Korea Advanced Institute of Science and Technology

JW1A.83

End-to-End Optimized High-Speed Single-Pixel Imaging via Pattern Scanning (</home/eposters/poster/?id=3522866>)

Presenter: Kangning Zhang , *UC Davis*

We demonstrated a new single-pixel imaging modality synthesizing light scanning and compressed sensing techniques. We optimized the image formation and reconstruction in an end-to-end training framework. Our method enables fast and high-quality compressed imaging.

Authors:Kangning Zhang, UC Davis / Junjie Hu, UC Davis / Weijian Yang, UC Davis

JW1A.84

Reference Wavelength Free Refractometry in Fiber Optic Directional Couplers (/home/eposters/poster/?id=3522958)

Presenter: Garima Bawa , *IIT Kanpur*

Using dispersion management, opposite spectral shifts around the *critical* wavelength have been effectively removed. By operating the fiber-optic directional coupler based bio-sensor close to its *critical* wavelength, we report ultra-high refractive index sensitivity ~ 13000 nm/RIU.

Authors:Garima Bawa, IIT Kanpur / Saurabh Tripathi, IIT Kanpur

JW1A.85

Ultrafast Phenomena Induced in Crystal by one-Shot Three-Dimensional Imaging With Optical Frequency Comb (/home/eposters/poster/?id=3525180)

Presenter: Takashi Kato , *The Univ. of Electro-Communications*

Using a 15-ps chirped pulse of an optical frequency comb, three-dimensional ultrafast imaging is demonstrated. We captured nm-level phase change associated with the shock-wave propagation in the LiNbO₃ crystal by developed all-optical Hilbert transform method.

Authors:Takashi Kato, The Univ. of Electro-Communications / Tamaki Morito, The Univ. of Electro-Communications / Kazuhiro Terada, The Univ. of Electro-Communications / Shintaro Kurata, The Univ. of Electro-Communications / Kaoru Minoshima, The Univ. of Electro-Communications

JW1A.86

Ptychographic Spectral Phase Retrieval by Deep Learning (/home/eposters/poster/?id=3524589)

Presenter: Wei-Cheng Chao , *National Tsing Hua University*

Deep learning is implemented to retrieve the spectral phase profiles of ultrashort pulses by using spectrally truncated spectrograms for the first time (to our best knowledge).

Authors:Wei-Cheng Chao, National Tsing Hua University / Shang-da Yang, National Tsing Hua University

JW1A.87

Near-Infrared Wavelength Selective Absorber in Tamm Plasmon Structure With Porous a-Ge (/home/eposters/poster/?id=3523097)

Presenter: sohee kim , *GIST*

We demonstrate near-infrared Tamm-Plasmon structure (TPs) with single material graded Germanium (Ge). The Ge-based TPs are fabricated with a porosity controllable process and show narrow-band resonance with high tunability.

Authors:sohee kim, GIST / Joo-Hwan Ko, GIST / Young Jin Yoo, GIST / Young Min Song, GIST

JW1A.88

a Highly Sensitive Differential Photoacoustic gas Sensor Based on Modified non-Local Euclidean Medians Algorithm (/home/eposters/poster/?id=3525001)

Presenter: Le Zhang , *Xidian University*

A upgrade differential photoacoustic gas sensor was established with a modified non-local Euclidean medians algorithm. The result shows that gas detection sensitivity is 83 ppb with sevenfold improvement than the original photoacoustic setup.

Authors:Le Zhang, Xidian University / Lixian Liu, Xidian University / Xueshi Zhang, Xidian University / Xukun Yin, Xidian University / Wei Li, Xidian University / Huiting Huan, Xidian University / Xiaopeng Shao, Xidian University

JW1A.89

Red Blood Cell Storage Monitoring by High-Throughput Single-Cell Image-Based Biophysical Profiling (/home/eposters/poster/?id=3531765)

Presenter: Evelyn Hok Yee Cheung , *The University of Hong Kong*

We demonstrate a label-free approach to monitoring the characteristics of stored red blood cells (RBCs), based on a large-scale single-cell morphological and biophysical profile of RBCs derived from high-throughput quantitative phase imaging flow cytometry (>10,000 cells/sec).

Authors:Evelyn Hok Yee Cheung, The University of Hong Kong / Dickson M. D. Siu, The University of Hong Kong / Kelvin C. M. Lee, The University of Hong Kong / Kenneth K. Y. Wong, The University of Hong Kong / Kevin Tsia, The University of Hong Kong

JW1A.91

All-Optical Coherent Lifting of Spin-Degeneracy in CsPbBr₃ Nanocrystals (/home/eposters/poster/?id=3524920)

Presenter: Megha Shrivastava , *IISER Bhopal*

We coherently lift the spin-degeneracy in CsPbBr₃ nanocrystals by breaking time-reversal symmetry all-optically without external magnetic field. Huge polarization-selective lifting ~50meV observed, corresponding to Rabi energy >100meV, is highest ever reported in semiconductors at room-temperature.

Authors: Megha Shrivastava, IISER Bhopal / Franziska Krieg, ETH Zürich / Maryna Bodnarchuk, ETH Zürich / Maksym Kovalenko, ETH Zürich / K. V. Adarsh, IISER Bhopal

JW1A.92

Unlocking the Ultrafast Charge Transfer in Colloidal CsPbBr₃/GO Heterostructure (/home/eposters/poster/?id=3524954)

Presenter: Naresh Maurya , *IISER Bhopal*

We studied the ultrafast charge transfer in type II CsPbBr₃/GO heterostructure in the strongly coupled regime to unlock their potential for perovskite solar cells and photodetectors. We demonstrate that GO act as potential hole-transport layer.

Authors: Naresh Maurya, IISER Bhopal / Megha Shrivastava, IISER Bhopal / Ajay Poonia, IISER Bhopal / K. V. Adarsh, IISER Bhopal

JW1A.93

Bandgap Renormalization and Trap-Induced Absorption in MoWS₂ Single-Crystal (/home/eposters/poster/?id=3524957)

Presenter: Pravrati Taank , *IISER Bhopal*

We studied many-body dynamics in MoWS₂ single-crystal using time and energy-resolved reflection spectroscopy. We detected ultrafast bandgap renormalization, overwhelmed by trap-induced absorption (TIA) at longer timescale. Furthermore, non-decaying TIA caused formation of long-lived trapped exciton.

Authors: Pravrati Taank, IISER Bhopal / K. V. Adarsh, IISER Bhopal

JW1A.94

High-Dimensional Quantum Cryptography Based on Multiplexing of Polarized Structured Photons (/home/eposters/poster/?id=3499132)

Presenter: Shuang Huang , *Nankai University*

We perform a proof-of-principle experiment of High-dimensional QKD based on multiplexing of different orders of polarized structured photons with 4D-BB84 protocol. The secret key rate per sifted photon is estimated about 2.604 bits.

Authors: Shuang Huang, Nankai University / Zhou Wang, Nankai University / Min Wang, Nankai University / Qian Tian, Nankai University / Chenghou Tu, Nankai University / Yongnan Li, Nankai University / Huitian Wang, Nanjing University

JW1A.96

Effect of Thickness of a Dye-Doped Polymeric Film on the Concentration Quenching of Luminescence (/home/eposters/poster/?id=3524205)

Presenter: Sangeeta Rout , *Norfolk State University*

We have studied the dependence of concentration quenching of luminescence on the thickness d of dye-doped polymeric films (HITC:PMMA) and found a strong inhibition of the donor-acceptor energy transfer (concentration quenching) at small values of d .

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Authors:Sangeeta Rout, Norfolk State University / S Koutsares, Norfolk State University / D Courtwright, Norfolk State University / E. Mills, Virginia State University / A Shorter, Virginia State University / S. Prayakarao, Virginia State University / C Bonner, Norfolk State University / Mikhail Noginov, Norfolk State University

JW1A.97

Towards Training Fault Tolerant and Noise Immune Diffractive Optical Neural Engines (/home/eposters/poster/?id=3525130)

Presenter: Soumyashree Panda , *IIT Gandhinagar, India*

We report a novel robust training regimen for Diffractive Optical Networks that uses gradient based regularization terms in the training objective. Enhanced fault tolerance and noise immunity has been observed with models trained with this method.

Authors:Soumyashree Panda, IIT Gandhinagar, India / Ravi Hegde, IIT Gandhinagar, India

JW1A.98

Existence of a Fundamental Tradeoff Between Absorptivity and Omnidirectionality in Metasurfaces (/home/eposters/poster/?id=3531773)

Presenter: Kunal Shastri , *Cornell University*

Perfect absorptivity coupled with omnidirectionality is a design goal for many absorbers and emitters used in sensing. We report the existence of a fundamental tradeoff between these two quantities in thin metasurface based absorbers.

Authors:Kunal Shastri, Cornell University / Francesco Monticone, Cornell University

JW1A.99

The Formation Mechanism of Femtosecond Laser-Induced Periodic Structures on Germanium (/home/eposters/poster/?id=3521814)

Presenter: Zhixuan Li , *Nankai University*

A hydrodynamic model was developed to describe the formation of fs-laser induced periodic structures on Ge based on the thin film equation. The significant role of transient electric field was demonstrated for the first time.

Authors:Zhixuan Li, Nankai University / Qiang Wu, Nankai University / Song Huang, Nankai University / Suyuan Wang, Civil Aviation University of China / Xiaoyang Hu, Nankai University / Xinda Jiang, Nankai University / Jianghong Yao, Nankai University / Jingjun Xu, Nankai University

JW1A.100

Ultrafast Charge-Transfer Mediated Indirect-Excitons in CsPbBr₃/MoS₂ Heterostructure (/home/eposters/poster/?id=3524921)

Presenter: RIYANKA KARMAKAR, *IISER Bhopal, India*

We demonstrate the ultrafast dynamics of light-induced indirect-excitons (IDEs) in CsPbBr₃/MoS₂ heterostructure using transient absorption spectroscopy. Our investigations describe the charge-transfer from CsPbBr₃ to MoS₂ as a dominant mechanism of IDEs formation with picoseconds lifetime.

Authors:RIYANKA KARMAKAR, IISER Bhopal, India / Dipankar Sen, Texas A&M University / Dipendranath Mandal, IISER Bhopal, India / K. V. Adarsh, IISER Bhopal, India

JW1A.101

Integrated Ge-Sb-S Chalcogenide Raman Laser (/home/eposters/poster/?id=3525667)

Presenter: Bin Zhang, *Sun Yat-Sen University*

We demonstrate an integrated Raman laser based on Ge-Sb-S high-Q microresonators. Both single-mode and multimode operation are shown with a low lasing threshold of ~9 mW. Besides, cascaded Raman lasing is demonstrated.

Authors:yufei huang, Sun Yat-Sen University / Jiaxin Zhao, Sun Yat-Sen University / Di Xia, Sun Yat-Sen University / Pingyang Zeng, Sun Yat-Sen University / Zelin Yang, Sun Yat-Sen University / Bin Zhang, Sun Yat-Sen University / Zhaohui Li, Sun Yat-Sen University

JW1A.102

Continuously Tunable Random Fiber Laser Based on a Partial-Reflection Random Fiber Grating (/home/eposters/poster/?id=3531298)

Presenter: Jiancheng Deng, *Huazhong University of Science and Technology*

We report a stable single-wavelength filter-free random fiber laser based on a partial-reflection random fiber grating and achieve continuous wavelength tuning in the temperature range of 25 °C to 500 °C.

Authors:Jiancheng Deng, Huazhong University of Science and Technology / Zuowei Xu, Huazhong University of Science and Technology / Xuewen Shu, Huazhong University of Science and Technology

JW1A.103

Power Scalability in Random Raman Fiber Laser Based on a Random Fiber Grating (/home/eposters/poster/?id=3531312)

Presenter: Jiancheng Deng , *Huazhong Univ of Science and Technology*

We report a novel high-power single-wavelength random Raman fiber laser based on the localized random feedback provided by an ultrashort random fiber grating inscribed by a femtosecond laser.

Authors:Jiancheng Deng, Huazhong Univ of Science and Technology / Ming Shen, Huazhong Univ of Science and Technology / Yanxin Li, Huazhong Univ of Science and Technology / Xuewen Shu, Huazhong Univ of Science and Technology

JW1A.104

Highly-Sensitive Infrared Photon Counting by Nondegenerate two-Photon Absorption Under mid-Infrared Pumping (/home/eposters/poster/?id=3531735)

Presenter: Yinqi Wang , *East China Normal University*

Infrared photon detection was realized based on nondegenerate two-photon absorption in silicon, where the mid-infrared pumping scheme significantly enhanced the sensitivity by eliminating background noises due to the harmonic excitation.

Authors:Jianan Fang, East China Normal University / Yinqi Wang, East China Normal University / Ming Yan, East China Normal University / E Wu, East China Normal University / Kun Huang, East China Normal University / Heping Zeng, East China Normal University

JW1A.105

Ultrasmall O-Band CWDM 4 λ MUX Based on Mosaic Structure for Dense Optical Interconnects (/home/eposters/poster/?id=3522818)

Presenter: Kodai Nakamura , *Hokkaido University*

An ultrasmall 4l wavelength multiplexer based on cascaded mosaic structure is proposed for dense optical interconnects for the first time. Direct-binary-search design shows the size can be drastically reduced, and is 1/20 of conventional one.

Authors:Kodai Nakamura, Hokkaido University / Fujisawa Takeshi, Hokkaido University / Yusuke Sawada, Hokkaido University / Takanori Sato, Hokkaido University / Kunimasa Saitoh, Hokkaido University

JW1A.107

High-Quality-Factor Chalcogenide Microresonators With Low Parametric Oscillation Threshold (/home/eposters/poster/?id=3525770)

Presenter: Bin Zhang , *Sun Yat-Sen University*

We demonstrated high-quality-factor (Q) chalcogenide (Ge-Sb-S) microresonators with intrinsic Q of 1.9×10^6 through an improved fabrication process, which enables a low optical parametric oscillation (OPO) threshold of 3.5 mW.

Authors:Pingyang Zeng, Sun Yat-Sen University / Jiayue Wu, Sun Yat-Sen University / Di Xia, Sun Yat-Sen University / Zelin Yang, Sun Yat-Sen University / Yaodong Sun, Sun Yat-Sen University / yufei huang, Sun Yat-Sen University / Jiaxin Zhao, Sun Yat-Sen University / Bin Zhang, Sun Yat-Sen University / Zhaohui Li, Sun Yat-Sen University

JW1A.109

A Structural Bamboo-Like Microfiber Grating Fabricated by one-Step-Tapering Fiber Preform (/home/eposters/poster/?id=3521787)

Presenter: Yanyan Zhi , *Jinan University*

A technique of forming microfiber-based optical structures is proposed and experimentally demonstrated by one-step-tapering fiber preform, via which the fabricated device is featured with flexibility of design, reproducibility, and structural stability.

Authors:Yanyan Zhi, Jinan University / Zixuan Liu, Jinan University / Lanlan Wang, Jinan University / Peiyuan Liu, Jinan University / Yuanpeng Li, Jinan University / Jie Li, Jinan University / Hao Liang, Jinan University / Bai-Ou Guan, Jinan University

JW1A.110

1.23-Tb/s per Wavelength Single-Waveguide on-Chip Optical Interconnect Enabled by Mode-Division Multiplexing (/home/eposters/poster/?id=3522808)

Presenter: Hanzi Huang , *Shanghai University*

We experimentally demonstrate a net capacity per wavelength of 1.23 Tb/s over a single silicon-on-insulator (SOI) multimode waveguide for optical interconnects employing on-chip mode-division multiplexing and 11×11 multiple-in-multiple-out (MIMO) digital signal processing.

Authors:Hanzi Huang, Shanghai University / Yetian Huang, Shanghai University / Yu He, Shanghai Jiao Tong University / Haoshuo Chen, Nokia Bell Labs / Yong Zhang, Shanghai Jiao Tong University / Qianwu Zhang, Shanghai University / Nicolas Fontaine, Nokia Bell Labs / Roland Ryf, Nokia Bell Labs / Yingxiong Song, Shanghai University / Yikai Su, Shanghai Jiao Tong University

JW1A.111

Observation of Transverse Anderson Localization of mid-Infrared Light in a Chalcogenide Transversely Disordered Optical Fiber (/home/eposters/poster/?id=3524331)

Presenter: Asuka Nakatani , *Toyota Technological Institute*

We experimentally demonstrate transverse Anderson localization of mid-infrared light by using a transversely disordered optical fiber made of chalcogenide glasses.

Authors:Asuka Nakatani, Toyota Technological Institute / Tong Tuan, Toyota Technological Institute / Morio Matsumoto, Furukawa Denshi Co., Ltd. / Goichi Sakai, Furukawa Denshi Co., Ltd. / Takenobu Suzuki, Toyota Technological Institute / Yasutake Ohishi, Toyota Technological Institute

JW1A.112

25.6 Tbps Pre-Compensated Waveform Propagation Using Optical Frequency Comb Synthesizer/Analyzer (/home/eposters/poster/?id=3525003)

Presenter: Nasrin Sultana , *Hajee Mohammad Danesh Science and Technology University*

A scanless dispersion pre-compensation system for an ultrafast 25.6 waveform using multilevel 8-ary amplitude and 32-ary phase modulation was controlled and compensated by a 200 GHz optical frequency comb synthesizer with a 6.4 THz bandwidth.

Authors:Nasrin Sultana, Hajee Mohammad Danesh Science and Technology University / Hiroaki Tada, Saitama University / Hayate Imai, Saitama University / Tatsutoshi shioda, Saitama University

JW1A.113

Erbium-Doped LNOI as a Gain Platform for Integrated Optics (/home/eposters/poster/?id=3525167)

Presenter: junmin xiang , *Shanghai Jiao Tong University*

We demonstrate a gain platform based on erbium-doped lithium niobate thin film for integrated waveguide amplifier and laser. Luminescence properties of the film were characterized and gain properties of optical waveguide were calculated.

Authors: junmin xiang, Shanghai Jiao Tong University / minglu cai, Shanghai Jiao Tong University / Tieying Li, Shanghai Jiao Tong University / Zeyu Xiao, Shanghai Jiao Tong University / Kan Wu, Shanghai Jiao Tong University / Jianping Chen, Shanghai Jiao Tong University

JW1A.114

Multi-Color Method for the Correction of Air Refractive Index Based on Dispersive Interferometry of Optical Frequency Comb (/home/eposters/poster/?id=3530941)

Presenter: Shilin Xiong, *Tsinghua University*

We propose a multi-color method for the self-correction of air refractive index in moist air based on spectral interference of optical frequency comb. The relative correction stability of 4.3×10^{-7} is achieved.

Authors: Shilin Xiong, Tsinghua University / Ruixue Zhang, Tsinghua University / Yue Wang, Tsinghua University / Siyu Zhou, Tsinghua University / Guanhao Wu, Tsinghua University

JW1A.115

Dynamic-Widefield-Magnetometry Using Nitrogen-Vacancy Defects in Diamond (/home/eposters/poster/?id=3531896)

Presenter: Madhur Parashar, *Indian Institute of Technology Kharagpur*

Widefield magnetometers based on nitrogen-vacancy defects in diamond are temporally static requiring few to several minutes of acquisition time. Here, employing per pixel frequency lock-in detection, we demonstrate widefield magnetic field images in few-seconds timescale.

Authors: Madhur Parashar, Indian Institute of Technology Kharagpur / Dasika Shishir, Indian Institute of Technology Bombay / Alok Gokhale, Indian Institute of Technology Bombay / Anuj Bathla, Indian Institute of Technology Bombay / Sharba Bandyopadhyay, Indian Institute of Technology Kharagpur / Kasturi Saha, Indian Institute of Technology Bombay

JW1A.116

Intelligent Breathing Dissipative Soliton Generation Utilizing an Evolutionary Algorithm (/home/eposters/poster/?id=3531870)

Presenter: Junsong Peng, *East China Normal University*

Breathing dissipative solitons are automatically generated in a mode-locked fiber laser utilizing an evolutionary algorithm. Intelligent control over their parameters is realized including breathing periods, breathing ratios, and the number of breathers.

Authors:Junsong Peng, East China Normal University / Heping Zeng, East China Normal University / XIUQI WU, East China Normal University

JW1A.117

Fourier Transform Spectral Analysis Based Fiber Nonlinearity-Insensitive OSNR Monitor (/home/eposters/poster/?id=3519196)

Presenter: Zhuili Huang , *Chongqing University*

A fiber nonlinearity-insensitive OSNR monitoring technique was developed based on Fourier transform spectral analysis and shallow neural networks for function fitting. The results show monitoring errors are less than ± 0.5 dB for 3-channel 25GBaud PDM-QPSK signals.

Authors:Zhuili Huang, Chongqing University / Ye Tian, Ningbo University / Xiaojing Long, Chongqing University / Chao Zhang, Beijing Institute of Spacecraft Environment Engineering / Yufei Liu, Chongqing University

JW1A.118

Effect of Residual Mechanical Jitter on Incoherent Beam Combination Through Different Atmospheric Turbulences (/home/eposters/poster/?id=3519298)

Presenter: Sanchita Ghosh , *IIIT hyderabad*

The effect of Residual Mechanical Jitter (RMJ) has been analysed on the incoherent beam combination through various atmospheric turbulences. It is observed that the RMJ effect is more prominent for lower turbulence than higher turbulence.

Authors:Sanchita Ghosh, IIIT hyderabad / Syed Azeemuddin, IIIT hyderabad / Jagannath Nayak, DRDO

JW1A.119

High Accuracy Intrusion Pattern Recognition Using a Dual-Stage-Recognition Network for Fiber Optic Distributed Sensing System (/home/eposters/poster/?id=3524960)

Presenter: Tao He , *Huazhong Univ of Science and Technology*

A dual-stage-recognition network combined with the fiber optic DAS system is designed to realize a high accuracy intrusion pattern recognition in practical complicated environments.

Authors: Tao He, Huazhong Univ of Science and Technology / Yijie Liu, Huazhong Univ of Science and Technology / Shixiong Zhang, Huazhong Univ of Science and Technology / Zhijun Yan, Huazhong Univ of Science and Technology / Deming Liu, Huazhong Univ of Science and Technology / Qizhen Sun, Huazhong Univ of Science and Technology

JW1A.120

the Ultimate Precision of Rangefinders and LiDARs Based on Time-of-Flight Measurements (/home/e posters/poster/?id=3530162)

Presenter: Zingway Pei , *NCHU*

We compare the ultimate timing precision of time-of-flight measurements for rangefinders and LiDARs, based on short-pulse, sine-wave modulated, and long-pulse, and derive both random and systematic contributions to the total error, finding new general results.

Authors: Silvano Donati, Universita degli Studi di Pavia / Giuseppe Martini, Universita degli Studi di Pavia / Wood-HI Cheng, NCHU / Zingway Pei, NCHU

JW1A.121

Broad-Range Self-Sweeping Linearly Polarized Ho-Doped Fiber Laser. (/home/e posters/poster/?id=3531208)

Presenter: Anastasia Vladimirskaia , *Institute of Automation and Electrometry*

We experimentally demonstrate a linearly polarized self-sweeping Ho-doped fiber laser with lasing near 2100 nm. The laser feature is wavelength tuning with range of 10 nm without any spectral filters.

Authors: Anastasia Vladimirskaia, Institute of Automation and Electrometry / Lobach Ivan, Institute of Automation and Electrometry / Kablukov Sergey, Institute of Automation and Electrometry

JW1A.122

an Accurate Disturbance Source Locating Method Based on Machine Learning for Complex Environments (/home/e posters/poster/?id=3531869)

Presenter: Yijie Liu , *Huazhong Univ of Science and Technology*

A method for disturbance positioning in noisy environment is introduced. By the partitioning algorithm and a well-trained B-P neural network classifier, an average locating accuracy of 95% was demonstrated in the field test.

Authors:Yijie Liu, Huazhong Univ of Science and Technology / Tao He, Huazhong Univ of Science and Technology / shixiong Zhang, Huazhong Univ of Science and Technology / Zhijun Yan, Huazhong Univ of Science and Technology / Deming Liu, Huazhong Univ of Science and Technology / Qizhen Sun, Huazhong Univ of Science and Technology

JW1A.123

a High-Performance Broadband Photodetector (UV-NIR) Based on Few Layer GaGeTe (/home/eposters/poster/?id=3521726)

Presenter: Srinivasa Tamalampudi , *New York University Abu Dhabi*

A photodetector based on the few-layered GaGeTe is demonstrated. It exhibits a broadband spectral response ranging from UV to NIR. A high responsivity of 1.5 A/W at 1310 nm and 750 A/W at 404 nm is measured. Furthermore, the devices is very stability under ambient condition.

Authors:Srinivasa Tamalampudi, New York University Abu Dhabi / Mahmoud Rasras, New York University Abu Dhabi

JW1A.124

Strong Purcell Enhancement in a“Nanopost” Single-Photon Source (/home/eposters/poster/?id=3525162)

Presenter: Yujing Wang , *Technical University of Denmark*

We report on a simple nanopost single-photon source geometry based on a quantum dot in a mesa placed on a metal mirror. A remarkably large Purcell enhancement of 9 for the smallest structure is obtained.

Authors:Yujing Wang, Technical University of Denmark / Andreas Østerkryger, Technical University of Denmark / Julien Claudon, CEA / Jean Gérard, CEA / Niels Gregersen, Technical University of Denmark

JW1A.125

Quantum Key Distribution Using Time-Gated SPADs Over Turbid Underwater Channels (/home/eposters/poster/?id=3522810)

Presenter: Shuangfeng Jiang , *The university of Edinburgh*

We investigate the optimisation of gate time period for single-photon detectors in an underwater quantum key distribution system. We explore the trade-off between received background and encoded photons to achieve minimum quantum bit error rate.

Authors:Shuangfeng Jiang, The university of Edinburgh / Wasiu Popoola, The university of Edinburgh / Majid Safari, The university of Edinburgh

JW1A.126

Enhanced Second Harmonic Generation From a Dielectric Encapsulated Multilayer Gallium Selenide (</home/eposters/poster/?id=3523176>)

Presenter: RABINDRA BISWAS , *INDIAN INSTITUTE OF SCIENCE, BANGALORE*

We experimentally demonstrate a simple approach to enhance second harmonic generation(SHG) from multilayer Gallium Selenide by encapsulating with an optimized thickness of low-index dielectric layers. 46-times enhancement is observed showing good agreement with nonlinear wave propagation simulation.

Authors:RABINDRA BISWAS, INDIAN INSTITUTE OF SCIENCE, BANGALORE / Suman Chatterjee, INDIAN INSTITUTE OF SCIENCE, BANGALORE / Jayanta Deka, INDIAN INSTITUTE OF SCIENCE, BANGALORE / Advaita Meenakshi, INDIAN INSTITUTE OF SCIENCE, BANGALORE / Kausik Majumdar, INDIAN INSTITUTE OF SCIENCE, BANGALORE / Varun Raghunathan, INDIAN INSTITUTE OF SCIENCE, BANGALORE

JW1A.127

Transmission Asymmetry in Nano-Opto-Mechanical Metamaterials (</home/eposters/poster/?id=3523183>)

Presenter: Jinxiang Li , *University of Southampton*

In linear optics, the transmission of (conventional) absorbers is identical in the forward and backward propagation directions. We have developed a nonlinear metamaterial providing intensity-dependent transmission asymmetry of up to 60% at microwatt power levels.

Authors:Jinxiang Li, University of Southampton / Kevin MacDonald, University of Southampton / Nikolay Zheludev, University of Southampton

JW1A.128

Stimulated Emission With Evanescent Gain in the Total Internal Reflection Geometry (</home/eposters/poster/?id=3523659>)

Presenter: Mikhail Noginov , *Norfolk State University*

We demonstrated amplified spontaneous emission (ASE) enabled by evanescent gain at an interface between two adjacent dielectrics. The ASE wave is outcoupled to the high-index medium at the critical angle, enabling observation of spectacular emission rings.

Authors:Joshua Asane, Norfolk State University / Md Golam Chowdhury, Norfolk State University / Kanij Khabir, Norfolk State University / Viktor Podolskiy, UMass Lowell / Mikhail Noginov, Norfolk State University

JW1A.129

Temporal Cavity Soliton in an Active Fiber Resonator (</home/eposters/poster/?id=3524995>)

Presenter: Nicolas Englebert , *Universite libre de Bruxelles*

We demonstrate the existence of temporal solitons in a coherently driven laser, pumped below its lasing threshold. We study how the gain saturation impacts this new localized structure, both theoretically and experimentally.

Authors:Nicolas Englebert, Universite libre de Bruxelles / Carlos Mas Arabí, Universite libre de Bruxelles / Pedro Parra-Rivas, Universite libre de Bruxelles / Simon-Pierre Gorza, Universite libre de Bruxelles / François Leo, Universite libre de Bruxelles

JW1A.130

Self-Pulsing in Coupled Kerr Ring Resonators (</home/eposters/poster/?id=3525021>)

Presenter: Jesús Yelo Sarrión , *Université Libre de Bruxelles*

Self-pulsing is an ubiquitous phenomenon arising in coupled nonlinear systems. We here experimentally study the self-pulsing dynamics occurring in two coupled fiber ring resonators. Our results are supported and extended by a detailed bifurcation analysis.

Authors:Jesús Yelo Sarrión, Université Libre de Bruxelles / Pedro Parra-Rivas, Université Libre de Bruxelles / Nicolas Englebert, Université Libre de Bruxelles / Carlos Mas Arabí, Université Libre de Bruxelles / François Leo, Université Libre de Bruxelles / Simon-Pierre Gorza, Université Libre de Bruxelles

JW1A.131

All-Dielectric Slot Metasurface With Ultra-High-Q Resonances (</home/eposters/poster/?id=3531393>)

Presenter: Francesco Dell Olio , *Polytecnic University of Bari*

A novel all-dielectric metasurface in silicon-on-insulator technology made of arrayed circular slots is proposed and theoretically studied. The metasurface exhibits quasi-bound states in the continuum resonances, having an ultra-high Q-factor up to 5×10^8

Authors:Jose Francisco Algorri, Universidad de Cantabria / Francesco Dell Olio, Polytecnic University of Bari / Pablo Roldan, Universidad de Cantabria / Luis Rodriguez Cobo, Instituto de Salud Carlos III / Jose Miguel Lopez Higuera, Instituto de Investigación Sanitaria Valdecilla (IDIVAL) / Jose Manuel Sanchez-Pena, Universidad Carlos III de Madrid / Dimitrios Zografopoulos, Consiglio Nazionale delle Ricerche

JW1A.132

20-W, 168 fs Yb:CALGO Regenerative Amplifier With 1-MHz Repetition Rate (</home/eposters/poster/?id=3530235>)

Presenter: geyang wang , *Xidian University*

We report on a 1-MHz repetition rate regenerative amplifier based on single Yb:CALGO crystal. It delivers 168 fs pulses with 20 W average power, centered at 1040 nm with a spectral bandwidth of 11 nm.

Authors:geyang wang, Xidian University / Chuan Bai, Xidian University / Rui Xu, Xidian University / Li Zheng, Xidian University / Renchong Lv, Xidian University / Han Liu, Xidian University / Wenlong Tian, Xidian University / Dacheng Zhang, Xidian University / Jiangfeng Zhu, Xidian University / Zhiyi Wei, Chinese Academy of Sciences

JW1A.133

Disentangling Charge Transfer, Heat Conduction, and Strain Effects at WS₂/Graphene Interface (/home/eposters/poster/?id=3518666)

Presenter: Ruiling Zhang, *Tsinghua university*

Combined micro-photoluminescence and Raman spectroscopies were used to disentangle charge transfer, heat conduction and strain effects at WS₂/Graphene interface through pump-power and temperature controls, allowing the first accurate determination of thermal conductance at the interface.

Authors:Ruiling Zhang, Tsinghua university / Lin Gan, Tsinghua university / Danyang Zhang, Tsinghua university / Zhen Wang, Tsinghua university / Cun-Zheng Ning, Tsinghua university

JW1A.134

WDM Integrated Silicon Nano-Slab Photodetector for Short-Reach Datacom on Silicon Nitride-on-SOI Platform (/home/eposters/poster/?id=3525413)

Presenter: Avijit Chatterjee, *Indian Institute of Science Bangalore*

We demonstrate 1X6 SiN echelle grating filters integrated with silicon nano-slab metal-semiconductor-metal photodetector for SWDM based short-reach interconnect. Echelle grating measures 4.3 dB insertion loss and 22 dB crosstalk. Photodetector records 0.59 A/W responsivity.

Authors:Avijit Chatterjee, Indian Institute of Science Bangalore / Shankar Selvaraja, Indian Institute of Science Bangalore

JW1A.135

Performance Analysis of CdTe Solar Cell Using Copper Telluride Back Surface Field for Efficiency Enhancement (/home/eposters/poster/?id=3531023)

Presenter: Sudarshan Jain, *Malaviya National Institute of Technology, Jaipur*

Performance analysis of the copper telluride back-surface field-based CdTe thin-film solar cell is presented and has demonstrated that back-surface field contributes most to the CdTe solar cells efficiency enhancement and shows better stability with temperature.

Authors: Sudarshan Jain, Malaviya National Institute of Technology, Jaipur / Vijay Janyani, Malaviya National Institute of Technology, Jaipur / Nikhil Deep Gupta, Visvesvaraya National Institute of Technology

JW1A.136

Investigation of Mach Zehnder Modulator Frequency Chirp (/home/eposters/poster/?id=3531821)

Presenter: Lam Bui , *Central Queensland University (CQUniversity)*

Mach Zehnder modulator chirp is rigorously derived and its behavior versus bias is studied showing the modulator can exhibit a single rather than dual singularities as often expected. The model is verified using rigorous simulations.

Authors: Lam Bui, Central Queensland University (CQUniversity)

JW1A.137

Compact, Energy-Efficient, and Low-Loss Thermo-Optic Silicon Optical Phase Shifter (/home/eposters/poster/?id=3519964)

Presenter: Huaqing Qiu , *Technical University of Denmark*

We experimentally demonstrate a compact silicon optical phase shifter based on thermo-optic effect. The loss, power consumption, modulation bandwidth, and footprint are 0.77 dB, 3.1 mW/p, 38 kHz, and $45 \times 45 \mu\text{m}^2$, respectively.

Authors: Huaqing Qiu, Technical University of Denmark / Yong Liu, Technical University of Denmark / Chao Luan, Technical University of Denmark / Deming Kong, Technical University of Denmark / Xiansong Meng, Technical University of Denmark / Xiaowei Guan, Technical University of Denmark / Yunhong Ding, Technical University of Denmark / Hao Hu, Technical University of Denmark

JW1A.138

Timing Jitter of Fractal Superconducting Nanowire Avalanche Photodetectors in the 2-Micrometer Wavelength Range (/home/eposters/poster/?id=3520664)

Presenter: Liang Xu , *Tianjin University*

We developed a femtosecond, mode-locked thulium-doped fiber laser to characterize fractal superconducting nanowire single-photon detectors at 1993 nm. The lowest timing jitter was 64.8 ps, which should be compared with 29.2 ps at 1560 nm.

Authors:Liang Xu, Tianjin University / Yun Meng, Tianjin University / Kai Zou, Tianjin University / Nan Hu, Tianjin University / Yu Cai, Tianjin University / Samuel Gyger, Royal Institute of Technology (KTH) / Stephan Steinhauer, Royal Institute of Technology (KTH) / Val Zwiller, Royal Institute of Technology (KTH) / Xiaolong Hu, Tianjin University

JW1A.139

Quantum Absorption Estimation for Saturable Samples (/home/eposters/poster/?id=3523316)

Presenter: Jake Biele , *University of Bristol*

We model the effect of saturation in absorption spectroscopy on quantum and classical probe performance. We derive a bound on the precision for each strategy, presenting an ideal quantum probe alongside methods to maximise precision classically.

Authors:Jake Biele, University of Bristol / Joshua Silverstone, University of Bristol / Jonathan Matthews, University of Bristol / Euan Allen, University of Bristol

JW1A.140

Germanium-Tin Lateral $p-i-n$ Waveguide Photodetectors for Mid-Infrared Silicon Photonics (/home/eposters/poster/?id=3527227)

Presenter: Guo-En Chang , *National Chung Cheng University*

We report on lateral $p-i-n$ GeSn waveguide photodetector on silicon substrates for complementary metal-oxide-semiconductor (CMOS)-compatible mid-infrared silicon photonics.

Authors:Kuan-Chih Lin, National Chung Cheng University / Harshvardhan Kumar, National Chung Cheng University / Guo-En Chang, National Chung Cheng University

JW1A.141

A Low Complexity Diagonalized Kalman Filter for Joint Equalization of Ultra-Fast RSOP and Large PMD in Presence of Residual CD (/home/eposters/poster/?id=3530618)

Presenter: Qi Zhang , *Beijing University of Posts and Telecomm*

A low complexity diagonalized Kalman filter is proposed in this paper, which be qualified for joint equalization of RSOP (up to 10Mrad/s) and PMD (DGD=100ps) in presence of residual CD (300ps/nm).

Authors: Qi Zhang, Beijing University of Posts and Telecomm / Nan Cui, Beijing University of Posts and Telecomm / Nannan Zhang, Beijing University of Posts and Telecomm / Xue Li, Beijing University of Posts and Telecomm / Leiya Hu, Beijing University of Posts and Telecomm / Lixia Xi, Beijing University of Posts and Telecomm / Xiaoguang Zhang, Beijing University of Posts and Telecomm

JW1A.142

Fair Sampling With a Highly Parallel Laser Simulator (/home/e posters/poster/?id=3530642)

Presenter: Vishwa Pal , *Indian Institute of Technology Ropar*

We present efficient fair sampling of ground-state manifold of XY spin Hamiltonian based on dissipatively coupled lasers that includes a massive parallelism. Our simulator could potentially be exploited to address various combinatorial optimization problems.

Authors: Vishwa Pal, Indian Institute of Technology Ropar / Simon Mahler, Weizmann Institute of Science / Asher Friesem, Weizmann Institute of Science / Nir Davidson, Weizmann Institute of Science

JW1A.143

Characterization of a Tunable Comb Source Based on a Silicon Micro-Ring Assisted Fiber Laser With Optical Injection (/home/e posters/poster/?id=3531847)

Presenter: Chu Chen , *National Chiao Tung University*

Performance of a tunable comb source based on a silicon micro-ring assisted fiber laser with optical injection is characterized. By increasing the fiber cavity nonlinearity, wider frequency spacing up to 2 THz can be achieved.

Authors: Cheng-Yuan Li, National Chiao Tung University / Chu Chen, National Chiao Tung University / Yi-Jang Hsu, National Chiao Tung University / Yin-Chieh Lai, National Chiao Tung University

JW1A.144

Simultaneous Combination and Nearly Self-Similar Pulse Compression of Five Pulses at Different Wavelengths (/home/e posters/poster/?id=3522825)

Presenter: Jiayao Huang , *Peking University*

Numerical simulation of five raised-cosine pulses with spectral separation of 0.1 nm with each other merged into a single compressed pulse (12.8 compression factor) of nearly 50% of total input energy in a dispersion decreasing nonlinear fiber is reported.

Authors:Jiayao Huang, Peking University / Feng Ye, Peking University / Kaliyaperumal Nakkeeran, University of Aberdeen / P. K. A. Wai, The Hong Kong Polytechnic University / Qian Li, Peking University

JW1A.145

Improvement of GaN Epitaxial Layer and AlGaIn/GaN HEMTs by Patterned Sapphire Substrate Technology (/home/eposters/poster/?id=3531994)

Presenter: Hsin-Jung Lee , *National Taiwan University*

A microstructure was designed to reduce the dislocations in the epitaxial GaN layer and improve electrical characteristics of HEMTs by using the patterned sapphire substrates technology. AlGaIn/GaN HEMTs with the maximum drain current density increased from 308 mA/mm to 469 mA/mm were achieved.

Authors:Cheng-Che Lee, National Taiwan University / Hsin-Jung Lee, National Taiwan University / Chien-Tsun Chan, National Taiwan University / Chieh-Hsiung Kuan, National Taiwan University

JW1A.147

a Compact, Selective and Embedded-System Enabled Photoacoustic Sensor for Multiple Trace Detection (/home/eposters/poster/?id=3517127)

Presenter: Xueshi Zhang , *Xidian university*

A compact, selective and embedded-system enabled photoacoustic sensor was established with self-designed modules which replaced laser controller, signal generator and Lock-in Amplifier. The results exhibit that normalized noise equivalent absorption (NNEA) coefficient achieves $2.12 \times 10^{-8} \text{cm}^{-1} \text{W/Hz}^{-1/2}$.

Authors:Xueshi Zhang, Xidian university / Lixian Liu, Xidian university / Le Zhang, Xidian university / Huiting Huan, Xidian university / Lei Dong, Xidian university / Ying Zhou, University of Electronic Science and Technology of China / Xiaopeng Shao, Xidian university

JW1A.148

Thrombin Detection on Ball Resonator Using Optical Backscatter Reflectometry (/home/eposters/poster/?id=3518639)

Presenter: Madina Shaimerdenova , *Nazarbayev University*

We detected thrombin protein on a ball resonator using optical backscatter reflectometer. The sensor was fabricated with CO2 laser splicing system, gold-sputtered, and functionalized for thrombin concentration dependency measurement. A linear trend was observed.

Authors:Madina Shaimerdenova, Nazarbayev University / Takhmina Ayupova, Nazarbayev University / Marzhan Sytabekova, Nazarbayev University / Daniele Tosi, Nazarbayev University

JW1A.149

Exercise Vital Signs Detection Employing FMCW Radar and Artificial Neural Networks (/home/eposters/poster/?id=3521076)

Presenter: King Leong Li , *National Chiao Tung University*

We present a frequency modulated continuous wave (FMCW) radar system for non-contact heart rate monitoring during exercise. 90% accuracy of predictions are achieved by employing a modified MobileNetV3 model for regression analysis.

Authors:King Leong Li, National Chiao Tung University / Shih-Hsuan Lai, National Chiao Tung University / Kyle Cheng, Wistron Corporation / Lindor Henrickson, National Chiao Tung University / Irwin Chen, Wistron Corporation / Vincent Wu, Wistron Corporation / Jyehong Chen, National Chiao Tung University

JW1A.151

Combining PM-IRRAS With Optical Imaging Techniques for *Operando* Studies of CO Oxidation (/home/eposters/poster/?id=3523067)

Presenter: Lisa Rämisch , *Lund university*

To bridge the pressure gap in heterogeneous catalysis and maximize the gain of operando information, we have combined PM-IRRAS with the imaging techniques SOR and PLIF and measured CO oxidation on a Pd(100) crystal.

Authors:Lisa Rämisch, Lund university / Sabrina Gericke, Lund university / Sebastian Pfaff, Lund university / Edvin Lundgren, Lund university / Johan Zetterberg, Lund university

JW1A.152

Fabrication of Sub-Wavelength Resolved Silver Acrylate Composite Microstructures (/home/eposters/poster/?id=3523693)

Presenter: Arun Jaiswal , *IIT Bombay*

Simultaneous two photon polymerization/reduction of metal-polymer composite resin has been utilized for fabrication of microstructures with silver loadings as high as 20 wt%. Feature Sizes as small as 370 nm are demonstrated.

Authors:Arun Jaiswal, IIT Bombay

JW1A.153

Experimental Comparison of Conventional and Femtosecond Optical Tweezers (/home/eposters/poster/?id=3525912)

Presenter: Ajitesh Singh , *Indian Institute of Technology Kanpur*

Systematic study of conventional and femtosecond optical tweezers demonstrates an interplay of thermal and optical nonlinearity due to tight focusing. Specifically, Brownian motion of the 250nm radius trapped bead is measured using a quadrant photodiode.

Authors: Ajitesh Singh, Indian Institute of Technology Kanpur / Soumendhra Bandyopadhyay, Indian Institute of Technology Kanpur / Krishna Singh, Indian Institute of Technology Kanpur / Deepak Kumar, Indian Institute of Technology Kanpur / Debabrata Goswami, Indian Institute of Technology Kanpur

JW1A.154

Joint Multi-Parameter Measurement With a Mach-Zehnder Interferometer Assisted by Parametric Amplifiers (/home/eposters/poster/?id=3531721)

Presenter: Zhe-Yu Ou , *Indiana University-Purdue University Indianapolis*

We present a linear interferometer with the assistance of an SU(1,1) interferometer, and achieve optimum quantum enhancement in the measurement precision of an arbitrary mixture of phase and amplitude modulation.

Authors: Wei Du, East China Normal University / Zhe-Yu Ou, Indiana University-Purdue University Indianapolis

JW1A.155

Magnetically Tunable Goos-Hanchen Shifts in Topological Quantum Materials (/home/eposters/poster/?id=3520373)

Presenter: Muzamil Shah , *Lahore University of Management Sciences*

We theoretically investigate the Goos-Hanchen (GH) shifts on the surface of a topological insulator (TI) thin film in the presence of an externally applied magnetic field. The potential applications are in optical heterodyne and bio-sensors.

Authors: Muzamil Shah, Lahore University of Management Sciences / Ali Akbar, Lahore University of Management Sciences / Mudasir Shah, Lahore University of Management Sciences

JW1A.157

Novel Coupling Schemes Between the Topological Cavity and Valley Modes in a Terahertz on-Chip Waveguide (/home/eposters/poster/?id=3521821)

Presenter: hao xiong , *Nankai University*

We demonstrated novel coupling phenomena between the topological cavity and valley modes in a terahertz on-chip waveguide. This work may provide insights for designs of topological photonic circuits and future applications in terahertz communications.

Authors:hao xiong, Nankai University / Yao Lu, Nankai University / Qiang Wu, Nankai University / Xitan Xu, Nankai University / Ruobin Ma, Nankai University / Jingjun Xu, Nankai University

JW1A.158

Switchable Polarization Eigenstates in non-Hermitian Plasmonic Systems With Phase Change Materials (</home/eposters/poster/?id=3522700>)

Presenter: Yuto Moritake , *Tokyo Institute of Technology*

We propose and numerically demonstrate reconfigurable non-Hermitian plasmonic systems loaded by phase-change materials. This system enables switching of unique polarization properties around exceptional points resulting from PT transition induced by the material phase transition.

Authors:Yuto Moritake, Tokyo Institute of Technology / Masaya Notomi, Tokyo Institute of Technology

JW1A.159

Electro-Optical Modulation in Lithium Niobate Metasurfaces (</home/eposters/poster/?id=3525063>)

Presenter: Bofeng Gao , *School of Physics and TEDA Applied Physics Institute, Nankai University*

We fabricated lithium niobate electro-optic metasurfaces and experimentally demonstrate the electro-optical phase modulation in LN metasurfaces using the optical heterodyne interference technique.

Authors:Bofeng Gao, School of Physics and TEDA Applied Physics Institute, Nankai University / Mengxin Ren, School of Physics and TEDA Applied Physics Institute, Nankai University / Wei Wu, School of Physics and TEDA Applied Physics Institute, Nankai University / Jingjun Xu, School of Physics and TEDA Applied Physics Institute, Nankai University

JW1A.160

Controlled Light Transport and Emission Using Photonic Structures With Short-Range Order (</home/eposters/poster/?id=3531238>)

Presenter: SUDHIR KUMAR SAINI , *IIT ROPAR*

We study the resonant frequency gap in the short-range order photonic system. The decay rate measurements are performed for an emitter embedded in these structures to validate the changes in the local density of states.

Authors:SUDHIR KUMAR SAINI, IIT ROPAR / Rajesh Nair, IIT ROPAR

JW1A.161

PT-Symmetric Double Ridge Semiconductor Lasers Emitting at 980 nm (/home/eposters/poster/?id=3531220)

Presenter: Wan-hua Zheng, *CAS Institute of Semiconductors*

Electrically injected Parity-time (PT)-symmetric double ridge semiconductor laser lasing at 980 nm range is fabricated. The side mode suppression ratio (SMSR) of the spectrum of the laser is 37.97 dB at current of 91 mA.

Authors: Ting Fu, CAS Institute of Semiconductors / Yufei Wang, CAS Institute of Semiconductors / Xuyan Zhou, CAS Institute of Semiconductors / Fangling Du, CAS Institute of Semiconductors / Jian Fan, CAS Institute of Semiconductors / Xueyou Wang, CAS Institute of Semiconductors / Jingxuan Chen, CAS Institute of Semiconductors / Aiyi Qi, CAS Institute of Semiconductors / Wan-hua Zheng, CAS Institute of Semiconductors

JW1A.163

Billiard-Like Resonances in Metallic Nanostructures and Their use for Efficient Ultrafast Nonlinear Optics (/home/eposters/poster/?id=3525552)

Presenter: Ihar Babushkin, *Leibniz Universität Hannover*

Here we show that discrete resonances, resulting from the quantum confinement of electronic wavefunctions in metallic nanostructures lead to a single strong composite resonance. It can be used for effective low-harmonic (for instance THz) generation.

Authors: Ihar Babushkin, Leibniz Universität Hannover / Ayhan Demircan, Leibniz Universität Hannover / Liping Shi, Westlake University / Uwe Morgner, Leibniz Universität Hannover / Joachim Herrmann, Max-Born-Institut / Anton Husakou, Max-Born-Institut

JW1A.165

Optically Pumped Spin VCSELs for Reservoir Computing (/home/eposters/poster/?id=3520997)

Presenter: Yigong Yang, *Soochow University*

We propose a reservoir computing system based on an optically pumped spin VCSEL subject to optical feedback and injection. It allows for parallel information processing and its rate reaches 10Gpbs, which outperforms most RC systems based on electrically pumped lasers.

Authors: Yigong Yang, Soochow University / Pei Zhou, Soochow University / Nianqiang Li, Soochow University

JW1A.166

Particle Swarm Optimization of SPM-Enabled Spectral Selection to Achieve Octave-Spanning Wavelength Shift (/home/eposters/poster/?id=3524701)

Presenter: Xincai Diao , *Institute of physics CAS*

We apply particle swarm optimization algorithm to optimize SPM-enabled spectral selection (SESS) and demonstrate highly efficient SESS which delivers MW peak-power femtosecond pulses with the wavelength tuning range exceeding one octave.

Authors:Xincai Diao, Institute of physics CAS

JW1A.167

Stability of Lithium Niobate Integrated Photonics in Nonlinear and Metrology Applications (/home/eposters/poster/?id=3524774)

Presenter: Victor Brasch , *CSEM*

We demonstrate that lithium niobate integrated photonics allows for reliable nonlinear applications under continuous femtosecond laser irradiation. Over >100 hours, a stable octave-spanning supercontinuum plus second-harmonic generation allows for direct self-referencing of a frequency comb.

Authors:Ewelina Obrzud, CSEM / Hamed Sattari, CSEM / Thibault Voumard, CFEL / Gregory Choong, CSEM / Séverine Denis, CSEM / Jacopo Leo, CSEM / Thibault Wildi, CFEL / Olivier Dubochet, CSEM / Michel Despont, CSEM / Steve Lecomte, CSEM / Tobias Herr, CFEL / Amir Ghadimi, CSEM / Victor Brasch, CSEM

JW1A.168

Cascaded Mach-Zehnder Interferometer and Ring Resonator With MXene for Temperature Sensing (/home/eposters/poster/?id=3525100)

Presenter: Q. Wu , *Beihang University*

We demonstrate an all-fiber temperature sensor utilizing a cascaded Mach-Zehnder interferometer and ring resonator with MXene $\text{Ti}_3\text{C}_2\text{T}_x$, showing a high conversion efficiency of $0.159 \pi/^\circ\text{C}$ and sensitivity of $1.03 \text{ nm}/^\circ\text{C}$.

Authors:Jiaxin Song, Beihang University / Meng Zhang, Beihang University / Q. Wu, Beihang University / Xiantao Jiang, Shenzhen University / Han Zhang, Shenzhen University / Zheng Zheng, Beihang University

JW1A.169

Inversionless Gain in a Microscale Vapor Cells (/home/eposters/poster/?id=3525305)

Presenter: Eliran Talker , *Hebrew University of Jerusalem*

We demonstrate gain without inversion towards lasing in a lossy medium, based on atomic interference in Rubidium vapor confined in microscale vapor cell. We also demonstrate the crucial role of miniaturization in achieving inversionless gain.

Authors:Eliran Talker, Hebrew University of Jerusalem / Noa Mazurski, Hebrew University of Jerusalem / Barash Yefim, Hebrew University of Jerusalem / Uriel Levy, Hebrew University of Jerusalem

JW1A.170

Loss INduced Switching Between Electromagnetically Induced Transparency and Critical Coupling in Chalcogenide Waveguide (/home/eposters/poster/?id=3525595)

Presenter: Bin Zhang , *Sun Yat-Sen University*

We propose a mechanism to harness the loss of phase change material (PCM) in a coupled high-Q resonators system for realizing a switching between on-chip electromagnetically induced transparency and critical coupling.

Authors:Yaodong Sun, Sun Yat-Sen University / Guiying Hu, Sun Yat-Sen University / Di Xia, Sun Yat-Sen University / Pingyang Zeng, Sun Yat-Sen University / Yi Xu, Department of Electronic Engineering, College of Information Science and Technology, Jinan University / Bin Zhang, Sun Yat-Sen University / Zhaohui Li, Sun Yat-Sen University

JW1A.172

Shingled sub-Diffraction Multi-Dimensional Optical Data Storage in Glass (/home/eposters/poster/?id=3525428)

Presenter: Jichao Gao , *Huazhong University of Sci. and Technol.*

A shingled sub-diffraction four-dimensional optical data storage approach is demonstrated.

Authors:Jichao Gao, Huazhong University of Sci. and Technol. / Jingyu Zhang, Huazhong University of Sci. and Technol.

JW1A.174

AI Enhances Femtosecond Spectral Interferometry (/home/eposters/poster/?id=3524720)

Presenter: Guoqing Pu , *University of California, Los Angeles*

We report AI enabled spectral interferometry that infers the magnitude and phase of femtosecond pulses directly from single-shot interference patterns with a performance that is superior to the widely used Hilbert transform algorithm.

Authors:Guoqing Pu, University of California, Los Angeles / Bahram Jalali, University of California, Los Angeles

JW1A.175

Uncorrelated Photon Pair Generation in Asymmetric Heterogeneously Coupled Waveguides (/home/eposters/poster/?id=3520996)

Presenter: Xiangyan Ding , *Harbin Institute of Technology*

We develop a technique to tailor modal group velocities in asymmetric heterogeneously coupled waveguides such that uncorrelated photon pairs can be generated directly. Design examples based on lithium niobate thin film waveguides are provided.

Authors:Xiangyan Ding, Harbin Institute of Technology / Jing Ma, Harbin Institute of Technology / Liying Tan, Harbin Institute of Technology / Amr Helmy, University of Toronto / Dongpeng Kang, Harbin Institute of Technology

JW1A.177

Angular Spectrum of Bound State in the Continuum for Near and Far Field Analysis (/home/eposters/poster/?id=3525520)

Presenter: Pravin Vaity , *DCMP & MS, TIFR, Mumbai*

We investigated the angular spectrum of bound state in the continuum (BIC) associated with topological charge and present an empirical tool to characterize BIC. While near-field confirms Bessel-Gaussian distribution, far-field is a perfect vortex.

Authors:Pravin Vaity, DCMP & MS, TIFR, Mumbai / Venu gopal Achanta, DCMP & MS, TIFR, Mumbai

JW1A.178

Dual-Layer SiN_x-on-SOI Grating Coupler as an Efficient Higher-Order Fiber Mode Multiplexer (/home/eposters/poster/?id=3521818)

Presenter: Lirong Cheng , *Tsinghua University*

We demonstrate a dual-layer grating coupler as an efficient higher-order fiber mode multiplexer. Four channels from a fiber array can be multiplexed into four distinct TE-polarized modes in a few-mode fiber using the proposed multiplexer.

Authors:Lirong Cheng, Tsinghua University / Simei Mao, Tsinghua University / Yixiang Hu, Tsinghua University / H. Y. Fu, Tsinghua University

JW1A.179

a Novel Approach to Reduce Attenuation Loss in Silica-Based Microstructured Optical Fibers (/home/eposters/poster/?id=3531768)

Presenter: Debashri Ghosh , *CSIR-CGCR*

Fabrication of hexagonal-lattice microstructured optical fiber (MOF) with Thulium-doped silica capillaries introduced in the first ring during stacking is presented for the first time which exhibits lower transmission loss compared to undoped MOF of similar design.

Authors:Anirban Dhar, CSIR-CGCRI / Debjit Dutta, CSIR-CGCRI / Nilotpal Choudhury, CSIR-CGCRI / Debashri Ghosh, CSIR-CGCRI

JW1A.180

Demonstration of Mapping Spin-Based Pancharatnam-Berry Phase to Modal Orbital Rotation in a few Mode Fiber (/home/eposters/poster/?id=3521804)

Presenter: Jian Wang, *WNLO, HUST*

We theoretically and experimentally demonstrate that spin-based Pancharatnam-Berry phase can be mapped to the first-order modal orbital rotation in a few mode fiber, which could be potentially applied to fiber sensing and mode management.

Authors:Hongya Wang, WNLO, HUST / Liang Fang, WNLO, HUST / Xi Zhang, WNLO, HUST / Yize Liang, WNLO, HUST / Jian Wang, WNLO, HUST

JW1A.181

MULTI-Wavelength Tunable Fiber Laser Based on Four-Leaf Clover Suspended Core Fiber Filter (/home/eposters/poster/?id=3524518)

Presenter: Zijuan Tang, *Beijing Jiaotong University*

In this paper, a dual-wavelength interval tunable and multi-wavelength switchable fiber laser is proposed and experimentally demonstrated by using a four-leaf clover suspended core fiber filter. The maximal tunable range of dual-wavelength is 41 nm.

Authors:Zijuan Tang, Beijing Jiaotong University / Zhenggang Lian, Yangtze Optical Electronics Co.,Ltd / shuqin Lou, Beijing Jiaotong University

JW1A.182

Phononic Integrated Circuitry With an Etchless Fabrication Process (/home/eposters/poster/?id=3524666)

Presenter: Ziyao Feng, *The Chinese University of Hong Kong*

We proposed, theoretically analyzed, and experimentally demonstrated a new type of phononic integrated waveguides, which can be fabricated with an etchless process, for guiding and routing gigahertz mechanical waves on a chip.

Authors:Ziyao Feng, The Chinese University of Hong Kong / Yang Liu, Tsinghua University / Lai Wang, Tsinghua University / Xiankai Sun, The Chinese University of Hong Kong

JW1A.183

Polarization Sensitive Photodetection Using Semiconducting Monolayers (/home/e posters/poster/?id=3521786)

Presenter: Sreejyothi Sankararaman , *Indian Institute of Technology Palakkad*

Localized plasmon resonance in metallic nanoparticles can enable polarization-dependent electric field enhancement. Semiconducting monolayers are used in conjunction with polarization-sensitive plasmonic structures, to maximize the field overlap and promote polarization-sensitive photon detection.

Authors:Sreejyothi Sankararaman, Indian Institute of Technology Palakkad / Krishna Balasubramanian, Indian Institute of Technology Kanpur / Revathy Padmanabhan, Indian Institute of Technology Palakkad

JW1A.184

Learning-Based Cell Detection in Digital Pathology (/home/e posters/poster/?id=3520162)

Presenter: Zhenbo Ren , *Northwestern Polytechnical University*

In blood testing, knowing the ratio and throughput of blood cells is crucial to help doctors make a clinical diagnosis. Here we propose a deep transfer learning strategy for accurate cell detection for digital pathology.

Authors:Zhenbo Ren, Northwestern Polytechnical University / Edmund Lam, University of Hong Kong / Jianlin Zhao, Northwestern Polytechnical University

JW1A.185

Ultra-Thin Silicon Photonics Meta-Detector for Perfect 850-950 nm Band Tunable Absorption (/home/e posters/poster/?id=3531475)

Presenter: Roy Avrahamy , *Ben-Gurion University of the Negev*

We introduce a silicon photonics meta-detector for perfect 850-950nm band tunable absorption. Optimized $<\lambda/4.5$ thin designs of 10nm Si film wrapped by a laterally asymmetric dual SiO₂-Air Si-SiO₂ gratings cavity, fully absorbs light of $>15\mu\text{m}$ penetration depth, in $<25\text{nm}$ effectively thin Si absorber.

Authors:Roy Avrahamy, Ben-Gurion University of the Negev / Benny Milgrom, The Jerusalem College of Technology / Moshe Zohar, Shamoon College of Engineering / Mark Auslender, Ben-Gurion University of the Negev / Tal David, Ben-Gurion University of the Negev / Amiel Ishaaya, Ben-Gurion University of the Negev

7:00 - 8:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - PhD-Level Transferrable Skills that Stand Out During Economic Downturns

The global management consulting firm McKinsey & Company recently released a report showing that there is a 20% deficit in the job market for job candidates who can do two things - research, and analysis. These two transferable skills are key skill that all PhDs have regardless of their background and makes them highly valuable job candidates, especially in times of uncertainty. In this webinar, we will detail the top 10 transferable skills that PhDs need to communicate on their resume and during their job search as a while, as well as the 3 categories of core competencies that PhDs must master and leverage in order to get hired in industry.

Special Event - Role and Applications of Lasers in Additive Manufacturing

You are invited to join the OSA Lasers in Manufacturing Technical Group for a panel discussion on the role and application of lasers in additive manufacturing. Our panelists will discuss the applicability of lasers for different additive manufacturing processes, such as laser powder bed fusion process, laser powder directed energy deposition process, and laser wire directed energy deposition process. The panel will also discuss the advantages and disadvantages of lasers compared to other energy sources, such as electron beam. Our panelists for this event will include Paul Gradl, NASA Marshall Space Flight Center; Ankit Saharan, EOS; Yashwanth Bandari, MELTIO; and Mike Vasquez, 3Degrees Consulting.

7:00 - 8:30 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - Workshop: Analog vs. Digital Photonic Information Processing

Special Event - Workshop: Achieving Level 5 Autonomy in Self Driving Cars

Special Event - Workshop: Is quantum technology ready for prime time?!

9:00 - 11:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FW2P

Advanced Photon Detection

Presider: Martin Stevens , *National Inst of Standards & Technology*

FW2P.1

Impedance-Matched Differential SNSPDs for Practical Photon Counting With sub-10 ps Timing Jitter.

Presenter: Marco Colangelo , *MIT*

We demonstrate large-area superconducting nanowire single-photon detectors (SNSPDs) with combined high system detection efficiency and low system jitter operation. We describe the device architecture and discuss optimal readout setup for practical applications.

Authors:Marco Colangelo, MIT / Andrew Beyer, Jet Propulsion Laboratory, California Institute of Technology / Boris Korzh, Jet Propulsion Laboratory, California Institute of Technology / Jason Allmaras, Jet Propulsion Laboratory, California Institute of Technology / Andrew Mueller, Jet Propulsion Laboratory, California Institute of Technology / Ryan Briggs, Jet Propulsion Laboratory, California Institute of Technology / Bruce Bumble, Jet Propulsion Laboratory, California Institute of Technology / Marcus Runyan, Jet Propulsion Laboratory, California Institute of Technology / Martin Stevens, National Institute of Standards and Technology / Adam McCaughan, National Institute of Standards and Technology / Di Zhu, MIT / Steve Smith, Cosmic Microwave Technology / Wolfgang Becker, Becker & Hickl GmbH / Lautaro Narváez, California Institute of Technology / Joshua Bienfang, National Institute of Standards and Technology / Simone Frasca, Jet Propulsion Laboratory, California Institute of Technology / Angel Velasco, Jet Propulsion Laboratory, California Institute of Technology / Edward Ramirez, Jet Propulsion Laboratory, California Institute of Technology / Alexander Walter, Jet Propulsion Laboratory, California Institute of Technology / Ekkehart Schmidt, Jet Propulsion Laboratory, California Institute of Technology / Emma Wollman, Jet Propulsion Laboratory, California Institute of Technology / Cristián Pena, Fermi National Accelerator Laboratory / Maria Spiropulu, California Institute of Technology / Richard Mirin, National Institute of Standards and Technology / Sae Woo Nam, National Institute of Standards and Technology / Karl Berggren, MIT / Matthew Shaw, Jet Propulsion Laboratory, California Institute of Technology

FW2P.2

Shot-Noise Limited Hot Electron Bolometer Integrated on Silicon-on-Insulator Photonics

Presenter: Francesco Martini , *IFN-CNR*

Shot-noise limited (SNL) detectors that can be integrated on several photonic platforms are essential for photonic quantum technologies. We integrated small-area Hot Electron Bolometers on SOI photonics, demonstrating SNL operations with only 1.1 μ W of input power.

Authors:Francesco Martini, IFN-CNR / Sara Cibella, IFN-CNR / Alessandro Gaggero, IFN-CNR / Francesco Mattioli, IFN-CNR / Roberto Leoni, IFN-CNR

FW2P.3

On-Chip Integration of Reconfigurable Quantum Photonics With Superconducting Photodetectors

Highlighted Talk

Presenter: Carlos Errando-Herranz , *KTH Royal Institute of Technology*

Scaling up quantum optics experiments requires on-chip reconfigurable quantum photonics, but their integration with detectors is a challenge. We show microelectromechanical reconfiguration of photonic circuits with on-chip superconducting single-photon detectors and demonstrate key applications.

Authors: Samuel Gyger, KTH Royal Institute of Technology / Julien Zichi, KTH Royal Institute of Technology / Lucas Schweickert, KTH Royal Institute of Technology / Ali Elshaari, KTH Royal Institute of Technology / Stephan Steinhauer, KTH Royal Institute of Technology / Saimon Covre da Silva, Johannes Kepler University Linz / Armando Rastelli, Johannes Kepler University Linz / Val Zwiller, KTH Royal Institute of Technology / Klaus Jöns, KTH Royal Institute of Technology / Carlos Errando-Herranz, KTH Royal Institute of Technology

FW2P.4

Superconducting Nanowire Photon-Number-Resolving Detectors Integrated With Current Reservoirs and YTron Readouts

Presenter: Kai Zou , *Tianjin University*

We propose and design superconducting nanowire photon-number-resolving detectors integrated with current reservoirs and yTron readouts, which can resolve up to 11 photons with high fidelity.

Authors: Kai Zou, Tianjin University / Yun Meng, Tianjin University / Liang Xu, Tianjin University / Nan Hu, Tianjin University / Zhao Wang, Tianjin University / Xiaolong Hu, Tianjin University

FW2P.5

Quantum Detector Tomography of High-Dimensional Multiplexed Superconducting Detectors

Presenter: Timon Schapeler , *Paderborn University*

We demonstrate quantum detector tomography of three different multiplexed SNSPDs, including a nonlinear detector of dimension $>10^3$. We use this to extract efficiency, dark-count and cross-talk probability from just four elements of the reconstructed POVMs.

Authors: Timon Schapeler, Paderborn University / Jan Philipp Höpker, Paderborn University / Tim Bartley, Paderborn University

FW2P.6

Splitting Exceptional Points by Photon-Number Resolved Detection of Multi-Mode Coherent States

Presenter: Konrad Tschernig , *Max-Born-Institut Berlin*

We show theoretically that lossy waveguide systems exhibit exceptional points, whose order is enhanced by the photon number resolved detection of their coherent exceptional modes.

Authors: Konrad Tschernig, Max-Born-Institut Berlin / Armando Perez-Leija, Max-Born-Institut Berlin / Kurt Busch, Humboldt-Universität zu Berlin

FW2P.7

Robust Performance of Superconducting Nanowire Single Photon Detectors Under High Magnetic Fields

Presenter: Claire Marvinney, *Oak Ridge National Laboratory*

We characterize amorphous superconducting nanowire single photon detectors in magnetic fields of -6T to 6T, enabling integrated quantum devices. We report a substantial anomalous asymmetry in the field dependent response. © 2020 The Authors.

Authors: Claire Marvinney, Oak Ridge National Laboratory / Yun-Yi Pai, Oak Ridge National Laboratory / Matthew Feldman, Vanderbilt University / Brian Lerner, Oak Ridge National Laboratory / Jie Zhang, Oak Ridge National Laboratory / Aaron Miller, Quantum Opus, LLC / Benjamin Lawrie, Oak Ridge National Laboratory

FW2Q

Novel Spectroscopy Techniques Developed for Materials Research

Presenter: Matthew Day, *The University of Michigan*

FW2Q.1

Extremely Non-Adiabatic Switch-Off of Deep-Strong Light-Matter Coupling

Presenter: Joshua Mornhinweg, *University of Regensburg*

Switching off deep-strong light-matter coupling extremely non-adiabatically results in pronounced subcycle polarization oscillations. Our quantum model verifies that light-matter decoupling occurs more than an order of magnitude faster than the optical cycle duration.

Authors: Maike Halbhuber, University of Regensburg / Joshua Mornhinweg, University of Regensburg / Viola Zeller, University of Regensburg / Cristiano Ciuti, Université de Paris / Dominique Bougeard, University of Regensburg / Christoph Lange, University of Regensburg / Rupert Huber, University of Regensburg

FW2Q.2

Moiré Pattern of Interference Dislocations and Superfluidity in Condensate of Indirect Excitons

Presenter: Jason Leonard , *University of California at San Diego*

We present a new mechanism, the moiré effect, which leads to the appearance of dislocations in interference patterns. Remote interference dislocations in condensate of indirect excitons originate from the moiré effect and evidence exciton superfluidity.

Authors: Jason Leonard, University of California at San Diego / Lunhui Hu, University of California at San Diego / Alexander High, University of California at San Diego / Aeron Hammack, University of California at San Diego / Congjun Wu, University of California at San Diego / Leonid Butov, University of California at San Diego / Kenneth Campman, University of California Santa Barbara / Arthur Gossard, University of California Santa Barbara

FW2Q.3

Super-Linear Behavior of Exciton Emission in Electrically-Gated Two-Dimensional Material

Presenter: Zhen Wang , *Tsinghua University*

An abnormal super-linear (as opposed to typical linear) dependence of exciton emission intensity on pumping power was observed in an electrically-gated two-dimensional semiconductor, due to an exquisite interplay and mutual conversion between excitons and trions.

Authors: Zhen Wang, Tsinghua University / Hao Sun, Tsinghua University / Qiyao Zhang, Tsinghua University / Jianxing Zhang, Tsinghua University / Jialu Xu, Tsinghua University / Jiacheng Tang, Tsinghua University / Cun-Zheng Ning, Tsinghua University

FW2Q.5

Predicting 2D THz Spectra Due to Nonlinear Phononics With First-Principles Calculations

Presenter: Lauren Davis , *Brigham Young University*

We present our method for creating first-principles models of two-dimensional (2D) terahertz spectra in solid materials. We demonstrate the accuracy of these models and their exciting potential in the growing field of nonlinear phononics.

Authors: Lauren Davis, Brigham Young University / Brittany Knighton, Brigham Young University / Megan Nielson, Brigham Young University / Aldair Alejandro, Brigham Young University / Jeremy Johnson, Brigham Young University

FW2Q.6

Superradiant Cathodoluminescence

Presenter: Aliaksei Horlach , *Technion*

We find that laser-driven free-electrons can be coherently-shaped to induce superradiance from many-body quantum emitters. This effect provides new capabilities in electron microscopy&spectroscopy, using high spatio-temporal resolution for coherent control and enhancement of cathodoluminescence.

Authors: Ori Reinhardt, Technion / Aliaksei Horlach, Technion / Ido Kaminer, Technion

FW2Q.7

Single-Photon Radiative Auger Emission From a Quantum Dot

Presenter: Clemens Spinnler, *University of Basel*

We report radiative Auger emission from singly-charged semiconductor quantum dots. The red-shifted satellite peaks show a single-photon nature and allow to determine single-particle splittings. Photon statistics of the emission are used to investigate single-electron dynamics.

Authors: Clemens Spinnler, University of Basel / Matthias C. Löbl, University of Basel / Liang Zhai, University of Basel / Giang Nam Nguyen, University of Basel / Alisa Javadi, University of Basel / Julian Ritzmann, Ruhr-Universität Bochum / Leonardo Midolo, Niels Bohr Institute, University of Copenhagen / Peter Lodahl, Niels Bohr Institute, University of Copenhagen / Andreas Wieck, Ruhr-Universität Bochum / Arne Ludwig, Ruhr-Universität Bochum / Richard Warburton, University of Basel

FW2Q.4

(Withdrawn) Room-Temperature Exciton Polariton Condensate and Lattices in Halide Perovskite Microcavities

Invited

Presenter: Qihua Xiong, *Nanyang Technological University*

Abstract not available.

Authors: Qihua Xiong, Nanyang Technological University

FW2M

Topological Photonics II

Presider: Ksenia Dolgaleva, *University of Ottawa*

FW2M.1

Arbitrary Control and Direct Measurement of Topological Windings of a non-Hermitian Band

Highlighted Talk

Presenter: Kai Wang, *Stanford University*

We experimentally demonstrate controllable nontrivial complex-energy windings of a non-Hermitian band by implementing lattices in a frequency synthetic dimension using a modulated ring resonator and directly measure the complex band structures and winding numbers.

Authors: Kai Wang, Stanford University / Avik Dutt, Stanford University / Ki Yang, Stanford University / Casey Wojcik, Stanford University / Jelena Vuckovic, Stanford University / Shanhui Fan, Stanford University

FW2M.2

Floquet Harper-Hofstadter Butterflies and Non-Hermitian Phase Transition in Quasicrystals

Presenter: Sebastian Weidemann, *University of Rostock*

The non-Hermitian Aubry-André-Harper model exhibits a non-Hermitian phase transition that coincides with a localization transition. We provide a high-resolution measurement of the Butterfly spectrum and propose experiments to measure those transitions, using a photonic lattice.

Authors: Mark Kremer, University of Rostock / Sebastian Weidemann, University of Rostock / Stefano Longhi, Politecnico di Milano and Istituto di Fotonica e Nanotecnologie del Consiglio Nazionale delle Ricerche / Martin Wimmer, Friedrich Schiller University Jena / Ulf Peschel, Friedrich Schiller University Jena / Alexander Szameit, University of Rostock

FW2M.3

Nonlinear Topological Pumping With Photons

Presenter: Marius Juergensen, *Pennsylvania State University*

We theoretically propose and experimentally demonstrate quantized nonlinear Thouless pumping, despite non-uniform occupation of topological bands; the effect has no analogue in the linear domain. We observe the effect in arrays of coupled waveguides.

Authors: Marius Juergensen, Pennsylvania State University / Sebabrata Mukherjee, Pennsylvania State University / Mikael Rechtsman, Pennsylvania State University

FW2M.4

Photonic Topological Insulators Controlled by Nonlocal Nonlinearity in Synthetic Dimensions

Presenter: Liat Nemirovsky Levy, *Technion*

We study nonlinear effects in synthetic space photonic topological insulators. This nonlinearity is nonlocal in the synthetic dimensions. We study time-periodic solitons making a cyclotron-like motion in the synthetic space bulk.

Authors:Liat Nemirovsky Levy, Technion / Moshe-Ishay Cohen, Technion / Mordechai segev, Technion

FW2M.5

Two-Dimensional Floquet Topological Insulator With PT-Symmetry

Presenter: Alexander Fritzsche , *University of Würzburg*

We present a theoretical proposal for a two-dimensional PT-symmetric topological insulator (TI) that supports two counter-propagating topologically protected boundary states and discuss ongoing experiments to confirm the theoretical predictions.

Authors:Alexander Fritzsche, University of Würzburg / Mark Kremer, Universität Rostock / Lukas Maczewsky, Universität Rostock / Yogesh Joglekar, Indiana University-Purdue University Indianapolis (IUPUI) / Matthias Heinrich, Universität Rostock / Ronny Thomale, University of Würzburg / Alexander Szameit, Universität Rostock

FW2M.6

Anomalous Floquet Thouless Pumping

Presenter: Yiming Pan , *Technion*

Here, we report a non-adiabatic topological pumping that can adiabatically manipulate non-adiabatic Floquet topological states in periodically-driven systems. We propose and demonstrate in waveguide array simulations Thouless-like topological pumping of non-adiabatic topological systems

Authors:Yiming Pan, Technion / Alex Dikopol'tsev, Technion / Eran Lustig, Technion / qingqing cheng, University of Shanghai for Science and Technology / Mordechai segev, Technion

FW2M.7

Dynamical Topological Phase Transitions in Nonlinear Su-Schrieffer-Heeger Lattices via Soliton Interactions

Presenter: domenico bongiovanni , *Nankai University*

We demonstrate dynamical topological phase transitions entirely driven by nonlinearity, which constitute an example of emergent nonlinear topological phenomena. These transitions in our system occur due to soliton interactions forming Su-Schrieffer-Heeger lattices.

Authors:domenico bongiovanni, Nankai University / Dario Jukić, University of Zagreb / Zhichan Hu, Nankai University / Frane Lunic, University of Zagreb / yi Hu, Nankai University / Daohong Song, Nankai University / Roberto Morandotti, INRS / Zhigang Chen, Nankai University / Hrvoje Buljan, Nankai University

FW2L

Nonlinear Photonics I

Presider: Tobias Herr , *Center for Free-Electron Laser Science*

FW2L.1

Non-Linear "Thermal Ratchet" for Light

Presenter: Moshe-Ishay Cohen , *Technion Israel Institute of Technology*

We show that non-local nonlinearity can induce a preferred direction for the flow of random photonic wavepackets even in periodic structures. The phenomenon is nonlinear hence the directional transport depends on the optical power.

Authors: Moshe-Ishay Cohen, Technion Israel Institute of Technology / Yonatan Sharabi, Technion Israel Institute of Technology / Yaakov Lumer, Technion Israel Institute of Technology / Mordechai segev, Technion Israel Institute of Technology

FW2L.2

Collective Dynamics in Nonlinear Resonators Coupled in Spatial and Synthetic Dimensions

Presenter: Aleksandr Tushin , *EPFL*

We theoretically investigate chaotic and stable structures in coupled-resonator chains and synthetic frequency dimension influenced by Kerr nonlinearity, thereby bringing insights in the emerging field of soliton generation in chains and lattices of high-Q resonators.

Authors: Aleksandr Tushin, EPFL / Alexey Tikan, EPFL / Tobias Kippenberg, EPFL

FW2L.3

Non-Linear Response of CdSe/CdS Quantum Dots Driven by Intense Terahertz Pulses

Presenter: Claudia Gollner , *TU Wien*

We report on the observation of quantum confined stark effect (QCSE) in CdSe/CdS core/shell quantum dots (QDs) directly driven by an intense THz field, generated in the organic crystal DAST, which is pumped with multi-millijoule mid-IR pulses.

Authors: Claudia Gollner, TU Wien / Rokas Jutas, TU Wien / Dmitry Dirin, Institute of Inorganic Chemistry, ETH Zurich / Simon Boehme, Institute of Inorganic Chemistry, ETH Zurich / Andrius Baltuska, TU Wien / Maksym Kovalenko, Institute of Inorganic Chemistry, ETH Zurich / Audrius Pugzlys, TU Wien

FW2L.4

Formation Dynamics and Snapshots of Self-Injection-Locking Dark Solitons

Presenter: Boqiang Shen , *California Institute of Technology*

We propose a model for understanding dark solitons formation dynamics in self-injection-locking laser-resonator systems using dynamical instabilities and domain walls. Snapshots of solitons are captured with dual-comb imaging techniques and validate the model.

Authors:Heming Wang, California Institute of Technology / Boqiang Shen, California Institute of Technology / Chengying Bao, California Institute of Technology / Warren Jin, University of California Santa Barbara / Lin Chang, University of California Santa Barbara / Mark Leal, University of California Santa Barbara / Avi Feshali, Anello Photonics / Mario Paniccia, Anello Photonics / John Bowers, University of California Santa Barbara / Kerry Vahala, California Institute of Technology

FW2L.5

Real-Time Imaging of Surface Waves With Nonlinear Near-Field Optical Microscopy

Presenter: jacob FR , *Technion*

We introduce nonlinear near-field optical microscopy (NNOM), capable of real-time evanescent wave imaging by nonlinear wave mixing. Using NNOM, we exhibit phase-resolved polarization- and spin-sensitive near-field mappings of plasmonic patterns using only standard optical components

Authors:jacob FR, Technion / Kobi Cohen, Technion / Jacob Kher-aldeen, Technion / Shimon Dolev, Technion / Shai Tsesses, Technion / Guy Bartal, Technion

FW2L.6

Mid-IR Supercontinua in Dispersion-Engineered as_2S_3 -Silica Nanospire Waveguides Pumped by fs Pulses at 2.8 μm

Presenter: Pan Wang , *MaxPlanck Institute for Science of Light*

We report generation of coherent octave-spanning mid-infrared supercontinua in As_2S_3 -silica waveguides pumped by a custom-built 2.8 μm femtosecond fiber laser. The fabricated hybrid waveguides are demonstrated to be long-term stable and water-resistant.

Authors:Pan Wang, MaxPlanck Institute for Science of Light / Jiapeng Huang, MaxPlanck Institute for Science of Light / Shangran Xie, MaxPlanck Institute for Science of Light / Johann Troles, Université de Rennes I, Sciences Chimiques de Rennes / Philip Russell, MaxPlanck Institute for Science of Light

FW2L.7

Establishing a Rigorous Relation Between Thermodynamic and Electrodynamic Pressures in Highly Multimoded Nonlinear Dielectric

Waveguides

Presenter: Huizhong Ren , *CREOL, University of Central Florida*

We present a new scaling law that relates the thermodynamic pressure with the electrodynamic forces in multimode nonlinear dielectric waveguides. Our results are in exact agreement with those obtained using the Maxwell stress tensor formalism.

Authors: Huizhong Ren, CREOL, University of Central Florida / Fan Wu, CREOL, University of Central Florida / Pawel Jung, CREOL, University of Central Florida / Nikolaos Efremidis, University of Crete / Mercedeh Khajavikhan, University of Southern California / Demetrios Christodoulides, CREOL, University of Central Florida

FW2L.8

Thermalization of Orbital Angular Momentum in Highly Multimoded Nonlinear Optical Fibers

Presenter: Fan Wu , *University of Central Florida*

We demonstrate that, due to nonlinear interactions, the orbital angular momentum in a multimode optical fiber can reach a thermal equilibrium state that is characterized by a temperature and a generalized Rayleigh-Jeans distribution.

Authors: Fan Wu, University of Central Florida / QI ZHONG, University of Central Florida / Huizhong Ren, University of Central Florida / Pawel Jung, University of Central Florida / Mercedeh Khajavikhan, University of Southern California / Demetrios Christodoulides, University of Central Florida

FW2N

Nanophotonic Platforms for Light Manipulation

Presenter: Giulia Tagliabue , *Rcole Polytechnique Federale de Lausanne*

FW2N.1

Gradient Index Subsurface Micro-Optics

Invited

Presenter: Lynford Goddard , *Univ of Illinois at Urbana-Champaign*

We present an overview of a new method to print 3D volumetric gradient index (GRIN) micro-optics inside a porous silica scaffold and show results for the focusing properties of an array of cylindrical GRIN lenses.

Authors:Alexander Littlefield, Univ of Illinois at Urbana-Champaign / Corey Richards, Univ of Illinois at Urbana-Champaign / Christian Ocier, Univ of Illinois at Urbana-Champaign / Dajie Xie, Univ of Illinois at Urbana-Champaign / Haibo Gao, Univ of Illinois at Urbana-Champaign / Paul Braun, Univ of Illinois at Urbana-Champaign / Lynford Goddard, Univ of Illinois at Urbana-Champaign

FW2N.2

High Performance Silicon Flat Optics at Visible Wavelengths

Presenter: Arturo Burguete Lopez , *King Abdullah Univ of Sci & Technology*

We present a platform for the design of high efficiency flat optics. Experimentally, we show common components such as polarizers, dichroics, and color filters with over 99% efficiency in the visible in 50nm of silicon.

Authors:Arturo Burguete Lopez, King Abdullah Univ of Sci & Technology / Maksim Makarenko, King Abdullah Univ of Sci & Technology / Fedor Getman, King Abdullah Univ of Sci & Technology / Andrea Fratalocchi, King Abdullah Univ of Sci & Technology

FW2N.3

All-Optically Controlled Active Liquid-Crystal Plasmonic Metasurface Platform

Presenter: Mukesh Sharma , *Tel Aviv University*

We experimentally demonstrate all optically-controlled active liquid crystal (LC) plasmonic metasurface platform, based on laser induced nematic to isotropic (*N-I*) phase transition, which enables polarization switching in twisted NLC layer that controls the color of transmitted and reflected light.

Authors:Mukesh Sharma, Tel Aviv University / Tal Ellenbogen, Tel Aviv University

FW2N.4

Nanoelectromechanical Tuning of Dual-Mode Resonant Metasurfaces

Presenter: Tianzhe Zheng , *California Institute of Technology*

We demonstrate nanoelectromechanical tuning of dual-mode resonant dielectric metasurfaces. The devices achieve intensity modulation over 40%, >10kHz speed, and 144° phase shift with 7V bias voltage.

Authors:Tianzhe Zheng, California Institute of Technology / Hyounghan Kwon, California Institute of Technology / Andrei Faraon, California Institute of Technology

FW2N.5

Controlling All-Optical Switching Speeds in an Epsilon-Near-Zero Enhanced Metasurface

Presenter: Soham Saha , *Purdue University*

We propose a novel approach to control the speed of all-optical switches. In an epsilon-near-zero-metasurface comprising materials with *picosecond*- and *nanosecond*-switching-timescales, the switching-speed is controlled by the material interacting more strongly with the probe.

Authors: Soham Saha, Purdue University / Benjamin Diroll, Argonne National Laboratory / Sarah Chowdhury, Purdue University / Alexander Kildishev, Purdue University / Richard Schaller, Argonne National Laboratory / Vladimir Shalaev, Purdue University / Zubin Jacob, Purdue University / Alexandra Boltasseva, Purdue University

FW2N.6

Phase Tuning of Huygens Metasurfaces by Optical Anisotropy

Presenter: Ziwei Yang , *Australian National University*

We demonstrate phase-only tuning of optical metasurfaces in the full 2π -range by controlling the optical anisotropy of their surroundings. The concept is exemplified in a liquid crystal infiltrated metasurface tuned by the temperature and bias-voltage.

Authors: Ziwei Yang, Australian National University / Mingkai Liu, Australian National University / Andrei Komar, Australian National University / Lei Xu, Australian National University / Dragomir Neshev, Australian National University

FW2N.7

Reconfigurable Unpatterned Metasurfaces via Acoustoelectric Gating of Graphene

Presenter: Amun Jarzembski , *Sandia National Laboratories*

Electric fields in a surface acoustic wave in a piezoelectric substrate can pattern charge in an adjacent graphene film via the acousto-electric effect and thus reconfigure the optical transmission in an unpatterned graphene metasurface.

Authors: Aleem Siddiqui, Sandia National Laboratories / Amun Jarzembski, Sandia National Laboratories / Michael Goldflam, Sandia National Laboratories / Thomas Beecham, Sandia National Laboratories

FW2O

Metamaterials

Presenter: Arka Majumdar , *University of Washington*

FW20.1**Terahertz Emission From Ultrafast Time-Varying Metamaterials**

Presenter: Juan Sebastian Toterogongora, *University of Sussex*

We demonstrate a time-dependent dielectric metasurface with sub-cycle dynamics coupled with a photoexcited electromagnetic source. The ultrafast photoexcitation of nanostructured Silicon acts as a temporal discontinuity affecting the nonlinear response responsible for terahertz emission.

Authors: Jacob Tunesi, University of Sussex / Luke Peters, University of Sussex / Juan Sebastian Toterogongora, University of Sussex / Luana Olivieri, University of Sussex / Andrea Fratolocchi, King Abdullah University of Science and Technology / Alessia Pasquazi, University of Sussex / Marco Peccianti, University of Sussex

FW20.2**Optical N -Invariant of Graphene's Viscous Hall Fluid**

Presenter: Todd Van Mechelen, *Purdue University*

We introduce a new topological classification of two-dimensional matter related to its optical properties. Graphene's viscous Hall fluid is the first candidate of this topological electromagnetic phase of matter with the underlying physical mechanism being Hall viscosity.

Authors: Todd Van Mechelen, Purdue University / Wenbo Sun, Purdue University / Zubin Jacob, Purdue University

FW20.3**Giant Electrogyration in a Nanomechanical Metamaterial**

Presenter: Eric Plum, *University of Southampton*

Electrogyration is electric-field-dependent polarization state rotation in chiral media. We demonstrate a metamaterial with a quadratic electrogyration constant of 7.8×10^{-14} rad m² V⁻², which is a million times stronger than in natural materials.

Authors: Qiang Zhang, University of Southampton / Eric Plum, University of Southampton / Jun-Yu Ou, University of Southampton / Hailong Pi, University of Southampton / Junqing Li, Harbin Institute of Technology / Kevin MacDonald, University of Southampton / Nikolay Zheludev, University of Southampton

FW20.4**Ultra-Strongly-Coupled Long-Range, Low-Loss Polaritonic Modes in Gold and Indium Tin Oxide Bi-Films at NIR Frequencies**

Presenter: Saumya Choudhary, *University of Rochester*

We demonstrate that ultra-strongly coupled SPP and ENZ modes in gold and indium tin oxide bi-films are strongly confined, can propagate for several microns, and offer a useful platform for nanophotonics at NIR frequencies.

Authors: Saumya Choudhary, University of Rochester / Saleem Iqbal, University of Rochester / Orad Reshef, University of Ottawa / Mohammad Karimi, University of Ottawa / Zahirul Alam, University of Ottawa / Robert Boyd, University of Rochester

FW20.5

Towards Strong-Coupling Regime in Singular Site-Controlled InGaAs Quantum Dots-Nanocavities

Presenter: Wei Liu , *University of California, Los Angeles, California*

We demonstrate the cavity quantum electrodynamics towards strong-coupling regime mediated by cavity loss and exciton pure dephasing in singular site-controlled quantum dot-nanocavity system, studied by micro-photoluminescence (μ -PL) and time-resolved PL (TRPL).

Authors: Wei Liu, University of California, Los Angeles, California / Jiahui Huang, University of California, Los Angeles, California / Alessio Miranda, École Polytechnique Fédérale de Lausanne, Lausanne / Benjamin Dwir, École Polytechnique Fédérale de Lausanne, Lausanne / Alok Rudra, École Polytechnique Fédérale de Lausanne, Lausanne / Elyahou Kapon, École Polytechnique Fédérale de Lausanne, Lausanne / Chee Wei Wong, University of California, Los Angeles, California

FW20.6

Strong Coupling in a Self-Coupled Terahertz Photonic Crystal

Presenter: Maria Kaeek , *Tel-Aviv University*

We demonstrate and study experimentally strong coupling in a monolithic, 1D terahertz photonic crystal, in which the guided modes are strongly coupled with the vibrational excitation of the organic material comprising the photonic structure.

Authors: Maria Kaeek, Tel-Aviv University / Ran Damari, Tel-Aviv University / Sharly Fleischer, Tel-Aviv University / Tal Schwartz, Tel-Aviv University

FW20.7

Second-Harmonic Generation Enhancement Through Stretching in Patterned Arrays of GaAs Nanowires

Presenter: Gregoire Saerens , *ETH Zürich*

Active tuning of the second-harmonic in patterned arrays of GaAs nanowires is presented. Experimental measurements for a 30% stretchable sample including size's distribution correlate with simulations. We obtained 2.2 times nonlinear enhancement.

Authors:Gregoire Saerens, ETH Zürich / Esther Bloch, ETH Zürich / kristina Frizyuk, ITMO university / Viola Valentina Neuling, ETH Zürich / Elizaveta Semenova, DTU Fotonik / Elizaveta Lebedkina, DTU Fotonik / Mihail Petrov, ITMO university / Rachel Grange, ETH Zürich / Maria Timofeeva, ETH Zürich

FW20.8

Halide Perovskite Metamaterial Directional Emitter

Presenter: Yixin Chen , *Texas A&M University*

We propose an integrated perovskite metamaterial that enables wavefront control of the light emitted from halide perovskites. Through the incorporation of dielectric metasurface and Bragg cavity, we experimentally show directional emission from $\text{CH}_3\text{NH}_3\text{PbI}_3$ (MAPbI₃) perovskites.

Authors:Yixin Chen, Texas A&M University / Jinze Cai, Texas A&M University / Xuezhi Ma, Texas A&M University / Shoufeng Lan, Texas A&M University / Zi Jing Wong, Texas A&M University

AW2T

Advanced Optical Imaging of Cancer

Presenter: Rupsa Datta , *Morgridge Institute for Research, Univer*

AW2T.1

Confocal Visible/NIR Photoacoustic Microscopy of Early-Stage Tumor With Structural, Functional and Nanoprobe Contrasts

Presenter: Jiangbo CHEN , *City University of Hong Kong*

We report fiber-based confocal visible/near-infrared optical-resolution photoacoustic microscopy that can image tumor microvasculature, oxygen saturation, and nanoprobe in a single scanning. It offers a new tool for early detection of tumors with multiple contrast modes.

Authors:Jiangbo CHEN, City University of Hong Kong / Yachao Zhang, City University of Hong Kong / Xiaozhen Li, City University of Hong Kong / Jingyi Zhu, City University of Hong Kong / Dengfeng Li, City University of Hong Kong / Shengliang Li, City University of Hong Kong / Chun-Sing Lee, City University of Hong Kong / Lidai Wang, City University of Hong Kong

AW2T.2

Near Infrared Photoimmunotherapy of Cancer

Presenter: Hisataka Kobayashi , *National Institutes of Health*

Near infrared photoimmunotherapy (NIR-PIT) is a targeted cancer photo-therapy based on antibody-photoabsorber (IR700) conjugates. By crashing cancer cells combined with innate and/or adjuvant immune-activation, NIR-PIT activates anti-cancer immunity resulted in curing local and metastatic cancers.

Authors:Hisataka Kobayashi, National Institutes of Health

AW2T.3

Emerging Advances in Reflectance Confocal Microscopy of Skin Cancers: Machine Learning-Based Image Analysis, Imaging-Guided Laser Ablation

Invited

Presenter: Milind Rajadhyaksha , *Memorial Sloan Kettering Cancer Center*

Reflectance confocal microscopy noninvasively detects skin cancers. Image acquisition, reading and analysis can be standardized and automated with machine learning-based algorithms. Diagnosis can be combined with laser ablation for an imaging-guided integrated diagnosis-and-treatment approach.

Authors:Milind Rajadhyaksha, Memorial Sloan Kettering Cancer Center

AW2T.4

Intracellular Doppler Spectroscopy and Deep Learning for Personalized Cancer Care

Presenter: David Nolte , *Purdue University*

Doppler infrared spectroscopy of intracellular dynamics in living tumor tissue predicts patient response to chemotherapy. This work presents the first use of digital holography and deep learning in a clinical setting for cancer therapy assessment.

Authors:David Nolte, Purdue University / Ran An, Animated Dynamics, Inc.

AW2T.5

Classifying Breast Cancer Cell Lines of Different Metastasis Potentials Using Visible Resonance Raman Spectroscopy and Machine Learning

Presenter: Binlin Wu , *Southern Connecticut State University*

We classified breast cancer cell lines of different metastatic potentials using visible resonance Raman spectroscopy, principal component analysis, and support vector machines. Cross validated classification accuracies of over 78% were achieved.

Authors:Binlin Wu, Southern Connecticut State University / Lin Zhang, College College of New York / Kenneth Jimenez, Southern Connecticut State University / Susie Boydston-White, Borough of Manhattan Community College / Eric Wang, Amity Regional High School / Cheng-hui Liu, College College of New York / Robert Alfano, College College of New York

AW2T.6

Improved Visualization of Brain Tumors With Innovative Fluorescence-Based Techniques

Invited

Presenter: Georg Widhalm , *Medical University of Vienna*

To be provided

Authors:Georg Widhalm, Medical University of Vienna

AW2S

Atmospheric and Gas Sensing

Presenter: Matthew Simons , *NIST*

AW2S.1

Field Deployment of a Multi-Pass Cell Based mid-IR Quantum Cascade Laser Dual-Comb Spectrometer

Presenter: JIE LIU , *Princeton University*

We present a recent field deployment of a mid-IR quantum cascade laser dual-comb spectroscopic extractive sensing system equipped with a 76m multi-pass cell. We report system capability in monitoring and localizing multiple gas emission sources.

Authors:JIE LIU, Princeton University / Chu Teng, Princeton University / Yifeng Chen, Princeton University / Charles Patrick, Princeton University / Jonas Westberg, Princeton University / Gerard Wysocki, Princeton University

AW2S.2

Gas Cell Based on Segmented Hollow-Core Photonic Crystal Fiber and its Application in an Intracavity Absorption Spectroscopy System

Presenter: Joshua Trevisanutto , *Lakehead University*

A gas cell was developed by segmenting Hollow-Core Photonic Crystal Fiber, which increased the rate at which gas could be exchanged and allowed the cell to be used in an Intra Cavity Absorption Spectroscopic system.

Authors:Gautam Das, Lakehead University / Joshua Trevisanutto, Lakehead University

AW2S.3

(Withdrawn) Analyzing Multiple Gases in a Mixture via Metamaterial Enabled Narrowband Pyroelectric Detectors

Presenter: Xiaochao Tan , *Huazhong Univ. of Science and Technology*

We demonstrated a multiplexed non-dispersive infrared (NDIR) gas sensing platform that can deduce the concentrations of multiple gases in a mixture based on the measured responses of metamaterial absorber enabled narrowband pyroelectric detectors.

Authors:Xiaochao Tan, Huazhong Univ. of Science and Technology / Heng Zhang, Huazhong Univ. of Science and Technology / Junyu Li, Huazhong Univ. of Science and Technology / Haowei Wan, Huazhong Univ. of Science and Technology / Qiushi Guo, Yale University / Houbin Zhu, Shandong University / Huan Liu, Huazhong Univ. of Science and Technology / Fei Yi, Huazhong Univ. of Science and Technology

AW2S.4

Optimized D-DFB Laser Diodes for the Detection of Trace Gases in the MIR Region

Presenter: Morten Hoppe , *Sacher Lasertechnik GmbH*

An optimized D-DFB design is presented, which guarantees the best possible performance in the range from 1.9 μm to 4.5 μm . Results for the performance and its suitability for detecting trace gases are shown.

Authors:Morten Hoppe, Sacher Lasertechnik GmbH / Christian Aßmann, Sacher Lasertechnik GmbH / Sebastian Schmidtmann, Sensor Photonics GmbH / Martin Honsberg, Sensor Photonics GmbH / Tobias Milde, Sacher Lasertechnik GmbH / Joachim Sacher, Sacher Lasertechnik GmbH

AW2S.5

Atmospheric Carbon Dioxide Absorption Measurement Using Integrated Lithium Niobate Nanophotonics

Presenter: Jiuyi Zhang , *Stevens Institute of Technology*

We use photon counting and a sweeping high-Q microring on chip to obtain the atmospheric carbon dioxide absorption spectrum around 1572.022 nm.

Authors:Jiuyi Zhang, Stevens Institute of Technology / Yong Meng Sua, Stevens Institute of Technology / Jiayang Chen, Stevens Institute of Technology / Jeevanandha Ramanathan, Stevens Institute of Technology / Chao Tang, Stevens Institute of Technology / Yongxiang Hu, NASA Langley Research Center / Yu-Ping Huang, Stevens Institute of Technology

AW2S.6

Infrared Laser-Induced Fluorescence With a Continuous-Wave Optical Parametric Oscillator

Presenter: Garrett Mathews , *Purdue University*

A continuous-wave optical parametric oscillator was used to produce spectrally resolved, infrared laser-induced fluorescence (IR-LIF) signals of CO₂ in a heated jet. Spatially resolved temperature measurements were obtained by spectral fitting to the IR-LIF signals.

Authors: Garrett Mathews, Purdue University / Joshua Stiborek, Purdue University / Christopher Goldenstein, Purdue University

AW2S.7

(Withdrawn) Characterization of the Laser-Induced Ignition Process in Space Propulsion

Presenter: Robert Stützer , *German Aerospace Center*

A research rocket combustor was ignited using a focused beam of a Q-switched laser system. The optical emission of the plasma discharge revealed crucial propellant properties and allowed insights into the ignition process.

Authors: Robert Stützer, German Aerospace Center

AW2S.8

Multi-Species Measurements During Shock Heated Hydrocarbon Pyrolysis With a Broadband mid-IR OPO

Presenter: Robert Greene , *University of Central Florida*

Multi-species measurements during shock heated hydrocarbon pyrolysis with a broadband mid-IR OPO

Authors: Robert Greene, University of Central Florida / Jessica Baker, University of Central Florida / Erik Ninnemann, University of Central Florida / Konstantin Vodopyanov, University of Central Florida / Subith Vasu, University of Central Florida

SW2A

UV and Visible Lasers

Presenter: Jing Zhang , *Rochester Institute of Technology*

SW2A.1

Passively Mode Locked 265 nm VECSEL Utilizing All-Intracavity Harmonic Generation

Presenter: Jason Meyer , *University of Arizona*

We present the results of an ultrafast 265 nm passively mode locked VECSEL utilizing two stage intracavity second harmonic generation. This novel design enhances the UV lasing output power without active stabilization.

Authors: Jason Meyer, University of Arizona / Michal Lukowski, University of Arizona / Chris Hassenius, University of Arizona / Ewan Wright, University of Arizona / Mahmoud Fallahi, University of Arizona

SW2A.2

Low Divergence Dual-Grating Distributed Feedback Lasers Operating at 1.0 μm

Presenter: Lianping Hou, *University of Glasgow*

A 1.0 μm laterally-coupled dual-wavelength distributed feedback laser is reported, with a frequency separation of 1.1 THz and near-circular output beam with small divergence angle of 20.6° (H) \times 22.8° (V).

Authors: Bin Hou, University of Glasgow / Shengwei ye, University of Glasgow / Song Liang, Institute of Semiconductors / John Marsh, University of Glasgow / Lianping Hou, University of Glasgow

SW2A.3

Deep UV Laser Diode With Compositionally Graded AlGaIn p-Cladding

Invited

Presenter: Maki Kushimoto, *Nagoya University*

We report on the challenges in the development of UV-C laser diodes on AlN substrates and their device characteristics. The key technology to realize is p-type conductivity control by using polarization doping.

Authors: Maki Kushimoto, Nagoya University / Ziyi Zhang, Asahi Kasei Corporation / Naoharu Sugiyama, Nagoya University / Leo Schowalter, Crystal IS Inc. / Yoshio Honda, Nagoya University / Chiaki Sasaoka, Nagoya University / Hiroshi Amano, Nagoya University

SW2A.4

Ultrawide Bandgap Semiconductors – From Materials to Technologies

Tutorial

Presenter: Nelson Tansu, *Lehigh University*

The paper will review the basics of III-Nitride semiconductor technologies. The advances in foundational technologies addressing microdisplay and deep UV photonics will be presented. Emerging ultrawide bandgap materials and the use of AI in material design will be discussed.

Authors: Nelson Tansu, Lehigh University

SW2R

Nonlinear Optical Phenomena at High Laser Intensities

Presenter: Jeremy Pigeon , *UCLA*

SW2R.1

Terahertz Emissions by Plasmas Created From Moderate to Relativistic Laser Intensities

Tutorial

Presenter: Luc Berge , *Commissariat a l'Energie Atomique*

While the energy of terahertz pulses produced by classical plasmas is limited to a few microjoules, it can reach the millijoule level at relativistic laser intensities. We review the main conversion mechanisms and current applications.

Authors: Luc Berge, Commissariat a l'Energie Atomique

SW2R.2

Generation of High Power Two-Color 10 μm and 5 μm Picosecond Pulses in Nonlinear Crystals

Presenter: Daniel Matteo , *University of California Los Angeles*

We report efficient second harmonic generation of picosecond CO₂ laser pulses at intensities up to 50 GW/cm² in GaSe, AgGaSe₂, CdGeAs₂, and Te. External energy conversion efficiency can reach 20% in AgGaSe₂.

Authors: Daniel Matteo, University of California Los Angeles / Eric Welch, University of California Los Angeles / Sergei Tochitsky, University of California Los Angeles / Peter Schunemann, BAE Systems / Shekhar Guha, Air Force Research Laboratory / Chan Joshi, University of California Los Angeles

SW2R.3

Nonlinear Pulse Compression in Double-Pass Multiple Plate Compression

Presenter: Chih-Hsuan Lu , *National Tsing Hua University*

A new double-pass multiple plate compression (DPMPC) scheme is first demonstrated, compressing the pulse from 190 fs to 17.8 fs with 57 % throughput and good beam quality.

Authors: Jia-Xuan Su, National Tsing Hua University / Bo-Han Chen, National Tsing Hua University / Jhan-Yu Guo, National Tsing Hua University / Kai Chen, Victoria university of wellington / Shang-da Yang, National Tsing Hua University / Chih-Hsuan Lu, National Tsing Hua University

SW2R.4

Guiding of Laser Pulses at the Theoretical Limit – 97% Throughput Hollow-Core Fibers

Presenter: Bruno Schmidt , *few-cycle Inc*

We describe a compact, 1-m-long, hollow-core fiber (HCF) with 97.4% transmission. 1 mJ, 170fs pulses are compressed to 25fs with 92% total efficiency, energy stability of 0.6% RMS and an M^2 parameter of about 1.05

Authors: Young-Gyun Jeong, INRS-EMT / Riccardo Piccoli, INRS-EMT / Andrea Rovere, INRS-EMT / Luca Zanutto, INRS-EMT / Gabriel Tempea, few-cycle Inc / Derrek Wilson, few-cycle Inc / Maksim Ivanov, few-cycle Inc / Alicia Ramirez, few-cycle Inc / Roberto Morandotti, INRS-EMT / François Légaré, INRS-EMT / Luca Razzari, INRS-EMT / Bruno Schmidt, few-cycle Inc

SW2R.5

Broadly Tunable Watt-Level Source of Few-Cycle Mid-Infrared Pulses Based on Yb-Doped Laser and Two-Channel Parametric Amplifier

Presenter: Rimantas Budriunas , *Light Conversion*

We present a twin optical parametric amplifier setup for generating broadly tunable mid-IR pulses. Sub-60fs pulses are demonstrated throughout 2.5-10 μ m tuning range. Output power >1 W at 3.5 μ m and >450 mW at 10 μ m is achieved with an 80W pump laser operating at 400kHz or 50kHz repetition rate.

Authors: Rimantas Budriunas, Light Conversion / Karolis Jurkus, Light Conversion / Arūnas Varanavičius, Vilnius University Laser Research Center

SW2H

Microresonators and Microcombs

Presenter: Reza Salem , *Thorlabs Inc*

SW2H.1

Gain-Switched Semiconductor Laser Driven Soliton Microcombs

Presenter: Wenle Weng , *Ecole Polytechnique Federale de Lausanne*

Using phase-engineered coherent laser pulses produced by gain-switched semiconductor lasers, we generate low-power-threshold soliton microcombs whose repetition frequencies are in the X-band and K-band microwave ranges.

Authors:Wenle Weng, Ecole Polytechnique Federale de Lausanne / Aleksandra Kaszubowska-Anandarajah, Trinity College Dublin / Jijun He, Ecole Polytechnique Federale de Lausanne / Prajwal Lakshmijayasimha, Dublin City University / Erwan Lucas, Ecole Polytechnique Federale de Lausanne / Junqiu Liu, Ecole Polytechnique Federale de Lausanne / Prince Anandarajah, Dublin City University / Tobias Kippenberg, Ecole Polytechnique Federale de Lausanne

SW2H.2

a Method for Increasing Thermal Stability of Short-Living Solitons in Silicon Nitride Microresonators

Presenter: Federico Sabattoli , *University of Pavia*

We exploit orthogonally polarized resonant modes to achieve thermal equilibrium for Kerr soliton generation in Si₃N₄ microrings. The improved thermal stability allows for soliton mode-locking simply by slow wavelength tuning or thermoelectric cooling.

Authors:Davide Grassani, University of Pavia / Federico Sabattoli, University of Pavia / Houssein El Dirani, STMicroelectronics / Laurène Youssef, Université Grenoble Alpes / Camille Petit-Etienne, Université Grenoble Alpes / Sébastien Kerdiles, Université Grenoble Alpes / Erwine Pargon, Université Grenoble Alpes / Marco Liscidini, University of Pavia / Corrado Sciancalepore, SOITEC / Daniele Bajoni, University of Pavia / Matteo Galli, University of Pavia

SW2H.3

Synchronization of Normal-GVD Kerr Combs

Presenter: Bok Young Kim , *Columbia University*

We demonstrate all-optical synchronization of Kerr combs in the normal group-velocity dispersion regime. Our results reveal the universality of Kerr comb synchronization and extend its scope beyond soliton modelocking.

Authors:Bok Young Kim, Columbia University / Jae Jang, Columbia University / Yoshitomo Okawachi, Columbia University / Xingchen Ji, Columbia University / Michal Lipson, Columbia University / Alexander Gaeta, Columbia University

SW2H.4

Subharmonic Synchronization of Soliton Microcomb Breathing Oscillations to Periodic Forces

Presenter: Jordan Stone , *NIST*

We show how soliton microcomb breathing oscillations synchronize to either the soliton repetition rate or to applied pump-laser phase modulation. In experiments, we observe locking ratios up to $N = 8$.

Authors: Jordan Stone, NIST / Jennifer Black, NIST / Scott Papp, NIST

SW2H.5

PhoXonic Whispering Gallery Mode Resonators: Parametrical Optomechanic Oscillations and its Applications

Invited

Presenter: Silvia Soria , *Ist di Fisica Applicata Nello Carrara*

We report on the experimental analysis of parametrical optomechanical oscillations and photoacoustical applications such as flow cytometers in hollow phoxonic whispering gallery mode resonators. Both phenomena can be enhanced or suppressed and showed chaotic behavior

Authors: Xavier Rosello -Mecho, University de Valencia / Gabriele Frigenti, Ist di Fisica Applicata Nello Carrara / Daniele Farnesi, Ist di Fisica Applicata Nello Carrara / Martina Delgado-Pinar, University de Valencia / Miguel V. Andres, University de Valencia / Giancarlo Righini, Ist di Fisica Applicata Nello Carrara / Gualtiero Nunzi Conti, Ist di Fisica Applicata Nello Carrara / Silvia Soria, Ist di Fisica Applicata Nello Carrara

SW2H.6

Zero-Dispersion Soliton Generation in a High-Q Fiber Fabry-Pérot Microresonator

Presenter: Zeyu Xiao , *Shanghai Jiao Tong University*

The zero-dispersion soliton is generated in a fiber FP microresonator with a Q factor of 10^7 . Its spectrum ranges from 1240 nm to 1700 nm with more than 6,286 comb lines in 40-dB power range.

Authors: Zeyu Xiao, Shanghai Jiao Tong University / Tieying Li, Shanghai Jiao Tong University / Minglu Cai, Shanghai Jiao Tong University / Hongyi Zhang, Shanghai Jiao Tong University / Yi Huang, Shanghai Jiao Tong University / Kan Wu, Shanghai Jiao Tong University / Jianping Chen, Shanghai Jiao Tong University

SW2H.7

Optical Dual-Comb Vernier Division of an Octave-Spanning Kerr Microcomb

Presenter: Nathan O'Malley , *Purdue University*

We measure the repetition rate of a 900 GHz octave-spanning soliton microcomb based on Vernier dual-comb frequency division implemented with two silicon nitride microresonator combs fabricated on the same wafer.

Authors: Mohammed Al Alshaykh, Purdue University / Cong Wang, Purdue University / Nathan O'Malley, Purdue University / Zhichao Ye, Chalmers University of Technology / Abdullah Al Noman, Purdue University / Daniel Leaird, Purdue University / Minghao Qi, Purdue University / Victor Torres-Company, Chalmers University of Technology / Andrew Weiner, Purdue University

SW2K

Terahertz Near-field Imaging and Field Confinement

Presenter: Pernille Klarskov Pedersen , *Aarhus Universitet*

SW2K.1

Terahertz Light Sources by Electronic-Oscillator-Driven Second Harmonic Generation in Extreme-Confinement Cavities

Presenter: Lamia Ateshian , *Massachusetts Institute of Technology*

We propose a coherent THz source by efficient, cascaded second harmonic generation from electronic oscillators. We introduce hybrid dielectric cavity designs combining extreme field concentration in high-Q resonators with phonon-resonance-enhanced nonlinear materials.

Authors: Lamia Ateshian, Massachusetts Institute of Technology / Hyeonrak Choi, Massachusetts Institute of Technology / Mikkel Heuck, Massachusetts Institute of Technology / Dirk Englund, Massachusetts Institute of Technology

SW2K.2

3D-Printed Resonant Gold Nanocones for Out-of-Plane Terahertz-Field-Driven Electron Photoemission

Presenter: Andrea Rovere , *INRS-Energie Materiaux et Telecom*

We numerically and experimentally investigate out-of-plane gold nanostructures resonating at terahertz frequencies for field-driven photoemission and compare their performance with a traditional non-resonant nanotip geometry.

Authors: Andrea Rovere, INRS-Energie Materiaux et Telecom / Riccardo Piccoli, INRS-Energie Materiaux et Telecom / Andrea Bertoncini, KAUST / Young-Gyun Jeong, INRS-Energie Materiaux et Telecom / Stéphane Payeur, INRS-Energie Materiaux et Telecom / François Vidal, INRS-Energie Materiaux et Telecom / O-Pil Kwon, Ajou University / Seung-Heon Lee, Ajou University / Jin-Hong Seok, Ajou University / Roberto Morandotti, INRS-Energie Materiaux et Telecom / Carlo Liberale, KAUST / Luca Razzari, INRS-Energie Materiaux et Telecom

SW2K.3

Compact THz Photogun Transversely Pumped by Twin Single-Cycle Pulses

Presenter: Tobias Kroh , *DESY*

A compact terahertz (THz) powered photogun reaching electron energies up to $\sim 3\text{keV}$ is presented. First experiments testing the performance of the device as well as challenges in future development are summarized and discussed.

Authors: Tobias Kroh, DESY / Timm Rohwer, DESY / Hannes Dinter, DESY / Max Kellermeier, DESY / Moein Fakhari, DESY / Michael Hemmer, DESY / Umit Demirbas, DESY / Huseyin Cankaya, DESY / Mikhail Pergament, DESY / Ralph Assmann, DESY / Nicholas Matlis, DESY / Franz Kärtner, DESY

SW2K.4

Demonstration of Near-Field THz Spectroscopy Using Ultrafast Electron Microscopy

Presenter: Michael Yannai , *Technion Israel Institute of Technology*

We probe near-field THz pulses with nm-fs spatio-temporal resolution, through their interaction with free-electron pulses in an ultrafast transmission electron microscope. Our experiment can help understand THz generation and nanoscale THz phenomena.

Authors: Michael Yannai, Technion Israel Institute of Technology / Raphael Dahan, Technion Israel Institute of Technology / Alexey Gorlach, Technion Israel Institute of Technology / Nicholas Rivera, Massachusetts Institute of Technology / Kangpeng Wang, Technion Israel Institute of Technology / Giovanni Maria Vanacore, University of Milano-Bicocca / Fabrizio Carbone, École Polytechnique Fédérale de Lausanne (EPFL) / Javier de Abajo, Institut de Ciències Fotoniques (ICFO) / Ido Kaminer, Technion Israel Institute of Technology

SW2K.5

Consequences of Antenna Effects on s-SNOM Imaging of a Photonic Mode

Presenter: Théo Hannotte , *IEMN*

We report on the influence of antenna effects on the imaging by THz s-SNOM of a photonic mode. Unknown radiation pattern from the probe and sample combination makes the interpretation of a s-SNOM image non-trivial.

Authors: Théo Hannotte, IEMN / Louis Thomas, IEMN / Cristiane Nascimento Santos, IEMN / Melanie Lavancier, IEMN / Sophie Eliet, IEMN / Benjamin Walter, Vmicro SAS / Marc Faucher, IEMN / Jean-François Lampin, IEMN / Romain Peretti, IEMN

SW2K.6

Anomalous Contrast in Broadband THz Near-Field Imaging of Gold Microstructures

Presenter: Angela Pizzuto , *Brown University*

We perform near-field THz imaging on a series of deeply subwavelength gold structures. We observe a contrast unrelated to changes in the material's local properties, which we attribute to electromagnetic standing waves.

Authors:Angela Pizzuto, Brown University / Xinzhong Chen, Stony Brook University / Mengkun Liu, Stony Brook University / Hai Hu, National Center for Nanoscience and Technology / Qing Dai, National Center for Nanoscience and Technology / Daniel Mittleman, Brown University

SW2K.7

THz Near-Field Microscopy of Graphene and Subwavelength Metal Structures

Invited

Presenter: Mengkun Liu , *Stony Brook University*

I will report the nano-imaging of graphene and extreme subwavelength metallic nanostructures via scattering-type scanning near-field optical microscopy (s-SNOM) in the GHz to THz frequency range. Our results reveal that the quantitative analysis of the near-field optical material contrasts in the long-wavelength regime requires a careful assessment of the size and configuration of conductive structures.

Authors:Mengkun Liu, Stony Brook University

SW2F

Photonics of Low Dimensional Materials I

Presider: Shengxi Huang , *Pennsylvania State University*

SW2F.1

Optical Cooling and Other Opportunities for Anti-Stokes Photoluminescence From All-Inorganic Perovskite Nanocrystals

Invited

Presenter: Matthew Sheldon , *Texas A&M University*

We have recently established that solution-processed all-inorganic colloidal CsPbX₃ nanocrystals are a champion materials system for laser cooling. We will highlight the materials and nanophotonic design constraints on cooling efficiency.

Authors:Matthew Sheldon, Texas A&M University

SW2F.2

High-Density two-Color Micro-LED Array Based on Brushing-Assisted Micropatterning of Quantum Dots

Presenter: Dacheng Mao , *UMass Amherst*

We report a 17 μm -pitched two-color micro-LED array based on brushing-assisted micro-patterning of quantum dots. Filtered by an integrated distributed Bragg reflector layer, our array features bright, localized, and fast light output near 462 nm and 623 nm with low spectral and spatial crosstalk.

Authors:Dacheng Mao, UMass Amherst / Zheshun Xiong, UMass Amherst / Matthew Donnelly, UMass Amherst / Guangyu Xu, UMass Amherst

SW2F.3

High-Stability Quantum dot Passivated With low Temperature Atomic Layer Deposition 3-in-1 Full-Color Light-Emitting Diodes

Presenter: Yu-Ming Huang , *National Chiao-Tung University*

We report a 3-in-1 mini-light emitting diode and combine ink-jet printing technique to achieve a full color in monolithic chip. Finally, make reliability test by low-temperature ALD technology at 2020 color gamut of red and green QDs during 300 hours reliability test under 50 °C/50 % RH condition.

Authors:Yu-Ming Huang, National Chiao-Tung University / Yu-Hau Liou, National Chiao-Tung University / An-Chen Liu, National Chiao-Tung University / Chien-Chung Lin, National Chiao-Tung University / Hao-Chung Kuo, National Chiao-Tung University

SW2F.4

All-Fiber, all-Optical Ultrafast Switch Based on two-Dimensional Nanomaterials

Presenter: Q. Wu , *Beihang University*

We present an all-fiber, all-optical modulator based on a polarization interferometer structure depositing with two-dimensional nanomaterials. Bright and stable modulated output signals can be achieved highlighting the potential for two-dimensional nanomaterial-based photonic applications.

Authors:Q. Wu, Beihang University / Meng Zhang, Beihang University / Zheng Zheng, Beihang University

SW2F.5

Light-Driven Graphene-Based Multifunctional Actuator

Presenter: Anjani Tiwari , *Indian Institute of Technology Kanpur*

We present a graphene-based actuator that is capable of performing multiple motions under uniform laser illumination. By varying the concentration of graphene nanoplatelets in the PDMS polymer, we control the actuator's movement direction.

Authors:Anjani Tiwari, Indian Institute of Technology Kanpur / Vivek Singh, Indian Institute of Technology Kanpur / S. Ramakrishna, Indian Institute of Technology Kanpur

SW2F.6

Electric Field- Induced Reduction Dynamics of Graphene Oxide and its Photo-Response

Presenter: Soma Saha , *Indian Institute of Technology Bombay*

We demonstrate the reduction mechanism of graphene oxide (GO) using prism-based attenuated total reflection platform. The connection between the change in current and reflectance of GO film during reduction was studied along with device photo-response. ©2021 The Author(s).

Authors:Soma Saha, Indian Institute of Technology Bombay / Sonatan Das, Indian Institute of Technology Bombay / Anindya Datta, Indian Institute of Technology Bombay / Tapanendu Kundu, Indian Institute of Technology Bombay

SW2F.7

Be-Doping Assessment in Self-Catalyzed MBE Grown GaAs Nanowires.

Presenter: PRIYANKA RAMASWAMY , *North Carolina A&T State University*

We report on the Be-dopant assessment in Ga-assisted molecular beam epitaxially grown nanowires using conductive-atomic force microscopy, X-ray photoelectron spectroscopy, and ultraviolet photoelectron spectroscopy.

Authors:PRIYANKA RAMASWAMY, North Carolina A&T State University / Mehul Parakh, North Carolina A&T State University / Rabin Pokharel, North Carolina A&T State University / Keith Jones, Asylum Research, an Oxford Instruments Company / Jia Li, North Carolina A&T State University / Shanthi Iyer, North Carolina A&T State University

SW2J

Tools for Ultrafast Spectroscopy

Presenter: Giacomo Coslovich , *SLAC*

SW2J.1

Seven-Octave High-Brightness and Carrier Envelope Phase-Stable Light Source

Presenter: Luke Maidment , *ICFO - Institut de Ciències Fotoniques*

We present a carrier-envelope-phase stable light source with simultaneous spectral coverage across 7 optical octaves (UV to THz) by combining soliton self-compression, dispersive wave generation and intra-pulse difference frequency generation.

Authors: Ugaitz Elu, ICFO - Institut de Ciències Fotoniques / Luke Maidment, ICFO - Institut de Ciències Fotoniques / Lenard Vamos, ICFO - Institut de Ciències Fotoniques / Francesco Tani, Max-Planck Institute for Science of Light / David Novoa, Max-Planck Institute for Science of Light / Michael H. Frosz, Max-Planck Institute for Science of Light / Valeriy Badikov, High Technologies Laboratory, Kuban State University / Dmitry Badikov, High Technologies Laboratory, Kuban State University / Valentin Petrov, Max-Born-Institute for Nonlinear Optics and Ultrafast Spectroscopy / Philip Russell, Max-Planck Institute for Science of Light / Jens Biegert, ICFO - Institut de Ciències Fotoniques

SW2J.2

Ultrafast Nano-Imaging and Control of Optical Switching in Strongly Coupled Infrared Quantum-Well Heterostructures

Presenter: Samuel Johnson , *University of Colorado at Boulder*

We perform ultrafast degenerate infrared pump-probe micro- to nano-scale imaging and spectroscopy of multi-quantum-well antenna heterostructures. We demonstrate coupling strength and phase rotation control through modification of the optical nano-cavity.

Authors: Samuel Johnson, University of Colorado at Boulder / Hans Bechtel, Lawrence Berkeley National Laboratory / Sander Mann, City University of New York / Nishant Nookala, The University of Texas at Austin / Andrea Alù, City University of New York / John Klem, Sandia National Laboratories / Igal Brener, Sandia National Laboratories / Mikhail Belkin, Technical University of Munich / Markus Raschke, University of Colorado at Boulder

SW2J.3

Ultrafast Spectroscopy of Biomolecules With Few-Femtosecond UV Pulses

Invited

Presenter: Rocio Borrego-Varillas , *Istituto di Fotonica e Nanotecnologie*

By using a novel UV beamline with sub-20-fs resolution we investigate the ultrafast dynamics of DNA nucleosides and thiobases, revealing the primary photo-induced processes occurring in sub-100 fs timescales.

Authors: Rocio Borrego-Varillas, Istituto di Fotonica e Nanotecnologie

SW2J.4

Tracking Chemical Reaction Using Soft-X-Ray Absorption Spectroscopy With a Table-top Water-Window X-ray Source

Presenter: Yi-Ping Chang , *University of Geneva*

We demonstrate femtosecond time-resolved soft-X-ray absorption spectroscopy of liquid samples by combining a sub-micrometer-thin flat liquid jet with a HHG source covering the entire water-window range and trace the valence-shell ionization dynamics at the carbon K-edge.

Authors:Tadas Balciunas, University of Geneva / Yi-Ping Chang, University of Geneva / Zhong Yin, ETH Zurich / Cedric Schmidt, University of Geneva / Kristina Zinchenko, ETH Zurich / Fernanda Nunes, ETH Zurich / Vit Svoboda, ETH Zurich / Adam Smith, ETH Zurich / Emanuele Rossi, ETH Zurich / Jean-Pierre Wolf, University of Geneva / Hans-Jakob Wörner, ETH Zurich

SW2J.5

Free-Running Dual-Comb Thin-Disk Laser Oscillator for Comb-Line-Resolved Spectroscopy

Presenter: Norbert Modsching, *Université de Neuchâtel*

We demonstrate the suitability of dual-comb thin-disk lasers for comb-line-resolved spectroscopy by measuring the absorption spectrum of acetylene. Operating with 240-fs, 6-8 W and 97-MHz, such sources are highly attractive for frequency-conversion into the mid-infrared.

Authors:Norbert Modsching, Université de Neuchâtel / Jakub Drs, Université de Neuchâtel / Pierre Brochard, Université de Neuchâtel / Julian Fischer, Université de Neuchâtel / Stéphane Schilt, Université de Neuchâtel / Valentin J. Wittwer, Université de Neuchâtel / Thomas Südmeyer, Université de Neuchâtel

SW2J.6

Coherently-Shaped Free Electrons as High-Resolution Probes of Coherence in Quantum Systems

Presenter: Ron Ruimy, *Technion Israel institute of technology*

We propose a novel technique that leverages free electrons coherently-shaped by laser pulses to measure quantum coherence in materials, opening the way toward the full characterization of the state of quantum systems at atomic-scale resolution.

Authors:Ron Ruimy, Technion Israel institute of technology / Alexey Gorlach, Technion Israel institute of technology / Chen Mechel, Technion Israel institute of technology / Nicholas Rivera, Massachusetts Institute of Technology / Ido Kaminer, Technion Israel institute of technology

SW2J.7

Time-Domain Single-Pixel Imaging

Presenter: Jiapeng Zhao, *University of Rochester*

We propose and demonstrate a single-pixel temporal imaging system with high resolution, efficiency, and sensitivity. A terahertz pulse with pulse energy as low as 5 fJ is compressively imaged with a resolution down to 16 fs.

Authors: Jiapeng Zhao, University of Rochester / Jianming Dai, Tianjin University / Boris Braverman, University of Ottawa / Xi-Cheng Zhang, University of Rochester / Robert Boyd, University of Rochester

SW2C

High-bandwidth Devices and Systems

Presenter: Jonathan Bradley, *McMaster University*

SW2C.1

High-Speed Optical Transceiver Based on low-Cost Silicon Ring Modulators and Detectors

Invited

Presenter: Meer Nazmus Sakib, *Intel Labs- Photonics Research*

We demonstrate a high-speed optical link with a transmitter based on silicon micro-ring modulators and a receiver based on all-silicon resonant photodetectors capable of demultiplexing and detecting 112 Gb/s PAM4 signals at datacom wavelengths.

Authors: Meer Nazmus Sakib, Intel Labs- Photonics Research

SW2C.2

40 G III-V Photodetectors on a Monolithic InP/SOI Platform

Presenter: Ying Xue, *Hong Kong Univ of Sci@Tech*

We report in-plane III-V p-i-n photodetectors selectively grown on (001) silicon-on-insulator (SOI) wafers. These devices feature a responsivity of around 0.7 A/W at 1550 nm and 1.8 A/W at 1310 nm, a low dark current of 6 nA at -1 V bias, and high-speed operation beyond 40 G.

Authors: Ying Xue, Hong Kong Univ of Sci@Tech / Yu Han, Hong Kong Univ of Sci@Tech / Yeyu Tong, The Chinese University of Hong Kong / Zhao Yan, Hong Kong Univ of Sci@Tech / Yi Wang, The Chinese University of Hong Kong / Hon Ki Tsang, The Chinese University of Hong Kong / Kei May Lau, Hong Kong Univ of Sci@Tech

SW2C.3

320 Gb/s WDM Transmission in Monolithically Integrated Al₂O₃:Er³⁺ Spiral Amplifier on Si₃N₄

Presenter: Themistoklis Chrysostomidis, *Aristotle University of Thessaloniki*

We report an 8×40Gb/s WDM data transmission through an Al₂O₃:Er³⁺ spiral waveguide amplifier on Si₃N₄ featuring 1.8dB/cm net gain. All data channels present clear eye diagrams and bit-error rate values above the KR4-FEC limit.

Authors:Themistoklis Chrysostomidis, Aristotle University of Thessaloniki / Ioannis Roumpos, Aristotle University of Thessaloniki / Konstantinos Fotiadis, Aristotle University of Thessaloniki / Jinfeng Mu, University of Twente / Athanasios Manolis, Aristotle University of Thessaloniki / Christos Vagionas, Aristotle University of Thessaloniki / Meindert Dijkstra, University of Twente / Sonia Garcia-Blanco, University of Twente / Konstantinos Vyrsoinos, Aristotle University of Thessaloniki / Theoni Alexoudi, Aristotle University of Thessaloniki

SW2C.4

A 30 Gb/s Monolithic Traveling-Wave Amplified Mach-Zehnder Modulator

Presenter: Navid Hosseinzadeh , *UC Santa Barbara*

A hybrid approach incorporates traveling-wave amplifier stages into the Mach-Zehnder modulator (MZM) to reduce the area and power and improve bandwidth in a 90-nm silicon photonic (SiPh) CMOS process. Optical measurements demonstrate data rates up to 30 Gb/s.

Authors:Navid Hosseinzadeh, UC Santa Barbara / Clint Schow, UC Santa Barbara / James Buckwalter, UC Santa Barbara

SW2C.5

Sub-Millimeter Large High-Speed Photodetector for FSO Communications

Presenter: Toshimasa Umezawa , *National Inst of Information & Comm Tech*

We present a 0.4-mm-large high-speed photodetector (PD), formed by series and parallel connected integration of 40 um diameter PDs. We successfully achieved the same 3-dB bandwidth (8.5 GHz) as that in 40 um single PD.

Authors:Toshimasa Umezawa, National Inst of Information & Comm Tech / Shinya Nakajima, National Inst of Information & Comm Tech / Atsushi Matsumoto, National Inst of Information & Comm Tech / Kouichi Akahane, National Inst of Information & Comm Tech / Naokatsu Yamamoto, National Inst of Information & Comm Tech

SW2C.6

Demonstration of on-Chip Gigahertz Acousto-Optic Modulation at Near-Visible Wavelengths

Presenter: Yue Yu , *The Chinese University of Hong Kong*

We demonstrated on-chip acousto-optic modulation at near-visible wavelengths on an etchless lithium niobate integrated platform. We obtained an intrinsic optical Q of 40,000 and measured acousto-optic modulation with the modulation frequency up to 2.44 GHz.

Authors: Yue Yu, The Chinese University of Hong Kong / Lai Wang, Tsinghua University / Xiankai Sun, The Chinese University of Hong Kong

SW2C.7

High-Speed Silicon Mach-Zehnder Modulator With Corrugated Waveguides for Data Center Interconnects

Presenter: Karanveer Singh, *Technische Universität Braunschweig*

An energy-efficient integrated silicon Mach-Zehnder modulator using 0.5 mm long corrugated waveguides with an extinction ratio of 30 dB is presented. Using this modulator, 15 Gb/s NRZ transmission is demonstrated with modulation efficiency ($V_{\pi}L$) of 0.065V.cm.

Authors: Karanveer Singh, Technische Universität Braunschweig / Arijit Misra, Technische Universität Braunschweig / Sourav Dev, Technische Universität Dresden / Reza Hosseini, SIMULIA Industry Process Consultant at Dassault Systemes / Stefan Preußler, Technische Universität Braunschweig / Kambiz Jamshidi, Technische Universität Dresden / Thomas Schneider, Technische Universität Braunschweig

SW2D

Neural Imaging Tools

Presenter: Mo Zohrabi, *University of Colorado at Boulder*

SW2D.1

Dual-Band 2-Photon Excitation Dual-Region Imaging With Subcellular Resolution Across 25mm² Field of View

Highlighted Talk

Presenter: Che-Hang Yu, *University of California, Santa Barbara*

We developed a dual-wavelength excitation, large field-of-view (25 mm²) two-photon microscope with temporal multiplexing and two completely independent scan engines coupled into the same objective for imaging in multiple areas with multiple wavelengths simultaneously.

Authors: Che-Hang Yu, University of California, Santa Barbara / Jeffrey Stirman, University of California, Santa Barbara / Spencer Smith, University of California, Santa Barbara

SW2D.2

Two-Photon Fiber STED Microscope Using Polarization Maintaining Fiber

Presenter: Brendan Heffernan , *University of Colorado, Boulder*

We demonstrate a two photon (2P) fiber STED microscope in which the excitation and STED light are delivered to the sample in polarization maintaining (PM) fiber.

Authors:Brendan Heffernan, University of Colorado, Boulder / Peter Riley, University of Colorado, Boulder / Omkar Supekar, University of Colorado, Boulder / Stephanie Meyer, University of Colorado / Nicholas George, University of Colorado / Diego Restrepo, University of Colorado / Mark Siemens, University of Denver / Emily Gibson, University of Colorado / Juliet Gopinath, University of Colorado, Boulder

SW2D.3

Large Field-of-View 3D Imaging Using Random Microlenses

Presenter: Feng Tian , *University of California Davis*

We demonstrate a lensless microscope using a single random microlens array and a fast local object reconstruction algorithm. Compared to other lensless imagers, our approach allows a large field of view and low computation complexity.

Authors:Feng Tian, University of California Davis / Junjie Hu, University of California Davis / Weijian Yang, University of California Davis

SW2D.4

Computational Imaging in the Multiple Scattering Regime Exploiting Linear Fluorescence Feedback

Invited

Presenter: Sylvain Gigan , *Sorbonne Université*

Linear fluorescence is the most widespread optical contrast mechanism, yet remains extremely challenging for deep imaging using scattered light. exploiting matrix factorization algorithms, I will show how fluorescence can be exploited for imaging and function activity recording.

Authors:Claudio Moretti, Laboratoire Kastler Brossel / Antoine Boniface, Laboratoire Kastler Brossel / Jonathan Dong, Laboratoire Kastler Brossel / Sylvain Gigan, Sorbonne Université

SW2D.5

Computational Miniature Mesoscope for Large-Scale 3D Fluorescence Imaging

Presenter: Yujia Xue , *Boston University*

We demonstrate a new wearable fluorescence imaging device named Computational Miniature Mesoscope (CM²), that achieves high-resolution single-shot volumetric imaging across a wide field-of-view.

Authors:Yujia Xue, Boston University / Ian Davison, Boston University / David Boas, Boston University / Lei Tian, Boston University

SW2D.6

Minimally-Invasive Lensless Computational Microendoscopy Leveraging Modal Decomposition

Presenter: Samuel Metais , *Johns Hopkins University*

We demonstrate a lensless epi-fluorescence computational microendoscope composed of a coded-aperture and multicore fiber. We find significant improvement in re-constructed image quality through modal decomposition of the fluorescence collected in each core of the fiber.

Authors:Samuel Metais, Johns Hopkins University / Jiayue Li, Johns Hopkins University / Jaewook Shin, Johns Hopkins University / Neil MacFarlane, Johns Hopkins University / Milad Alemohammad, Johns Hopkins University / Maged Harraz, Johns Hopkins University / Amy Foster, Johns Hopkins University / Mark Foster, Johns Hopkins University

SW2B

Fiber Amplifiers and Oscillators

Presenter: Darren Hudson , *CACI - Photonics Solutions*

SW2B.1

High Power all-Fiberized Laser Oscillator Employing Novel Constant-Cladding Tapered-Core Yb-Doped Fiber

Presenter: Yun Ye , *National Univ. of Defense Tech.*

We proposed and demonstrated a high-power all-fiberized laser oscillator with a novel constant-cladding tapered-core (CCTC) Yb-doped fiber for the first time. The output power was scaled to 1514 W with an optical-to optical efficiency of ~64%.

Authors:Yun Ye, National Univ. of Defense Tech. / Xianfeng Lin, Huazhong University of Science and Technology / Xiaoming Xi, National Univ. of Defense Tech. / Baolai Yang, National Univ. of Defense Tech. / Chen Shi, National Univ. of Defense Tech. / Hanwei Zhang, National Univ. of Defense Tech. / Xiaolin Wang, National Univ. of Defense Tech. / Jinyan Li, Huazhong University of Science and Technology / Xiaojun Xu, National Univ. of Defense Tech.

SW2B.2

All-Fiber, Optical Parametric Oscillator Based on Birefringent Phase Matching in a Polarization Maintaining Fiber

Presenter: Orkhongua Batjargal , *The University of Arizona*

We present an all-fiber, synchronously pumped, optical parametric oscillator based on birefringent phase matching in a polarization maintaining fiber. The laser system produces ultrashort signal and idler pulses near 930 nm and 1230 nm.

Authors:Orkhongua Batjargal, The University of Arizona / Yukun Qin, The University of Arizona / Khanh Kieu, The University of Arizona

SW2B.3

Transverse Mode Instability Threshold Manipulation in a Core-Pumped Raman Amplifier

Presenter: Victor Distler , *Fraunhofer Institute for Applied Optics and Precision Engineering*

The threshold of transverse mode instability induced by stimulated Raman scattering is examined. Therefore, key parameters for transverse mode instabilities in a passive fiber high-power core-pumped Raman amplifier are experimentally investigated and discussed.

Authors:Victor Distler, Fraunhofer Institute for Applied Optics and Precision Engineering / Friedrich Möller, Fraunhofer Institute for Applied Optics and Precision Engineering / Benjamin Yildiz, Fraunhofer Institute for Applied Optics and Precision Engineering / Marco Plötner, Fraunhofer Institute for Applied Optics and Precision Engineering / Till Walbaum, Fraunhofer Institute for Applied Optics and Precision Engineering / Thomas Schreiber, Fraunhofer Institute for Applied Optics and Precision Engineering

SW2B.4

22mJ Coherent Beam Combining From Three 85 μ m Core CCC Fiber Amplifiers

Presenter: Alexander Rainville , *University of Michigan*

We demonstrate coherent beam combining of pulses from 3 chirally-coupled core optical fibers into a single 22mJ pulse, achieving >7mJ per channel combining and allowing for future temporal combination and compression at high energy

Authors:Alexander Rainville, University of Michigan / Mingshu Chen, University of Michigan / Mathew Whittlesey, University of Michigan / Qiang Du, Lawrence Berkeley National Laboratory / Almantas Galvanauskas, University of Michigan

SW2B.5

High Peak-Power Pulse Amplification in Very-Large Mode-Area Er-Doped Amplifiers

Presenter: Jeffrey Nicholson , *OFS Labs*

We present nanosecond-pulse amplification in very-large mode-area amplifiers with varying Er absorptions and effective areas. Diffraction limited, 0.54 mJ pulses with 851 kW peak power in a 10 kHz pulse train at 1560 nm are achieved.

Authors: Jeffrey Nicholson, OFS Labs / Anthony DeSantolo, OFS Labs / Cang Jin, OFS Labs / Man Yan, OFS Labs / Patrick Wisk, OFS Labs / Eric Monberg, OFS Labs / Vasiliy Lukonin, OFS Labs / Ian Sun, OFS Labs / Mona Niu, OFS Labs / Zachary Goldberg, OFS Labs

SW2B.6

Dual-Pass Pre-Chirp Managed Amplification With High Gain and High Average Power

Presenter: Yao Zhang, *Xidian University*

We demonstrate the first dual-pass pre-chirp managed amplification in a rod-type Yb-fiber that amplifies 23-mW broadband pulses to 101.5-W with 36.5-dB gain. After compression, the system delivers 2- μ J, 67-fs pulses.

Authors: Yao Zhang, Xidian University

SW2B.7

Turning Nonlinearity From Problem to Advantage in Ultrafast Fiber Amplifiers

Invited

Presenter: Pavel Sidorenko, *Cornell University*

We review the recent advances in fiber-based sources of ultrashort pulses based on the gain-managed nonlinear regime. We discuss how highly nonlinear pulse evolution can be exploited to overcome typical limits of fiber-based sources.

Authors: Pavel Sidorenko, Cornell University / Frank Wise, Cornell University

SW2I

Atomic and Solid-State Quantum Sensors

Presenter: Kasturi Saha, *Indian Institute of Technology, Bombay*

SW2I.1

Standoff Atomic Magnetometry in the Lab and in the Sky

Tutorial

Presenter: Dmitry Budker, *Helmholtz Institute Mainz & UC Berkeley*

We will discuss recent advances in remote atomic magnetometry, including measurements in the mesosphere some 90 km above ground using sodium laser-guidestar techniques and laboratory vapor-cell measurements employing detection via mirrorless lasing.

Authors:Dmitry Budker, Helmholtz Institute Mainz & UC Berkeley

SW21.2

Rydberg Atom-Based AC/DC Voltage Measurements

Presenter: Nikunj Prajapati , *University of Colorado*

We determine DC and AC electric field strengths through measurements of Stark shifts in Rydberg electromagnetically-induced transparency. This demonstrates the potential for Rydberg atom-based calibrations of AC/DC voltage sources from 0-12 V.

Authors:Nikunj Prajapati, University of Colorado / Amy Robinson, University of Colorado / Eric Norrgard, National Institute of Standards and Technology / Matt Simons, National Institute for Standards and Technology / Christopher Holloway, National Institute for Standards and Technology

SW21.3

Angle of Arrival of a Radio-Frequency Field From Sub-Wavelength Rydberg Atom-Based Phase Measurements

Presenter: Amy Robinson , *University of Colorado*

Rydberg atoms in a vapor cell are used to measure the angle-of-arrival (AoA) of an incident radio-frequency plane wave through sub-wavelength phase measurements using a heterodyne technique.

Authors:Amy Robinson, University of Colorado / Nikunj Kumar Prajapati, University of Colorado / Damir Senic, Ansys / Matthew Simons, National Institute of Standards and Technology / Joshua Gordon, National Institute of Standards and Technology / Christopher Holloway, National Institute of Standards and Technology

SW21.4

Fiber-Optic Quantum Sensors for Applications in Micromagnetics and Thermal Imaging

Presenter: Sean Blakley , *Texas A&M University*

High-resolution thermal and magnetic vector gradient imaging is demonstrated using diamond quantum sensors in a microstructured fiber probe platform. These sensors are capable of *in situ* magnetic field and temperature measurements with 160 pT/ $\sqrt{\text{Hz}}$ and 25 mK/ $\sqrt{\text{Hz}}$ sensitivities.

Authors: Sean Blakley, Texas A&M University / Ilya Fedotov, M. V. Lomonosov Moscow State University / Xiaohan Liu, Texas A&M University / Christopher Vincent, Texas A&M University / Xinghua Liu, Texas A&M University / Alexey Akimov, Texas A&M University / Philip Hemmer, Texas A&M University / Aleksei Zheltikov, Texas A&M University

SW2I.5

Forty-Fold Speedup of NV⁻ Center Magnetometry With Sequential Bayesian Experiment Design

Presenter: Sergey Dushenko , *University of Maryland College park/NIST*

In magnetometry using quantum defects in diamond (NV⁻ centers), we demonstrate forty-fold speedup with sequential Bayesian experiment design as compared with conventional NV-magnetometry using frequency-swept measurements.

Authors: Sergey Dushenko, University of Maryland College park/NIST / Sean Blakley, University of Maryland College park/NIST / Kapildeb Ambal, University of Maryland College park/NIST / Robert McMichael, National Institute of Standards and Technology

AW2E

A&TTR on Integrated Photonics in Neural Networks I

Presenter: Yasha Yi , *University of Michigan*

AW2E.1

Multiplane Light Conversion to Build Unitary Optical Networks

Invited

Presenter: Nicolas Fontaine , *Nokia Bell Labs*

To be provided

Authors: Nicolas Fontaine, Nokia Bell Labs

AW2E.2

Machine Learning Based Optical Phased Arrays Design for on-Chip Solid State Lidar System

Invited

Presenter: ARASH KAZEMIAN , *QunFa Inc*

We are developing an integrated solid state Lidar system with potentially low cost, compact size, lightweight, low power, high performance, and high reliability. It can be easily concealed into the body of any vehicle. Hence, it will not compromise the aerodynamics or the design aesthetics of the vehicle in any way.

Authors:ARASH KAZEMIAN, QunFa Inc

AW2E.3

Photonic TPU & Memory for Machine Intelligence

Invited

Presenter: Volker Sorger , *George Washington University*

Here, I introduce a Photonic TPU (P-TPU), a PIC-based ASIC for vector matrix multiplication acceleration and report on a programmable multi-level non-volatile photonic random access memory (P-RAM).

Authors:Volker Sorger, George Washington University

AW2E.4

Optical Neuromorphic Processing Based on Kerr Microcombs

Presenter: David Moss , *Swinburne University of Technology*

We report a new approach to ONNs based on integrated Kerr micro-combs that is programmable, highly scalable and capable of reaching ultra-high speeds. We demonstrate a single perceptron at 11.9 Giga-OPS at 8 bits /OP, or 95.2 Gbps. We then demonstrate a convolutional accelerator at 11 TeraOPs/s.

Authors:David Moss, Swinburne University of Technology / xingyuan xu, Monash / arnan Mitchell, RMIT / Mengxi tan, Swinburne University of Technology / Jiayang Wu, Swinburne University of Technology / bill corcoran, Monash / roberto morandotti, INRS

AW2E.5

Reservoir Computing With Low-Power-Consumption All-Optical Nonlinear Activation Using Membrane SOA on Si

Presenter: Takuma Tsurugaya , *NTT Device Technology Labs, NTT Corporation*

We demonstrate reservoir computing using a fiber delay line and membrane semiconductor optical amplifier on Si. Thanks to its small active volume and low fiber-coupling loss, the reservoir consumes only 43 mW for nonlinear activation.

Authors: Takuma Tsurugaya, NTT Device Technology Labs, NTT Corporation / Tatsuro Hiraki, NTT Device Technology Labs, NTT Corporation / Mitsumasa Nakajima, NTT Device Technology Labs, NTT Corporation / Takuma Aihara, NTT Device Technology Labs, NTT Corporation / Nikolaos Panteleimon Diamantopoulos, NTT Device Technology Labs, NTT Corporation / Takuro Fujii, NTT Device Technology Labs, NTT Corporation / Toru Segawa, NTT Device Technology Labs, NTT Corporation / Shinji Matsuo, NTT Device Technology Labs, NTT Corporation

JW2G

Special Symposium - Mid-infrared and Thermal Photonics I: Thermal Radiation Control and Energy

President: Ognjen Ilic , *University of Minnesota*

JW2G.1

Manipulating Heat at Nanoscale - in Far and Near-Field

Invited

Presenter: Gaurang Bhatt , *Columbia University*

Here we will show a method to achieve broadband enhancement of thermal emission in far-field from an intrinsically poor thin-film emitter coupled to an external optical cavity. We will also discuss our recent experimental results on near-field radiative heat transfer and integrated near-field thermophotovoltaic on silicon platform.

Authors: Michal Lipson, Columbia University / Gaurang Bhatt, Columbia University

JW2G.2

Strong Coupling in Polaritonic Media: Towards on-Chip Infrared Nanophotonics

Invited

Presenter: Joshua Caldwell , *Vanderbilt University*

Here we will discuss the opportunity to implement polaritonic strong coupling between different media in an effort to dictate the polaritonic dispersion relation, and thus, the propagation and resonant properties of these materials.

Authors: Joshua Caldwell, Vanderbilt University

JW2G.3

Incandescent Metasurface Modulated Beyond 10 MHz

Invited

Presenter: Jean-Jacques Greffet , *Institut d'Optique*

To be provided

Authors: Jean-Jacques Greffet, Institut d'Optique

JW2G.4

Planck Spectroscopy

Presenter: Yuzhe Xiao , *University of Wisconsin-Madison*

We developed and experimentally demonstrated a minimalistic spectroscopic technique that does not require wavelength-selective components such as prisms, gratings, or interferometers —instead using the temperature and wavelength dependence of Planck's law of thermal emission.

Authors: Yuzhe Xiao, University of Wisconsin-Madison / Chenghao Wan, University of Wisconsin-Madison / Jad Salman, University of Wisconsin-Madison / Ian Maywar, University of Wisconsin-Madison / Jonathan King, University of Wisconsin-Madison / Alireza Shahsafi, University of Wisconsin-Madison / Mikhail Kats, University of Wisconsin-Madison

JW2G.5

a Double-Sided Radiative Cooling Architecture With a Record Local Cooling Power Density of 270 W/m²

Presenter: Lyu Zhou , *State University of New York at Buffalo*

We report a double-sided radiative cooling system with a record high local cooling power density of ~270 W/m². The configuration of the system was investigated theoretically and a superior cooling performance was demonstrated experimentally.

Authors: Lyu Zhou, State University of New York at Buffalo / Haomin Song, State University of New York at Buffalo / Nan Zhang, State University of New York at Buffalo / Jacob Rada, State University of New York at Buffalo / Matthew Singer, State University of New York at Buffalo / Qiaoqiang Gan, State University of New York at Buffalo

12:00 - 13:45 (Pacific Time (US & Canada) DST, UTC - 07:00)

FW3M

Optical Forces and Single-molecule Manipulation

Presenter: Ognjen Ilic , *University of Minnesota*

FW3M.1

Unidirectional Electronic Currents in Asymmetric Nanojunctions Driven by Strong Optical Fields

Presenter: Ihar Babushkin , *Leibniz Universität Hannover*

We show the creation of unidirectional currents in nanojunctions in strong optical fields at ambient conditions, with no phase stabilization of the driver. The mechanism is rooted in the inter-cycle interference of the electronic wavepackets in the nanogap.

Authors:Ihar Babushkin, Leibniz Universität Hannover / Liping Shi, Westlake University / Anton Husakou, Max-Born-Institut / Oliver Melchert, Leibniz Universität Hannover / Bettina Frank, Universität Stuttgart / Yuemin Ji, Institute of Physics and Ce Carl von Ossietzky University Oldenburgnter of Interface Science / Gustav Wetzel, Leibniz Universität Hannover / Ayhan Demircan, Leibniz Universität Hannover / Christoph Lienau, Institute of Physics and Ce Carl von Ossietzky University Oldenburgnter of Interface Science / Harald Giessen, Universität Stuttgart / Misha Ivanov, Max-Born-Institut / Uwe Morgner, Leibniz Universität Hannover / Milutin Kovacev, Leibniz Universität Hannover

FW3M.2

Single sub-10 nm Biomolecule Manipulation Enabled by Opto-Thermo-Electrohydrodynamic Tweezers

Presenter: Chuchuan Hong , *Vanderbilt University*

Our opto-thermo-electrohydrodynamic tweezers (OTET) enables the trapping and dynamic manipulation of sub-10 nm size biomolecules several microns away from the high intensity laser focus thereby mitigating detrimental photo-induced heating effect.

Authors:Chuchuan Hong, Vanderbilt University / Sen Yang, Vanderbilt University / Justus Ndukaife, Vanderbilt University

FW3M.3

Optical Trapping of Nanoparticles With Plasmonic Apertures Generated by Algorithm

Presenter: Neuton Li , *Australian National University*

Plasmonic apertures for optical nanotweezers are designed by an algorithm and fabricated with a helium ion microscope. Optical trapping experiments are performed. At every laser intensity, an algorithm-designed structure can outperform a conventional plasmonic aperture.

Authors:Neuton Li, Australian National University / Jasper Cadusch, University of Melbourne / Kenneth Crozier, University of Melbourne

FW3M.4

All-Dielectric Nanoantenna for Low Power Optical Trapping of Nanoscale Objects With Ultra-low Heat Generation

Presenter: Yuxi Jiang , *Vanderbilt University*

We report a dielectric nanoantenna system for the low-power optical trapping of nanoscale objects with ultra-low photothermal heating effect and enhanced trapping stability.

Authors:Yuxi Jiang, Vanderbilt University / Chuchuan Hong, Vanderbilt University / Sen Yang, Vanderbilt University / Justus Ndukaife, Vanderbilt University

FW3M.5

Coherent Control of Single-Molecule Switching Reactions With Femtosecond Atomic Forces

Highlighted Talk

Presenter: Lukas Kastner , *University of Regensburg*

Applying femtosecond atomic forces to key atoms of a single-molecule switch allows us to coherently steer a frustrated structural rotation that modulates the molecule's switching probability by up to 39%. © 2020 The Author(s)

Authors:Lukas Kastner, University of Regensburg / Dominik Peller, University of Regensburg / Thomas Buchner, University of Regensburg / Carmen Roelcke, University of Regensburg / Florian Albrecht, University of Regensburg / Nikolaj Moll, IBM-Research Zurich / Rupert Huber, University of Regensburg / Jascha Repp, University of Regensburg

FW3M.6

Electrically Controlled Graphene Nano-Ribbon Plasmonic Conveyor Belt Network

Presenter: Peter Liu , *State University of New York at Buffalo*

We present a graphene nano-ribbon based plasmonic conveyor belt network for simultaneous and independent trapping and transportation of multiple nano-objects, which are entirely achieved by electrostatically varying the carrier density distribution in the graphene structures.

Authors:Peter Liu, State University of New York at Buffalo / Puspita Paul, State University of New York at Buffalo

AW3S

LiDAR

Presenter: Ilko Ilev , *U.S. Food and Drug Administration*

AW3S.2

Megapixel per Second Hardware Efficient LiDAR Based on Microcombs

Presenter: Anton Lukashchuk , *EPFL*

We show a novel architecture for massively parallel FMCW LiDAR based on multiheterodyne mixing of two triangular chirped soliton microcombs using a single laser source and a single coherent receiver. We demonstrate a proof of concept experiment with 5.6 MPix/s detection rates.

Authors:Anton Lukashchuk, EPFL / Johann Riemensberger, EPFL / maxim karpov, EPFL / Junqiu Liu, EPFL / Tobias Kippenberg, EPFL

AW3S.4

A Pulsed-Coherent Lidar System With a Chip Based Optical Frequency Comb

Presenter: Li-Yang Chen , *University of California, Los Angeles*

We demonstrate a pulsed-coherent lidar system with a microresonator generated optical frequency comb which achieves sub-10 μm precision and 30- μm INL_{Max} with a 5-MSa/s sampling rate.

Authors:Li-Yang Chen, University of California, Los Angeles / Abhinav Kumar Vinod, University of California, Los Angeles / James McMillan, University of California, Los Angeles / Hao Liu, University of California, Los Angeles / Hangbo Yang, University of California, Los Angeles / Chih-Kong Ken Yang, University of California, Los Angeles / Chee Wei Wong, University of California, Los Angeles

AW3S.5

Hybrid Machine Vision Systems Achieve High-Speed Video Rates With Object and Scene Tracking

Presenter: Frank Rodriguez , *University of California at Riverside*

Hybrid vision systems may enable real-time image processing in remote, power/energy-limited applications. We demonstrate 40k/17k frame-per-second self-motion inference rates with optical processing, which is 3 orders of magnitude faster than current all-electronic state-of-the-art.

Authors:Frank Rodriguez, University of California at Riverside / Baurzhan Muminov, University of California at Riverside / Luat Vuong, University of California at Riverside

AW3S.6

FMCW Ranging and Speed Measurement Based on Frequency Sweep Predistortion of DFB Laser

Presenter: Xianyi Cao , *Shanghai Jiao Tong University*

An iterative method for generating linear frequency sweep from a DFB laser at 1550nm is demonstrated. An object with speed of ~6m/s at 7m is detected by the FMCW lidar, indicating a good sweep linearity.

Authors: Xianyi Cao, Shanghai Jiao Tong University / Chao Li, Shanghai Jiao Tong University / Kan Wu, Shanghai Jiao Tong University / JiaXuan Long, Shanghai Jiao Tong University / Jianping Chen, Shanghai Jiao Tong University

AW3S.7

Solid-State FMCW LiDAR Based on a 2D Disperser

Presenter: Zhi Li, *Tsinghua University*

By employing a tunable laser and a 2D disperser, we experimentally realize a frequency-modulated continuous-wave lidar system that performs ranging and 2-dimensional non-mechanical beam-steering simultaneously. Reconfigurable high imaging resolution and precise ranging are achieved.

Authors: Zhi Li, Tsinghua University / Zihan Zang, Tsinghua University / Xuanyi Liu, Tsinghua University / Lican Wu, Tsinghua University / H. Y. Fu, Tsinghua University

AW3S.1

Mission-Driven Design of Laser Systems for Space-Based Sensing and Communications

Invited

Presenter: Andrew Schober, *Fibertek, Inc.*

We'll discuss how unique mission requirements drive laser design features including performance, size, weight, power consumption, and reliability in the context of specific LIDAR sensing and laser communications missions and systems.

Authors: Andrew Schober, Fibertek, Inc.

AW3S.3

Smoke Sensing With a Short-Range Elastic Micro-Lidar

Presenter: Romain Ceolato, *ONERA*

The aim of this work is to present the advances in aerosols profiling with a short-range elastic lidar system. Our results demonstrate the feasibility of short-range elastic micro-lidar measurements of smoke. The objective is to retrieve the radiative properties (backscattering) of soot particles.

Authors: Lucas Paulien, ONERA / Matthew Berg, Kansas State University / Romain Ceolato, ONERA

12:00 - 14:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FW3P

Cold Atoms and Quantum Measurement

Presider: Rudolph Kohn , *Space Dynamics Laboratory*

FW3P.1

Quantum Noise Imaging Using Quadrature Squeezed Vacuum Optical Fields

Presenter: Irina Novikova , *College of William & Mary*

We propose imaging techniques that utilized quantum fluctuation analysis of a squeezed vacuum field to image opaque objects at low-photon environment. Our method uses a CCD camera-based homodyne detection, allowing noise quadrature selection.

Authors: Irina Novikova, College of William & Mary / Savannah Cuozzo, College of William & Mary / Nikunj Prajapati, College of William & Mary / pratik Barge, Louisiana State University / Narayan Bhusal, Louisiana State University / Lior Cohen, Louisiana State University / Hwang Lee, Louisiana State University / Eugenyi mikhailov, College of William & Mary

FW3P.2

EIT Cooling of Atoms in Optical Dipole Traps

Presenter: Hwang sub , *Korean Adv Inst of Science and Tech*

Neutral atoms trapped in an array of optical dipole traps are EIT-cooled to a temperature of $T_f = 2.8 \mu\text{K}$. With an observed EIT cooling rate of 1400/s for theory limit of $n_\infty = 0.03$, we measure the average quanta of $n_{exp} = 1.5$.

Authors: Hwang sub, Korean Adv Inst of Science and Tech / Andrew Byun, Korean Adv Inst of Science and Tech / Jaewook Ahn, Korean Adv Inst of Science and Tech

FW3P.3

Stimulated Slowing of Yb Atoms on the Narrow $^1S_0 \rightarrow ^3P_1$ Transition

Presenter: Tanaporn Na Narong , *Stanford University*

We propose a method for slowing, cooling and trapping Yb atoms using stimulated forces and only the $^1S_0 \rightarrow ^3P_1$ transition. With laser frequency chirp, our computer simulation predicts a MOT loading rate over 10^8 atoms/s.

Authors: Tanaporn Na Narong, Stanford University / Leo Hollberg, Stanford University

FW3P.4

Phase Retrieval of Vortices in Bose-Einstein Condensates

Presenter: Ron Ziv , *Technion - Israel Institute of Technology*

We propose a measurement scheme enabling reconstruction of the amplitude and phase of wavefunctions in Bose-Einstein condensates from their momentum power-spectrum. Our method reduces ambiguities and allows the reconstruction of arrays of vortices.

Authors:Ron Ziv, Technion - Israel Institute of Technology / Yoav Sagi, Technion - Israel Institute of Technology / Yonina Eldar, Weizmann Institute of Science / Mordechai segev, Technion - Israel Institute of Technology

FW3P.5

Tomography of Quantum States in a Phonon Network of Trapped Ions

Invited

Presenter: Kihwan Kim , *Tsinghua University*

We present the experimental realization of the bosonic network by using the vibrational modes of multiple trapped ions and demonstration of quantum state tomography for an arbitrary multi-mode phonon state with a definite number of phonons.

Authors:Kihwan Kim, Tsinghua University

FW3P.6

Sub-Wavelength Spin Excitations Driven by Stimulated Raman Transitions in Ultracold Gases

Presenter: Yigal Ilin , *Technion – Israel Institute of Technology*

We present sub-wavelength periodic spin textures of spatially varying Raman Rabi frequency created by evanescent-wave optical lattice. Our results open the door to the study of spin excitation dynamics in ultracold gases.

Authors:Yigal Ilin, Technion – Israel Institute of Technology / Shai Tsesses, Technion – Israel Institute of Technology / Guy Bartal, Technion – Israel Institute of Technology / Yoav Sagi, Technion – Israel Institute of Technology

FW3P.7

Intrinsic Calibration of Molecular Alignment Using Rotational Echoes

Presenter: Dina Rosenberg , *Tel Aviv University*

We propose the use of rotational echoes for obtaining the degree of molecular alignment induced in a gas. The method is independent of various parameters and relies on intrinsic dynamics of the rotational echo response.

Authors:Dina Rosenberg, Tel Aviv University / Sharly Fleischer, Tel Aviv University

Machine Learning and Applications

Presider: Michael Brodsky , *US Army Research Laboratory*

FW3N.1

Machine Learning Derived Entanglement Witnesses

Presenter: Larry Wu , *University of Toronto*

We demonstrate a correspondence between linear support vector machines (SVM) and entanglement witnesses, and use this correspondence to generate entanglement witnesses for bipartite qubit, tripartite qubit, and bipartite qutrit systems.

Authors: Larry Wu, University of Toronto / Eric Zhu, University of Toronto / Li Qian, University of Toronto

FW3N.2

Quantum-Enhanced Data Classification With a Variational Entangled Sensor Network

Presenter: Yi Xia , *University of Arizona*

We report the experimental demonstration of supervised learning assisted by an entangled sensor network (SLAEN). We show an entanglement-enabled reduction in the error probability for classification of multidimensional radio-frequency signals.

Authors: Yi Xia, University of Arizona / Wei Li, University of Arizona / Quntao Zhuang, University of Arizona / Zheshen Zhang, University of Arizona

FW3N.3

Classical Shadows and Bayesian Mean Estimation: a Comparison

Presenter: Joseph Lukens , *Oak Ridge National Laboratory*

Classical shadows enable remarkably efficient estimation of quantum observables, yet their connection to conventional techniques is unclear. In simulated examples we show that Bayesian mean estimation attains lower error on average, whereas classical shadows excel for specific states of interest.

Authors: Joseph Lukens, Oak Ridge National Laboratory / Kody Law, University of Manchester / Ryan Bennink, Oak Ridge National Laboratory

FW3N.4

Quantum-Optimal Binary Object Classification in Sub-Diffraction Incoherent Imaging

Presenter: Michael Grace , *University of Arizona*

We derive the quantum limit on average error for hypothesis tests between any two incoherent, diffraction-limited objects and identify quantum-optimal measurements that achieve a quadratic scaling improvement over direct imaging.

Authors: Michael Grace, University of Arizona / Saikat Guha, University of Arizona

FW3N.5

Practical Semi-Device-Independent Quantum Random Number Generators

Presenter: Marco Avesani, *Università degli Studi di Padova*

We describe a series of works where different Semi-DI protocols for Quantum Random Number generation are proposed and experimentally realized using photonic systems. These protocols exploit both discrete and continuous variables to generate private randomness

Authors: Marco Avesani, Università degli Studi di Padova / Hamid Tebyanian, Università degli Studi di Padova / Davide Marangon, Università degli Studi di Padova / Paolo Villoresi, Università degli Studi di Padova / Giuseppe Vallone, Università degli Studi di Padova

FW3N.6

Robust Self-Testing on Photonic Quantum Networks

Presenter: Iris Agresti, *La Sapienza University of Rome*

In this work, we experimentally self-test the states generated by two quantum network basic topologies. In detail, we provide lower bounds on their fidelity with respect to a target, through a scalable and versatile protocol.

Authors: Iris Agresti, La Sapienza University of Rome / Beatrice Polacchi, La Sapienza University of Rome / Davide Poderini, La Sapienza University of Rome / Emanuele Polino, La Sapienza University of Rome / Alessia Suprano, La Sapienza University of Rome / Ivan Šupić, Université de Genève / Joseph Bowles, Institute of Photonic Sciences-ICFO / Gonzalo Carvacho, La Sapienza University of Rome / Daniel Cavalcanti, Institute of Photonic Sciences-ICFO / Fabio Sciarrino, La Sapienza University of Rome

FW3N.7

LDPC-Coded Squeezed-Displaced States-Based Quantum Communications

Presenter: Ivan Djordjevic, *University of Arizona*

We demonstrate that LDPC-coded squeezed-displaced-states-based QPSK has better tolerance to background noise and significantly outperforms corresponding coherent states-based counterpart. For average number of thermal photons 0.3, for LDPC-code of rate 0.8, the improvement is >3 dB.

Authors: Ivan Djordjevic, University of Arizona

FW3N.8

A Belief Propagation-Based Quantum Joint-Detection Receiver for Superadditive Optical Communications

Presenter: Kaushik Seshadreesan , *University of Arizona*

We design a quantum joint-detection receiver for binary-phase-shift-keyed optical communications using belief propagation with quantum messages. For an exemplary tree code, the receiver attains the block-Helstrom limit in discriminating the codewords and achieves superadditive capacity.

Authors: Narayanan Rengaswamy, University of Arizona / Kaushik Seshadreesan, University of Arizona / Saikat Guha, University of Arizona / Henry Pfister, Duke University

FW3L

Nonlinear Photonics at Surfaces and Membranes

Presenter: Konstantinos Makris , *University of Crete*

FW3L.1

Unraveling and Predicting the Nonlinear-Optical Refractive Response of Graphene

Invited

Presenter: Nathalie Vermeulen , *Vrije Universiteit Brussel*

Graphene exhibits a strong nonlinear-optical refractive response to light pulses, but its impact on the pulses' spatiotemporal evolution is challenging to analyze and predict. We solve this issue using non-perturbative calculations and spectral broadening experiments.

Authors: Nathalie Vermeulen, Vrije Universiteit Brussel / Hugo Thienpont, Vrije Universiteit Brussel / David Castello-Lurbe, Vrije Universiteit Brussel

FW3L.2

(Withdrawn) Mid-Infrared Supercontinuum Generation in a Hybrid Graphene on Silicon Germanium Waveguide

Presenter: Pierre Demongodin , *Institut des nanotechnologies de Lyon*

We experimentally demonstrate that hybrid graphene/ SiGe waveguides could effectively enhance the mid-infrared supercontinuum bandwidth. Through impacting the supercontinuum dynamics, graphene could provide unique opportunities to control the supercontinuum performance of mid-IR chip-based devices.

Authors: Pierre Demongodin, Institut des nanotechnologies de Lyon / Rémi Armand, Institut des nanotechnologies de Lyon / Milan Sinobad, Institut des nanotechnologies de Lyon / Alberto Della Torre, Institut des nanotechnologies de Lyon / Jean-Michel Hartmann, CEA-Leti / Vincent Reboud, CEA-Leti / Jean-Marc Fedeli, CEA-Leti / Christian Grillet, CEA-Leti / Christelle Monat, Institut des nanotechnologies de Lyon

FW3L.3

Second Harmonic Generation From a Single Plasmonic Nanorod Strongly Coupled to a WSe₂ Monolayer

Presenter: Chentao Li , *Emory University*

By observing a pronounced splitting in the second harmonic signal, we report the first experimental investigation of the nonlinear properties of a strongly coupled system consisting of a WSe₂ monolayer and a single gold nanorod.

Authors: Chentao Li, Emory University / Xin Lu, Emory University / Ajit Srivastava, Emory University / S. David Storm, University of Maryland, Baltimore County / Rachel Gelfand, University of Maryland, Baltimore County / Matthew Pelton, University of Maryland, Baltimore County / Maxim Sukharev, Arizona State University / Hayk Harutyunyan, Emory University

FW3L.4

Hybrid Bistability in Nano-Opto-Mechanical Metamaterial

Presenter: Domitrios Papas , *University of Southampton*

A nanowire array decorated with plasmonic resonators acts as optically bistable device. The optical properties of this metamaterial exhibit hysteresis and bistability when it is driven by a piezo actuator across its mechanical resonance frequency.

Authors: Domitrios Papas, University of Southampton / Jun-Yu Ou, University of Southampton / Eric Plum, University of Southampton / Nikolay Zheludev, University of Southampton

FW3L.5

Optical Thermalization in Highly Multimoded Integrated Nonlinear 2D Photonic Membrane Systems

Presenter: Babak Bahari , *University Southern California*

We study optical thermalization dynamics in integrated photonic coupled-cavity arrangements on a Si_3N_4 platform. We show that isolated photonic bandgap modes can reach positive or negative temperatures that can be predicted effortlessly using optical thermodynamics.

Authors: Babak Bahari, University Southern California / Jae-Hyuck Choi, University Southern California / Sepehr Ahmadzadeh, University Southern California / Pawel Jung, University of Central Florida / Fan Wu, University of Central Florida / Demetrios Christodoulides, University of Central Florida / Mercedeh Khajavikhan, University of Central Florida

FW3L.6

Controlling Nonlinear Interactions in Metasurfaces Using Collective Lattice Effects

Invited

Presenter: Mikko Huttunen, *Tampere University*

Collective lattice effects in metasurfaces can result in very high quality factors. Here we present our recent results in utilizing such effects to realize more efficient and novel nonlinear metasurfaces, such as all-optical metasurface switches.

Authors: Mikko Huttunen, Tampere University / Orad Reshef, University of Ottawa / Jussi Kelavuori, Tampere University / Timo Stolt, Tampere University / Heikki Rekola, University of Eastern Finland / Petri Karvinen, University of Eastern Finland / Tommi Hakala, University of Eastern Finland / Robert Boyd, University of Ottawa / Ksenia Dolgaleva, University of Ottawa

FW30

Metasurfaces and Lasers

Presenter: Berardi Sensale-Rodriguez, *University of Utah*

FW30.1

Suppressing Meta-Holographic Artifacts by Laser Coherence Tuning

Presenter: Yaniv Eliezer, *Yale University*

Metaholograms suffer from imaging coherent artifacts originating from the electromagnetic cross-talk and defects of nanoscale features. Here, we introduce an efficient method to remove the artifacts by precisely fine-tuning the spatial coherence of illumination.

Authors: Yaniv Eliezer, Yale University / Geyang Qu, Harbin Institute of Technology / Wenhong Yang, Harbin Institute of Technology / Yujie Wang, Harbin Institute of Technology / Hasan Yilmaz, Yale University / Shumin Xiao, Harbin Institute of Technology / Qinghai Song, Harbin Institute of Technology / Hui Cao, Yale University

FW30.2

Low-Threshold Lasing From Anapole Metasurfaces

Presenter: Yuri Kivshar , *Australian National University*

We study active metasurfaces composed of arrays of split-nanodisk resonators made of InGaAs slab with embedded InGaAsP quantum wells. We demonstrate lasing from high-Q localized anapole modes with high coherence, narrow linewidth, and low threshold.

Authors:Aditya Tripathi, Australian National University / Sergey Kruk, Australian National University / HA-REEM KIM, Korea University / Hong-Gyu Park, Korea University / Mikhail Rybin, ITMO University / Yuri Kivshar, Australian National University

FW30.3

Ultrashort Pulse Compression via Metasurfaces

Presenter: Marcus Ossiander , *Harvard University*

We experimentally demonstrate a transmissive metasurface providing broadband negative group delay dispersion applicable in the visible to near-infrared region. The metacompressor can compress ultrashort laser pulses or compensate the dispersion of up to 4-mm-thick fused silica.

Authors:Marcus Ossiander, Harvard University / Yao-Wei Huang, Harvard University / Wei-Ting Chen, Harvard University / Zhenhao Wang, TU Graz / Yousef Ahmed Ibrahim, Harvard University / martin schultze, TU Graz / Federico Capasso, Harvard University

FW30.4

Silicon Nitride Metasurfaces in Structural Colors and Advanced Coherent Light Sources

Presenter: Kuo-Ping Chen , *National Chiao-Tung University*

Dielectric metasurface-based artificial pixels are promising candidates for developing flat, flexible, and/or wearable displays. In this work, we have demonstrated the silicon nitride metasurfaces with the function of structural colors and also lasing nanodevices.

Authors:Jhen-Hong Yang, National Chiao-Tung University / Kuo-Ping Chen, National Chiao-Tung University

FW30.5

Multipole Resonances for Directional Lasing and Wavefront Shaping

Invited

Presenter: Viktoriia Babicheva , *University of New Mexico*

The ultra-thin high-refractive-index nanostructures can be designed for amplitude and phase modulation in light-emitting devices. We analyze the gallium arsenide nanopillars to establish a guideline for the desired phase modulation in the metasurfaces.

Authors: Vahid Karimi, University of New Mexico / Viktoriia Babicheva, University of New Mexico

FW30.6

Eliminating Dual-Polarization Laser Emission and Spatial Hole Burning by Using Parity-Time-Symmetric Eigenstates

Presenter: Jean-Francois Bisson , *Universite de Moncton*

The polarization states of a resonator made of anisotropic mirrors are shown to coalesce into a single eigenstate at the exceptional point and to eliminate spatial hole burning, thereby promoting single mode laser operation.

Authors: Jean-Francois Bisson, Universite de Moncton / Yves Christian Nonguierma, Universite de Moncton

FW30.7

Non-Local Multifunctional Metasurfaces and Their External Cavity Laser Application

Presenter: Christina Spaegele , *Harvard University*

We design and experimentally test a new type of non-local metasurfaces allowing multiple independent functions at large deflection angles and we use it to demonstrate external cavity lasers with advanced beam shaping functions.

Authors: Christina Spaegele, Harvard University / Michele Tamagnone, Harvard University / Dmitry Kazakov, Harvard University / Marcus Ossiander, Harvard University / Marco Piccardo, Istituto Italiano di Tecnologia / Federico Capasso, Harvard University

AW3T

Advances in Compact Devices and Clinical Applications

Presenter: Tilman Schmolz , *Carl Zeiss Meditec Inc*

AW3T.1

(Withdrawn) Title to be Determined

Invited

Presenter: Ryan Shelton , *PhotoniCare Inc.*

To be provided

Authors:Ryan Shelton, PhotoniCare Inc.

AW3T.2

A Compact Spectroscopic Laser Sensor for Time-Resolved Breath Oxygen Monitoring Towards Clinical use

Presenter: Charles Patrick , *Princeton Unviersity*

A compact laser-based optical sensor for continuous in-airway monitoring of oxygen at high sampling rate is designed and tested for future use in a clinical setting.

Authors:Charles Patrick, Princeton Unviersity / Jonas Westberg, Princeton Unviersity / Gerard Wysocki, Princeton Unviersity

AW3T.3

a Colorimetric Assay With Optoelectronic Readout for High-Sensitivity and Rapid Detection of Infectious Diseases

Presenter: Xiahui Chen , *Arizona State University*

Using Ebola protein as a target antigen biomarker, a plasmonic nanoparticle based colorimetric assay is designed with a portable optoelectronic readout, showing ~40 pM limit of detection within minutes and at a high specificity.

Authors:Xiahui Chen, Arizona State University / Shoukai Kang, University of Washington / zhi zhao, Beijing University of Technology / Ashif Ikbal, Arizona State University / Jiawei Zuo, Arizona State University / Yu Yao, Arizona State University / Liangcai Gu, University of Washington / Chao Wang, Arizona State University

AW3T.4

Precise and Fast Autofocus Measuring Device for High-Resolution High-Speed Pupillometry

Presenter: Mario Hesker , *RWTH Aachen University TOS*

We present a light-intense optical device for high-speed measurement of pupil size at 1000 fp/s with automatic focusing by software edge contrast measurement and focus tracking using a liquid lens within one second

Authors:Mario Hesker, RWTH Aachen University TOS / Cailing Fu, RWTH Aachen University TOS / Matthias Heinrichs, Stellar DBS GmbH / Jochen Stollenwerk, RWTH Aachen University TOS / Peter Loosen, RWTH Aachen University TOS

AW3T.5

Characterization of Micromirrors Embedded in Parylene Photonic Waveguides for Out-of-Plane Light Delivery

Presenter: Jay Reddy , *Carnegie Mellon University*

We have recently demonstrated flexible Parylene photonic waveguides with embedded micromirrors. Here, the out-of-plane beam profile of the micromirrors is characterized using a combination of simulation and experiments.

Authors: Jay Reddy, Carnegie Mellon University / Mohammad Malekoshoraie, Carnegie Mellon University / Maysamreza Chamanzar, Carnegie Mellon University

AW3T.6

Contact Lens-Based Sensing of Lysozyme in Tear Fluid Using a Mobile Well-Plate Reader

Presenter: Zach Ballard , *University of California Los Angeles*

We report the quantification of lysozyme in tear fluid using contact lenses and a mobile-phone well-plate reader. We observed significantly lower lysozyme levels in human participants with dry eye disease compared to healthy controls.

Authors: Zach Ballard, University of California Los Angeles / Sarah Bazargan, University of California Los Angeles / Diane Jung, University of California Los Angeles / Shyama Sathianathan, University of California Los Angeles / Ashley Clemens, University of California Los Angeles / Daniel Shir, University of California Los Angeles / Saba Al-Hashimi, Stein Eye Intstitute / Aydogan Ozcan, University of California Los Angeles

AW3T.7

Graded-Index Fiber on-Chip Absorption Spectroscopy

Presenter: Kamalpreet Gill , *University of South Australia*

Absorption spectroscopy is demonstrated with microfluidic devices using collimating graded-index fibers. The optofluidics setup allows for absorption measurements to be performed with 10x smaller volumes than for standard cuvettes but with comparable sensitivity.

Authors: Nicolas Riesen, University of South Australia / Kamalpreet Gill, University of South Australia / Craig Priest, University of South Australia / Nicholas Phillips, University of South Australia / Bin Guan, University of South Australia / David Lancaster, University of South Australia

SW3H

Light Interaction with High/Low-Dimensional Materials

Presenter: Vitaly Gruzdev , *University of New Mexico*

SW3H.1

Ultrafast Ablation and the Role of Avalanche Ionization in Transition Metal Dichalcogenides

Presenter: Joel Solomon , *UNCC*

Avalanche ionization is shown to be the dominant carrier generation mechanism in the ultrafast ablation of transition metal dichalcogenides. Carrier densities reaching 22% of the total valence band population are needed for ablation to occur.

Authors: Joel Solomon, UNCC / Hsin-Yu Yao, National Tsing Hua University / Li-Syuan Lu, National Chiao Tung University / Wen-Hao Chang, National Chiao Tung University / Tsing-Hua Her, UNCC / Chih Wei Luo, National Chiao Tung University

SW3H.2

Permanent Optically-Induced Strain in hBN

Presenter: Cecilia Chen , *Columbia University*

We demonstrate the creation of permanent, localized strain structures in hBN with a phonon-resonant femtosecond laser at 7.3 μm . We spatially resolve the strain profile of the resulting micron-scale bubbles using Raman and AFM measurements.

Authors: Cecilia Chen, Columbia University / Jared Ginsberg, Columbia University / Samuel Moore, Columbia University / M. Jadidi, Columbia University / Baichang Li, Columbia University / Sang Hoon Chae, Columbia University / Kenji Watanabe, National Institute for Materials Science / Takashi Taniguchi, National Institute for Materials Science / James Hone, Columbia University / Dmitri Basov, Columbia University / Alexander Gaeta, Columbia University

SW3H.3

5D Optical Data Storage With 100% Readout Accuracy in Silica Glass

Highlighted Talk

Presenter: Huijun Wang , *University of Southampton*

5D optical data storage is realized in fused silica based on ultralow-loss birefringent nanopores (type X modification) by femtosecond laser writing. A book was recorded in 4-bit voxels with nearly 100% readout accuracy.

Authors: Huijun Wang, University of Southampton / Yuhao Lei, University of Southampton / Lei Wang, University of Southampton / Masaaki Sakakura, University of Southampton / Yanhao Yu, University of Southampton / Xin Chang, University of Southampton / Gholamreza Shayeganrad, University of Southampton / Peter Kazansky, University of Southampton

SW3H.4

Control Interlayer Excitons in 2D Heterostructures With Acoustic Waves

Presenter: Ruoming Peng , *University of Washington*

Propagating acoustic wave on the piezoelectric substrate carries strong piezoelectric field which can interact with the interlayer exciton in the MoSe₂/WSe₂ heterostructures. We observe GHz acoustic wave modulates the intensity of photoluminescence and induces a blue shift of emission energy.

Authors: Ruoming Peng, University of Washington / Jiayi Zhu, University of Washington / Xiaodong Xu, University of Washington / Mo Li, University of Washington

SW3H.5

Dispersive Coupling Between MoSe₂ and a Zero-Dimensional Integrated Nanocavity

Presenter: David Rosser, *University of Washington*

We demonstrate dispersive coupling between the neutral exciton in monolayer MoSe₂ and a zero-dimensional, small mode volume nanocavity with an estimated exciton cavity coupling of ~ 4:3 meV and a cooperativity of $C \sim 3:4$.

Authors: David Rosser, University of Washington / Dario Gerace, Università di Pavia / Yueyang Chen, University of Washington / Yifan Liu, University of Washington / James Whitehead, University of Washington / Albert Ryou, University of Washington / Lucio Andreani, Università di Pavia / Arka Majumdar, University of Washington

SW3H.6

Thermalization of Exciton-Polaritons in Strongly Coupled 2D Hybrid Perovskites

Presenter: Prathmesh Deshmukh, *City University of New York*

We study thermalization of exciton-polaritons in 2D hybrid organic-inorganic perovskites strongly coupled to a planar microcavity. The integrated PL exhibits a bottleneck effect and the extracted lattice temperature shows cooling behavior of up to 35 meV.

Authors: Prathmesh Deshmukh, City University of New York / Mandeep Khatoniar, City University of New York / Lianfeng Zhao, Princeton University / Barry P. Rand, Princeton University / Vinod Menon, City University of New York

SW3H.7

Wideband Acousto-Optical Modulation on Suspended Thin-Film Lithium Niobate

Presenter: Ahmed Hassanien, *University of Illinois at Urbana Champaign*

We present a wideband acousto-optic modulator on a suspended thin-film lithium niobate where both light and acoustic waves are guided simultaneously. The modulator has a center frequency of 1.9 GHz and bandwidth of 70 MHz.

Authors:Ahmed Hassanien, University of Illinois at Urbana Champaign / Edmond Chow, University of Illinois at Urbana Champaign / Steffen Link, University of Illinois at Urbana Champaign / Yansong Yang, University of Illinois at Urbana Champaign / Lynford Goddard, University of Illinois at Urbana Champaign / Songbin Gong, University of Illinois at Urbana Champaign

SW3R

Ultrafast Nonlinear Dynamics and Frequency Conversion

Presenter: Konstantin Vodopyanov

SW3R.1

Chiral Young's Double Slit Experiment and Polarization of Chirality

Invited

Presenter: Olga Smirnova , *Max Born Institute*

I will introduce a new concept of synthetic chiral light, which is chiral already in the dipole approximation, and show how structuring its handedness in space can lead to new extremely efficient enantio-sensitive optical observables.

Authors:Olga Smirnova, Max Born Institute

SW3R.2

Quantum Random Number Generation via Dynamically-Controlled Coupled-Resonator-Based Kerr Oscillator

Presenter: Yoshitomo Okawachi , *Columbia University*

We demonstrate real-time quantum random number generation using an integrated silicon nitride coupled-ring-resonator-based degenerate optical parametric oscillator (DOPO). We achieve fast DOPO turn-on/off via dynamic modulation of the cavity decay time using integrated heaters.

Authors:Yoshitomo Okawachi, Columbia University / Bok Young Kim, Columbia University / Yun Zhao, Columbia University / Xingchen Ji, Columbia University / Michal Lipson, Columbia University / Alexander Gaeta, Columbia University

SW3R.3

Machine Learning With Multimode Fibers

Presenter: Ugur Tegin , *Ecole Polytechnique Federale de Lausanne*

A novel optical computing framework by harnessing spatiotemporal nonlinear effects of multimode fibers for machine learning is presented. With linear and nonlinear interactions of the spatial fiber modes, a brain-inspired computation engine is experimentally realized.

Authors:Ugur Tegin, Ecole Polytechnique Federale de Lausanne / Mustafa Yildirim, Ecole Polytechnique Federale de Lausanne / Ilker Oguz, Ecole Polytechnique Federale de Lausanne / Christophe Moser, Ecole Polytechnique Federale de Lausanne / Demetri Psaltis, Ecole Polytechnique Federale de Lausanne

SW3R.4

Modeling Harmonic and Supercontinuum Generation in Polycrystalline Materials

Presenter: Jiahui Gu , *University of Arizona*

We develop a comprehensive model to simulate random quasi-phase-matched frequency conversion in polycrystalline media, and present simulations which shed light on the mechanisms of supercontinuum generation and the properties of generated radiation in zinc-blende materials.

Authors:Jiahui Gu, University of Arizona / Sergey Vasilyev, IPG Photonics – Southeast Technology Center / Mike Mirov, IPG Photonics – Southeast Technology Center / Miroslav Kolesik, University of Arizona

SW3R.5

Supercontinuum Generation in Optofluidic Microstructured Optical Fibers

Presenter: Saher Junaid , *Leibniz institute of Photonics technology*

Supercontinuum generation in microstructured optical fiber with CS₂ as a core-material is presented. The sample provides a new dispersion landscape with the zero-dispersion-wavelength approaching telecommunication wavelengths allowing for intense nonlinear frequency broadening across near-infrared

Authors:Saher Junaid, Leibniz institute of Photonics technology / Bierlich Jörg, Leibniz institute of Photonics technology / Alexander Hartung, Leibniz institute of Photonics technology / Mario Chemnitz, Institut national de la recherche scientifique / Markus Schmidt, Leibniz institute of Photonics technology

SW3R.6

Frequency Comb-Like High Energy gas-Filled Fiber Raman Laser Spanning From 1.68 μm to 2.4 μm

Presenter: Yazhou Wang , *Technical University of Denmark*

A Raman laser with distinct lines at 1683, 1868, 2099, and 2394 nm is reported based on a hydrogen-filled nested anti-resonant fiber, with high pulse energies of 18.25, 14.4, 14.1, and 8.2 μJ , respectively.

Authors: Yazhou Wang, Technical University of Denmark / Abubakar Adamu, Technical University of Denmark / Md Selim Habib, Florida Polytechnic University / Manoj Dasa, Technical University of Denmark / Jose Antonio-Lopez, University of Central Florida / Rodrigo Amezcua Correa, University of Central Florida / Ole Bang, Technical University of Denmark / Christos Markos, Technical University of Denmark

SW3R.7

Nonlinear Generation of Energetic Ultrashort Vortex Pulses With Spectral and Topological Charge Diversity

Presenter: Havva Begüm Kabagöz, *Boston University*

We demonstrate the generation of ~ 170 -fs, ~ 5 -nJ pulses of spectrally diverse light carrying orbital angular momentum of user-controlled topological charge by exploiting the selectivity and efficiency of the soliton self-mode conversion phenomenon in optical fibers.

Authors: Havva Begüm Kabagöz, Boston University / Zelin Ma, Boston University / Siddharth Ramachandran, Boston University

SW3K

Terahertz Emission and Pulse Shaping

Presenter: Frank Hegmann, *University of Alberta*

SW3K.1

Steering the Slipstream: Moving Fronts to Tailor Terahertz Pulses

Presenter: David Cooke, *McGill University*

Relativistically moving dielectric perturbations provide an exotic pathway for control over the spatiotemporal properties of light. We present our recent experimental results in applying this technique to the triggering and structuring of coherent terahertz pulses.

Authors: Aidan Schiff-Kearn, McGill University / Lauren Gingras, McGill University / Simon Bernier, McGill University / Nima Chamanara, McGill University / Kartiek Agarwal, McGill University / Jean-Michel Ménard, University of Ottawa / David Cooke, McGill University

SW3K.2

Terahertz Pulse Shaping Using Diffractive Optical Networks

Presenter: Muhammed Veli, *University of California, Los Angeles*

We demonstrate diffractive optical networks that are trained with deep learning to engineer input terahertz pulses into desired temporal waveforms using passive diffractive surfaces that control the spectral phase and amplitude of the output pulse.

Authors: Muhammed Veli, University of California, Los Angeles / Deniz Mengu, University of California, Los Angeles / Nezhil Yardimci, University of California, Los Angeles / Yi Luo, University of California, Los Angeles / Jingxi Li, University of California, Los Angeles / Yair Rivenson, University of California, Los Angeles / Mona Jarrahi, University of California, Los Angeles / Aydogan Ozcan, University of California, Los Angeles

SW3K.3

THz Generation Using the Tilted Pulse Front Method in the Limit of Small Beam Sizes

Presenter: Frank Wulf, *Ruhr-University Bochum*

We investigate THz generation using tilted pulse fronts with high power, high repetition rate driving lasers. It is shown that small beam sizes limit the maximum conversion efficiency due to spatial walk-off.

Authors: Frank Wulf, Ruhr-University Bochum / Tim Vogel, Ruhr-University Bochum / Samira Mansourzadeh, Ruhr-University Bochum / Martin Hoffmann, Ruhr-University Bochum / Clara Saraceno, Ruhr-University Bochum

SW3K.4

(Withdrawn) Sub-Nanosecond Terahertz Radiation Obtained With Aperiodically Poled Lithium Niobate and HMQ-TMS

Presenter: Roger Cudney, *CICESE*

We report a terahertz radiation source based on DFG in HMQ-TMS. The pump pulses are obtained by OPG in an aperiodically-poled crystal. We obtained 40 nJ THz pulses using 38 μ J, 0.85 ns pump pulses.

Authors: Miriam Carrillo-Fuentes, CICESE / Citlali Minor, CICESE / Roger Cudney, CICESE / Seung-Heon Lee, Ajou University / O-Pil Kwon, Ajou University

SW3K.5

Intra-Cavity Broadband THz Generation Inside a Diode-Pumped Solid-State Laser Oscillator

Presenter: Marin Hamrouni, *Laboratoire Temps Fréquence*

We drive optical rectification in GaP directly inside a sub-100-fs Yb-oscillator at 22-W intracavity power and 7-W of pump power, leading to >10-fold increase of efficiency with respect to pump power compared to similar technologies.

Authors: Marin Hamrouni, Laboratoire Temps Fréquence / Jakub Drs, Laboratoire Temps Fréquence / Julian Fischer, Laboratoire Temps Fréquence / Kenichi Komagata, Laboratoire Temps Fréquence / Norbert Modsching, Laboratoire Temps Fréquence / Valentin J. Wittwer, Laboratoire Temps Fréquence / François Labaye, Laboratoire Temps Fréquence / Thomas Südmeyer, Laboratoire Temps Fréquence

SW3K.6

THz Generation Control in Fe/X Spintronic Multilayers by Chemical Bonding at Epitaxial Fe/GaAs(001) Interfaces

Presenter: Roman Adam , *Research Centre Julich*

Abstract: We report an additional degree of control of THz transients in Fe/X spintronic emitters grown on GaAs(001). We ascribe the field-independent enhancement of the THz amplitude to specific chemical bonding at the epitaxial Fe/GaAs(001) interface.

Authors: Roman Adam, Research Centre Julich / Genyu Chen, University of Rochester / Daniel Bürgler, Research Centre Julich / Derang Cao, Research Centre Julich / Sarah Heidtfeld, Research Centre Julich / Debamitra Chakraborty, University of Rochester / Jing Cheng, University of Rochester / Ivan Komissarov, University of Rochester, Rochester / Hilde Hardtdegen, Research Centre Jülich / Martin Mikulics, Research Centre Jülich / Claus Schneider, Research Centre Julich / Roman Sobolewski, University of Rochester, Rochester

SW3K.7

(Withdrawn) Picosecond Spin-Seebeck Effect in Antiferromagnets

Invited

Presenter: Chiara Ciccarelli , *University of Cambridge*

We use optical pump – THz emission to measure spin-charge conversion at $Y_3Fe_5O_{12}$ (YIG)|Pt interface. We isolate the temperature dependence of the spin-mixing conductance and observe features that are correlated to the bands of magnon spectrum in YIG.

Authors: Chiara Ciccarelli , *University of Cambridge*

SW3F

Photonics of Low Dimensional Materials II

Presenter: Shengxi Huang , *Pennsylvania State University*

SW3F.1

(Withdrawn) Near-Field Optical Characterization Techniques of Twisted and Indirectly Nanostructured 2D Materials

Invited

Presenter: Frank Koppens , *ICFO -Institut de Ciencies Fotoniques*

Two-dimensional materials offer extraordinary potential for control of light and light-matter interactions at the atomic scale. In this talk, we present nanoscale optical techniques such as near-field optical microscopy and photocurrent nanoscopy, and reveal with nanometer spatial resolution unique observations of the optical properties of twisted 2D materials. We will also show record-small nanoscale polaritonic cavities, where the resonances are not associated to the eigenmodes of the cavity.

Authors: Frank Koppens, ICFO -Institut de Ciencies Fotoniques

SW3F.2

Stacking of Two-Dimensional Materials to Large-Area Heterostructures by Wafer Bonding

Presenter: Arne Quellmalz , *KTH Royal Institute of Technology*

The integration of 2D materials for photonic applications is not compatible with high-volume manufacturing. We report a generic methodology that uses only readily available semiconductor equipment and experimentally demonstrate the stacking of graphene and molybdenum disulfide (MoS₂).

Authors: Arne Quellmalz, KTH Royal Institute of Technology / Simon Sawallich, Protemics GmbH / Maximilian Prechtel, Universität der Bundeswehr München / Oliver Hartwig, Universität der Bundeswehr München / Siwei Luo, Universität der Bundeswehr München / Stefan Wagner, AMO GmbH / Georg Düsberg, Universität der Bundeswehr München / Max Lemme, AMO GmbH / Frank Niklaus, KTH Royal Institute of Technology / Kristinn Gylfason, KTH Royal Institute of Technology

SW3F.3

Direct Growth of Transparent Graphene Electrodes on GaN LEDs Using Metal Proximity Catalytic Effect

Presenter: Fangzhu Xiong , *Beijing University of Technology*

High-quality graphene was obtained directly on GaN epiwafers at low temperature using the metal proximity catalytic effect. Metal catalyze graphene without contacting with it ensure high performance of graphene-GaN LED.

Authors:Fangzhu Xiong, Beijing University of Technology / Weiling Guo, Beijing University of Technology / Le Wang, Beijing University of Technology / Zaifa Du, Beijing University of Technology / Jie Sun, Fuzhou University

SW3F.4

Enhancing Second Harmonic Generation of Transition Metal Dichalcogenides Through 1D Nanoscrolls

Presenter: Shengxi Huang , *Pennsylvania State University*

We fabricated MoS2 nanoscrolls with different chiralities. As a 1D material, MoS2 nanoscrolls show second harmonic generation (SHG) intensity up to 98 times stronger than that of monolayer MoS2, with chirality dependence.

Authors:Qingkai Qian, Pennsylvania State University / Shengxi Huang, Pennsylvania State University

SW3F.5

Two-Dimensional GeP-Based NIR Phototransistor

Presenter: Ghada Dushaq , *New York University*

we demonstrate a gate-tunable photodetector based on multilayerd 2D GeP. Results show high responsivity and relatively low dark current with stable, reproducible, and remarkable broadband spectral response from UV to optical communication wavelengths

Authors:Ghada Dushaq, New York University / Mahmoud Rasras, New York University

SW3F.6

A Neuromorphic Graphene UV Phototransistor

Presenter: Christian Frydendahl , *Hebrew University of Jerusalem*

We demonstrate an artificial neuron by integrating graphene with flash memory. The structure exhibits neural plasticity by doping graphene via trapped charges in a nitride layer, with potential applications in memory, tunable plasmonics, sensing, etc.

Authors:Christian Frydendahl, Hebrew University of Jerusalem / S.R.K.Chaitanya Indukuri, Hebrew University of Jerusalem / Meir Grajower, California Institute of Technology / Noa Mazurski, Hebrew University of Jerusalem / Joseph Shappir, Hebrew University of Jerusalem / Uriel Levy, Hebrew University of Jerusalem

SW3F.7

Graphdiyne-Based Saturable Absorber for Mode-Locked Erbium-Doped Fiber Laser

Presenter: Q. Wu , *Beihang University*

We demonstrate a self-starting, all-fiber erbium-doped laser mode-locked by graphdiyne-based saturable absorber, delivering 364 fs pulses with 9.18 nm spectral bandwidth. Our work highlights the potential of graphdiyne-based devices for future photonic technologies.

Authors:Jingjing Fan, Beihang University / Meng Zhang, Beihang University / Q. Wu, Beihang University / Wenli Bao, Shenzhen University / Han Zhang, Shenzhen University / Zheng Zheng, Beihang University

SW3B

Novel Device Applications

Presenter: Karen Grutter , *The Laboratory for Physical Sciences*

SW3B.1

on-Chip Optical Tweezers Based on Micro-Reflectors

Presenter: Jin-Sheng Lu , *Harvard University*

We introduce a new class of on-chip optical tweezers with high trapping efficiency, compact footprint, and broadband operation by integrating free-form micro-reflectors to the facets of waveguides.

Authors:Jin-Sheng Lu, Harvard University / Shaoliang Yu, Massachusetts Institute of Technology / Vincent Ginis, Harvard University / Simon Kheifets, Harvard University / Soon Wei Daniel Lim, Harvard University / Min Qiu, Westlake University / Tian Gu, Massachusetts Institute of Technology / Juejun Hu, Massachusetts Institute of Technology / Federico Capasso, Harvard University

SW3B.2

Sidelobe-Free Beam-Steering Using Optical Phased Arrays for Neural Probes

Presenter: Fu-Der Chen , *Max Plank Institute*

We demonstrate implantable neural probes with integrated silicon nitride optical phased arrays (OPAs) fabricated on 200mm wafers for wavelengths near 480nm. A free-propagation slab enables the emission of a single steerable beam from an OPA.

Authors:Fu-Der Chen, Max Plank Institute / Youngho Jung, Max Plank Institute / Tianyuan Xue, University of Toronto / Jason C. C. Mak, University of Toronto / Xianshu Luo, Advanced Micro Foundry / Patrick Lo, Advanced Micro Foundry / Michael Roukes, California Institute of Technology / Joyce Poon, Max Plank Institute / Wesley Sacher, Max Plank Institute

SW3B.3

Material Identification by Plasmonic Infrared Microspectrometer Employing Machine Learning

Presenter: Jiajun Meng , *University of Melbourne*

We demonstrate a microspectrometer comprising plasmonic filters integrated with an infrared camera. Blackbody light illuminates the material being studied, with transmitted light collected by the microspectrometer. The latter uses machine learning to identify the material.

Authors:Jiajun Meng, University of Melbourne / Luke Weston, University of Melbourne / Sivacarendran Balendhran, University of Melbourne / Dandan Wen, University of Melbourne / Jasper Cadusch, University of Melbourne / Ranjith Unnithan, University of Melbourne / Kenneth Crozier, University of Melbourne

SW3B.4

High Repetition Rate Detection With Dual-Comb Vernier Frequency Division in Microresonators

Presenter: Zijiao Yang , *University of Virginia*

A Vernier frequency division method is reported in this work to detect sub-THz microresonator soliton rep-rate. Our method vastly reduces the electrical bandwidth for rep-rate detection, and we stabilized 200 GHz rep-rate to a 1 GHz reference.

Authors:Zijiao Yang, University of Virginia / Beichen Wang, University of Virginia / Xiaobao Zhang, University of Virginia / Xu Yi, University of Virginia

SW3B.5

Towards an Integrated Exceptional Point Enhanced Ring Laser Gyroscope

Presenter: Yuzhou Liu , *University of Southern California*

Utilizing the properties of exceptional points, we propose and demonstrate a new type of ring laser gyroscope on an active photonic integrated platform that exhibits a considerably higher sensitivity.

Authors:Yuzhou Liu, University of Southern California / Ardy Winoto, Infinera Inc. / Gloria Hoefler, Infinera Inc. / Demetrios Christodoulides, University of Central Florida, CREOL / Mercedeh Khajavikhan, University of Southern California

SW3B.6

Photonic Arbitrary Linear Transformations in the Frequency Synthetic Dimension

Presenter: Avik Dutt , *Stanford University*

Arbitrary linear transformations are central to photonic quantum information processing and machine learning. We present a photonic architecture of time-modulated micro-ring resonators with tunable couplings between frequency modes to achieve arbitrary frequency-dimension linear transformations.

Authors: Siddharth Buddhiraju, Stanford University / Avik Dutt, Stanford University / Momchil Minkov, Stanford University / Ian Williamson, Stanford University / Shanhui Fan, Stanford University

SW3B.7

Quantum Information Hardware Based on Color Center Nanophotonics

Invited

Presenter: Marina Radulaski, *University of California Davis*

Color centers integrated into nanophotonic devices offer functionalities applied in quantum communication, simulation and computation. We explore various regimes of single-emitter and multi-emitter cavity quantum electrodynamics for applications in quantum information hardware.

Authors: Marina Radulaski, University of California Davis / Victoria Norman, University of California Davis / Sridhar Majety, University of California Davis / Pranta Saha, University of California Davis / Jesse Patton, University of California Davis / Liang Li, University of California Davis / Miranda Bell, University of California Davis / Richard Scalettar, University of California Davis

SW3Q

Particle Acceleration, Far-IR and High Harmonic Source Generation

Presenter: Csaba Toth, *Lawrence Berkeley National Laboratory*

SW3Q.1

Petawatt Laser Guiding and Electron Beam Acceleration to 8 GeV in Laser-Heated Capillary Discharge Waveguide

Invited

Presenter: Anthony Gonsalves, *Lawrence Berkeley National Laboratory*

The combination of an electrical discharge with laser plasma heating was used to guide petawatt laser pulses over 15 diffraction lengths and generate electron beams with energy up to 8GeV via laser wakefield acceleration.

Authors: Anthony Gonsalves, Lawrence Berkeley National Laboratory

SW3Q.2

Improvement of the Temporal Contrast of pre-Pulses by Post-Pulses in a Petawatt J-KAREN-P Laser Facility

Presenter: Hiromitsu Kiriyama , *National Inst. Quantum & Rad Sc & Tech*

We demonstrate the removal of the pre-pulses based on the exploration of the generation of pre-pulses by post-pulses through the nonlinear process associated with the B-integral in the laser chain of the petawatt facility J-KAREN-P.

Authors:Hiromitsu Kiriyama, National Inst. Quantum & Rad Sc & Tech / Yasuhiro Miyasaka, National Inst. Quantum & Rad Sc & Tech / Akito Sagisaka, National Inst. Quantum & Rad Sc & Tech / Koichi Ogura, National Inst. Quantum & Rad Sc & Tech / Mamiko Nishiuchi, National Inst. Quantum & Rad Sc & Tech / Akira Kon, National Inst. Quantum & Rad Sc & Tech / Alexander Pirozhkov, National Inst. Quantum & Rad Sc & Tech / Yuji Fukuda, National Inst. Quantum & Rad Sc & Tech / Nicholas Dover, National Inst. Quantum & Rad Sc & Tech / Kotaro Kondo, National Inst. Quantum & Rad Sc & Tech / Masaki Kando, National Inst. Quantum & Rad Sc & Tech / Kiminori Kondo, National Inst. Quantum & Rad Sc & Tech / Stefan Bock, Helmholtz-Zentrum Dresden-Rossendorf (HZDR) / Tim Ziegler, Helmholtz-Zentrum Dresden-Rossendorf (HZDR) / Tomas Püschel, Helmholtz-Zentrum Dresden-Rossendorf (HZDR) / Karl Zeil, Helmholtz-Zentrum Dresden-Rossendorf (HZDR) / Ulrich Schramm, Helmholtz-Zentrum Dresden-Rossendorf (HZDR)

SW3Q.3

A Study of Ultrashort Pulse Train Generated via Tailored Transparent Delay Mask

Presenter: Andrea Marasciulli , *CNR-INO*

Trains of femtosecond pulses generated by a delay mask are considered for application to laser driven acceleration of particles. Here we show the results of numerical simulations and a preliminary experimental characterization of a two-pulse configuration.

Authors:Andrea Marasciulli, CNR-INO / Fernando Brandi, CNR-INO / Lorenzo Fulgentini, CNR-INO / Luca Labate, CNR-INO / Paolo Tomassini, CNR-INO / Leonida Gizzi, CNR-INO

SW3Q.4

Simulations on the Propagation Dynamics of TW Square-Aperture CO₂ Laser Pulses in the Atmosphere

Presenter: Paris Panagiotopoulos , *University of Arizona*

We simulate the linear and nonlinear propagation dynamics of multi-TW 10.6 μm square-frame wavepackets in the atmosphere. It is shown that the location of the obscuration is critical for multiple-filamentation and energy delivery downstream.

Authors:Paris Panagiotopoulos, University of Arizona / Miroslav Kolesik, University of Arizona / Victor Hasson, University of Arizona / Sergei Tochitsky, University of California Los Angeles / Jerome Moloney, University of Arizona

SW3Q.5

Flexible High-Field Far-IR Source for Driving Nonlinear Phononics

Presenter: Jiaoyang Zheng, *Cornell University*

We report a high-field sub-picosecond far-infrared (8-21 μm) tunable source with flexible control of bandwidth and pulse duration that can be used to study nonlinear phononic coupling effects arising from resonant excitation of infrared-active phonons.

Authors: Wei-Zung Chang, Cornell University / Jiaoyang Zheng, Cornell University / Noah Flemens, Cornell University / Dylan Heberle, Cornell University / Jeffrey Moses, Cornell University

SW3Q.6

Choice of an Efficient Gas Target for High-Order Harmonic Generation

Presenter: Robin Weissenbilder, *Lund University*

We present a simple method for choosing an efficient high-order harmonic generation (HHG) gas target, given the driving laser characteristics. The predictions are validated by simulations based on solving the time-dependent Schrödinger and propagation equations.

Authors: Robin Weissenbilder, Lund University / Chen Guo, Lund University / Cord Arnold, Lund University / Anne L'huillier, Lund University

SW3Q.7

Recent Progress and Perspectives of High-Harmonic Generation Inside Thin-Disk Laser Oscillators

Presenter: Jakub Drs, *University of Neuchatel*

We discuss recent developments and the state-of-the-art of high-harmonic generation inside thin-disk laser oscillators and their potential for further scaling of the XUV performance.

Authors: Jakub Drs, University of Neuchatel / Julian Fischer, University of Neuchatel / François Labaye, University of Neuchatel / Norbert Modsching, University of Neuchatel / Valentin J. Wittwer, University of Neuchatel / Thomas Südmeyer, University of Neuchatel

SW3J

Ultrafast Pulse Measurements

Presenter: Zsuzsanna Major, *GSI Helmholtzzentrum für Schwerionenfors*

SW3J.1

Unified FROG for Characterizing 205 nm to 2000 nm, s or p Polarization, From 2-Cycle to 100 ps.

Presenter: Derrek Wilson , *Institut National de la Recherche Scientifique*

A Frequency Resolved Optical Gating instrument accepting s or p polarized input pulses ranging from 205 nm to 2000 nm, durations from 2 cycles to 100 ps, and nano-Joule energies is presented.

Authors:Derrek Wilson, Institut National de la Recherche Scientifique / Alicia Ramirez, few-cycle Inc. / Mayank Kumar, Institut National de la Recherche Scientifique / Adrien Longa, Institut National de la Recherche Scientifique / Antoine Laramée, Institut National de la Recherche Scientifique / Heide Ibrahim, Institut National de la Recherche Scientifique / François Légaré, Institut National de la Recherche Scientifique / Bruno Schmidt, few-cycle Inc.

SW3J.2

Spatiospectral Characterization of Pulsed-Beams via Broadband Ptychography

Presenter: David Goldberger , *Colorado School of Mines*

We demonstrate spatio-spectral characterization of complicated pulse-beams via Broadband Ptychography. Reconstructions of the complex field of multiple spectral components from complicated probe illumination produced by a modelocked Ti:sapphire laser are presented.

Authors:David Goldberger, Colorado School of Mines / Jonathan Barolak, Colorado School of Mines / Charles Durfee, Colorado School of Mines / Daniel Adams, Colorado School of Mines

SW3J.3

PHz Electronic Device Design for Waveguide-Integrated Carrier-Envelope Phase Detection

Presenter: Dario Cattozzo Mor , *Massachusetts Institute of Technology*

We design and simulate electrically-connected plasmonic bow-tie nanoantennas integrated onto a Si₃N₄ waveguide for carrier-envelope-phase detection of few-cycle pulse trains. Our results demonstrate a promising route to waveguide-integrated petahertz electronics for CEP detection and stabilization.

Authors:Dario Cattozzo Mor, Massachusetts Institute of Technology / Yujia Yang, Massachusetts Institute of Technology / Neetesh Singh, Deutsches Elektronen Synchrotron (DESY) & Center for Free-Electron Laser Science & University of Hamburg / Felix Ritzkowsky, Deutsches Elektronen Synchrotron (DESY) & Center for Free-Electron Laser Science & University of Hamburg / Franz Kärtner, Deutsches Elektronen Synchrotron (DESY) & Center for Free-Electron Laser Science & University of Hamburg / Karl Berggren, Massachusetts Institute of Technology / Phillip Keathley, Massachusetts Institute of Technology

SW3J.4

Orbital-Angular-Momentum-Based Detection of Internal Phase Motions in Optical Soliton Molecules

Presenter: Yuwei Zhao , *TIANJIN UNIVERSITY*

We demonstrate an orbital angular momentum (OAM)-resolved diagnostics that maps the temporal phase difference to spatial interference pattern to extract the long-term relative phase evolution behaviors in femtosecond doublet and triplet soliton molecules.

Authors: Yuwei Zhao, TIANJIN UNIVERSITY / Jintao Fan, Leibniz Universität Hannover / Youjian Song, TIANJIN UNIVERSITY / Ming-lie Hu, TIANJIN UNIVERSITY

SW3J.5

All-Optical Sampling of few-Cycle Infrared Waveforms Using Tunneling in a Solid

Presenter: Yangyang Liu , *University of Central Florida*

We demonstrate that tunneling and multiphoton excitation in a dielectric solid can provide an ultrafast temporal “gate” for characterizing high-energy, few-cycle waveforms. Using this technique, near- and mid-infrared pulses are measured.

Authors: Yangyang Liu, University of Central Florida / Shima Gholam-Mirzaei, University of Central Florida / John Beetar, University of Central Florida / Jonathan Nesper, University of Central Florida / Ahmed Yousif, University of Central Florida / M. Nrisimhamurty, University of Central Florida / Michael Chini, University of Central Florida

SW3J.6

Single-Shot Measurement of Infrared Laser Waveforms Using Multiphoton Photoconductivity in an Image Sensor

Presenter: Yangyang Liu , *University of Central Florida*

Perturbative nonlinear optics has long been leveraged to characterize the duration of femtosecond pulses in a single shot. We show that multiphoton photoconductivity in an image sensor allows single-shot measurement of few-cycle optical waveforms.

Authors: Yangyang Liu, University of Central Florida / Jonathan Nesper, University of Central Florida / Michael Chini, University of Central Florida

SW3J.7

Reliable Characterization of Unstable Pulse Trains in Third-Order Versions of Frequency-Resolved Optical Gating

Presenter: Rick Trebino , *Georgia Institute of Technology*

We show that the RANA approach, which reliably retrieves pulses in stable trains, reliably retrieves pulses in third-order FROG even in the presence of unstable pulse shapes. Importantly, it reliably indicates the presence of instability.

Authors: Rana Jafari, Georgia Institute of Technology / Rick Trebino, Georgia Institute of Technology

SW3J.8

Demonstration of Spectrally Recycled Space-Time Wave Packets

Presenter: Layton Hall , *University of Central Florida, CREOL*

By spectrally recycling the spatial spectrum of a space-time wave packet, we circumvent the intrinsic correlation between the spatial and temporal bandwidths, thereby enabling ultra-low group velocities in free space at low numerical aperture.

Authors:Layton Hall, University of Central Florida, CREOL / Ayman Abouraddy, University of Central Florida, CREOL / Rick Trebino, University of Central Florida, CREOL

SW3C

Silicon Photonics

Presenter: Ozdal Boyraz , *University of California Irvine*

SW3C.1

Microring Modulators in a New Silicon Photonics Optimized 45 nm Monolithic Electronics-Photonics SOI CMOS Platform

Presenter: Kenaish Al Qubaisi , *Boston University*

We report on microring modulators in the new 45CLO photonics-optimized 45 nm electronic-photonic CMOS platform. Interdigitated disk and vertical-junction rib microring designs are demonstrated, with 20 GHz bandwidth at 25 Gbps data rate.

Authors:Kenaish Al Qubaisi, Boston University / Anatol Khilo, Ayar Labs / Hayk Gevorgyan, Boston University / Milos Popovic, Boston University

SW3C.2

Loop Reflector Assisted Si-Ge Waveguide Avalanche Photodiodes

Presenter: Yuan Yuan , *Hewlett Packard Labs*

A Si-Ge waveguide avalanche photodiode with loop reflector has been demonstrated to enhance the responsivity without compromising the speed. It enables a responsivity of 1.12 A/W, a bandwidth of 25 GHz, a constant gain-bandwidth product of 296 GHz, and a highest gain-bandwidth product of 497 GHz.

Authors:Yuan Yuan, Hewlett Packard Labs / Zhihong Huang, Hewlett Packard Labs / Xiaoge Zeng, Hewlett Packard Labs / Di Liang, Hewlett Packard Labs / Marco Fiorentino, Hewlett Packard Labs / Raymond Beusoleil, Hewlett Packard Labs

SW3C.3

Experimental Demonstration of a WDM-Based Integrated Optical Decoder for Compact Optical Computing

Presenter: Chenghao Feng, *University of Texas at Austin*

We propose and experimentally demonstrate a 3-8 wavelength-division-multiplexing (WDM) based optical decoder using microring-based add-drop switches and filters. The proposed decoder has a smaller footprint and consumes lower power compared with previous designs.

Authors: Chenghao Feng, University of Texas at Austin / Jiaqi Gu, University of Texas at Austin / Hanqing Zhu, University of Texas at Austin / David Pan, University of Texas at Austin / Ray Chen, University of Texas at Austin

SW3C.4

One-to-one Coupling Higher Order Modes in a Fiber to Higher Order Modes in Silicon Waveguide

Presenter: Oscar Jimenez Gordillo, *Columbia University*

We demonstrate experimentally a mode converter between a silicon waveguide and a few-mode fiber compatible with mode-division multiplexing. We convert 4 TE modes of a silicon waveguide to the $LP_{01,x}$, $LP_{01,y}$, $LP_{11a,x}$, $LP_{11a,y}$ modes of the fiber.

Authors: Oscar Jimenez Gordillo, Columbia University / Utsav Dave, Columbia University / Michal Lipson, Columbia University

SW3C.5

High Shift Efficiency O-Band Spoked-Ring Modulator Allowing Fully Electro-Optic Channel Tuning in a 45nm CMOS Platform

Highlighted Talk

Presenter: Hayk Gevorgyan, *Boston University*

Vertical-junction microring modulators are demonstrated in a 45 nm CMOS platform, showing record O-band resonance-shift efficiency 30 GHz/V. This enables wavelength locking and tolerance/temperature compensation without thermal tuning, for efficient, wide parallel optical buses and cryogenic links.

Authors: Hayk Gevorgyan, Boston University / Derek Van Orden, Ayar Labs Inc. / Deniz Onural, Boston University / Dorde Gluhovic, Boston University / Bohan Zhang, Boston University / Anatol Khilo, Ayar Labs Inc. / Vladimir Stojanovic, University of California, Berkeley / Mark Wade, Ayar Labs Inc. / Milos Popovic, Boston University

SW3C.6

Hybrid Chalcogenide-Silicon Subwavelength Grating Waveguides Microring Resonators

Presenter: Philippe Jean, *COPL*

We present the fabrication and optical measurement of hybrid chalcogenide-silicon subwavelength grating waveguides microring resonators. The ring resonators exhibit nearly athermal behavior with $d\lambda/dT = -2.87$ pm/K and intrinsic quality factor of $Q_i > 50000$.

Authors: Philippe Jean, COPL / Alexandre Douaud, COPL / Sophie Larochelle, COPL / Younès Messaddeq, COPL / Wei Shi, COPL

SW3C.7

Observation of 1D Self-Healing Airy Beams on a Silicon Photonic Chip

Presenter: Rui Chen , *University of Washington*

The self-healing and non-diverging behaviours of Airy beams are observed on a silicon-on-insulator integrated photonic platform near 1550nm.

Authors: Zhuoran Fang, University of Washington / Rui Chen, University of Washington / Albert Ryou, Atom Computing / Arka Majumdar, University of Washington

SW3A

Microwave Photonics

Presenter: Andreas Beling , *University of Virginia*

SW3A.1

Single-Sideband Modulation Through Polarization Interband Transition in Thin-Film Lithium Niobate Waveguide

Presenter: Di Zhu , *Harvard University*

We demonstrate an electro-optic polarization modulator on thin-film lithium niobate. It realizes indirect interband transition between two polarization modes and enables non-reciprocal, single-sideband modulation.

Authors: Di Zhu, Harvard University / Yaowen Hu, Harvard University / Boris Desiatov, Harvard University / Linbo Shao, Harvard University / Mengjie Yu, Harvard University / Marko Loncar, Harvard University

SW3A.2

An ENOB-Enhanced Optical Analog-to-Digital Converter With Cascaded Step-Size MMI and Modulo Operation

Presenter: Yan He , *Beijing Univ of Posts & Telecom*

We experimentally demonstrated an ENOB-enhanced optical ADC with modulo operation on 7-period optical input/output transfer function of cascaded step-size MMI. A 2.8-bit enhancement of ENOB was realized, compared to the previous one with only 1-period.

Authors: Yan He, Beijing Univ of Posts & Telecom / Chang Liu, Beijing Univ of Posts & Telecom / Jifang Qiu, Beijing Univ of Posts & Telecom / Yue Liu, Beijing Univ of Posts & Telecom / Yan Li, Beijing Univ of Posts & Telecom / Jian Wu, Beijing Univ of Posts & Telecom

SW3A.3

High Bit Resolution, Wavelength-Insensitive Coherent Electro-Optic Digital-to-Analog Converters Based on Circuit Topology

Presenter: Shota Kita, *NTT Corp.*

An electro-optic digital-to-analog converter consisting of Si cascaded Y branches presented wavelength-insensitive 4-bit-converted analog intensity with an identical input voltage of < 50 mV. The same configuration demonstrated up to 8-bit operation.

Authors: Shota Kita, NTT Corp. / Guangwei Cong, AIST / Kengo Nozaki, NTT Corp. / Morifumi Ohno, AIST / Yuriko Maegami, AIST / Noritsugu Yamamoto, AIST / Koji Yamada, AIST / Akihiko Shinya, NTT Corp. / Masaya Notomi, NTT Corp.

SW3A.4

Narrowband Microwave-Photonic Notch Filtering Using Brillouin Interactions in Silicon

Presenter: Shai Gertler, *Yale University*

We present narrowband RF-photonic filters in an integrated silicon platform. Using Brillouin interactions, the filters yield narrowband (~MHz) filter bandwidths with high signal rejection, and demonstrate tunability over a wide (~GHz) frequency range.

Authors: Shai Gertler, Yale University / Nils Otterstrom, Yale University / Michael Gehl, Sandia National Laboratories / Andrew Starbuck, Sandia National Laboratories / Christina Dallo, Sandia National Laboratories / Andrew Pomerene, Sandia National Laboratories / Douglas Trotter, Sandia National Laboratories / Anthony Lentine, Sandia National Laboratories / Peter Rakich, Yale University

SW3A.5

Switchable and Broadband Silicon Integrated Microwave Photonic Filter

Presenter: Yuansheng Tao, *Peking University*

A silicon integrated microwave photonic filter with switchable filtering response and sub-GHz bandwidth is experimentally demonstrated. The frequency tunable range of the notch and bandpass filtering functions are 3-25 GHz and 3-20 GHz, respectively.

Authors:Yuansheng Tao, Peking University / Haowen Shu, Peking University / Ming Jin, Peking University / Zihan Tao, Peking University / Xingjun Wang, Peking University

SW3A.6

An InP Reflective SOA-EAM for 10 Gb/s Colorless Multi-IFoF/MmWave Fiber-Wireless Uplink in 5G Networks

Presenter: Kebede Tesema Atra , *III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti)*

We experimentally present a 10-Gb/s Fiber Wireless IFoF/V-band uplink of four 625Mbaud 16QAM signals with a linear, high-power monolithically integrated reflective electroabsorption modulator with semiconductor optical amplifier for 5G mmWave fronthaul networks.

Authors:Kebede Tesema Atra, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti) / Eugenio Ruggeri, Aristotle University of Thessaloniki, Center for Interdisciplinary Research and Innovation, Greece / Giancarlo Cerulo, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti) / Jean-Guy Provost, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti) / Karim Mekhazni, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti) / Christos Vagionas, Aristotle University of Thessaloniki, Center for Interdisciplinary Research and Innovation, Greece / Alexandre Garreau, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti) / Frederic Pommereau, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti) / Carmen Gomez, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti) / Catherine Fortin, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti) / Jean-Francois Paret, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti) / Arnaud Wilk, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti) / Cédric Ware, LTCl, Télécom Paris, Institut polytechnique de Paris / Didier Erasme, LTCl, Télécom Paris, Institut polytechnique de Paris / Franck Mallecot, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti) / Amalia Miliou, Aristotle University of Thessaloniki, Center for Interdisciplinary Research and Innovation, Greece / Mohand Achouche, III-V Lab (a joint laboratory between Nokia Bell Labs, Thales Research and Technology, and CEA Leti)

SW3A.7

Modulation Characteristics of a Delay-Controlled Optoelectronic Oscillator

Presenter: Pouria Sanjari , *University of Pennsylvania*

A rapidly adjustable, continuously tuned optoelectronic oscillator is implemented using an integrated variable delay line. The oscillator has a tuning range of 594-634MHz and is capable of being modulated with frequencies higher than 400MHz.

Authors: Pouria Sanjari, University of Pennsylvania / Firooz Aflatouni, University of Pennsylvania

SW3A.8

Optical Gyrotator and Microwave-to-Optical Converter Using HBAR Modes

Presenter: Anat Siddharth , *EPFL*

We demonstrate efficient modulation of optical resonators by partially releasing the substrate of the integrated MEMS-photonic stack. The increased interaction between the microwave and optical signals enables to realize gyrotators as well as MWoptical converters.

Authors: Anat Siddharth, EPFL / Terence Blésin, EPFL / Hao Tian, Purdue University / Wenle Weng, EPFL / Rui Wang, EPFL / Junqiu Liu, EPFL / sunil bhav, Purdue University / Tobias Kippenberg, EPFL

SW3D

Novel Biophotonic Illumination and Sources

Presenter: Michael Young , *University of Colorado*

SW3D.1

Pushing the Limits of High-Speed (Linear and Nonlinear) Microscopy

Tutorial

Presenter: Kevin Tsia , *University of Hong Kong*

This tutorial will cover the latest technologies that could allow researchers to reprioritize imaging speed in the microscopy design and applications, especially in capturing fast dynamic biological processes and large-scale interrogation of cells, tissues, or even organisms.

Authors: Kevin Tsia, University of Hong Kong

SW3D.2

Single-Shot Non-Diffracting Light-Sheet Microscopy by Dispersion of Light

Presenter: Vahid Ebrahimi , *University of Central Florida*

We demonstrate that non-diffracting light-sheet can be generated instantaneously by dispersing wavelengths of diode lasers or supercontinuum light source.

Authors:Vahid Ebrahimi, University of Central Florida / Jialei Tang, University of Central Florida / Kyu Young Han, University of Central Florida

SW3D.3

Entangled Two-Photon Absorption in Commercial Fluorophores

Presenter: Tobias Gäbler , *Fraunhofer Institute of Applied Optics and Precision Engineering IOF*

Our study addresses the applicability of simple and common fluorophores for entangled two-photon fluorescence microscopy. Using CW-pumped SPDC waveguides, we can measure linear absorption rates of entangled photons in standard fluorophores in life science.

Authors:Tobias Gäbler, Fraunhofer Institute of Applied Optics and Precision Engineering IOF / Nitish Jain, Fraunhofer Institute of Applied Optics and Precision Engineering IOF / Josue León Torres, Fraunhofer Institute of Applied Optics and Precision Engineering IOF / Patrick Hendra, Fraunhofer Institute of Applied Optics and Precision Engineering IOF / Markus Gräfe, Fraunhofer Institute of Applied Optics and Precision Engineering IOF

SW3D.4

Deep Learning Powered Single Cell Biological Microlasers

Presenter: Zhen Qiao , *Nanyang Technological University*

Laser modes from single cell lasers were analyzed by deep learning analysis. The results demonstrated a prediction of cell sizes with subwavelength-level accuracy, showing the potential of laser mode imaging in single cell physical analysis.

Authors:Zhen Qiao, Nanyang Technological University / Wen Sun, Nanyang Technological University / Randall Ang, Nanyang Technological University / YU-CHENG CHEN, Nanyang Technological University

SW3D.5

Optofluidic Fiber Laser With Full-Color Lasing Emission

Presenter: Chenlu Wang , *Nanyang Technological University*

A programmable full-color optofluidic fiber laser based on manipulating the nanostructure of dye-doped cholesteric liquid crystal microdroplets was first presented. This work paves the way for the tunable light source with high controllability.

Authors:Chenlu Wang, Nanyang Technological University / Chaoyang Gong, Nanyang Technological University / Yifan Zhang, Nanyang Technological University / YU-CHENG CHEN, Nanyang Technological University

AW3E

A&TTR on Integrated Photonics in Neural Networks II

Presider: Yasha Yi , *University of Michigan*

AW3E.1

Optical Processing for Artificial Neural Vision

Invited

Presenter: David Brady , *Duke University*

Convolutional neural networks have become established as the primary mechanisms for image processing over the past decade. While general purpose optical neural networks remain a long term project, in the near term optical prefilters act as the first layers of electronic deep convolutional networks and enable 10-100x reduction in system power per reconstructed voxel.

Authors:David Brady, Duke University

AW3E.2

All-Optical Neural Network With Programmable Linear Transformation

Invited

Presenter: Xue Feng , *Tsinghua University*

In our previous works, programmable arbitrary linear optical operations have been demonstrated on discrete phase-coherent spatial modes. Thus, in this work, we proposed and demonstrated a programmable ONN scheme for various image identification tasks.

Authors:Yidong Huang, Tsinghua University / Xue Feng, Tsinghua University

AW3E.3

Single-Pixel Image Classification via Nonlinear Optics and Deep Neural Network

Presenter: Santosh Kumar , *Stevens Institute of Technology*

We propose and experimentally demonstrate a hybrid system which utilizes a nonlinear mode-selective optical method to extract the features with single-pixel detection and subsequently recognize the high-resolution images from a deep neural network

Authors:Santosh Kumar, Stevens Institute of Technology / Ting Bu, Stevens Institute of Technology / He Zhang, Stevens Institute of Technology / Irwin Huang, Stevens Institute of Technology / Yuping Huang, Stevens Institute of Technology

AW3E.4

A Codesigned Photonic Electronic MAC Neuron With ADC-Embedded Nonlinearity

Presenter: Lorenzo De Marinis , *Scuola Superiore Sant'Anna*

We present a reduced-precision integrated photonic electronic multiply-accumulate (MAC) neuron with ADC-embedded nonlinearity. The proposed device trades off speed with resolution, outperforming both analog and digital electronic solutions in terms of speed and energy consumption

Authors:Lorenzo De Marinis, Scuola Superiore Sant'Anna / Alessandro Catania, University of Pisa / Piero Castoldi, Scuola Superiore Sant'Anna / Paolo Bruschi, University of Pisa / Massimo Piotto, University of Pisa / Nicola Andriolli, National Research Council of Italy

AW3E.5

Massively-Parallel Amplitude-Only Fourier Optical Convolutional Neural Network

Presenter: Volker Sorger , *George Washington University*

Here we introduce a novel amplitude-only Fourier-optical processor paradigm and demonstrate a prototype system capable of processing large-scale $\sim(2,000 \times 1,000)$ matrices in a single time-step and 100 microsecond-short latency, for accelerating machine-learning applications.

Authors:Mario Miscuglio, George Washington University / Zibo Hu, George Washington University / Shurui Li, UCLA / Jonathan George, George Washington University / Roberto Capanna, George Washington University / Hamed Dalir, Optelligence LLC / Philippe Bardet, George Washington University / Puneet Gupta, UCLA / Volker Sorger, George Washington University

AW3E.6

Conditional Machine Learning-Based Inverse Design Across Multiple Classes of Photonic Metasurfaces

Presenter: Christopher Yeung , *University of California, Los Angeles*

We present a machine learning-based photonics design strategy centered on encoding image colors with material and structural data. Given input target spectra, our model can accurately determine the optimal metasurface class, materials, and structure.

Authors:Christopher Yeung, University of California, Los Angeles / Ryan Tsai, University of California, Los Angeles / Benjamin Pham, University of California, Los Angeles / Yusaku Kawagoe, University of California, Los Angeles / David Ho, University of California, Los Angeles / Julia Liang, University of California, Los Angeles / Mark Knight, Northrop Grumman Corporation / Aaswath Raman, University of California, Los Angeles

A&TTR on Optical Technologies for Autonomous Cars and Mobility

Presenter: Mohammad Umar Piracha , *AEye, Inc.*

AW31.1

Autonomous Cars and Lidar

Invited

Presenter: Simon Verghese , *Lidar Systems at Waymo*

Before graduating from X as Waymo, Google's autonomous car project had been using custom sensors such as lidars, radars, and cameras for several years. In their 5th generation, the sensors are designed to meet the challenging requirements of moving people and goods safely and efficiently in dense cities and on highways. Our goal is to make them affordable while meeting the performance needed for driverless operation in various applications and weather conditions. This talk will review some history of the project and describe a few use-cases for lidars and machine learning on Waymo vehicles.

Authors: Simon Verghese, Lidar Systems at Waymo

AW31.3

Optical 3D Sensors and Applications

Invited

Presenter: Rui Zhang , *Amazon Lab 126*

We will talk about sensor technologies used for autonomous driving cars, e.g. stereo camera, APD, SPAD, FMCW, 360-degree Lidar, and facing-forward Lidar. We will also briefly introduce rule based and deep-learning based obstacle detection approaches.

Authors: Rui Zhang, Amazon Lab 126

AW31.4

The Road to Infinite Resolution With Baraja Spectrum-Scan

Invited

Presenter: Cibby Pulikkaseril , *Baraja*

Autonomous vehicles require high performance LIDAR in order to achieve transformational levels of autonomy - in this talk, Cibby Pulikkaseril, co-founder and CTO at Baraja, will present common requirements for automotive LIDAR. From this, he will derive the physical limitations of technologies in the space, and how Baraja aims to excel.

Authors: Cibby Pulikkaseril, Baraja

AW31.2

How Self-Driving Cars See, Perceive, and Navigate With C-SWaP in Mind

Invited

Presenter: Christy Fernandez-Cull , *Massachusetts Inst of Tech Lincoln Lab*

This talk will focus on Lyft Level 5's platforms and it's role in improving people's lives with the worlds best transportation in mind. We will highlight strengths and weakness of sensing modalities, highlight cost, and comment on both the constellation and orchestration of sensors on vehicle. This talk is the cross-section of hardware and software is leveraged for sense, think and act functions on an autonomous vehicle.

Authors:Christy Fernandez-Cull, Massachusetts Inst of Tech Lincoln Lab

12:00 - 14:20 (Pacific Time (US & Canada) DST, UTC - 07:00)

JW3G

Special Symposium - Symposium- Mid-infrared and Thermal Photonics II: Mid-IR Photonics From Glass to Gas

Presenter: Camille Bres , *EPFL*

JW3G.1

SWIR to LWIR Standoff Chemical Sensing Using Comb Sources

Invited

Presenter: Inuk Kang , *LGS Labs, CACI*

We present SWIR to LWIR standoff chemical sensing using comb sources. We developed agile fiber-based comb sources covering ~1.55-2 μ m and 8-13 μ m. Chemical agents are identified by analyzing the return spectra using a machine-learning algorithm.

Authors:Inuk Kang, LGS Labs, CACI / Mihaela Dinu, LGS Labs, CACI / Andrew Grant, LGS Labs, CACI / Jim Jaques, LGS Labs, CACI / Luke Pfister, Los Alamos National Laboratory / Rohit Bhargava, UIUC / Scott Carney, University of Rochester

JW3G.2

MIR Glass Integrated Photonics

Invited

Presenter: Steve Madden , *Australian National University*

Integrated Photonics revolutionized fiber optic communications and promises the same for Mid-infrared sensor technologies. This paper will discuss the crucial roles glass materials can play through their inherent planar processibility and range of optical functionalities.

Authors: Steve Madden, Australian National University

JW3G.4

(Withdrawn) Towards Compact and Reliable mid-Infrared Supercontinuum Sources Based on Cascaded Fibers

Invited

Presenter: Thibaut Sylvestre , *CNRS FEMTO-ST Université Bourgogne Franche-comté*

We review all our recent works on supercontinuum generation towards the mid-IR using a variety of soft-glass photonic crystal fibers and report a compact and reliable cascaded fiber system spanning from 2 to 10 μm .

Authors: Thibaut Sylvestre, CNRS FEMTO-ST Université Bourgogne Franche-comté

JW3G.5

(Withdrawn) Mid-Infrared Photonics for Frequency-Comb Generation and Dual-Comb Spectroscopy

Invited

Presenter: Nathalie Picqué , *Max-Planck-Institut fur Quantenoptik*

Recent progress in mid-infrared photonics extends frequency comb techniques to the molecular fingerprint region from 2 to 20 μm , of prime interest to spectroscopy and sensing of molecules.

Authors: Nathalie Picqué, Max-Planck-Institut fur Quantenoptik

JW3G.3

New Frontier of Chemical Sensing With Integrated Photonics

Invited

Presenter: Sergio Nicoletti , *CEA - Leti*

Photoacoustic spectroscopy is a sensitive technique for chemical detection. Coupled with cascade lasers, photoacoustic can address applications in industrial control, emission monitoring or biomedical analyses. At CEA-Leti, we worked on sensors combining QCL and PA on a single chip.

Authors: Sergio Nicoletti, CEA - Leti

15:00 - 17:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Photon Emitters and Interfaces

Presenter: Galan Moody

FW4I.1

Low-Noise GaAs Quantum Dots in a $p-i-n$ Diode

Presenter: Liang Zhai , *University of Basel*

Our GaAs quantum dots device exhibits ultra-low noise as evidenced by optical linewidths close-to-the ideal limit, an elimination of blinking, charge locked by Coulomb blockade, high-fidelity spin initialization, and a long electron-spin lifetime.

Authors:Liang Zhai, University of Basel / Giang Nam Nguyen, University of Basel / Matthias C. Löbl, University of Basel / Clemens Spinnler, University of Basel / Alisa Javadi, University of Basel / Julian Ritzmann, Ruhr-Universität Bochum / Andreas Wieck, Ruhr-Universität Bochum / Arne Ludwig, Ruhr-Universität Bochum / Richard Warburton, University of Basel

FW4I.2

Single Photon Generation in a Topological Slow Light Waveguide

Presenter: Kazuhiro Kuruma , *Research Center for Advanced Science and Technology*

We report a topologically-protected single photon source in a slow light waveguide based on valley photonic crystals. Purcell-enhanced single photon generation from a quantum dot and its robust propagation in the topological waveguide are demonstrated.

Authors:Kazuhiro Kuruma, Research Center for Advanced Science and Technology / Hironobu Yoshimi, Research Center for Advanced Science and Technology / Yasutomo Ota, Institute for Nano Quantum Information Electronics / Ryota Katsumi, Research Center for Advanced Science and Technology / Masahiro Kakuda, Institute for Nano Quantum Information Electronics / Marko Loncar, Harvard University / Yasuhiko Arakawa, Institute for Nano Quantum Information Electronics / Satoshi Iwamoto, Research Center for Advanced Science and Technology

FW4I.3

Spin-Photon Interfaces for Quantum Networks

Invited

Presenter: Sophia Economou , *Virginia Tech*

I will present our scheme for generating photonic repeater graph states from a spin-photon interface and our novel dynamical decoupling protocols for selective, high-fidelity control of a nuclear spin register coupled to a defect spin.

Authors:Sophia Economou, Virginia Tech

FW4I.4

Field-Based Design of a Resonant Dielectric Antenna for Coherent Spin-Photon Interfaces

Presenter: Linsen Li , *Massachusetts Institute of Technology*

We propose a field-based design of dielectric antennas interfacing diamond color centers with a 0.4 numerical aperture far-field Gaussian mode. This enables a highly efficient spin-photon interface with 93.2% mode overlap and 421 Purcell Factor.

Authors:Linsen Li, Massachusetts Institute of Technology / Hyeongrak Choi, Massachusetts Institute of Technology / Mikkel Heuck, Massachusetts Institute of Technology / Dirk Englund, Massachusetts Institute of Technology

FW4I.5

Narrow-Linewidth tin-Vacancy Centers in Diamond Waveguides

Presenter: Alison Rugar , *Stanford University*

We have fabricated waveguides containing tin-vacancy centers in diamond, promising optically accessible spin qubit candidates. The tin-vacancy centers in waveguides display narrow linewidths of ~ 36 MHz.

Authors:Alison Rugar, Stanford University / Shahriar Aghaeimeibodi, Stanford University / Constantin Dory, Stanford University / Haiyu Lu, Stanford University / Patrick McQuade, Stanford University / Sattwik Deb Mishra, Stanford University / Shuo Sun, Stanford University / Zhi-Xun Shen, Stanford University / Nicholas Melosh, Stanford University / Jelena Vuckovic, Stanford University

FW4I.6

Room-Temperature Single-Photon Emitters in Silicon Nitride

Presenter: Alexander Senichev , *Purdue University*

We report the discovery of room-temperature quantum emitters in silicon nitride. Photophysical analysis reveals bright ($>10^5$ counts/s), stable, and pure single-photon emission with an average of $g^{(2)}(0)$ of about 0.25 collected from a hundred emitters.

Authors:Alexander Senichev, Purdue University / Samuel Peana, Purdue University / Zachariah Martin, Purdue University / Demid Sychev, Purdue University / Xiaohui Xu, Purdue University / Zhaxylyk Kudyshev, Purdue University / Alexei Lagutchev, Purdue University / Alexandra Boltasseva, Purdue University / Vladimir Shalaev, Purdue University

FW4I.7

Coherent Excitation of Hexagonal Boron Nitride Single Photon Emitters via Optical Repumping

Presenter: Simon White , *University of Technology Sydney*

Coherent excitation of quantum emitters in hexagonal boron nitride is inhibited by electron decay into intermediate dark states or spectral diffusion. We present an optical co-excitation scheme to reduce these transitions and amplify the photoluminescence.

Authors: Simon White, University of Technology Sydney / Ngoc My Hanh Duong, University of Technology Sydney / Alexander Solntsev, University of Technology Sydney / Je-Hyung Kim, Ulsan National Institute of Science and Technology / Mehran Kianinia, University of Technology Sydney / Igor Aharonovich, University of Technology Sydney

FW4K

Topological Physics Studied by Optical Spectroscopies

Presenter: Liuyan Zhao , *University of Michigan*

FW4K.1

Evolution of Nonthermal Electrons in Pump-Probe Electron Relaxation Dynamic

Presenter: MengXing Na , *University of British Columbia*

We study the relaxation of photoexcited electrons in graphite using TR-ARPES. Observed nonthermal electron distributions are modelled using Boltzmann rate-equations, leading to the identification of nonthermal phases in the fluence-delay phase space with broad implications.

Authors: MengXing Na, University of British Columbia / Fabio Boschini, University of British Columbia / Arthur K. Mills, University of British Columbia / Matteo Michiardi, University of British Columbia / Ryan P. Day, University of British Columbia / Berend Zwartsenberg, University of British Columbia / Giorgio Levy, University of British Columbia / Sergey Zhdanovich, University of British Columbia / Alexander F. Kemper, North Carolina State University / David Jones, University of British Columbia / Andrea Damascelli, University of British Columbia

FW4K.2

Propagation-Induced Radiation Limits in 3D Dirac Semimetal High Harmonic Generation

Presenter: Jeremy Lim , *Singapore University of Technology and Design*

We show that terahertz pulse propagation in 3D Dirac semimetals induces a phase shift in the nonlinear current, leading to destructive interference in the radiated harmonics and an optimal thickness for high harmonic generation.

Authors: Jeremy Lim, Singapore University of Technology and Design / Yee Sin Ang, Singapore University of Technology and Design / Lay Kee Ang, Singapore University of Technology and Design / Liangjie Wong, Nanyang Technological University

FW4K.3

Ultrafast Raman-Induced Coupling of Femtosecond Soliton Molecules via Optical Terahertz Phonons

Presenter: Georg Herink , *Universitat Bayreuth*

We identify the origin of closely-bound soliton states in femtosecond lasers via real-time spectroscopy: Impulsive Raman scattering stimulates coherent optical phonon vibrations, undulating the propagation of trailing solitons, enabling soliton-binding and rapid Raman-sampling.

Authors:Alexandra Voelkel, Universitat Bayreuth / Georg Herink, Universitat Bayreuth

FW4K.4

A Raman Perspective on Extreme Mobility in Topological Semimetals

Invited

Presenter: Kenneth Burch , *Boston College*

Topological semimetals display a range of novel transport phenomena, including enormous magnetoresistance and mobilities. Using Raman spectroscopy we have uncovered a novel mechanism for phonons to play a central role in this phenomena.

Authors:Kenneth Burch, Boston College

FW4K.5

Highly Efficient Terahertz Generation Using 3D Dirac Semimetal Cd₃As₂

Presenter: Lu Wang , *Nanyang Technological University*

We present Cd₃As₂ as a promising candidate for terahertz generation by leveraging its significant third-order optical nonlinearity. We predict an efficiency over 5000 times that of LiNbO₃ in a propagation distance of 300 nm.

Authors:Lu Wang, Nanyang Technological University / Jeremy Lim, Singapore University of Technology and Design / Liangjie Wong, Nanyang Technological University

FW4K.6

Spin-Phonon Interactions in Quantum Spin Liquid Candidate α -RuCl₃

Presenter: Yun-Yi Pai , *Oak Ridge National Laboratory*

We study spin-phonon interactions in quantum spin liquid candidate RuCl_3 under magnetic fields of up to 6T and mK temperatures with polarization-resolved Raman spectroscopy.

Authors:Yun-Yi Pai, Oak Ridge National Laboratory / Claire Marvinney, Oak Ridge National Laboratory / Matthew Feldman, Oak Ridge National Laboratory / Kai Xiao, Oak Ridge National Laboratory / Jiaqiang Yan, Oak Ridge National Laboratory / Benjamin Lawrie, Oak Ridge National Laboratory

FW4K.7

A Study of Phonon Modes of Magnetic Two-Dimensional Materials Using Optical Spectroscopy

Presenter: Jin ho Kang , *UCLA*

Raman spectroscopy measuring phonon vibration modes of $\text{MnBi}_{2n}\text{Te}_{3n+1}$ ($n=1,2$) showed abnormal changes in linewidths of MnBi_2Te_4 . Out-of-plane force constant was also estimated via Davydov splitting of A_{1g} mode (136 cm^{-1}) of MnBi_4Te_7 .

Authors:Jin ho Kang, UCLA / Yujin Cho, UCLA / liangbo liang, ORNL / Xiangru Kong, ORNL / Subhajit Ghosh, UCR / Fariborz Kargar, UCR / Chaowei Hu, UCLA / Alexander Balandin, UCR / David Geohegan, ORNL / Alexander A. Puzik, ORNL / Ni Ni, UCLA / Chee Wei Wong, UCLA

FW4G

Applications of Structured Light

Presenter: Kai Wang , *Stanford University*

FW4G.1

Structured Light in Biology

Tutorial

Presenter: Halina Rubinsztein-Dunlop , *University of Queensland*

Sculptured light promises high flexibility and an opportunity for trapping and driving complex biological systems enabling trapping and manipulating nano and micron-size objects or even using these objects inside a biological cell.

Authors:Halina Rubinsztein-Dunlop, University of Queensland

FW4G.2

Evolution of Total Angular Momentum and Berry Phase in 3D Structured Light

Presenter: Ahmed Dorrah , *Harvard University*

Vector beams can be structured to change their polarization state and topological charge locally with propagation. We report on the observation of Berry phase factor accompanying these transitions and provide a recipe for engineering it on demand.

Authors:Ahmed Dorrah, Harvard University / Michele Tamagnone, Harvard University / Noah Rubin, Harvard University / Aun Zaidi, Harvard University / Federico Capasso, Harvard University

FW4G.3

Conservation of Spatiotemporal Orbital Angular Momentum of Light in Second-Harmonic Generation

Presenter: Guan Gui , *JILA*

By generating the second-harmonic of spatiotemporal orbital angular momentum light, conservation of transverse orbital angular momentum is observed, while the topology of such second-harmonic pulses can be modified by complex spatiotemporal astigmatism.

Authors:Guan Gui, JILA / Nathan Brooks, JILA / Margaret Murnane, JILA / Henry Kapteyn, JILA / Chen-Ting Liao, JILA

FW4G.4

Optical Density Variations Induced by an Optical Vortex

Presenter: Ruitao Wu , *CREOL*

We demonstrate the steady-state reduction of optical density along the path of vortex beams. The adjustable properties of the external field control the temporal and spatial scales of this radial transport of mass.

Authors:Cristian-Hernando Acevedo, CREOL / Ruitao Wu, CREOL / Jerome Miller, Clemson University / Eric Johnson, Clemson University / Aristide Dogariu, CREOL

FW4G.5

Structuring Phase and Polarization Singularity Sheets in 2D

Presenter: Soon Wei Daniel Lim , *Harvard University*

Beyond one-dimensional optical singularity topologies, we demonstrate 0D (point) and 2D (sheet) singularities. We engineer phase and polarization sheet singularities through inverse-design, by maximizing the field phase gradient, and demonstrate metasurface-enabled realizations of each.

Authors:Soon Wei Daniel Lim, Harvard University / Joon-Suh Park, Harvard University / Maryna Meretska, Harvard University / Ahmed Dorrah, Harvard University / Federico Capasso, Harvard University

Nonlinear Nano-optics

Presider: Jinghui Yang

FW4H.1

Enhancement of Spontaneous Parametric Down-Conversion in Nonlinear Metasurfaces

Presenter: Anna Fedotova , *Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena*

We experimentally demonstrate biphoton generation by spontaneous parametric down-conversion in resonant metasurfaces. In our metasurfaces, Mie-type resonances enable over 7 times more efficient biphoton generation compared to an unstructured thin film.

Authors:Anna Fedotova, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Tomas Santiago, Max Planck Institute for the Science of Light / Vitaliy Sultanov, Max Planck Institute for the Science of Light / Maximilian Weissflog, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Mohammadreza Younesi, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Isabelle Staude, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Thomas Pertsch, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Frank Setzpfandt, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Maria Chekhova, Max Planck Institute for the Science of Light

FW4H.2

Extraordinarily Strong Second Harmonic Generation Enhancement in Hybrid Plasmon-Fiber Cavity System

Presenter: Qi Ai , *4th Physics Institute and Research Center SCoPE, University of Stuttgart, Pfaffenwaldring 57*

We demonstrate a high-quality plasmon-fiber cavity in a doubly resonant configuration which can exhibit second-harmonic generation with over 5 orders of magnitude enhancement compared to gold nanoparticles on a fused silica substrate. © 2020 The Author(s)

Authors:Qi Ai, 4th Physics Institute and Research Center SCoPE, University of Stuttgart, Pfaffenwaldring 57 / Florian Sterl, 4th Physics Institute and Research Center SCoPE, University of Stuttgart, Pfaffenwaldring 57 / Han Zhang, Department of Physics, The Chinese University of Hong Kong, Shatin / Jianfang Wang, Department of Physics, The Chinese University of Hong Kong, Shatin / Harald Giessen, 4th Physics Institute and Research Center SCoPE, University of Stuttgart, Pfaffenwaldring 57

FW4H.3

Nonlinear Metasurfaces With Asymmetric Light Generation

Highlighted Talk

Presenter: Sergey Kruk , *Paderborn University*

We demonstrate a novel class of metadevices with asymmetric nonlinear response. We fabricate translucent metasurfaces that generate completely independent images in transmission for the opposite directions of illumination at the third-harmonic frequency.

Authors:Sergey Kruk, Paderborn University / Lei Wang, Australian National University / Basudeb Sain, Paderborn University / Zhaogang Dong, A*STAR / Joel Yang, A*STAR / Thomas Zentgraf, Paderborn University / Yuri Kivshar, Australian National University

FW4H.4

Optical Control of X-ray Emission

Presenter: Elina Sendonaris , *Massachusetts Institute of Technology*

We theoretically show that photonic structures can be used to control the X-ray spectrum generated through spontaneous parametric down-conversion. As an example, we show how 1D and 3D photonic crystals can enable enhanced X-ray emission.

Authors:Elina Sendonaris, Massachusetts Institute of Technology / Jamison Sloan, Massachusetts Institute of Technology / Nicholas Rivera, Massachusetts Institute of Technology / Marin Soljačić, Massachusetts Institute of Technology

FW4H.5

Demonstration of Wavelength Conversion by FWM Near 1550-nm in a Sub-Wavelength Antenna-ENZ Metasurface

Presenter: Karapet Manukyan , *University of Southern California*

We experimentally demonstrate wavelength conversion by four-wave mixing in an epsilon-near-zero based metasurface. We observed conversion efficiency of 0.16% using a 127-nm thick metasurface near the 1550-nm C band with 4-GW/cm² pump peak intensity.

Authors:Karapet Manukyan, University of Southern California / cong liu, University of Southern California / Zahirul Alam, University of Ottawa / Kai Pang, University of Southern California / Hao Song, University of Southern California / Ahmad Fallahpour, University of Southern California / Joshua R. Hendrickson, Wright-Patterson AFB / Evan M. Smith, KBR / Dennis E. Walker, Wright-Patterson AFB / Shivashankar Vangala, Wright-Patterson AFB / Robert Boyd, University of Ottawa / Moshe Tur, Tel Aviv University / Alan Eli Willner, University of Southern California

FW4J

Metasurfaces and Materials

Presenter: Rajesh Menon , *University of Utah*

FW4J.1

Manipulation of Exciton Dynamics and Annihilation in Single-Layer WSe₂ Using a Toroidal Dielectric Metasurface

Presenter: Long Yuan , *Los Alamos National Laboratory*

We control the exciton dynamics and annihilation in single-layer WSe₂ coupled with a dielectric metasurface by tailoring the spectral overlap of excitonic and toroidal resonances.

Authors: Long Yuan, Los Alamos National Laboratory / Jeeyoon Jeong, Sandia National Laboratories / Kevin Kwock, Columbia University / Ting Luk, Sandia National Laboratories / James Schuck, Columbia University / Emanuil Yanev, Columbia University / James Hone, Columbia University / Dmitry Yarotski, Los Alamos National Laboratory / Igal Brener, Sandia National Laboratories / Rohit Prasankumar, Los Alamos National Laboratory

FW4J.2

Plasmonic Diatomic Metasurfaces for Full-Stokes Polarization Perfect Absorption

Presenter: yao liang , *Swinburne University of Technology*

We demonstrate experimentally perfect absorbers for arbitrary polarization (linear, circular, or elliptical) in the mid-IR based on plasmonic diatomic metasurfaces, which provide perfect absorption for any specific polarization and almost total reflection for the orthogonal polarization.

Authors: yao liang, Swinburne University of Technology / Han Lin, Swinburne University of Technology / kirill koshelev, Australian National University / Fengchun Zhang, South China Normal University / Yunyi Yang, Swinburne University of Technology / Jiayang Wu, Swinburne University of Technology / Yuri Kivshar, Australian National University / Baohua Jia, Swinburne University of Technology

FW4J.3

Engineering Nearest Neighbor Coupling in Huygens Metasurfaces

Presenter: Isaac Oguntoye , *Tulane University*

Nearest neighbor coupling in antenna systems tends to reduce the overall optical efficiency of the system. Here, we compare arrays of disc and donut resonators that confine the impinging beam locally. Maximum optical efficiency of 70% for anomalous refraction is achieved.

Authors: Isaac Oguntoye, Tulane University / Siddharth Padmanabha, Tulane University / Brittany Simone, Tulane University / Adam Ollanik, University of Colorado Boulder / Matthew Escarra, Tulane University

FW4J.4

High-Speed Spectrally Selective Photodetection With Metasurfaces

Invited

Presenter: Maiken H. Mikkelsen , *Duke University*

Here we integrate a plasmonic metasurface with an aluminium nitride pyroelectric thin film to demonstrate spectrally selective, room-temperature thermal detectors from 660–2,000 nm with an instrument-limited 700 ps response time.

Authors:Maiken H. Mikkelsen, Duke University

FW4J.5

Bianisotropic Characterization of Metasurfaces With Plasmon-Enhanced Nonlinearity

Presenter: Omer Yesilyurt , *Purdue University*

Bianisotropic characterization of plasmon-enhanced Kerr-nonlinearity is developed. An equivalent homogeneous film with effective nonlinear parameters (n_2 and α) can be employed to substitute for the plasmonic metasurface with enhanced nonlinearity and reduce simulation complexity.

Authors:Omer Yesilyurt, Purdue University / Ludmila Prokopeva, Purdue University / Alexander Kildishev, Purdue University

FW4J.6

(Withdrawn) Designing Electromagnetic Topological States via Staggered Bianisotropy Patterns

Presenter: Maxim Gorlach , *ITMO University*

Photonic topological structures open rich possibilities in disorder-robust routing and localization of light. Here we propose a design based on spatially varying bianisotropic response which enables reconfigurable topological states even in simple lattice geometries.

Authors:Daniel Bobylev, ITMO University / Daria Smirnova, Australian National University / Maxim Gorlach, ITMO University

FW4J.7

Topological Bulk Laser in Kagome Lattice

Presenter: Stephan Wong , *School of Physics and Astronomy, Cardiff*

By introducing an imaginary gauge field, we demonstrate topologically protected bulk modes extended over a two-dimensional kagome lattice with rhombus geometry. Using the kagome lattice with gain/loss, a phase-locked broad-area topological laser can be realized.

Authors:Stephan Wong, School of Physics and Astronomy, Cardiff / Sang Soon Oh, School of Physics and Astronomy, Cardiff

AW4N

AT1 Enhanced Contrast and Quantitative Phase Imaging in Microscopy

Presenter: David Nolte , *Purdue University*

AW4N.1

Deep Learning Denoise and Sharpen Fluorescence Microscopy Image Volumes

Invited

Presenter: Jiji Chen , *NIH*

To be provided

Authors:Jiji Chen, NIH

AW4N.2

Circumventing the Optical Diffraction Limit Using Customized Speckles

Presenter: Nicholas Bender , *Yale University*

We design and create special speckle patterns for parallelized nonlinear pattern-illumination microscopy based on fluorescence photoswitching. In a proof-of-principle experimental demonstration, we obtain a spatial resolution three times higher than the diffraction limit.

Authors:Nicholas Bender, Yale University / Mengyuan Sun, Yale University / Hasan Yilmaz, Yale University / Joerg Bewersdorf, Yale University / Hui Cao, Yale University

AW4N.3

Spectrally Gated Microscopy (SGM) With Flat Optics

Presenter: Eitan Edrei , *The Hebrew University of Jerusalem*

We introduce a new optical modality to enable three-dimensional imaging by rejecting out-of-focus light via spectral gating. Our modality doesn't require axial physical scanning and can potentially achieve better sectioning capabilities than current state-of-the-art technology

Authors:Eitan Edrei, The Hebrew University of Jerusalem / Aharon Weiss, The Hebrew University of Jerusalem / Jacob Engelberg, The Hebrew University of Jerusalem / Roy Zektzer, The Hebrew University of Jerusalem / Uriel Levy, The Hebrew University of Jerusalem

AW4N.4

Spatially-Chirped Modulation Microscopy at 2 μ m

Presenter: Xiaomeng Cui , *The University of Hong Kong*

We report the first demonstration of the spatially chirped microscopy with a narrow linewidth optical parametric oscillator at $2\mu\text{m}$. We realized the multipixel imaging with a single-pixel photodetector and achieved $79\text{-}\mu\text{m}$ lateral resolution.

Authors: Xiaomeng Cui, The University of Hong Kong / Jiawei Shi, The University of Hong Kong / Kenneth K. Y. Wong, The University of Hong Kong

AW4N.5

Phase Sensitive Two-Photon Microscopy

Presenter: Niraj Soni, *The University of Hong Kong*

Phase sensitive two-photon microscopy is demonstrated using transport-of-intensity equation-based phase retrieval algorithm. Amplitude and phase information of the complex field of two-photon microscopy signal has been retrieved for fluorescence bead and presented.

Authors: Niraj Soni, The University of Hong Kong / SABIR UL ALAM, The University of Hong Kong / Renjie Zhou, The Chinese University of Hong Kong / Kenneth K. Y. Wong, The University of Hong Kong

AW4N.6

Spectrally Encoded Quantitative Phase Imaging Microscopy Using 2- μm Fiber Laser

Presenter: Niraj Soni, *The University of Hong Kong*

Spectrally encoded quantitative phase imaging microscopy is demonstrated using $2\text{-}\mu\text{m}$ wavelength fiber laser source. Experimental setup and preliminary results of amplitude and phase information of the complex field of the sample are presented here.

Authors: Niraj Soni, The University of Hong Kong / Sabir Ul Alam, The University of Hong Kong / Jiawei Shi, The University of Hong Kong / Kenneth K. Y. Wong, The University of Hong Kong

AW4N.7

Plasmonic Calibration in Label-Free Surface-Enhanced Raman Spectroscopy for Improved Multivariate Analysis of Living Cells

Presenter: Wonil Nam, *Virginia Tech*

We report that plasmonically enhanced electronic Raman scattering signals from metal nanostructures can serve as a surface-enhanced Raman spectroscopy calibration internal standard to improve multivariate analysis of living biological systems.

Authors: Wonil Nam, Virginia Tech / Xiang Ren, Virginia Tech / Inyoung Kim, Virginia Tech / Masoud Agah, Virginia Tech / Wei Zhou, Virginia Tech

AW4M

Light Monitoring and Control

Presider: Alexandra Artusio-Glimpse , *National Inst of Standards & Technology*

AW4M.1

Demonstration of Novel Silicon Optical Switching on Digital Radio Over Fibre Link for Next-Generation Fronthaul

Presenter: Junfei Xia , *University of Cambridge*

We for the first time propose a silicon photonic switching architecture for digital radio-over-fibre fronthaul links. An over 55dB dynamic range of RF input power is demonstrated and the minimum required optical received power is tested at -23.9dBm

Authors:Junfei Xia, University of Cambridge / Tongyun Li, University of Cambridge / Adrian Wonfor, University of Cambridge / Qixiang Cheng, University of Cambridge / Keren Bergman, Columbia University / Richard Penty, University of Cambridge

AW4M.2

Fast Spatial Sampling With Phase Controlled Resonant Scanner

Presenter: Zhanghao Sun , *Stanford University*

Through phase controlling a 2D MEMS scanner, we achieve fast and flexible spatial information sampling. The scanning pattern is designed and a hardware prototype with wide-band phase control is demonstrated. This system facilitates fast LiDAR operation at ~100Hz frame rate.

Authors:Zhanghao Sun, Stanford University / Ronald Quan, Stanford University / Olav Solgaard, Stanford University

AW4M.3

Fluorescence Imaging Technology for High Power Laser Beam Profiling

Invited

Presenter: Masaki Tsunekane , *Canare Electric Co., Ltd.*

Fluorescence imaging technology combined with a $>2\text{MW}/\text{cm}^2$ damage threshold, fluorescent plate and a CMOS camera was developed for real-time 2D beam profiling of high-power lasers without any attenuators and any computer-aided image reconstructions.

Authors:Masaki Tsunekane, Canare Electric Co., Ltd.

AW4M.4

Room Temperature Planar Absolute Radiometer for High-Accuracy Optical Power Measurements

Presenter: Anna Vaskuri , *National Institute of Standards and Technology*

We introduce a planar absolute radiometer for room temperature (PARRoT) that will replace NIST's 50-year-old detector standard for free-space CW laser power measurements and lower the measurement uncertainty ($k = 2$) from 0.86% to 0.12%.

Authors:Anna Vaskuri, National Institute of Standards and Technology / Michelle Stephens, National Institute of Standards and Technology / Nathan Tomlin, National Institute of Standards and Technology / Matthew Spidell, National Institute of Standards and Technology / Christopher Yung, National Institute of Standards and Technology / Andrew Walowitz, National Institute of Standards and Technology / Cameron Straatsma, Laboratory for Atmospheric and Space Physics / David Harber, Laboratory for Atmospheric and Space Physics / John Lehman, National Institute of Standards and Technology

AW4M.5

Tapered Optical Fibers for Fluorescence Lifetime Photometry

Presenter: Marco Bianco , *Istituto Italiano di Tecnologia (IIT)*

We describe a system exploiting a multi-anode array placed in the far-field plane of a tapered optical fiber to perform fluorescence lifetime photometry with depth-resolution in brain tissue.

Authors:Marco Bianco, Istituto Italiano di Tecnologia (IIT) / Antonio Balena, Istituto Italiano di Tecnologia (IIT) / Marco Pisanello, Istituto Italiano di Tecnologia (IIT) / Filippo Pisano, Istituto Italiano di Tecnologia (IIT) / Leonardo Sileo, Istituto Italiano di Tecnologia (IIT) / Barbara Spagnolo, Istituto Italiano di Tecnologia (IIT) / Cinzia Montinaro, Istituto Italiano di Tecnologia (IIT) / Bernardo Sabatini, Harvard Medical School / Massimo De Vittorio, Istituto Italiano di Tecnologia (IIT) / Ferruccio Pisanello, Istituto Italiano di Tecnologia (IIT)

AW4M.6

Gas-Filled Kagome Hollow-Core Fiber Cell for Compact Laser Frequency Stabilization Systems

Presenter: E. Anne Curtis , *National Physical Laboratory*

We report on longevity studies of fully sealed gas-filled Kagome hollow-core fiber cells for applications in compact laser frequency stabilization systems, and investigate and address baseline offsets due to electronic and optical components.

Authors:E. Anne Curtis, National Physical Laboratory / Nicola Black, National Physical Laboratory / Geoffrey Barwood, National Physical Laboratory / Patrick Gill, National Physical Laboratory

AW4M.7

Resonant Chalcogenide-Metal-Fluoropolymer Nanograting for Tunable Pyroelectric Sensing

Presenter: Le Wei , *Iowa State University*

A resonant pyroelectric detector was demonstrated to support narrowband and tunable photopyroelectric by integrating a chalcogenide-metal-fluoropolymer resonant grating and pyroelectric membrane. The device's near-infrared absorption and pyroelectric characteristics can be tuned using a bias voltage

Authors: Le Wei, Iowa State University / Meng Lu, Iowa State University / Liang Dong, Iowa State University / Jingjing Qiang, Iowa State University

SW4C

Intense Field Light - Matter Interaction

Presenter: Carl Liebig, *US AFRL Wright Patterson*

SW4C.1

Novel Materials-Based Laser Acceleration

Presenter: Huiyang Deng, *Stanford University*

We demonstrate the first laser acceleration based on novel dielectric materials (Al₂O₃ and Ga₂O₃) with high laser damage thresholds, opening a new venue for performance optimization of dielectric laser accelerators.

Authors: Huiyang Deng, Stanford University / Kenneth Leedle, Stanford University / Yu Miao, Stanford University / Dylan Black, Stanford University / Karel Urbanek, Stanford University / Josh McNeur, Friedrich-Alexander-Universität / Martin Kozak, Friedrich-Alexander-Universität / Andrew Ceballos, Stanford University / Peter Hommelhoff, Friedrich-Alexander-Universität / Olav Solgaard, Stanford University / Robert Byer, Stanford University / James Harris, Stanford University

SW4C.2

Laser Annealing of Anodic TiO₂ Nanotubes: Explosive Solid Phase Crystallization Into Anatase

Presenter: Nadezhda Bulgakova, *HiLASE, Institute of Physics CAS*

Annealing of amorphous TiO₂ nanotubes has been performed by nano-, pico- and femtosecond lasers. Only picosecond high-power laser of the HiLASE Centre enabled achieving crystallization into anatase phase via explosive solid-phase crystallization at high throughput.

Authors:Inam Mirza, HiLASE, Institute of Physics CAS / Hanna Sopha, University of Pardubice / Hana Turcicova, HiLASE, Institute of Physics CAS / David Pavlinak, Masaryk University / Ondrej Novak, HiLASE, Institute of Physics CAS / Jiri Muzik, HiLASE, Institute of Physics CAS / Yuri Shukhov, S.S. Kutateladze Institute of Thermophysics SB RAS / Sergey Starinskiy, S.S. Kutateladze Institute of Thermophysics SB RAS / Martin Smrz, HiLASE, Institute of Physics CAS / Jan Michalicka, Brno University of Technology / Milos Krbal, University of Pardubice / Jhonatan Rodriguez Pereira, University of Pardubice / Ludek Hromadko, University of Pardubice / Eva Kolibalova, University of Pardubice / Nathan Goodfriend, HiLASE, Institute of Physics CAS / Alexander Bulgakov, HiLASE, Institute of Physics CAS / Tomas Mocek, HiLASE, Institute of Physics CAS / Jan Macak, University of Pardubice / Nadezhda Bulgakova, HiLASE, Institute of Physics CAS

SW4C.3

Strong Light Field Effects in Solids

Tutorial

Presenter: Koichiro Tanaka , *Kyoto University*

In this short lecture, we review nonlinear optical phenomena in solid materials under the strong light field. Especially, we focus on the high harmonic generation process and introduce the semi-classical model and the dynamical symmetry concept.

Authors:Koichiro Tanaka, Kyoto University

SW4C.4

Conical Third Harmonic Generation due to Multipulse Optical Damage of Transparent Dielectrics at High Repetition Rates

Presenter: Robertas Grigutis , *Laser Research Center Vilnius University*

We report on conical third harmonic generation by filamentation of high repetition rate femtosecond laser pulses in transparent dielectrics which results from in-bulk optical damage of the material in the form of quasiperiodic nanograting.

Authors:Robertas Grigutis, Laser Research Center Vilnius University / Marius Navickas, Laser Research Center Vilnius University / Gintaras Tamošauskas, Laser Research Center Vilnius University / Vytautas Jukna, Laser Research Center Vilnius University / Kestutis Staliunas, Laser Research Center Vilnius University / Audrius Dubietis, Laser Research Center Vilnius University

SW4C.5

Intense Few-Cycle Pulse, Conical Pit Interaction Simulations Predicting Extreme Material States

Presenter: Joseph Smith , *Ohio State University*

We use fully three-dimensional particle-in-cell simulations to model intense few-cycle pulses interacting with nano-structured conical pits in fused silica and report on laser damage creation of high energy density conditions and excited electron dynamics.

Authors: Joseph Smith, Ohio State University / Simin Zhang, Ohio State University / Vitaly Gruzdev, University of New Mexico / Enam Chowdhury, Ohio State University

SW4F

Terahertz Spectroscopy and Applications

Presenter: George Keiser, *Washington College*

SW4F.1

Subcycle Sampling of Quantum Fields With Nonclassical Temporal Gates

Presenter: Patrick Cusson, *Polytechnique Montreal*

Time-domain analysis of quantum fields has been recently demonstrated through a nonlinear mixing with coherent-state probes. Here we consider nonclassical probes with engineered noise distributions to improve the detected fidelity of the quantum signals.

Authors: Patrick Cusson, Polytechnique Montreal / Stéphane Virally, Polytechnique Montreal / Denis Seletskiy, Polytechnique Montreal

SW4F.2

Brightening and Control of Quenched Quantum Dots With Strong Terahertz Pulses

Presenter: Frank Gao, *Massachusetts Institute of Technology*

We demonstrate the reversible brightening of quenched quantum dot photoluminescence using high-field-strength short terahertz pulses. This effect is attributed to the removal of excess charges and the subsequent reduction in nonradiative Auger recombination.

Authors: Frank Gao, Massachusetts Institute of Technology / Jiaojian Shi, Massachusetts Institute of Technology / Zhuquan Zhang, Massachusetts Institute of Technology / Hendrik Utzat, Massachusetts Institute of Technology / Ulugbek Barotov, Massachusetts Institute of Technology / Ardavan Farahvash, Massachusetts Institute of Technology / Jinchun Han, Massachusetts Institute of Technology / Chan-Wook Baik, Samsung Advanced Institute of Technology / Kyung-Sang Cho, Samsung Advanced Institute of Technology / Vladimir Bulovic, Massachusetts Institute of Technology / Adam Willard, Massachusetts Institute of Technology / Nuh Gedik, Massachusetts Institute of Technology / Mounji Bawendi, Massachusetts Institute of Technology / Keith Nelson, Massachusetts Institute of Technology

SW4F.3

2D MXenes: THz Conductivity and Applications

Invited

Presenter: Lyubov Titova, *Worcester Polytechnic Institute*

Electronic properties of 2D MXenes can be tuned by their chemistry and structure. We report on THz spectroscopy study of several members of MXene family and discuss their potential applications in THz devices.

Authors: Lyubov Titova, Worcester Polytechnic Institute

SW4F.4

THz Analysis of MAPbI₃ at the Interface With Graphene and Silver Nanowire Electrodes

Presenter: Hyeyoung Ahn, *National Chiao Tung University*

We present the successful applications of THz spectroscopic analysis in realization of the suppressed tetragonal-to-cubic phase transition of graphene/MAPbI₃ under solar cell operation conditions and its chemical degradation upon incorporating with AgNW bottom electrode.

Authors: Zhi-Wei Huang, National Chiao Tung University / Yu-Heng Hong, National Chiao Tung University / Ting-Jui Kuo, National Chiao Tung University / Tsung Sheng Kao, National Chiao Tung University / Hyeyoung Ahn, National Chiao Tung University

SW4F.5

Ultrafast Carrier Dynamics in (Bi_{1-x}In_x)₂Se₃ Thin Films: From Topological to Band Insulator

Presenter: Kateryna Kushnir, *Worcester Polytechnic Institute*

Replacing some of the Bi atoms with In transforms Bi₂Se₃ from a topological to a band insulator. We have used time-resolved terahertz spectroscopy to study carrier dynamics in (Bi_{1-x}In_x)₂Se₃ films across this transition.

Authors: Kateryna Kushnir, Worcester Polytechnic Institute / Teng Shi, Worcester Polytechnic Institute / Zhengtianyue Wang, University of Delaware / Stephanie Law, University of Delaware / Lyubov Titova, Worcester Polytechnic Institute

SW4F.6

Terahertz Material Characterization With Visible Light

Presenter: Mirco Kutas, *Fraunhofer ITWM*

We measure optical properties of samples in the terahertz frequency range by detecting only visible photons. In our quantum-inspired measurement technique, properties of terahertz photons are transferred via biphoton correlation into the visible spectral range.

Authors: Mirco Kutas, Fraunhofer ITWM / Björn Haase, Fraunhofer ITWM / Jens Klier, Fraunhofer ITWM / Daniel Molter, Fraunhofer ITWM / Georg von Freymann, Fraunhofer ITWM

SW4F.7

Noninvasive THz Measurement of Intraocular Pressure

Presenter: Andrew Chen , *Stony Brook University*

Endothelial damage related to elevated intraocular pressure (IOP) was investigated using a THz corneal scanner. An increase in the IOP in rabbit and porcine eyes corresponded to increased THz reflectivity. Endothelial damage was confirmed independently using SEM.

Authors: Andrew Chen, Stony Brook University / Arjun Virk, Stony Brook University / Zachery Harris, Stony Brook University / Azin Abazari, Stony Brook University / Robert Honkanen, Stony Brook University / M. Hassan Arbab, Stony Brook University

SW4A

Integrated Frequency Combs

Presenter: Yuan Yuan , *Hewlett Packard Labs*

SW4A.1

Rapid and Large Scanning of a Microresonator Soliton Comb With the Frequency-Shift Tracking of all Comb Modes

Presenter: Naoya Kuse , *Tokushima University*

We demonstrate a rapid and large scanning of a microresonator soliton comb by employing a feedback loop assisted with a feedforward signal, in which the frequency shift of all comb modes is also tracked.

Authors: Naoya Kuse, Tokushima University / Takeshi Yasui, Tokushima University / Kaoru Minoshima, University of Electro-Communications

SW4A.2

Generation of High-Power, High-Coherence Millimeter-Wave Using Microresonator Solitons

Presenter: Beichen Wang , *University of Virginia*

100 GHz millimeter-waves are generated by photodetecting microresonator solitons. It provides 6 dB enhancement in output power and two orders of magnitude linewidth reduction when compared to mmWave generation method of two laser heterodyne detection.

Authors:Beichen Wang, University of Virginia / Jesse S. Morgan, University of Virginia / Keye Sun, University of Virginia / Mandana Jahanbozorgi, University of Virginia / Zijiao Yang, University of Virginia / Madison Woodson, Freedom Photonics LLC / Steven Estrella, Freedom Photonics LLC / Andreas Beling, University of Virginia / Xu Yi, University of Virginia

SW4A.3

Stable Formation of Multiple Solitons in an Optical Microresonator Assisted by Saturable Absorption

Presenter: Ayata Nakashima , *Keio University*

We numerically investigate soliton microcomb generation with a saturable absorption effect. We found that a cavity-integrated saturable absorber allows the formation of a much higher number of solitons than possible with a Kerr-only monolithic cavity.

Authors:Ayata Nakashima, Keio University / Shun Fujii, Keio University / Riku Imamura, Keio University / Keigo Nagashima, Keio University / Takasumi Tanabe, Keio University

SW4A.4

Broadband Dual-Pumped Normal-GVD Kerr Combs

Presenter: Yoshitomo Okawachi , *Columbia University*

We demonstrate broadband Kerr comb generation spanning >250 nm in a normal group-velocity-dispersion silicon-nitride microresonator using two frequency-nondegenerate pumps. Numerical modeling using a modified Lugiato-Lefever equation reveals the onset of switching waves.

Authors:Yoshitomo Okawachi, Columbia University / Bok Young Kim, Columbia University / Jae Jang, Columbia University / Xingchen Ji, Columbia University / Michal Lipson, Columbia University / Alexander Gaeta, Columbia University

SW4A.5

Ultra-Broadband Dissipative Kerr Soliton Microcomb Through Dual Pumping Operation

Highlighted Talk

Presenter: Gregory Moille , *Joint Quantum Institute*

We demonstrate ultra-broadband dissipative Kerr soliton microcombs through dual-pumping. Non-degenerate four-wave mixing produces a new set of phase-stable dispersive waves and a comb bandwidth that far exceeds that set by the resonator's geometric dispersion

Authors:Gregory Moille, Joint Quantum Institute / Edgar Perez, Joint Quantum Institute / Ashutosh Rao, National Institute of Standards and Technology / Xiyuan Lu, National Institute of Standards and Technology / Yanne Chembo, University of Maryland / Kartik Srinivasan, Joint Quantum Institute

SW4A.6

Fully Integrated Broad-Band High Power Frequency Comb Based on a Multimode Gain Chip

Presenter: Andres Gil-Molina , *Columbia University*

We generate a Kerr frequency comb in a SiN ring spanning over 150nm with 23mW pump power. Self-injection locking of a multi-mode chip-based gain allows access to high pump power while maintaining single mode operation

Authors:Andres Gil-Molina, Columbia University / Yair Antman, Columbia University / Ohad Westreich, Columbia University / Xingchen Ji, Columbia University / Alexander Gaeta, Columbia University / Michal Lipson, Columbia University

SW4A.7

Real-Time Observation of Breathing Soliton and Soliton Molecules Dynamics in Strong Coupled Microcavity

Presenter: Wenting Wang , *University of California Los Angeles*

Direct and temporal magnified real-time observations of the breathing soliton dynamics in a strong-coupled high-Q microcavity are reported. Temporal oscillating soliton pulse train with tunable amplitude modulation depth and relative breathing phase is observed.

Authors:Wenting Wang, University of California Los Angeles / Xinghe Jiang, University of California Los Angeles / Abhinav Kumar Vinod, University of California Los Angeles / Hao Liu, University of California Los Angeles / Mingbin Yu, State Key Laboratory of Functional Materials for Informatics / Dim-Lee Kwong, Institute of Microelectronics / Chee Wei Wong, University of California Los Angeles

SW4E

On-Chip Optical Signal Routing

Presenter: Nathan Youngblood , *University of Oxford*

SW4E.1

Nano-Optic Broadband Power Splitter Design via Cycle-Consistent Adversarial Deep Learning

Presenter: Yingheng Tang , *Mitsubishi Electric Research Labs*

A novel generative deep learning model with a cycle-consistent adversarial network is introduced for optimizing 550 nm broad bandwidth (1250 nm to 1800 nm) power splitters with arbitrary target splitting ratios.

Authors: Yingheng Tang, Mitsubishi Electric Research Labs / Keisuke Kojima, Mitsubishi Electric Research Labs / Toshiaki Koike-Akino, Mitsubishi Electric Research Labs / Ye Wang, Mitsubishi Electric Research Labs / Devesh Jha, Mitsubishi Electric Research Labs / Kieran Parsons, Mitsubishi Electric Research Labs / Minghao Qi, Purdue University

SW4E.2

Compact Broadband Rapid-Adiabatic Polarization Splitter- Rotators in a Monolithic Electronic-Photonic SOI Platform

Presenter: MANUJ KUMAR SINGH , *Boston University*

We demonstrate a novel compact, ultra-broadband polarization splitter-rotator (PSR) based on a photonic magic-T and rapid adiabatic mode splitter (RAMS). Polarization cross-talk is ~ -14 dB over 70 nm around 1550 nm, with IL < -0.3 dB and a > 5 x length reduction over a conventional adiabatic PSR

Authors: Josep Fargas Cabanillas, Boston University / MANUJ KUMAR SINGH, Boston University / Bohan Zhang, Boston University / Milos Popovic, Boston University

SW4E.3

Integrated Multiplexing and Switching in Wavelength, Polarization and Mode

Invited

Presenter: Yikai Su , *Shanghai Jiao Tong University*

We review recent results on integrated silicon photonic chips for (de)multiplexing and switching, which operate in wavelength, polarization, and mode dimensions.

Authors: Yikai Su, Shanghai Jiao Tong University / Yu He, Shanghai Jiao Tong University / Ruihuan Zhang, Shanghai Jiao Tong University / Yong Zhang, Shanghai Jiao Tong University

SW4E.4

Athermal WDM (de)Multiplexer Based on Polysilicon Cascaded Mach-Zehnder Interferometers in Bulk CMOS

Presenter: Zhan-Wen Song , *National Sun Yat-sen University*

We demonstrate an athermal WDM (de)multiplexer by realizing strip/subwavelength grating polysilicon waveguide based cascaded MZIs in bulk CMOS. Measured temperature sensitivity for all channels is around -20 pm/oC with a slope of -0.25 pm/oC/nm.

Authors:Zhan-Wen Song, National Sun Yat-sen University / Cheng-Tse Tang, National Sun Yat-sen University / Po-Hsiang Huang, National Sun Yat-sen University / Yung-Jr Hung, National Sun Yat-sen University

SW4E.5

Low-Channel-Crosstalk WDM (de)Multiplexer Based on Sagnac-Grating-Assisted Cascaded MZIs on SOI

Presenter: Chia-Chen Chou , *NATIONAL SUN YAT-SEN UNIVERSITY*

A sharp bandpass filter, realized by inserting apodized gratings in a Sagnac interferometer, is connected to the output ports of cascaded MZIs to demonstrate a WDM (de)multiplexer with a low channel crosstalk of -42 dB.

Authors:Chia-Chen Chou, NATIONAL SUN YAT-SEN UNIVERSITY / Tzu-Hsiang Yen, NATIONAL SUN YAT-SEN UNIVERSITY / Yen-Chieh Wang, NATIONAL SUN YAT-SEN UNIVERSITY / Yung-Jr Hung, NATIONAL SUN YAT-SEN UNIVERSITY

SW4E.6

Compact, Broadband Waveguide Two-Mode (De)-Multiplexers Based on Rapid Adiabatic Coupling

Presenter: Josep Fargas Cabanillas , *Boston University*

The concept of rapid adiabaticity is applied to design a mode evolution based two-spatial-mode mux-demux chain, shorter than conventional adiabatic devices by a factor of 4. The 100-um-long device measures <-26dB cross-talk over 80nm bandwidth and IL <0.2dB at 1550nm

Authors:Josep Fargas Cabanillas, Boston University / Bohan Zhang, Boston University / Milos Popovic, Boston University

SW4E.7

C and L Band 1×12 AWG Based on 3-μm SOI Platform With 100 GHz Channel Spacing and low Polarization Sensitivity

Presenter: Yu Wang , *IPI-ECO Research Institute, Eindhoven University of Technology*

C- and L-band polarization insensitive 1×12 AWG with 100GHz channel-spacing is fabricated on SOI. Results show <3.8dB loss, <-30dB crosstalk, <2.6dB polarization dependent loss, <0.1nm polarization dependent wavelength shift and <0.3dB BER penalty at 10Gbps.

Authors: Yu Wang, IPI-ECO Research Institute, Eindhoven University of Technology / Srivathsa Bhat, VTT Technical Research Centre of Finland Ltd / Netsanet Tessema, IPI-ECO Research Institute, Eindhoven University of Technology / Rafael Kraemer, IPI-ECO Research Institute, Eindhoven University of Technology / Bitao Pan, IPI-ECO Research Institute, Eindhoven University of Technology / Antonio Napoli, Infinera, Germany / Giovanni Delrosso, VTT Technical Research Centre of Finland Ltd / Nicola Calabretta, IPI-ECO Research Institute, Eindhoven University of Technology

JW4B

Special Symposium - Super Symposium on Advances in Quantum Technologies: Rydberg Quantum Technologies

Presider: Na Young Kim , *University of Waterloo*

JW4B.1

Quantum Algorithms on a Quantum Computer With Rydberg Interactions

Invited

Presenter: Mark Saffman , *University of Wisconsin-Madison*

We report progress in running hybrid algorithms on a neutral atom quantum computer. The hardware consists of a two-dimensional array of optically trapped Cs atoms. Universal quantum gates are implemented with microwave and laser pulses that access Rydberg states. VQE and QAOA algorithms are implemented for studies of spin models and combinatorial optimization problems respectively.

Authors: Mark Saffman, University of Wisconsin-Madison

JW4B.2

Trapped Rydberg Ions: a new Platform for Quantum Information Processing

Invited

Presenter: Ferdinand Schmidt-Kaler , *Universität Mainz*

Trapped Rydberg ions are discussed as new platform for quantum computing [1,2]. High fidelity state preparation and dipolar interactions between ions in Rydberg states are explored. The enhanced polarizability can be used to control the interactions [3,4].

[1] A. Mokhberi, M. Hennrich, F. Schmidt-Kaler, *Adv. At. Mol. Phys.*, Academic Press, Ch. 4, 69 (2020)

[2] T. Feldker, et al, *Phys. Rev. Lett.* 115, 173001 (2015)

[3] J. Vogel, et al., *Phys. Rev. Lett.* 123, 153603 (2019)

[4] C Zhang, et al., *Nat.* 580, 345 (2020)

Authors: Ferdinand Schmidt-Kaler, Universität Mainz

JW4B.3

Photonic Qubits and Qutrits Using Rydberg Polaritons

Invited

Presenter: Charles Adams , *University of Durham*

To be provided

Authors: Charles Adams, University of Durham

JW4B.4

Exploring New Scientific Frontiers With Programmable Atom Arrays

Invited

Presenter: Mikhail Lukin , *Harvard University*

We will discuss the recent advances involving programmable, coherent manipulation of quantum many-body systems using atom arrays excited into Rydberg states. Specifically, we will describe our recent technical upgrades that now allow the control over 200 atoms in two-dimensional arrays. Recent results involving the realization of exotic phases of matter, study of quantum phase transitions and exploration of their non-equilibrium dynamics will be presented. In particular, we will report on realization and probing of quantum spin liquid states - the exotic states of matter have thus far evaded direct experimental detection. Finally, realization and testing of quantum optimization algorithms using such systems will be discussed.

Authors: Mikhail Lukin, Harvard University

AW4D

A&TTR on Light-based Micro and Nano Manufacturing

Presenter: Maria Farsari , *FORTH/IESL*

AW4D.1

Laser Induced Forward Transfer of 2D Materials and Metallic Nanostructures: an Advanced Fabrication Solution for the Digital Printing of Optoelectronic Components and Sensors

Invited

Presenter: Ioanna Zergioti , *National Technical University of Athens*

2D semiconductors, hold great promise as active materials in flexible electronics applications, owing to their exquisite optoelectronic and mechanical properties. The use of Laser Induced Forward Transfer for the precise and micro-scale printing of metallic and graphene pixels on conventional and flexible substrates in a single step process will be reported.

Authors:Ioanna Zergioti, National Technical University of Athens

AW4D.2

Ultrafast Laser Fabrication of Biomimetic Surfaces and Related Applications

Invited

Presenter: Emmanuel Stratakis , *Inst of Electronic Structure & Laser*

Highly controllable, biomimetic structures, exhibiting multifunctional water repellent, anti-reflection, friction reduction and photoresponsive properties can be directly written on metallic and dielectric surfaces upon processing with femtosecond laser beams of tailored shape and polarization.

Authors:Emmanuel Stratakis, Inst of Electronic Structure & Laser

AW4D.3

Multilayer Holographic Perceptrons for All-Optical Aberration Detection

Presenter: Elena Goi , *USST*

We present aberration detectors based on multi-layered perceptrons printed by two-photon nanolithography. Through all-optical inference, the perceptrons can collect phase information from a point spread function performing direct aberration detection in a single step.

Authors:Elena Goi, USST / Steffen Schoenhardt, USST / Min Gu, USST

AW4D.4

Simple one-Step-Tapering 20µm-to-50µm Monolithic MFA for Long-Distance High-Power Laser Transmission Applications

Presenter: Rumao Tao , *China Academy of Engineering Physics*

A 20 μ m-to-50 μ m monolithic MFA has been designed and fabricated by only one-step-tapering. With the MFA, 1kW laser beam with nearly diffraction-limited beam quality has been demonstrated after 15m propagation in highly multimode 50 μ m/0.11 NA fiber with different bend diameters.

Authors:Rumao Tao, China Academy of Engineering Physics / Yu Liu, China Academy of Engineering Physics / Lianghua Xie, China Academy of Engineering Physics / Chun Zhang, China Academy of Engineering Physics / Wenjie Wu, China Academy of Engineering Physics / Shan Huang, China Academy of Engineering Physics / Huaqing Song, China Academy of Engineering Physics / Min Li, China Academy of Engineering Physics / Xi Feng, China Academy of Engineering Physics / Benjian Shen, China Academy of Engineering Physics / Honghuan Lin, China Academy of Engineering Physics / Jianjun Wang, China Academy of Engineering Physics / Feng Jing, China Academy of Engineering Physics

AW4D.5

Laser Lithography for Bioprinting: From 3D Scaffolds to Plant Based Resins

Invited

Presenter: Mangirdas Malinauskas , *Vilniaus Universitetas*

The ultrafast laser direct writing 3D lithography is presented by covering its physical and technological working principles, current *state-of-the-art* and potential for advanced (nano-)printing of diverse materials ranging from biocompatible, biodegradable and renewable organics to amorphous, ceramic and crystalline inorganics.

Authors:Mangirdas Malinauskas, Vilniaus Universitetas

JW4L

Quantum Transduction

Presider: Elizabeth Goldschmidt , *Univ of Illinois at Urbana-Champaign*

JW4L.1

Engineering Spin-Phonon Coupling Rates for the Silicon Vacancy Center in Diamond Phononic Crystal Cavities

Presenter: Cleaven Chia , *Harvard University*

We design diamond phononic crystal cavities to couple GHz phonons to silicon vacancy center spin qubits, with coupling rates of 1.45-3.63 MHz that would enable strong coherent spin-phonon interactions at cryogenic temperature \sim 4K.

Authors:Cleaven Chia, Harvard University / Michelle Chalupnik, Harvard University / Marko Loncar, Harvard University

JW4L.2

Optomechanical Spin Control of Nitrogen-Vacancy Centers in Diamond

Presenter: Prasoon Kumar Shandilya , *University of Calgary*

We demonstrate optomechanical manipulation of nitrogen-vacancy electron spins in a diamond cavity for the first time. Our work paves the way for the realization of quantum networks at room temperature based on phonon-spin coupling.

Authors:Prasoon Kumar Shandilya, University of Calgary / David Lake, University of Calgary / Matthew Mitchell, University of Calgary / Denis Sukachev, University of Calgary / Paul Barclay, University of Calgary

JW4L.3

Microwave to Optical Frequency Conversion Using Rare Earth Crystals

Invited

Presenter: Rose Ahlefeldt , *The Australian National University*

Crystals fully concentrated in the rare earth ion erbium have potential as single-photon frequency converters for quantum computing. When magnetically ordered, these crystals offer a magnon transition at microwave frequencies, an optical transition in the telecom band, and a strong magneto-optical nonlinearity for frequency conversion. I will discuss modelling that suggests unit efficiency is possible and describe our early experimental implementations of a frequency converter in these crystals.

Authors:Rose Ahlefeldt, The Australian National University / Matthew Berrington, The Australian National University / Jevon Longdell, The University of Otago

JW4L.4

Quantum Control of Microwave-to-Optical Transducers for Inhomogeneous Broadening Compensation

Presenter: Sattwik Deb Mishra , *Stanford University*

We use numerical optimization to design the temporal shape of the laser field driving an inhomogeneous ensemble of quantum emitters in order to restore superradiance effects and improve single photon microwave-to-optical transduction efficiencies.

Authors:Sattwik Deb Mishra, Stanford University / Rahul Trivedi, Stanford University / Amir Safavi-Naeini, Stanford University / Jelena Vuckovic, Stanford University

JW4L.5

(Withdrawn) Microwave Quantum Illumination Based on Cavity Magnonics

Presenter: Qizhi Cai , *Univ. of Elec. Sci. and Tech. of China*

We propose a microwave-optical entanglement source based on cavity magnonics and analyze its performance in the application of microwave quantum illumination. Our results pave the way for developing quantum enhanced sensing via magnonic systems.

Authors: Qizhi Cai, Univ. of Elec. Sci. and Tech. of China / Jinkun Liao, Univ. of Elec. Sci. and Tech. of China / Bohai Shen, Univ. of Elec. Sci. and Tech. of China / Guang-Can Guo, Univ. of Elec. Sci. and Tech. of China / Qiang Zhou, Univ. of Elec. Sci. and Tech. of China

JW4L.6

A Vertically Loaded Diamond Microdisk Resonator (VLDMoRt) Towards a Scalable Quantum Network

Presenter: Yuqin Duan, *MIT*

We design and fabricate a vertically loaded diamond microdisk resonator (VLDMoRt) that enhances spin-photon entanglement generation and free-space fiber-matched coupling rate from quantum emitters.

Authors: Yuqin Duan, MIT / Kevin Chen, MIT / Dirk Englund, MIT / Matthew Trusheim, MIT

JW4L.7

Simulation, Fabrication and Control of Nanophotonic Circuits Including Diamond-Based Quantum Emitters

Presenter: Jan Olthaus, *University of Muenster*

Simultaneous access to several solid-state spin systems with Purcell-enhanced coupling of single photons into photonic integrated circuits is demonstrated. Photonic crystal cavities embedded in tantalum pentoxide waveguides enable optical detection of magnetic resonances.

Authors: Jan Olthaus, University of Muenster / Philip Schrinner, University of Muenster / Carsten Schuck, University of Muenster / Doris Reiter, University of Muenster

17:00 - 17:20 (Pacific Time (US & Canada) DST, UTC - 07:00)

Exhibit Hall Event - Technology Showcase: Going Beyond Laser Test and Measurement: New Power Meters and Energy Meters for Emerging Laser Applications

Gentec Electro-Optics, Inc.: With recent advances in the science and applications of lasers, emerging applications are now using higher power sources, faster pulsed lasers with high repetition rates, non-conventional wavelengths and increasingly efficient sources. These advances come with new challenges for laser power and energy measurement. At Gentec-EO, we remain on the lookout for new trends and applications, and we adapt our offer to these new opportunities. In this technology showcase, we will present our latest developments in terms of laser measurement instruments: - FASTER energy detectors that can measure pulse-to-pulse energy at higher repetition rates, - SMARTER power meters that communicate via bluetooth to allow for remote monitoring of your laser processes, and TOUGHER high-power detectors that can withstand incredibly high damage thresholds. Speaker: Félicien Legrand, Gentec Electro-Optics, Inc.

17:20 - 17:40 (Pacific Time (US & Canada) DST, UTC - 07:00)

Exhibit Hall Event - Technology Showcase: Simulation of Micro-LEDs by Synopsys Photonic Device Tools

Synopsys: This talk demonstrates how to simulate micro-LEDs with the improved LED Utility in the 2021.03 release of RSoft Photonic Device Tools. It covers both thin-film and nano-wire types of micro-LEDs. Advanced features and tips will be demonstrated to deal with complex structures. Speaker: Chenglin Xu, Synopsys, Inc., USA

Thursday, 13 May

4:00 - 5:45 (Pacific Time (US & Canada) DST, UTC - 07:00)

STh1A

Application of Hollow Core Fibers

Presenter: Guoqing Chang , *Institute of Physics, CAS*

STh1A.1

Plasma and Fiber Spatial Multi-Mode Initiated Stable Soliton Self-Compression and Spectral Bouncing in air-Filled Kagome HCPCF

Presenter: Foued Amrani , *GPPMM Xlim*

We report on a nonlinear compression down to 20 fs in air-filled HCPCF. Novel spectral-temporal dynamic is demonstrated. Spectral bouncing of the compressed pulse is triggered by the interplay between Raman redshift and plasma blueshift.

Authors: Martin Maurel, GPPMM Xlim / Foued Amrani, GPPMM Xlim / Ihar Babushkin, Leibnitz Hannover University / Benoit Debord, GPPMM Xlim / Frédéric Gérôme, GPPMM Xlim / Fetah Benabid, GPPMM Xlim

STh1A.2

Hollow Core Fiber Microwave Photonics Link

Presenter: Zitong Feng , *University of Southampton*

A 7.7 km long link made of Nested Antiresonant Nodeless Fiber is demonstrated to reduce microwave link loss by over 15 dB as compared to a link made of SMF-28.

Authors: xi zhang, University of Southampton / Zitong Feng, University of Southampton / Hesham Sakr, University of Southampton / John Hays, University of Southampton / Francesco Poletti, University of Southampton / David Richardson, University of Southampton / Radan Slavik, University of Southampton

STh1A.3

Fabrication and Characterization of Iodine Vapor Photonic Microcell

Presenter: Clément Goïcoechéa , *GPPMM - Xlim CNRS UMR7252 - University of Limoges*

A standalone FC/PC connectorized and sealed Iodine filled hollow core fiber with coupling efficiency as high as 75% and an absorption contrast reaching 65% on the P(33) 6-3 transition at room temperature is demonstrated.

Authors: Clément Goïcoechéa, GPPMM - Xlim CNRS UMR7252 - University of Limoges / Thomas Billotte, GPPMM - Xlim CNRS UMR7252 - University of Limoges / Matthieu Chafer, GLOphotonics / Martin Maurel, GLOphotonics / Jenny Jouin, IRCER - CNRS UMR7315 - Centre Européen de la Céramique / Philippe Thomas, IRCER - CNRS UMR7315 - Centre Européen de la Céramique / Frédéric Gérôme, GPPMM - Xlim CNRS UMR7252 - University of Limoges / Benoit Debord, GPPMM - Xlim CNRS UMR7252 - University of Limoges / Fetah Benabid, GPPMM - Xlim CNRS UMR7252 - University of Limoges

STh1A.4

Controlling the Attenuation of Hollow Core Fibers Using Gas-Induced Differential Refractive Index

Presenter: Thomas Kelly, *University of Southampton*

We demonstrate significant confinement loss reduction in anti-resonant hollow-core fibers through refractive index changes induced by differential gas pressure filling of the core and cladding elements. In our fiber, loss reduces 2.8-fold at 1.3 μ m.

Authors: Thomas Kelly, University of Southampton / Peter Horak, University of Southampton / Ian Davidson, University of Southampton / Matthew Partridge, University of Southampton / Gregory Jasion, University of Southampton / Shuichiro Rikimi, University of Southampton / Austin Taranta, University of Southampton / David Richardson, University of Southampton / Francesco Poletti, University of Southampton / Natalie Wheeler, University of Southampton

STh1A.5

Fibre-Based Pressure-Controlled Sources for Quantum Optics

Invited

Presenter: Nicolas Joly, *Universität Erlangen-Nürnberg*

We present progress towards the generation of photon triplet states and realisation of a tunable source of entangled photons. In both cases, control of the phase-matching is achieved through gas-pressure tuning.

Authors: Nicolas Joly, Universität Erlangen-Nürnberg / Jonas Hammer, Max-Planck Institute for the Science of Light / Maria Chekhova, Max-Planck Institute for the Science of Light

STh1A.6

Single-Mode Inhibited Coupling Fiber for sub-Doppler Spectroscopy

Presenter: Thomas Billotte, *GPPMM - Xlim CNRS UMR 7252 - University of Limoges*

We report on the use and qualification of the recently developed single-mode hybrid hollow-core photonic crystal fiber for a robust acetylene photonic micro-cell based optical frequency reference

Authors: Thomas Billotte, GPPMM - Xlim CNRS UMR 7252 - University of Limoges / Guillaume Baclet, LP2N - Institut d'Optique d'Aquitaine - Université de Bordeaux / Jonas Osório, GPPMM - Xlim CNRS UMR 7252 - University of Limoges / Frédéric Delahaye, GLOPhotonics / Vincent Mançois, LP2N - Institut d'Optique d'Aquitaine - Université de Bordeaux / Adèle Hilico, LP2N - Institut d'Optique d'Aquitaine - Université de Bordeaux / Martin Maurel, GLOPhotonics / Matthieu Chafer, GLOPhotonics / Foued Amrani, GPPMM - Xlim CNRS UMR 7252 - University of Limoges / Frédéric Gérôme, GPPMM - Xlim CNRS UMR 7252 - University of Limoges / Benoit Debord, GPPMM - Xlim CNRS UMR 7252 - University of Limoges / Philippe Bouyer, LP2N - Institut d'Optique d'Aquitaine - Université de Bordeaux / Simon Bernon, LP2N - Institut d'Optique d'Aquitaine - Université de Bordeaux / Fetah Benabid, GPPMM - Xlim CNRS UMR 7252 - University of Limoges

4:00 - 6:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FTh1P

Quantum Emitters Coupled to Nanophotonics

Presenter: Kihwan Kim , *Tsinghua University*

FTh1P.1

Unraveling the few-Photon Scattering Processes Induced by a Single Quantum Emitter Embedded in a Waveguide

Invited

Presenter: Hanna Le Jeannic , *Niels Bohr Institute*

Few-photon scattering on a two-level system can be a path towards quantum nonlinear operations. Such process, quite complex, can be unraveled by measuring the few-photon statistics of an attenuated laser going through an emitter.

Authors: Hanna Le Jeannic, Niels Bohr Institute

FTh1P.2

Exploring Collective Quantum Phenomena Using Nanofiber Mediated Atom-Light Interaction

Presenter: Jeremy Berroir , *Laboratoire Kastler-Brossel*

We report storage and retrieval of a single collective excitation of an atomic ensemble coupled to an optical nanofiber. We further provide theoretical and experimental advances on controllable atomic Bragg mirrors and atomic cavity systems.

Authors:Jeremy Berroir, Laboratoire Kastler-Brossel / Tridib Ray, Laboratoire Kastler-Brossel / Jeremy Raskop, Laboratoire Kastler-Brossel / Neil V. Corzo, Laboratoire Kastler-Brossel / Dmitriy Kupriyanov, St-Petersburg State Polytechnic University / Alban Urvoy, Laboratoire Kastler-Brossel / Julien Laurat, Laboratoire Kastler-Brossel

FTh1P.3

Topological and Localized States in Waveguide Quantum Electrodynamics

Presenter: Janet Zhong, *Australian National University*

We study theoretically a periodic array of atoms coupled to a waveguide and demonstrate that atom-photon interactions lead to formation of self-induced quantum Hall phases, Hofstadter butterfly and exotic localized three-photon states.

Authors:Janet Zhong, Australian National University / Alexander Poshakinskiy, Ioffe Institute / Yongguan Ke, Sun-Yat Sen University / Chaohong Lee, Sun-Yat Sen University / Nikita Olekhno, ITMO University / Yuri Kivshar, Australian National University / Alexander Poddubny, Australian National University

FTh1P.4

Systematic Design of Photonic Crystal Waveguides for Strong Coupling With Trapped Cold Atoms

Presenter: Adrien Bouscal, *Sorbonne Université*

We present a proposal for trapping Rubidium cold atoms near a novel design of a GaInP photonic crystal waveguide with characteristics optimized through systematic and inverse design. Purcell factors higher than unity are predicted.

Authors:Adrien Bouscal, Sorbonne Université / Alban Urvoy, Sorbonne Université / Jeremy Berroir, Sorbonne Université / Tridib Ray, Sorbonne Université / Malik Kemiche, CNRS / Sukanya Mahapatra, CNRS / Fabrice Raineri, CNRS / Ariel Levenson, CNRS / Kamel Bencheikh, CNRS / Christophe Sauvan, Institut d'Optique Graduate School / Jean-Jacques Greffet, Institut d'Optique Graduate School / Julien Laurat, Sorbonne Université

FTh1P.5

Optical Pumping of Few Shallow Donor Qubits in ZnO Nanostructures

Presenter: Maria Viitaniemi, *University of Washington*

Electrons bound to shallow donor impurities in ZnO are a promising solid state qubit candidate. Small ensembles of defects in ZnO nanostructures exhibit high optical homogeneity and donor spin initialization, comparable to bulk materials.

Authors: Maria Viitaniemi, University of Washington / Christian Zimmermann, University of Washington / Vasilis Niaouris, University of Washington / E. Senthil Kumar, Simon Fraser University / Simon Watkins, Simon Fraser University / Kai-Mei C. Fu, University of Washington

FTh1P.6

Telecom Spin-Photon Quantum Interface Based on Silicon Nanophotonics

Presenter: Christina Wicker , *University of Chicago*

We develop a telecom-band nanophotonic spin-photon interface with erbium dopants in silicon. We perform photoluminescence spectroscopy of Er^{3+} in silicon-on-insulator (SOI) wafers and measure Purcell enhancement, optical linewidths and transition dipoles in nanophotonic cavities.

Authors: Christina Wicker, University of Chicago / Yizhong Huang, University of Chicago / Hong Qiao, University of Chicago / Tian Zhong, University of Chicago

FTh1P.7

Heralded Quantum Random Access Memory in a Scalable Photonic Integrated Circuit Platform

Presenter: Kevin Chen , *Massachusetts Institute of Technology*

We propose a scalable photonic integrated circuit implementation of a heralded quantum random access memory and analyze its theoretical operation fidelity and efficiency.

Authors: Kevin Chen, Massachusetts Institute of Technology / Wenhan Dai, Massachusetts Institute of Technology / Carlos Errando-Herranz, Massachusetts Institute of Technology / Seth Lloyd, Massachusetts Institute of Technology / Dirk Englund, Massachusetts Institute of Technology

FTh1N

Novel Ideas in Quantum Information

Presenter: Fabrizio Piacentini , *INRIM*

FTh1N.1

Pancharatnam-Berry Phase and Non-Local Control of Light Dissipation

Presenter: Ruixiang Guo , *Nanyang Technological University*

We experimentally demonstrate for the first time that absorption of one of the photons from the entangled pair can be switched on and off by controlling the Pancharatnam-Berry phase of the other photon.

Authors: Ruixiang Guo, Nanyang Technological University / Anton Vetlugin, Nanyang Technological University / Cesare Soci, Nanyang Technological University / Nikolay Zheludev, University of Southampton

FTh1N.2

Nonclassicality Phase-Space Inequalities: Theory and Experiment

Presenter: Martin Bohmann, *Austria Academy of Sciences*

We derive phase-space-inequality conditions for the verification of nonclassicality and implement them experimentally. We certify quantum correlations even if the phase-space distributions are nonnegative and demonstrate noise and loss robustness.

Authors: Martin Bohmann, Austria Academy of Sciences / Nicola Biagi, Consiglio Nazionale delle Ricerche / Jan Sperling, University of Paderborn / Alessandro Zavatta, Consiglio Nazionale delle Ricerche / Marco Bellini, Consiglio Nazionale delle Ricerche / Elizabeth Agudelo, Austria Academy of Sciences

FTh1N.3

Implementing Observation-Dependent Suppression and Enhancement of Two-Photon Coincidences in the Hong-Ou-Mandel Experiment

Presenter: Max Ehrhardt, *University of Rostock, Institute for Phy*

We investigate the Hong-Ou-Mandel interference of photon pairs in birefringent waveguides with polarization-dependent losses. Depending on the detection basis, we show seamless tunability all the way from enhancement to full suppression of indistinguishable photons.

Authors: Max Ehrhardt, University of Rostock, Institute for Phy / Matthias Heinrich, University of Rostock, Institute for Phy / Alexander Szameit, University of Rostock, Institute for Phy

FTh1N.4

All-Optical Quadrature Measurement of Over-THz-Bandwidth Continuous-Wave Squeezed Light

Presenter: Takahiro Kashiwazaki, *NTT Corporation*

We achieved all-optical quadrature measurement of continuous-wave over-3-dB squeezed light at up to 3.7-THz sideband frequencies using LiNbO₃-waveguide optical parametric amplifiers, which showed high-gain broadband phase-sensitive amplification.

Authors: Takahiro Kashiwazaki, NTT Corporation / Naoto Takanashi, The University of Tokyo / Asuka Inoue, NTT Corporation / Takushi Kazama, NTT Corporation / Koji Enbutsu, NTT Corporation / Ryoichi Kasahara, NTT Corporation / Takeshi Umeki, NTT Corporation / Akira Furusawa, The University of Tokyo

FTh1N.5

Experimental Realization of a non-Abelian U(3) Holonomy

Presenter: Vera Neef, *Institut für Physik, Universität Rostock*

We experimentally realize a U(3) holonomy. By adiabatically propagating quantum states in appropriately designed photonic waveguide systems, we evolve on closed loops within a degenerate subspace of dark states, resulting in a non-Abelian geometric phase.

Authors: Vera Neef, Institut für Physik, Universität Rostock / Julien Pinske, Institut für Physik, Universität Rostock / Friederike Klauck, Institut für Physik, Universität Rostock / Lucas Teuber, Institut für Physik, Universität Rostock / Mark Kremer, Institut für Physik, Universität Rostock / Max Ehrhardt, Institut für Physik, Universität Rostock / Matthias Heinrich, Institut für Physik, Universität Rostock / Stefan Scheel, Institut für Physik, Universität Rostock / Alexander Szameit, Institut für Physik, Universität Rostock

FTh1N.6

the Synthetic Hilbert Space of Laser-Driven Free-Electrons

Presenter: Guy Braiman, *Technion*

We propose the concept of free-electrons carrying *qudits*. We find how electron-laser interactions can shape the electron energy states into arbitrarily-large synthetic Hilbert spaces, exemplified here for size-4.

Authors: Guy Braiman, Technion / Ori Reinhardt, Technion / omer levi, Technion / Chen Mechel, Technion / Ido Kaminer, Technion

FTh1N.7

Free Electrons Can Induce Quantum Correlations Between Two Separate Photonic Cavities

Presenter: Gefen Baranes, *Technion*

We find that free electrons passing through two independent photonic cavities induce quantum correlations between them, creating nonzero quantum mutual information and second-order coherence. The concept is general and applicable for example in electron-phonon interactions.

Authors: Gefen Baranes, Technion / Ron Ruimy, Technion / Alexey Gorlach, Technion / Ido Kaminer, Technion

FTh1N.8

A Scalable Scheme for Generating Multi-Photon Entangled States From a Single Deterministic Single-Photon Source

Presenter: Daniel Istrate, *The Hebrew University of Jerusalem*

We present an all-fiber compact scheme to scalably generate arbitrary number polarization entangled photons. Utilizing a single solid-state quantum dot as a high-brightness single photon source, we demonstrate entanglement of up to four photons. We show further venues our flexible scheme offers.

Authors: Daniel Istrate, The Hebrew University of Jerusalem / Yehuda Pilnyak, The Hebrew University of Jerusalem / Juan Loredó, CNRS Centre for Nanoscience and Nanotechnology, Université Paris-Sud, Université Paris-Saclay / Carlos Antón, CNRS Centre for Nanoscience and Nanotechnology, Université Paris-Sud, Université Paris-Saclay / Niccolo Somaschi, Quandela / Paul Hilaire, CNRS Centre for Nanoscience and Nanotechnology, Université Paris-Sud, Université Paris-Saclay / Hélène Ollivier, CNRS Centre for Nanoscience and Nanotechnology, Université Paris-Sud, Université Paris-Saclay / Martin Esmann, CNRS Centre for Nanoscience and Nanotechnology, Université Paris-Sud, Université Paris-Saclay / Lior Cohen, The Hebrew University of Jerusalem / Leonid Vidro, The Hebrew University of Jerusalem / Clément Millet, CNRS Centre for Nanoscience and Nanotechnology, Université Paris-Sud, Université Paris-Saclay / Aristide Lamaître, CNRS Centre for Nanoscience and Nanotechnology, Université Paris-Sud, Université Paris-Saclay / Isabelle Sagnes, CNRS Centre for Nanoscience and Nanotechnology, Université Paris-Sud, Université Paris-Saclay / Abdelmounaim Harouri, CNRS Centre for Nanoscience and Nanotechnology, Université Paris-Sud, Université Paris-Saclay / Loïc Lanco, Université Paris Diderot, Paris, France / Pascale Senellart, CNRS Centre for Nanoscience and Nanotechnology, Université Paris-Sud, Université Paris-Saclay / Hagai Eisenberg, The Hebrew University of Jerusalem

FTh1O

Engineering Multiphoton Sources

Presenter: Alejandra Valencia, *Universidad de los Andes (Colombia)*

FTh1O.1

Spontaneous and Stimulated Three Photon Generation

Presenter: Milica Banic , *University of Toronto*

We study spontaneous and stimulated three photon generation rates in resonant and non-resonant structures. In the stimulated regime, we find that current technology allows for the generation of 10^5 photons per second in both structures.

Authors: Milica Banic, University of Toronto / Marco Liscidini, University of Pavia / Nicolas Quesada, Xanadu / John Sipe, University of Toronto

FTh10.2

Multi-Photon Fock-State Generation via Climbing the Fock Ladder

Presenter: Benjamin Brecht , *University of Paderborn*

We demonstrate the enhanced generation of Fock-states with up to three photons using a parametric down-conversion source that combines time-multiplexing and quantum feedback and outperforms conventional state generation methods.

Authors: Melanie Engelkemeier, University of Paderborn / Jan Sperling, University of Paderborn / Johannes Tiedau, University of Paderborn / Sonja Barkhofen, University of Paderborn / Ish Dhand, University of Ulm / Martin Plenio, University of Ulm / Benjamin Brecht, University of Paderborn / Christine Silberhorn, University of Paderborn

FTh10.3

Quantum State Engineering and Quantum Communications With AlGaAs Chips

Invited

Presenter: Sara Ducci , *Université de Paris*

The production of photon pairs via SPDC in AlGaAs chips combines the advantages of device compactness, extreme versatility and high-dimensionality of the generated quantum state allowing to engineer particle exchange statistics and implementing quantum networks.

Authors: Sara Ducci, Université de Paris

FTh10.4

Entangled Photon Pair Generation From an AlGaAs-on-Insulator Microring Resonator

Presenter: Trevor Steiner , *University of California, Santa Barbara*

Time-energy entangled-photon pair generation is shown from a $Q > 1$ million AlGaAs-on-insulator microring resonator with an internal generation rate greater than 20×10^9 pairs $\text{sec}^{-1} \text{mW}^{-2}$, heralded single photon purity $> 99\%$, and a visibility $> 97\%$.

Authors: Trevor Steiner, University of California, Santa Barbara / Joshua Castro, University of California, Santa Barbara / Lin Chang, University of California, Santa Barbara / Quynh Dang, University of California, Santa Barbara / Weiqiang Xie, University of California, Santa Barbara / Chenlei Li, University of California, Santa Barbara / Justin Norman, University of California, Santa Barbara / John Bowers, University of California, Santa Barbara / Galan Moody, University of California, Santa Barbara

FTh10.5

Mie Resonances in the Spectrum of Spontaneous Parametric Down-Conversion

Presenter: Tomas Santiago, *Max Planck Institute for the Science of Light*

We report on the first-time generation of biphotons via spontaneous parametric down-conversion driven by Mie-type resonances in subwavelength metasurfaces. The measured biphoton spectrum reveals that emission predominantly occurs at the resonant wavelength of the metasurface.

Authors: Tomas Santiago, Max Planck Institute for the Science of Light / Anna Fedotova, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Vitaliy Sultanov, Max Planck Institute for the Science of Light / Maximilian Weissflog, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Mohammadreza Younesi, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Isabelle Staude, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Thomas Pertsch, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Frank Setzpfandt, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Maria Chekhova, Max Planck Institute for the Science of Light

FTh10.6

Polarization Entangled Photon Pairs With Factorable Spectra Engineered by Un-Even Three-Stage Nonlinear Interferometers

Presenter: Liang Cui, *Tianjin University*

Polarization-entangled photon pairs with factorable spectra are generated by using a nonlinear interferometer, in which three nonlinear fibers with lengths following binomial distribution are sandwiched with two 10-m-long standard single mode fibers.

Authors: Pengyu Gao, Tianjin University / Mingyi Ma, Tianjin University / Liang Cui, Tianjin University / Xiaoying Li, Tianjin University

FTh10.7

Mid-Infrared Photon-Pair Generation in AgGaS₂ Crystals

Presenter: Mohit Kumar , *Friedrich-Schiller-University Jena*

We demonstrate non-degenerate photon-pair generation by spontaneous parametric down conversion in silver gallium sulfide AgGaS₂. Idler photons in the mid-infrared spectral range above 6 μm wavelength are generated with corresponding signal photons in the visible.

Authors: Mohit Kumar, Friedrich-Schiller-University Jena / Thomas Pertsch, Friedrich-Schiller-University Jena / Frank Setzpfandt, Friedrich-Schiller-University Jena

FTh1J

Nonlinear Photonics II

Presider: Pawel Jung

FTh1J.1

Experimental Observation of the Stern Gerlach Effect in Nonlinear Optics

Highlighted Talk

Presenter: Ofir Yesharim , *Tel Aviv University*

The optical analogue of the Stern Gerlach effect is experimentally demonstrated, using the sum frequency generation process, whereby a light beam is deflected into two distinct angles owing to a gradient in the nonlinear coupling.

Authors: Ofir Yesharim, Tel Aviv University / Aviv Karnieli, Tel Aviv University / Giuseppe Di Domenico, Tel Aviv University / Sivan Trajtenberg-Mills, Tel Aviv University / Ady Arie, Tel Aviv University

FTh1J.2

Nonlinear Optical Spintronics: Topological Hall Effect and Anderson Localization

Presenter: Aviv Karnieli , *Tel Aviv University*

We propose nonlinear optical systems that are analogous to spin-transport in magnetic materials. We find a topological Hall effect for light in skyrmionic nonlinear photonic crystals, and spin-Anderson localization in optical spin-glass.

Authors: Aviv Karnieli, Tel Aviv University / Shai Tseses, Technion / Ido Kaminer, Technion / Guy Bartal, Technion / Ady Arie, Tel Aviv University

FTh1J.3

Fano Discrete-Continuum Interactions in Broadband Parametric Downconversion

Presenter: Ryotatsu Yanagimoto , *Stanford University*

We identify broadband parametric downconversion (PDC) in the few-pump-photon regime as a Fano-type discrete-continuum interaction. We derive analytic expressions for PDC dynamics, revealing quantum phenomena including complete pump depletion and bound states in the continuum.

Authors:Ryotatsu Yanagimoto, Stanford University / Edwin Ng, Stanford University / Marc Jankowski, Stanford University / Tatsuhiro Onodera, Cornell University / Martin Fejer, Stanford University / Hideo Mabuchi, Stanford University

FTh1J.4

Observation of Induced Transparency and Slow Light via Thermo-Optic Effect on a Silicon Chip

Presenter: Marco Clementi , *Università di Pavia*

We demonstrate a novel form of induced transparency and associated slow light due to thermo-optic effect. The phenomenon provides group delay as high as 0.5 μs in a silicon photonic crystal cavity at room temperature.

Authors:Marco Clementi, Università di Pavia / Simone Iadanza, Cork Institute of Technology / Sebastian Schulz, University of St. Andrews / Giulia Urbinati, Università di Pavia / Dario Gerace, Università di Pavia / Liam O'Faolain, Cork Institute of Technology / Matteo Galli, Università di Pavia

FTh1J.5

Rainbow Spiral Emission From Optical Fibers

Presenter: Mario Ferraro , *Sapienza University of Rome*

We observed the generation of a spiral-shaped intensity beams from optical fibers under suitable coupling conditions. In nonlinear regime, we observed rainbow-spiral emission thanks to the generation of supercontinuum in the fiber.

Authors:Fabio Mangini, University of Brescia / Mario Ferraro, Sapienza University of Rome / Mario Zitelli, Sapienza University of Rome / Vladimir Kalashnikov, Sapienza University of Rome / Alioune Niang, University of Brescia / Tigran Mansuryan, Université de Limoges / Fabrizio Frezza, Sapienza University of Rome / Alessandro Tonello, Université de Limoges / Vincent Couderc, Université de Limoges / Alejandro Aceves, Southern Methodist University / Stefan Wabnitz, Sapienza University of Rome

FTh1J.6

Graded Nanofilm Controlled Dispersion and Supercontinuum Generation in Exposed Core Fibers

Presenter: Tilman Lühder , *Leibniz-IPHT*

Depositing high refractive index nanofilms with controlled thicknesses on exposed core fibers enables thickness tunable supercontinuum generation. Thickness gradients along the fiber allow for optimizing for spectral flatness and extension of bandwidth toward the infrared.

Authors: Tilman Lühder, Leibniz-IPHT / Henrik Schneidewind, Leibniz-IPHT / Sebastian Goerke, Leibniz-IPHT / Kay Schaarschmidt, Leibniz-IPHT / Erik Schartner, The University of Adelaide / Heike Ebendorff-Heidepriem, The University of Adelaide / Markus Schmidt, Leibniz-IPHT

FTh1J.7

Generation of Tornado Waves

Presenter: Dimitris Papazoglou , *Foundation for Research and Technology-Hellas (FORTH)*

We experimentally generate Tornado Waves using a single phase modulation device. We show that, by applying spatial multiplexing techniques, such complex superimposing fields that carry orbital angular momentum of opposite handedness can be efficiently generated.

Authors: Dimitris Mansour, Foundation for Research and Technology-Hellas (FORTH) / Apostolos Brimis, Foundation for Research and Technology-Hellas (FORTH) / Konstantinos Makris, Foundation for Research and Technology-Hellas (FORTH) / Dimitris Papazoglou, Foundation for Research and Technology-Hellas (FORTH)

FTh1K

Near-field Imaging and Enhanced Sensing

Presenter: Wei Zhou , *Virginia Tech*

FTh1K.1

SEIRA Sensing of Different Sugars at Physiological Concentrations

Presenter: Harald Giessen , *University of Stuttgart*

We utilize resonant plasmonic surface-enhanced infrared absorption in combination with machine learning principal component analysis to detect aqueous glucose solutions down to g/l and to differentiate between five various sugars simultaneously.

Authors: Diana Pfezer, University of Stuttgart / Julian Karst, University of Stuttgart / Lucca Kühner, University of Stuttgart / Mario Hentschel, University of Stuttgart / Harald Giessen, University of Stuttgart

FTh1K.2

Nanophotonic Chiral Sensing: How Does it Actually Work?

Presenter: Steffen Both , *University of Stuttgart*

Nanophotonic chiral sensing has recently attracted a lot of attention; however, a thorough understanding is still missing. We present a general theory that provides deep insight into the underlying interactions.

Authors:Steffen Both, University of Stuttgart / Harald Giessen, University of Stuttgart / Thomas Weiss, University of Stuttgart

FTh1K.3

Spectrometer-Free Electron Probe of Ultrafast Thermal Dynamics in Optically Excited Samples

Presenter: Vahagn Mkhitarian , *ICFO-Institut de Ciències Fòniques, The Barcelona Institute of Science and Technology*

We show that the plasmon excitation ultrafast dynamics in nanostructures can be followed through energy integrated, momentum resolved signals of inelastically scattered electrons without the need to have highly-monochromatized electron beams and electron spectrometers.

Authors:Vahagn Mkhitarian, ICFO-Institut de Ciències Fòniques, The Barcelona Institute of Science and Technology / Eduardo Dias, ICFO-Institut de Ciències Fòniques, The Barcelona Institute of Science and Technology / Fabrizio Carbone, École Polytechnique Fédérale de Lausanne (EPFL) / Javier Garcia de Abajo, ICFO-Institut de Ciències Fòniques, The Barcelona Institute of Science and Technology

FTh1K.4

Deep Learning-Based Spectral Reconstruction on a Chip Using a Scalable Plasmonic Encoder

Presenter: Artem Goncharov , *UCLA*

We demonstrate a deep learning-based spectroscopy framework using a low-cost on-chip plasmonic encoder. When blindly tested on N=14,648 random spectra our system shows competitive performance, where the reconstruction of an unknown spectrum on average takes ~28 μ s.

Authors:Artem Goncharov, UCLA / Calvin Brown, UCLA / Zach Ballard, UCLA / Mason Fordham, UCLA / Ashley Clemens, UCLA / Yunzhe Qiu, UCLA / Yair Rivenson, UCLA / Aydogan Ozcan, UCLA

FTh1K.5

Diffraction Metagrating Sensor: an Improved Technique for Response Intensification

Presenter: Rifat Ahmmed Aoni , *The Australian National University*

We propose a novel concept for refractive-index sensing with enhanced sensitivity and robustness to source intensity. The proposed sensor is based on dielectric Huygens' metagrating and experimentally shows the maximum sensitivity of 616 RIU^{-1} .

Authors:Rifat Ahmmed Aoni, The Australian National University / Shridhar Manjunath, The Australian National University / Buddini Karawdeniya, The Australian National University / Khosro Kamali, The Australian National University / Lei Xu, Nottingham Trent University / Mohsen Rahmani, Nottingham Trent University / Andrey Miroshnichenko, University of New South Wales / Dragomir Neshev, The Australian National University

FTh1K.6

Quantitative Waveform Sampling on Atomic Scales

Presenter: Carmen Roelcke , *University of Regensburg*

Using a molecular switch as a local field sensor, we directly sample the temporal shape and strength of atomically confined light field transients inside the tunneling gap of a scanning tunneling microscope.

Authors:Carmen Roelcke, University of Regensburg / Dominik Peller, University of Regensburg / Lukas Kastner, University of Regensburg / Thomas Buchner, University of Regensburg / Alexander Neef, University of Regensburg / Johannes Hayes, University of Regensburg / Franco Bonafé, Max Planck Institute for the Structure and Dynamics of Matter, Center for Free Electron Laser Science / Dominik Sidler, Max Planck Institute for the Structure and Dynamics of Matter, Center for Free Electron Laser Science / Michael Ruggenthaler, Max Planck Institute for the Structure and Dynamics of Matter, Center for Free Electron Laser Science / Angel Rubio, Max Planck Institute for the Structure and Dynamics of Matter, Center for Free Electron Laser Science / Jascha Repp, University of Regensburg / Rupert Huber, University of Regensburg

FTh1K.7

Giant Enhancement of Fluorescence-Detected Circular Dichroism of a Chiral Molecule Inside Photonic Hyper Crystals

Presenter: SITA RAMA KRISHNA INDUKURI , *Hebrew university of Jerusalem*.

We demonstrate experimentally enhanced Fluorescence-Detected Circular Dichroism (FD CD) of a Chiral Molecule embedded within a negative refractive index hyperbolic metamaterial photonic hyper crystals (HMMP C).

Authors:SITA RAMA KRISHNA INDUKURI, Hebrew university of Jerusalem. / Nityanand Sharma, Hebrew university of Jerusalem. / Christian Frydendahl, Hebrew university of Jerusalem. / Noa Mazurski, Hebrew university of Jerusalem. / Uriel Levy, Hebrew university of Jerusalem.

FTh1K.8

Watching in Situ the Hydrogen Diffusion Dynamics in Magnesium on the Nanoscale

Presenter: Julian Karst , *University of Stuttgart*

We present a method to image the phase transition from metallic magnesium to dielectric magnesium hydride on the nanometer scale in-situ. This allows to understand and improve the intrinsically limited diffusion kinetics and switching speeds.

Authors: Julian Karst, University of Stuttgart / Florian Sterl, University of Stuttgart / Heiko Linnenbank, University of Stuttgart / Thomas Weiss, University of Stuttgart / Mario Hentschel, University of Stuttgart / Harald Giessen, University of Stuttgart

FTh1M

BICs and More

Presenter: Chia Wei Hsu , *University of Southern California*

FTh1M.1

Bound States in the Continuum Employed for Maximizing Metasurface Chirality

Presenter: M. Gorkunov , *Shubnikov Institute of Crystallography*

We propose a general approach to design metasurfaces hosting bound states in the continuum for achieving maximum chirality with transparency to one circular polarization and full resonant absorption (or reflection) of the other polarization.

Authors: M. Gorkunov, Shubnikov Institute of Crystallography / Alexander Antonov, Shubnikov Institute of Crystallography / Yuri Kivshar, Australian National University

FTh1M.2

Experimental Observation of Bound States in the Continuum Generated by Spatial Symmetry Breaking

Presenter: Taiki Yoda , *NTT Basic Research Laboratories*

We have experimentally demonstrated a new formation mechanism of off- Γ bound states in the continuum (BICs), which are generated by a simple symmetry breaking of trivial at- Γ BICs in photonic crystals.

Authors: Taiki Yoda, NTT Basic Research Laboratories / Yuto Moritake, Tokyo Institute of Technology / Masaaki Ono, NTT Basic Research Laboratories / Eiichi Kuramochi, NTT Basic Research Laboratories / Masaya Notomi, NTT Basic Research Laboratories

FTh1M.3

Symmetry Controlled Nonlinear Beam Shaping in Engineered Optical Media

Presenter: Danilo Gomes Pires , *Duke University*

We exploit the synergy between engineered colloidal media and orbital angular momentum (OAM) elliptical and higher order Bessel-Gauss integrated in time beams to study new regimes on nonlinear light matter interactions and on-demand beam shaping.

Authors: Danilo Gomes Pires, Duke University / Jerome Miller, Clemson University / Eric Johnson, Clemson University / Natalia M. Litchinitser, Duke University

FTh1M.4

Quasibound States in the Continuum for Bidirectional Symmetry-Breaking Nonlinear Metasurfaces

Presenter: Muliang Zhu , *Georgia Institute of Technology*

We demonstrate an amorphous silicon metasurface featuring quasibound states in the continuum with both co-polarized and cross-polarized symmetry breaking for efficient third harmonic generation.

Authors: Muliang Zhu, Georgia Institute of Technology / Chentao Li, Emory University / Tianren Fan, Georgia Institute of Technology / Sajjad AbdollahRamezani, Georgia Institute of Technology / Xi Wu, Georgia Institute of Technology / Hayk Harutyunyan, Emory University / Ali Adibi, Georgia Institute of Technology

FTh1M.5

Using Symmetry Bandgaps to Create Bound States in the Continuum in 3D Photonic Crystals

Presenter: Alexander Cerjan , *Pennsylvania State University*

We show that photonic-crystal environments can create symmetry-specific bandgaps that host a wide variety of symmetry-protected lines of bound states in the continuum, which we prove to be impossible in homogeneous environments.

Authors: Alexander Cerjan, Pennsylvania State University / Christina Jörg, Pennsylvania State University / Wladimir Benalcazar, Pennsylvania State University / Sachin Vaidya, Pennsylvania State University / Chia Wei Hsu, University of Southern California / Georg von Freymann, University of Kaiserslautern / Mikael Rechtsman, Pennsylvania State University

FTh1M.6

Tailored non-Hermiticity Induced Suppression of Scattering

Presenter: Andrea Steinfurth , *Universtät Rostock*

Light waves passing through inhomogeneous media commonly are subject to scattering and subsequent interference. We have optically implemented tailored non-Hermitian media in which scattering is suppressed for stationary as well as for time-dependent field distributions.

Authors:Andrea Steinfurth, Universität Rostock / Ivor Krešić, Vienna University of Technology / Sebastian Weidemann, Universität Rostock / Mark Kremer, Universität Rostock / Konstantinos Makris, University of Crete / Matthias Heinrich, Universität Rostock / Stefan Rotter, Vienna University of Technology / Alexander Szameit, Universität Rostock

FTh1M.7

Arbitrary Designer Mode Convertor and on-Chip OAM Generator With Configurable Topological Charge Using Waveguide-Integrated Metasurface

Presenter: Yuan Meng, *Tsinghua University*

Leveraging waveguide-integrated metasurface platform, designer mode convertors capable of exclusively exciting arbitrary high-order modes with high-purity reaching 98% are proposed. We also report on-chip scalable broadband vortex-beam-generators with configurable topological charge from -3 to +3.

Authors:Yuan Meng, Tsinghua University / Tiantian He, Tsinghua University / zhoutian Liu, Tsinghua University / Futai Hu, Tsinghua University / Qirong Xiao, Tsinghua University / Mali Gong, Tsinghua University

FTh1M.8

Coherent Backscattering of Spatially Entangled Photons

Presenter: Mamoon Safadi, *The Hebrew University of Jerusalem*

We report the first observation of coherent backscattering of spatially entangled photons and show that the backscattering cone of entangled photons corresponds to that of single photons with half the wavelength.

Authors:Mamoon Safadi, The Hebrew University of Jerusalem / Ohad Lib, The Hebrew University of Jerusalem / Yaron Bromberg, The Hebrew University of Jerusalem

ATh1R

Micro, Nano Fabrication and 3D Printing

Presenter: Beat Neuenschwander, *Bern University of Applied Sciences*

ATh1R.1

Stitching-Free 3D Printing of Millimeter-Sized Highly Transparent Spherical and Aspherical Optical Components

Presenter: Simon Ristok , *University of Stuttgart*

We fabricate and characterize spherical and aspherical polymer lenses on the millimeter scale by stitching-free 3D printing via two-photon polymerization. The imaging quality is excellent, being comparable to commercially available glass lenses.

Authors: Simon Ristok, University of Stuttgart / Simon Thiele, University of Stuttgart / Andrea Toulouse, University of Stuttgart / Alois Herkommer, University of Stuttgart / Harald Giessen, University of Stuttgart

ATh1R.2

3D Printed Hybrid Refractive/Diffractive Achromat and Apochromat for the Visible Wavelength Range

Presenter: Michael Schmid , *University of Stuttgart*

We demonstrate 3D-printed hybrid refractive/diffractive achromats and apochromats by using DOEs and simultaneously combining two different photoresists. These combinations drastically reduce chromatic aberrations in 3D-printed micro optics for the visible wavelength range.

Authors: Michael Schmid, University of Stuttgart / Simon Thiele, University of Stuttgart / Alois Herkommer, University of Stuttgart / Harald Giessen, University of Stuttgart

ATh1R.3

From Single to Multi-Scaled Periodic Surface Structures: Towards Multifunctional Surfaces Using Laser Based Microfabrication Methods

Invited

Presenter: Andrés Lasagni , *Technische Universität Dresden*

This study reports on the fabrication functionalized surfaces with enhanced properties using micro and nano-topographical features produced using laser based fabrication methods. By the combination of different structural elements, multifunctional surfaces are also produced.

Authors: Andrés Lasagni, Technische Universität Dresden / Stephan Milles, Technische Universität Dresden / Christoph Zwahr, Technische Universität Dresden

ATh1R.4

Electrospray Microthruster Based on Bessel-Beam Laser- Machined Microcapillaries Embedded in Glass

Presenter: Brian Canfield , *University of Tennessee Space Institute*

We discuss fabrication and operation of robust, prototype electro spray microthrusters prepared in glass using Bessel-beam ultrafast laser micromachining. Electro spray of ionic liquid in vacuum is confirmed by measuring alternating currents with a Faraday cup.

Authors: Brian Canfield, University of Tennessee Space Institute / Alexander Terekhov, University of Tennessee Space Institute / Trevor Moeller, University of Tennessee Space Institute / Lino Costa, University of Tennessee Space Institute

ATh1R.5

The Deepest Subwavelength LIPSS on ZnO by Reduction of the Damage Threshold

Presenter: Yaoyao Liu , *Nankai University*

The smallest spatial period of LIPSS on ZnO monocrystal was achieved through metal/ZnO heterointerface assisted femtosecond laser processing. Simultaneously, the damage threshold of ZnO was decreased by 54% due to the metal film coating.

Authors: Yaoyao Liu, Nankai University / Qiang Wu, Nankai University / Jianghong Yao, Nankai University / Jingjun Xu, Nankai University

ATh1R.6

Ultrafast Self-Assembling of Quasi-Hexagonal Periodic Surface Structures on a Sapphire Crystal

Presenter: Iaroslav Gnilitskiy , *"NoviNano Lab" LLC*

We report generation of quasi-hexagonal microstructures of variable shape on a surface of crystalline sapphire wafer by scanning multiple 266-femtosecond laser pulses at wavelength 1030 nm. Mechanisms and potential applications of the microstructures are discussed.

Authors: Iaroslav Gnilitskiy, "NoviNano Lab" LLC / Vitaly Gruzdev, University of New Mexico

ATh1R.7

Design and Fabrication of 3D Interconnects for Photonic Neuronal Networks Using Two-Photon Polymerization

Presenter: Ricardo Adão , *INL - Int. Iberian Nanotech. Lab.*

Photonic neuromorphic networks composed of spiking nanolight sources require novel approaches for compact and efficient optical interconnection. We design, simulate and fabricate 3D polymer waveguides and obtain promising elevated structures suited for complex waveguide crossings

Authors: Ricardo Adão, INL - Int. Iberian Nanotech. Lab. / Bruno Romeira, INL - Int. Iberian Nanotech. Lab. / Jana Nieder, INL - Int. Iberian Nanotech. Lab.

ATh1S

Optical Fibers for Sensing Applications I

Presenter: Peter Mosley , *University of Bath*

ATh1S.1

Highly Sensitive and Compact Fiber Optic Ultrasound Sensor

Presenter: Liuyang Yang , *Huazhong Univ of Science and Technology*

A highly sensitive and compact fiber optic ultrasound sensor based on a composite sensing film is demonstrated. Assisted with the coherent demodulation, a NEP of 0.46kPa and the bandwidth of 20MHz are successfully achieved.

Authors:Liuyang Yang, Huazhong Univ of Science and Technology / Fang Fang, Huazhong Univ of Science and Technology / Liangye Li, Huazhong Univ of Science and Technology / Dongchen Xu, Huazhong Univ of Science and Technology / Qizhen Sun, Huazhong Univ of Science and Technology

ATh1S.2

Distributed Intrinsic Fabry-Pérot Fiber Interferometers for Ultrasonic Vibration Measurement

Presenter: Yuqi Li , *University of Pittsburgh*

This paper demonstrates a robust and low-cost interrogation method for distributed ultrasonic vibration measurements using multiplexable intrinsic Fabry-Pérot fiber interferometers for high frequency measurements up to 20 kHz.

Authors:Yuqi Li, University of Pittsburgh / Kehao Zhao, University of Pittsburgh / Jieru Zhao, University of Pittsburgh / Michael Buric, National Energy Technology Laboratory / Ruishu Wright, National Energy Technology Laboratory / Kevin Chen, University of Pittsburgh

ATh1S.3

Optical Fiber Photonic Crystal Hydrophone for Acoustic Bio-Sensing

Presenter: Simon Lorenzo , *Stanford University*

We fabricate, assemble, and characterize a compact, robust, and scalably fabricated photonic crystal hydrophone capable of measuring acoustic signals from single cardiomyocytes with a minimum detectable pressure of 3 $\mu\text{Pa}/\sqrt{\text{Hz}}$ and a 19 kHz bandwidth.

Authors:Simon Lorenzo, Stanford University / Yu-Po Wong, Stanford University / Olav Solgaard, Stanford University

ATh1S.4

Intelligent Structure Monitoring for Tunnel Steel Loop Based on Distributed Acoustic Sensing

Presenter: Die Hu , *Huazhong Univ of Science and Technology*

A tunnel steel loop reinforcement invalidation monitoring technology based on optical fiber distributed acoustic sensing (DAS) is proposed and demonstrated. Assisted with machine learning, the identification accuracy rate of invalid degree is up to 97.8%

Authors:Die Hu, Huazhong Univ of Science and Technology / Bin Tian, Huazhong Univ of Science and Technology / Hao Li, Huazhong Univ of Science and Technology / Cunzheng Fan, Huazhong Univ of Science and Technology / Tao Liu, Huazhong Univ of Science and Technology / Tao He, Huazhong Univ of Science and Technology / Yijie Liu, Huazhong Univ of Science and Technology / Zhijun Yan, Huazhong Univ of Science and Technology / Qizhen Sun, Huazhong Univ of Science and Technology

ATh1S.5

Simulating Fast Dynamics in Distributed Acoustic Sensing Using Finite Difference Time Domain Method

Presenter: Prasanth P P , *Indian Institute of Technology Madras*

We introduce a FDTD method to simulate dynamic phase evolution of backscattered radiation in Distributed Acoustic sensing system and demonstrate its use for detecting high frequency perturbations.

Authors:Prasanth P P, Indian Institute of Technology Madras / Neethu Sasikumar, Indian Institute of Technology Madras / D. Venkitesh, Indian Institute of Technology Madras / Balaji Srinivasan, Indian Institute of Technology Madras

ATh1S.6

a Mach-Zehnder, Fabry-Perot Hybrid Fiber Interferometer

Presenter: Nabil Md Rakinul Hoque , *University of Alabama in Huntsville*

We report the experimental demonstration of a Mach-Zehnder-Fabry-Perot hybrid fiber interferometer. Preliminary characterization shows low background and good stability with an all-passive isolation system.

Authors:Nabil Md Rakinul Hoque, University of Alabama in Huntsville / Lingze Duan, University of Alabama in Huntsville

ATh1S.7

(Withdrawn) Fiber-Optic Interferometric Sensors With High-Radiation Tolerance and Megahertz Measurement Bandwidth

Presenter: Yun Liu , *Oak Ridge National Laboratory*

We have developed a fiber-optic low-coherence interferometric sensor and a polarization-insensitive all-fiber phase-shifted demodulator. The sensors have been successfully applied to measure megahertz dynamic strains in a spallation target with GRad radiation dose.

Authors:Yun Liu, Oak Ridge National Laboratory / Cary Long, Oak Ridge National Laboratory / Bing Qi, Oak Ridge National Laboratory / Robert Sangrey, Oak Ridge National Laboratory / Drew Winder, Oak Ridge National Laboratory

ATh1S.8

Multipoint Curvature Sensing With Multicore Fiber Bragg Gratings and Two-Photon Absorption Process in Si-APD

Presenter: Yosuke Tanaka , *Tokyo Univ of Agriculture and Technology*

Multipoint curvature sensing with multicore fiber Bragg gratings is realized using intensity correlation measurement based on two-photon absorption process in Si-APD, where reflection spectra from multiple gratings with almost the same Bragg wavelengths are discriminated.

Authors:Yosuke Tanaka, Tokyo Univ of Agriculture and Technology / Naofumi Sonoda, Tokyo Univ of Agriculture and Technology / Tetsuya Abe, Tokyo Univ of Agriculture and Technology

STh1B

Structured Light Sources

Presenter: Shang-da Yang , *National Tsing Hua University*

STh1B.1

Classically Entangled Vectorial Structured Light Towards Multiple Degrees of Freedom and Higher Dimensions

Presenter: Yijie Shen , *University of Southampton*

Vector beam with spin-orbital non-separable coupling acts as classically entangled state with two degrees of freedom, here we generalize the ray-wave structured vectorially structured light to create multi-degree-of-freedom control towards high-dimensional classical entanglement.

Authors:Yijie Shen, University of Southampton / Zhaoyang Wang, Tsinghua University / Xilin Yang, University of California / Isaac Nape, University of the Witwatersrand / Darryl Naidoo, CSIR National Laser Centre / Xing Fu, Tsinghua University / Andrew Forbes, University of the Witwatersrand

STh1B.2

Direct Generation of Vortex Lattice Modes From an Intracavity Frequency Doubled Pr:YLF Laser

Presenter: Srinivasa Rao Allam , *Chiba Univeristy*

We report on, for the first time, the direct generation of visible (640 nm) and ultraviolet (320 nm) optical vortex lattice modes from the frequency doubled diode-pumped Pr³⁺:YLF laser.

Authors:Srinivasa Rao Allam, Chiba Univeristy / Katsuhiko Miyamoto, Chiba Univeristy / Takashige Omatsu, Chiba Univeristy

STh1B.3

High-Purity Orbital Angular Momentum States From a Visible Metasurface Laser

Invited

Presenter: Andrew Forbes , *University of the Witwatersrand*

We demonstrate the selection of twisted light carrying Orbital Angular Momentum (OAM) of $l = 100$ with an 88% purity by arbitrary spin-to-orbit coupling inside a visible solid-state laser with a metasurface device.

Authors:Darryl Naidoo, CSIR - NLC / Hend Sroor, University of the Witwatersrand / Yao-Wei Huang, Harvard University / Bereneice Sephton, University of the Witwatersrand / Adam Vallés, University of the Witwatersrand / Vincent Ginis, Harvard University / Qiwen Zhan, University of Shanghai / Cheng-Wei Qiu, National University of Singapore / Antonio Ambrosio, Harvard University / Federico Capasso, Harvard University / Andrew Forbes, University of the Witwatersrand

STh1B.4

Intracavity-Mode-CONversion Structured-Light Laser

Presenter: Jing Pan , *Key Laboratory of Photonic Control Technology (Tsinghua University), Ministry of Education*

The astigmatic mode converter is exploited as an intracavity element to establish a structured-light laser scheme, realizing free control of two-dimensional indices of laser modes and large-range tunability of radial- and orbital-angular-momenta (p -to- $4\hbar$ and l -to- $\pm 15\hbar$).

Authors:Jing Pan, Key Laboratory of Photonic Control Technology (Tsinghua University), Ministry of Education / Yijie Shen, University of Southampton / wang hao, Key Laboratory of Photonic Control Technology (Tsinghua University), Ministry of Education / Zhaoyang Wang, Key Laboratory of Photonic Control Technology (Tsinghua University), Ministry of Education / Zhensong Wan, Key Laboratory of Photonic Control Technology (Tsinghua University), Ministry of Education / Xing Fu, Key Laboratory of Photonic Control Technology (Tsinghua University), Ministry of Education / Hengkang Zhang, Key Laboratory of Photonic Control Technology (Tsinghua University), Ministry of Education / Qiang Liu, Key Laboratory of Photonic Control Technology (Tsinghua University), Ministry of Education

STh1B.5

Multi-Dimension Control on Complex Perfect Vortex Array

Presenter: wang hao , *Beijing Institute of Technology*

A scheme is proposed to generate perfect vortex (PV) array with multi-tunable dimensions including multi-ring, topological charge, eccentricity, size and element number. The “Bear PV” along with assorted arrays are constructed to solidify foregoing theory.

Authors:wang hao, Beijing Institute of Technology / Shiyao Fu, Beijing Institute of Technology / Chunqing Gao, Beijing Institute of Technology

STh1B.6

Experimental Validation of Free-Space Coherent Beam Combining Simulations for Filled Aperture Configuration

Presenter: Awakash Dixit , *Indian Institute of Technology Madras*

A theoretical model for filled aperture coherent beam combining has been developed and the simulation results are validated through coherent beam combination of two 100 W laser beams using a diffractive optical element.

Authors:Awakash Dixit, Indian Institute of Technology Madras / M. S. Sooraj, Indian Institute of Technology Madras / C. Linslal, Indian Institute of Technology Madras / A. Padmanabhan, Indian Institute of Technology Madras / D. Venkitesh, Indian Institute of Technology Madras / Balaji Srinivasan, Indian Institute of Technology Madras

STh1B.7

Towards Real-Time Adaptable Machine Learning-Based Photoinjector Shaping

Presenter: Jack Hirschman , *Stanford University*

Hardware-based machine learning for photoinjector manipulation is a promising solution for real-time adaptive electron-beam manipulation. We present preliminary studies towards this goal including simulations of the optical system and early machine learning results.

Authors:Jack Hirschman, Stanford University / Randy Lemons, SLAC National Accelerator Laboratory / Ryan Coffee, SLAC National Accelerator Laboratory / Federico Belli, Heriot-Watt University / Sergio Carbajo, SLAC National Accelerator Laboratory

STh1G

Novel Laser Concepts

Presenter: Abdoulaye Ndao , *Boston University*

STh1G.1

Topological Vortex Lasers Based on Spin-Momentum-Locked Edge Mode

Invited

Presenter: Ren-Min Ma , *Peking University*

We report an out-of-plane radiation feature of spin-momentum locking in a non-Hermitian topological photonic system and demonstrate a high performance topological vortex laser based on it.

Authors:Ren-Min Ma, Peking University

STh1G.2

(Withdrawn) Topological Micro Laser Array

Presenter: Zhitong Li , *University of Texas at Dallas*

We explore a suspended coupled InGaAsP micro-ring laser array configured under a 1D non-Hermitian topological model. Compared to traditional semiconductor micro laser arrays, this topological protected laser array shows low threshold robust edge mode lasing.

Authors:Zhitong Li, University of Texas at Dallas / Xi-Wang Luo, University of Texas at Dallas / Abouzar Gharajeh, University of Texas at Dallas / Junpeng Hou, University of Texas at Dallas / Chuanwei Zhang, University of Texas at Dallas / Qing Gu, University of Texas at Dallas

STh1G.3

Vortex Microlaser With Ultrafast Tunability

Presenter: Zhifeng Zhang , *University of Pennsylvania*

Based on the concepts of spin-orbit interaction, angular momentum conservation and transient optical gain controlled non-Hermitian symmetry breaking, we demonstrate an ultrafast-tunable vortex microlaser, providing emissions with controlled integer (fractional) OAM charge.

Authors:Zhifeng Zhang, University of Pennsylvania / Xingdu Qiao, University of Pennsylvania / Bikashkali Midya, University of Pennsylvania / Kevin Liu, University of Pennsylvania / Haoqi Zhao, University of Pennsylvania / Jingbo Sun, Duke University / Tianwei Wu, University of Pennsylvania / Danilo Gomes Pires, Duke University / Wenjing Liu, University of Pennsylvania / Zihao Gao, University of Pennsylvania / Ritesh Agarwal, University of Pennsylvania / Josep Miquel Jornet, Northeastern University / Stefano Longhi, Politecnico di Milano and Istituto di Fotonica e Nanotecnologie del Consiglio Nazionale delle Ricerche / Natalia M. Litchinitser, Duke University / Liang Feng, University of Pennsylvania

STh1G.4

Room Temperature Electrically Pumped Topological Insulator Laser Based on Quantum Spin Hall Effect

Highlighted Talk

Presenter: Jae-Hyuck Choi , *University of Southern California*

We report the first room temperature and electrically pumped topological insulator laser. Based on a structure that mimics the quantum spin Hall Hamiltonian for photons, this laser generates single frequency emission at a telecom spectral band.

Authors:Jae-Hyuck Choi, University of Southern California / William Hayenga, University of Southern California / yuzhou Liu, University of Southern California / Midya Parto, CREOL / Babak Bahari, University of Southern California / Demetrios Christodoulides, CREOL / Mercedeh Khajavikhan, University of Southern California

STh1G.5

High Power and High Beam Quality Surface Grating VCSELs

Presenter: Fumio Koyama , *Tokyo Institute of Technology*

We demonstrate single-mode surface grating VCSELs with mm-long oxide-aperture, exhibiting 3W pulsed output power and high beam quality. Stable single mode operation is obtained by shallow surface grating with beam divergence angle of 0.053° .

Authors:AHMED HASSAN, Tokyo Institute of Technology / XIAODONG GU, Tokyo Institute of Technology / MASANORI NAKAHAMA, Tokyo Institute of Technology / Satoshi Shinada, National Institute of Information and Communications Technology / Moustafa Ahmed, Minia University / Fumio Koyama, Tokyo Institute of Technology

STh1G.6

Room Temperature Hot-Pressed Fe:ZnSe Ceramic Laser

Presenter: Karki Krishna , *University of Alabama at Birmingham*

We report the first room-temperature gain-switched Fe:ZnSe hot-pressed ceramics laser pumped by $2.94 \mu\text{m}$ radiation of mechanically Q-switched Er:YAG laser. The maximum output energy was 41 mJ with 25% slope efficiency at 3Hz repetition rate.

Authors:Karki Krishna, University of Alabama at Birmingham / Shengquan Yu, Alfred University / Vladimir Fedorov, University of Alabama at Birmingham / Yiquan Yu, Alfred University / Sergey Mirov, University of Alabama at Birmingham

STh1L

Laser-based and Nonlinear Sources in the Mid-IR

Presenter: Youjian Song , *Tianjin University*

STh1L.1

Generation, Nonlinear Conversion and Applications of Mid-IR Ultrashort Pulses

Invited

Presenter: Irina Sorokina , *Norges Teknisk Naturvitenskapelige Univ*

The talk reviews our recent advances in fiber based ultrafast mid-IR lasers and frequency combs starting at 2.1 microns and extending beyond 6 microns, with peak powers up to GW level. The more and more demanding requirements set by the modern industrial applications such as fine material processing call for controlling the light generation to its extremes. In case of fine processing of semiconductors understanding and careful analysis of the nonlinear optical phenomena in its complexity allowed finding an optimum laser wavelength as well as optimum set of laser parameters, enabling for the first time 3D structures and stealth dicing of silicon with sub-wavelength spatial resolution. The same type of ultrashort-pulsed sources allows obtaining highly efficient (~50%) internally coherent sub-three cycle frequency combs in 3-6 micron range, opening the way to even longer wavelength combs and new industrial and bio-medical applications.

Authors: Irina Sorokina, Norges Teknisk Naturvitenskapelige Univ

STh1L.2

Continuous Wavelength Tuning Across 3.9–12.0 μm From a 1040-nm-Pumped Optical Parametric Oscillator Based on Orientation-Patterned GaP Grown on GaAs

Presenter: Derryck Reid , *Heriot-Watt University*

We report the first nonlinear frequency conversion—specifically optical parametric oscillation—in OPGaP layers grown by hydride vapor-phase epitaxy on OPGaAs templates. A fan-out grating provides continuously wavelength-tunable broadband pulses covering 3.9–12 μm .

Authors: Peter Schunemann, BAE Systems / Kerr Johnson, Chromacity Ltd. / Carl Farrell, Chromacity Ltd. / Luke Maidment, ICFO / Yiwen Shi, University of Electronic Science and Technology of China / Jake Charsley, Heriot-Watt University / Marius Rutkauskas, Heriot-Watt University / Derryck Reid, Heriot-Watt University

STh1L.3

0.5-W Few-Cycle Frequency Comb at 4 μm From an Efficient Simulton-Based Optical Parametric Oscillator

Presenter: Robert Gray , *California Institute of Technology*

We report generation of three-cycle pulses at 4.18 μm with 565-mW average power, 900-nm instantaneous FWHM bandwidth, 350% slope efficiency, and 44% conversion efficiency, based on a half-harmonic optical parametric oscillator operating in simulton regime.

Authors: Mingchen Liu, California Institute of Technology / Robert Gray, California Institute of Technology / Arkadev Roy, California Institute of Technology / Kirk Ingold, U.S. Military Academy / Evgeni Sorokin, Vienna University of Technology / Irina Sorokina, Norwegian University of Science and Technology / Peter Schunemann, BAE Systems / Alireza Marandi, California Institute of Technology

STh1L.4

Mid-Infrared Octave-Spanning Supercontinuum Generation in an All-Normal Dispersion SiGe Waveguide

Presenter: Milan Sinobad , *INL Lyon*

We report supercontinuum generation from an all-normal dispersion SiGe-on-Si waveguide pumped with 205 fs pulses at 4 μm . The supercontinua are spanning over an octave for both orthogonal polarizations of the fundamental mode.

Authors: Milan Sinobad, INL Lyon / Alberto Della Torre, INL Lyon / Rémi Armand, INL Lyon / Barry Luther-Davies, Australian National University / Pan Ma, Australian National University / Stephen Madden, Australian National University / Arnan Mitchell, RMIT University / David Moss, Swinburne University of Technology / Jean-Michel Hartmann, Université Grenoble Alpes / Jean-Marc Fedeli, Université Grenoble Alpes / Christelle Monat, INL Lyon / Christian Grillet, INL Lyon

STh1L.5

5-11 μm Supercontinuum Generation Using Cascaded Nonlinearities in Fluoride Fiber and ZGP

Presenter: Reza Salem , *Thorlabs, Inc.*

We present a femtosecond-pumped, octave-spanning, FTIR-compatible supercontinuum covering 5-11 μm . The SC is generated with record efficiency in ZGP through intra-pulse DFG of a spectrally broaden fiber laser with a 15-fs pulse centered around 2- μm .

Authors: Reza Salem, Thorlabs, Inc. / Sterling Backus, Thorlabs, Inc. / Dongfeng Liu, Thorlabs, Inc. / Chenchen Wan, Thorlabs, Inc. / Scott Domingue, Thorlabs, Inc. / Matthew Kirchner, Thorlabs, Inc. / Alex Cable, Thorlabs, Inc. / Peter Fendel, Thorlabs, Inc.

STh1L.6

Alignment-Free Mid-IR Source Tunable From 5 to 20 μm by Mixing Two Independently Tunable OPOs

Presenter: Florian Mörz , *4th Physics Institute and Research Center SCoPE, University of Stuttgart*

Difference frequency generation setups suffer from beam pointing offsets during wavelength tuning due to angular phase-matching. We present a stable scheme that circumvents crystal rotation and achieves a 10 times efficiency improvement for $\lambda > 11 \mu\text{m}$.

Authors: Florian Mörz, 4th Physics Institute and Research Center SCoPE, University of Stuttgart / Tobias Steinle, 4th Physics Institute and Research Center SCoPE, University of Stuttgart / Heiko Linnenbank, 4th Physics Institute and Research Center SCoPE, University of Stuttgart / Andy Steinmann, 4th Physics Institute and Research Center SCoPE, University of Stuttgart / Harald Giessen, 4th Physics Institute and Research Center SCoPE, University of Stuttgart

STh1L.7

Intra-Pulse Difference Frequency Generation Spanning 7 to 14 μm With a 1-GHz Mode-Locked Laser Comb

Presenter: Nazanin Hoghooghi, *University of Colorado Boulder*

We present generation of MIR light from 1 GHz mode-locked lasers centered at 1.56 μm via intra-pulse difference frequency generation of 21.5 fs pulses. The generated MIR spectrum approaches an octave around 10 μm .

Authors: Nazanin Hoghooghi, University of Colorado Boulder / Alexander Lind, University of Colorado Boulder / Daniel Lesko, University of Colorado Boulder / Sida Xing, University of Colorado Boulder / Peter Chang, University of Colorado Boulder / Gregory Rieker, University of Colorado Boulder / Scott Diddams, NIST

STh1E

THz and Infrared Photonics

Presenter: Georgia Theano Papadakis, *Stanford University*

STh1E.1

(Withdrawn) Terahertz Photonic Devices Based on Bi-Dimensional Materials Tutorial

Presenter: Miriam Vitiello, *Scuola Normale Superiore di Pisa*

Abstract not available.

Authors: Miriam Vitiello, Scuola Normale Superiore di Pisa

STh1E.2

Tunable Infrared Optics Enabled by Defect-Engineering of Vanadium Dioxide Using Focused Ion Beam

Presenter: Chenghao Wan, *University of Wisconsin - Madison*

We demonstrate a simple method of spatially modulating the phase transition of vanadium dioxide using a focused ion beam (FIB). The modulated phase-transition characteristics were quantitatively analyzed, enabling a new platform for tunable infrared optics.

Authors: Chenghao Wan, University of Wisconsin - Madison / Jura Rensberg, Friedrich-Schiller-Universität Jena / Zhen Zhang, Purdue University / Martin Hafermann, Friedrich-Schiller-Universität Jena / Hongyan Mei, University of Wisconsin - Madison / Yuzhe Xiao, University of Wisconsin - Madison / Jad Salman, University of Wisconsin - Madison / Shriram Ramanathan, Purdue University / Carsten Ronning, Friedrich-Schiller-Universität Jena / Mikhail Kats, University of Wisconsin - Madison

STh1E.3

Optically-Triggered Optical Limiters for Short-Wavelength Infrared Sensor Protection

Presenter: Michael Wood , *Sandia National Laboratories*

We report experimental and numerical developments extending the operating range of vanadium dioxide based optical limiters into the short-wavelength infrared. Pixelated sensor elements have been fabricated which show optically-triggered limiting of a 2.7 μm probe.

Authors: Michael Wood, Sandia National Laboratories / Alec McKay, Sandia National Laboratories / Theodore Morin, Sandia National Laboratories / Darwin Serkland, Sandia National Laboratories / Ting Luk, Sandia National Laboratories / Steve Wolfley, Sandia National Laboratories / Loren Gastian, Sandia National Laboratories / John Mudrick, Sandia National Laboratories / Ben Jaspersen, University of Illinois / Harley Johnson, University of Illinois

STh1E.4

2.7 kW Fiber Amplifier Enabled by Constant-Cladding Tapered-Core Ytterbium-Doped Fiber

Presenter: Xianfeng Lin , *National Laboratory for Optoelectronics*

We report a co-pumping fiber amplifier based on constant-cladding tapered-core Yb-doped fiber, and achieved a 2704 W laser output with the laser slope efficiency of 82.1%.

Authors: Xianfeng Lin, National Laboratory for Optoelectronics / Zhilun Zhang, National Laboratory for Optoelectronics / Yingbin Xing, National Laboratory for Optoelectronics / Jinyan Li, National Laboratory for Optoelectronics

STh1E.5

Highly-Doped Er:LiYF₄ Waveguiding Epitaxial Films for ~2.7 μm Laser Sources

Presenter: Ilya Basyrova , *Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie*

Single-crystalline oriented highly-doped 9.6 at.% Er³⁺:LiYF₄ waveguiding thin films (30-50 μm) are grown by Liquid Phase Epitaxy. Their polarized spectroscopic properties are studied. The maximum stimulated-emission cross-section is 1.61×10^{-20} cm² at 2720 nm for π-polarization.

Authors: liza Basyrova, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie / Pavel Loiko, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie / Gurvan Brasse, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie / Abdelmjid Benayad, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie / Jean-Louis Doualan, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie / Alain Braud, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie / Patrice Camy, Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie

STh1E.6

2.35-μm InGaSb/GaSb SESAM

Presenter: Behcet Alaydin , *ETH Zürich*

We present GaSb-based SESAM at 2.35 μm with record low recovery times (τ_{fast} 0.16 ps and τ_{slow} 1.9 ps) and adequate optical parameters: modulation depth 1.69%, saturation fluence 10.59 μJ/cm², and non-saturable loss 0.81%.

Authors: Behcet Alaydin, ETH Zürich / Jonas Heidrich, ETH Zürich / Marco Gaulke, ETH Zürich / Matthias Golling, ETH Zürich / Ajanta Barh, ETH Zürich / Ursula Keller, ETH Zürich

STh1Q

Active Devices for Photonic Integrated Circuits

Presenter: Joyce Poon , *Max-Planck-Inst für Mikrostrukturphysik*

STh1Q.1

Cryogenic Operation of DC Kerr Silicon Photonic Modulators

Presenter: Uttara Chakraborty , *Massachusetts Institute of Technology*

We demonstrate DC-Kerr-effect-based modulation at a temperature of 5 K at GHz speeds in silicon photonic phase shifters fabricated in a CMOS-compatible process. The cryogenic performance of the devices remains comparable to that at room temperature.

Authors:Uttara Chakraborty, Massachusetts Institute of Technology / Jacques Carolan, Massachusetts Institute of Technology / Genevieve Clark, MITRE Corporation / Darius Bunandar, Massachusetts Institute of Technology / Gerald Gilbert, MITRE Corporation / Jelena Notaros, Massachusetts Institute of Technology / Michael Watts, Massachusetts Institute of Technology / Dirk Englund, Massachusetts Institute of Technology

STh1Q.2

Synthetic Pockels Modulators in Silicon

Presenter: Christian Bottenfield , *Georgia Institute of Technology*

We report the performance of a synthetic Pockels modulator based on a dominant DC Kerr effect on a commercial silicon platform, present expressions for quantifying fundamental performance, and compare performance to state-of-the-art modulators.

Authors:Christian Bottenfield, Georgia Institute of Technology / Richard DeSalvo, L3Harris Technologies / Stephen Ralph, Georgia Institute of Technology

STh1Q.3

Tunable High Quality-Factor Silicon Microring Resonator Driven by High-Mobility Transparent Conductive Oxide

Presenter: Alan Wang , *Oregon State University*

We demonstrated a silicon microring resonator driven by a titanium-doped indium oxide capacitor with 10 nm hafnium oxide insulator, achieving a high quality-factor of 11,700 with a high electro-optic tunability of 120 pm/V.

Authors:Wei-Che Hsu, Oregon State University / Cheng Zhen, Oregon State University / Alan Wang, Oregon State University

STh1Q.4

Low-Power Electro-Optic Actuators for Large-Scale Programmable Photonic Circuits

Invited

Presenter: Wim Bogaerts , *Ghent University - IMEC*

Photonic integrated circuits are becoming increasingly more complex, especially with the emergence of programmable photonic circuits. These require many tunable photonic elements, such as electro-optic phase shifters and tunable couplers. We will discuss our progress in compact, low-power silicon photonics actuators based on heaters, liquid crystal and MEMS that can be scaled up to large circuits.

Authors:Wim Bogaerts, Ghent University - IMEC / Lukas Van Iseghem, Ghent University - IMEC / Pierre Edinger, KTH Royal Institute of Technology / Hamed Sattari, Ecole Polytechnique Federale de Lausanne (EPFL) / Alain Takabayashi, Ecole Polytechnique Federale de Lausanne (EPFL) / Xiangfeng Chen, Ghent University - IMEC / Hong Deng, Ghent University - IMEC / Peter Verheyen, imec vzw / Antonio Ribeiro, Ghent University - IMEC / Umar Khan, Ghent University - IMEC / Niels Quack, Ecole Polytechnique Federale de Lausanne (EPFL) / Kristinn Gylfason, KTH Royal Institute of Technology

STh1Q.5

Fully Reconfigurable Coupled-Resonator Optical Waveguides (CROWs) With 10 nW Static Power MEMS

Presenter: YOUNGJAE PARK, *DGIST*

We report on fully reconfigurable CROWs with MEMS-tunable waveguides. Resonator-to-resonator and resonator-to-waveguide coupling are fully tunable. Resonance of a resonator is also widely tunable to cover its full FSR. The static power consumption per tunable coupler is below 10nW.

Authors:YOUNGJAE PARK, *DGIST* / Dong U. Kim, *DGIST* / Doyun Kim, *DGIST* / Myung S. Hong, *DGIST* / Alain Takabayashi, *EPFL* / Youngjae Jeong, *KAIST* / Seungjun Han, *KAIST* / Niels Quack, *EPFL* / Kyoungsik Yu, *KAIST* / Sangyoon Han, *DGIST*

STh1Q.6

16-Core Recirculating Programmable Si Photonic MEMS

Presenter: Doyun Kim, *DGIST*

We report on a 16-core recirculating programmable photonic array based on MEMS-tunable directional couplers. The photonic array has a compact footprint ($0.04\text{mm}^2/\text{cell}$) and negligible static power consumption. Waveguide-coupled single-ring resonators, CROWs, and add-drop filters are demonstrated.

Authors:Doyun Kim, *DGIST* / YOUNGJAE PARK, *DGIST* / Dong U. Kim, *DGIST* / Myung S. Hong, *DGIST* / Alain Takabayashi, *EPFL* / Youngjae Jeong, *KAIST* / Jongwoo Park, *KAIST* / Seungjun Han, *KAIST* / Niels Quack, *EPFL* / Kyoungsik Yu, *KAIST* / Sangyoon Han, *DGIST*

STh1Q.7

Femtojoule, Femtosecond, All-Optical Switching in Integrated Lithium Niobate Photonics

Presenter: Qiushi Guo , *California Institute of Technology*

We demonstrate an integrated nonlinear splitter in quasi-phase-matched lithium niobate nanophotonic waveguide featuring femtojoule all-optical switching with instantaneous response and 8.5 dB extinction, opening opportunities for on-chip ultrafast energy-efficient all-optical information processing.

Authors: Qiushi Guo, California Institute of Technology / Ryoto Sekine, California Institute of Technology / Luis Ledezma, California Institute of Technology / Devin Dean, Cornell University / Rajveer Nehra, California Institute of Technology / Arkadev Roy, California Institute of Technology / Alireza Marandi, California Institute of Technology

STh1H

Biophotonic Sensors and Devices

Presider: Haihang Ye , *University of Texas at Dallas*

STh1H.1

Support for Photonic Innovations at the National Science Foundation

Presenter: Steven Ellis , *NSF*

Abstract: Cross-foundational and discipline-specific programs at the National Science Foundation support innovations in photonics and other technologies. Interested researchers should consult with the cognizant program officers to ask about program fit and relevance.

Authors: Steven Ellis, NSF

STh1H.2

Monolithically Integrated Electronic-Photonic Ultrasound Receiver Using Microring Resonator

Presenter: Panagiotis Zarkos , *University of California Berkeley*

The first optical ultrasound sensor with co-integrated read-out circuitry is presented. Based on a micro-ring resonator (MRR), it has a measured 7.3mV/kPa sensitivity, 480Pa minimum detectable pressure, operating at 80% fractional bandwidth around 5MHz.

Authors: Panagiotis Zarkos, University of California Berkeley / Sidney Buchbinder, University of California Berkeley / Christos Adamopoulos, University of California Berkeley / Olivia Hsu, Stanford University / Sarika Madhvapathy, University of California Berkeley / Jake Winnery, University of California Berkeley / Pavan Bhargava, University of California Berkeley / Vladimir Stojanovic, University of California Berkeley

STh1H.3

(Withdrawn) High-Resolution Optoacoustic Imaging With Silicon-Photonics Point-Sensor

Presenter: Rami Shnaiderman , *Technische Universität München*

We use the silicon-photonics platform to create a miniaturized optical ultrasound sensor with sub-micron aperture. Raster-scan optoacoustic mesoscopy images acquired with the sensor show 2- and 6-fold enhancements in lateral and axial resolutions over state-of-the-art piezoelectric sensors.

Authors:Rami Shnaiderman, Technische Universität München / Okan Ülgen, Technische Universität München / Qutaiba Mustafa, Technische Universität München / Vasilis Ntziachristos, Technische Universität München

STh1H.4

Ultracompact Optics-Free Chip-Scale Spectrometer With Integrated LEDs

Presenter: Tuba Sarwar , *University of Michigan*

We report the design of an optics-free, ultra-thin chip-scale optical spectrometer with monolithically integrated GaN light-emitting diodes that are suitable for reflectance or fluorescence spectroscopy.

Authors:Tuba Sarwar, University of Michigan / Juhyeon Kim, University of Michigan / Srinivasa Cheekati, University of Michigan / Pei-Cheng Ku, University of Michigan

STh1H.5

Integration of DFB Laser With Fluorescence Analysis on a Single Chip

Presenter: Han Zhang , *University of California, Santa Cruz*

We demonstrate integration of a DFB laser and an analyte detection region on a single chip. We showcase its sensing and pneumatically switchable functionalities with the detection of fluorescent nanoparticles and their concentration measurement.

Authors:Han Zhang, University of California, Santa Cruz / Tyler Sano, University of California, Santa Cruz / Holger Schmidt, University of California, Santa Cruz

STh1H.6

Millimeter-Scale Chip-Based Supercontinuum Generation for Optical Coherence Tomography

Presenter: Xingchen Ji , *Columbia University*

We demonstrate a supercontinuum light source for OCT imaging in a compact 1 mm² Si₃N₄ chip. We achieve 105 dB sensitivity and a 6-dB sensitivity roll-off at 1.81 mm with only 300 μW incident power.

Authors:Xingchen Ji, Columbia University / Diana Mojahed, Columbia University / Yoshitomo Okawachi, Columbia University / Alexander Gaeta, Columbia University / Christine Hendon, Columbia University / Michal Lipson, Columbia University

STh1H.7

Quantum Upper Limit SERS From sub-1-nm Random Gaps for Quantitative Chemical and Biological Sensing

Presenter: Nan Zhang , *State University of New York at Buffalo*

We report a strategy to fabricate high-density random metallic nanopatterns with accurately controlled nanogaps defined by atomic-layer-deposition and self-assembled-monolayer processes for quantitative chemical and biological sensing with a record-high uniformity over a large area.

Authors:Nan Zhang, State University of New York at Buffalo / Matthew Singer, State University of New York at Buffalo / Kuang-hui Li, King Abdullah University of Science and Technology / Lyu Zhou, State University of New York at Buffalo / Boon Ooi, King Abdullah University of Science and Technology / Qiaoqiang Gan, State University of New York at Buffalo

STh1H.8

Imaging-Based Optofluidic Biosensors Enabled by All-Dielectric Metasurfaces

Presenter: Yasaman Jahani , *École Polytechnique Fédérale de Lausanne(EPFL)*

We present optofluidic label-free biosensors leveraging high quality-factor resonances emanated from bound-states-in-the-continuum and novel data processing. The sensors are based on imaging and offer solutions to remove sophisticated spectroscopy instrumentations towards point-of-care applications.

Authors:Yasaman Jahani, École Polytechnique Fédérale de Lausanne(EPFL) / Eduardo Arvelo, École Polytechnique Fédérale de Lausanne(EPFL) / Filiz Yesilkoy, University of Wisconsin-Madison / kirill koshelev, Australian National University / Chiara Cianciaruso, École Polytechnique Fédérale de Lausanne(EPFL) / Michele De palma, École Polytechnique Fédérale de Lausanne(EPFL) / Yuri Kivshar, Australian National University / Hatice Altug, École Polytechnique Fédérale de Lausanne(EPFL)

STh11.1

28 Channel PAM8 WDM PON Transmission Based on a Single Time-Lens Source

Presenter: Xiaoyu Xu , *Technical University of Denmark*

We demonstrate a PAM8 WDM-PON transmission using a transmitter with TDM-WDM conversion based on optical time-lens. 28×375 Mb/s WDM channels are generated and transmitted over 20 km with BER below 3.8×10^{-3} .

Authors: Xiaoyu Xu, Technical University of Denmark / Deming Kong, Technical University of Denmark / Peter Girouard, Technical University of Denmark / Mads Lillieholm, Technical University of Denmark / Leif Oxenløwe, Technical University of Denmark / Pengyu Guan, Technical University of Denmark

STh11.2

Enumerative Sphere Shaping: Performance Analysis and Experimental Demonstration in DMT Systems

Presenter: Yizhao Chen , *Huazhong University of Science and Technology*

We propose to apply ESS in DMT systems and find that it produces MB-like probability distributions over a large SNR range. Compared to CCDM, ESS with block length 100 achieves receiver sensitivity gain of 0.82 dB in 20-km SSMF transmission experiments at high shaping rates.

Authors: Yizhao Chen, Huazhong University of Science and Technology / Junda Chen, Huazhong University of Science and Technology / Li Wang, Huazhong University of Science and Technology / Tianhao Tong, Huazhong University of Science and Technology / Yating Xiang, Huazhong University of Science and Technology / Ming Tang, Huazhong University of Science and Technology / Deming Liu, Huazhong University of Science and Technology

STh11.3

40Gbaud Quasicoherent Receiver

Presenter: Varghese Thomas , *Georgia Institute of Technology*

Quasicoherent receivers strike a complexity-performance tradeoff between fully digital coherent receivers and traditional direct detect receivers. We achieve PAM-2 40GBaud signaling using a quasicoherent receiver by relying on full wave detection-based envelope detection

Authors: Varghese Thomas, Georgia Institute of Technology / Stephen Ralph, Georgia Institute of Technology / Siddharth Varughese, Georgia Institute of Technology

STh11.4

Active Demultiplexer-Enabled 300G 16-QAM SSB-DMT Transmission Using Optical Frequency Combs

Presenter: Syed Ahmad , *Dublin City University*

We present an OFC and an active demultiplexer based transmitter, achieving a BER below HD-FEC limit, for 40 km fiber transmission of 25 Gb/s/λ SSB-DMT, for all tones within 20 dB from the spectral peak.

Authors: Syed Ahmad, Dublin City University / Prajwal Lakshmi Jayasimha, Dublin City University / Aleksandra Kaszubowska-Anandarajah, Trinity College Dublin / Prince Anandarajah, Dublin City University

STh11.5

Future Long-Reach Optical Access Network With Digital Coherent Technologie

Invited

Presenter: Takuya Kanai , *NTT Corporation*

The use of digital coherent technologies offers many advantages to future optical access systems. This paper introduces approaches based on DSP technologies to realize long-reach TDM-PON systems.

Authors: Takuya Kanai, NTT Corporation / Ryo Koma, NTT Corporation / Jun-ichi Kani, NTT Corporation / Tomoaki Yoshida, NTT Corporation

STh11.6

Chirp-Like-Polyphase-Sequence Based DCrT-S-ACO-OFDM for Bandwidth-Limited Direct-Detection Systems

Presenter: Zhaoquan Fan , *South China University of Technology*

We propose a novel DCrT-S-ACO-OFDM based on chirp-like polyphase sequences. Experiments of a 34.4-Gbit/s direct-detection ACO-OFDM system under 10-GHz system bandwidth limitation show that the proposed scheme outperforms conventional ACO-OFDM, DFT-S-ACO-OFDM and OCT-precoded ACO-OFDM.

Authors: Chengqiang Wang, South China University of Technology / Zhaoquan Fan, South China University of Technology / Jian Zhao, South China University of Technology

STh11.7

Linearized Single Sideband Modulation Link With High Power Efficiency

Presenter: Yunping Bai , *State Key Laboratory of Information Photonics and Optical Communications*

A novel linearized single sideband modulation link with tunable optical carrier to sideband ratio is proposed and experimentally demonstrated. The link can realize dispersion immunity, suppressing nonlinearity and improving power efficiency simultaneously.

Authors:Yunping Bai, State Key Laboratory of Information Photonics and Optical Communications / Shanguo Huang, State Key Laboratory of Information Photonics and Optical Communications / Zhonghan Su, State Key Laboratory of Information Photonics and Optical Communications / Zhennan Zheng, State Key Laboratory of Information Photonics and Optical Communications / xi Yao song, State Key Laboratory of Information Photonics and Optical Communications / Hao Zhang, State Key Laboratory of Information Photonics and Optical Communications / Guanjun Gao, State Key Laboratory of Information Photonics and Optical Communications / Xinlu Gao, State Key Laboratory of Information Photonics and Optical Communications

STh1F

Network Management and Machine Learning

Presider: Francesco Da Ros , *DTU Fotonik*

STh1F.1

Physical Layer Security Management Through Machine Learning

Invited

Presenter: Marija Furdek , *Chalmers Tekniska Högskola*

We examine the applicability, accuracy and scalability of supervised, unsupervised and semi-supervised learning techniques in diagnosing optical layer security breaches, and discuss how to deploy and incorporate these techniques into network management architecture and procedures.

Authors:Marija Furdek, Chalmers Tekniska Högskola / Carlos Natalino, Chalmers Tekniska Högskola

STh1F.2

Deep Learning Assisted Pre-Carrier Phase Recovery EVM Estimation for Coherent Transmission Systems

Presenter: Yuchuan Fan , *KTH Royal Institute of Technology*

We exploit deep supervised learning and amplitude histograms of coherent optical signals captured before carrier phase recovery (CPR) to perform time-sensitive and accurate error vector magnitude (EVM) estimation for 32 Gbaud mQAM signal monitoring purposes.

Authors:Yuchuan Fan, KTH Royal Institute of Technology / Aleksejs Udalcovs, Research Institutes of Sweden / Xiaodan Pang, KTH Royal Institute of Technology / Carlos Natalino, Chalmers University of Technology / Richard Schatz, KTH Royal Institute of Technology / Marija Furdek, Chalmers University of Technology / Sergei Popov, KTH Royal Institute of Technology / Oskars Ozolins, KTH Royal Institute of Technology

STh1F.3

Performance-Enhanced Amplified O-Band WDM Transmission Using Machine Learning Based Equalization

Presenter: Yang Hong , *University of Southampton*

We investigate the performance of a machine learning-based equalization in an amplified 4×50-Gb/s O-band WDM system. The results show that the scheme offers significant receiver sensitivity improvements over decision-feedback equalization, especially at more dispersive wavelengths.

Authors:Yang Hong, University of Southampton / Stavros Deligiannidis, University of West Attica / Natsupa Taengnoi, University of Southampton / Kyle Bottrill, University of Southampton / Naresh Thipparapu, University of Southampton / Yu Wang, University of Southampton / Jayanta Sahu, University of Southampton / David Richardson, University of Southampton / Charis Mesaritakis, University of the Aegean / Adonis Bogris, University of West Attica / Periklis Petropoulos, University of Southampton

STh1F.4

Maxwell-Boltzmann PMF Design Using Machine Learning for Reconfigurable Optical Fiber Networks

Presenter: Henrik Hansen , *DTU Fotonik*

A neural network is used to predict the optimal Maxwell-Boltzmann probabilistic constellation shaping for a nonlinear channel with inline dispersion-compensation. The network uses only system parameters available at the transmitter and thus requires no feedback

Authors:Henrik Hansen, DTU Fotonik / Metodi Yankov, DTU Fotonik / Leif Oxenløwe, DTU Fotonik / Søren Forchhammer, DTU Fotonik

STh1F.5

Dual-Learning Based Neural Networks for Short-Reach Optical Communications

Presenter: Hao Chen , *South China University of Technology*

We propose a novel dual-learning (DL) based NN that operates in a self-regularization manner to improve the generalization ability and show in 28Gbaud PAM-4 experiments that this method outperforms filtering solutions and conventional NN methods.

Authors:Hao Chen, South China University of Technology / Xing Liu, South China University of Technology / Zhaoquan Fan, South China University of Technology / Chengju Hu, South China University of Technology / Jian Zhao, South China University of Technology

STh1F.6

SOAs and Digital Linearization in Optical Networks -- a Stochastic Investigation

Presenter: Jacqueline SIME , *Ecole Nationale d'Ingénieurs de Brest, Lab-STICC, CNRS, UMR 6285*

Digital predistortion has recently spurred interest in photonics. In this paper, the authors perform a sensitivity analysis of three digital predistortion algorithms and demonstrate an increase in performance and, in some cases, robustness to uncertainties.

Authors:Jacqueline SIME, Ecole Nationale d'Ingénieurs de Brest, Lab-STICC, CNRS, UMR 6285 / Pascal Morel, Ecole Nationale d'Ingénieurs de Brest, Lab-STICC, CNRS, UMR 6285 / Igor Stievano, Politecnico di Torino, Dipartimento di Elettronica e Telecomunicazioni / Mihai Telescu, Univ Brest, Lab-STICC, CNRS, UMR 6285 / Noël Tanguy, Univ Brest, Lab-STICC, CNRS, UMR 6285 / Stéphane Azou, Ecole Nationale d'Ingénieurs de Brest, Lab-STICC, CNRS, UMR 6285

STh1F.7

Experimental Demonstration of Remotely Controlled and Powered Optical Switching Based on Laser-Delivered Bias and Control Signals

Presenter: Ahmad Fallahpour , *University of Southern California*

We experimentally demonstrate a remotely controlled and powered optical switch. The data channel, switching control signal and optical power are wavelength multiplexed in a 7.66 km SMF and transmitted to the remote switch. We transmit a 20 Gbaud QPSK signal that is switched at 2 Mb/s rate.

Authors:Ahmad Fallahpour, University of Southern California / Amir Minoofar, University of Southern California / Fatemeh Alishahi, University of Southern California / kaiheng zou, University of Southern California / Samer Idres, University of Southern California / Hossein Hashemi, University of Southern California / Jonathan Habif, University of Southern California / Moshe Tur, Tel Aviv University / Alan Eli Willner, University of Southern California

STh1C

Precision Timing and Synchronization

Presenter: Haifeng Jiang , *National Time Service Center (China)*

STh1C.1

Temporal and Spatial Challenges for Electron Acceleration Inside Dielectric Laser Accelerators in the Relativistic Regime

Invited

Presenter: Huseyin Cankaya , *University of Hamburg*

We will discuss the temporal and spatial challenges for electron acceleration inside dielectric laser accelerators to demonstrate electron acceleration in the relativistic regime and show recent acceleration results in 100 MeV electron energy range.

Authors:Huseyin Cankaya, University of Hamburg / Frank Mayet, Deutsches Elektronen-Synchrotron (DESY) / Willi Kuroopka, Deutsches Elektronen-Synchrotron (DESY) / Christoph Mahnke, Deutsches Elektronen-Synchrotron (DESY) / Caterina Vidoli, Deutsches Elektronen-Synchrotron (DESY) / Luca Genovese, Deutsches Elektronen-Synchrotron (DESY) / Francois Lemery, Deutsches Elektronen-Synchrotron (DESY) / Florian Burkart, Deutsches Elektronen-Synchrotron (DESY) / Sebastian Schulz, Deutsches Elektronen-Synchrotron (DESY) / Thorsten Lamb, Deutsches Elektronen-Synchrotron (DESY) / Mikheil Titberidze, Deutsches Elektronen-Synchrotron (DESY) / Jost Mueller, Deutsches Elektronen-Synchrotron (DESY) / Ralph Assmann, Deutsches Elektronen-Synchrotron (DESY) / Ingmar Hartl, Deutsches Elektronen-Synchrotron (DESY) / Franz Kärtner, University of Hamburg

STh1C.2

Referencing Laser Frequency to Ultra-Stable Clocks for Future MCM Missions

Presenter: Andrew Wade , *The Australian National University*

We present an electro-optic technique that generates an independent readout of optical cavity mode frequency spacing. We demonstrate a fractional frequency drift resolution of 1 ppb, sufficient to meet expected future mass change mission requirements.

Authors:Andrew Wade, The Australian National University / Emily Rose Rees, The Australian National University / Daniel Shaddock, The Australian National University / Kirk McKenzie, The Australian National University

STh1C.3

151-as Jitter, 22-GHz Pulse Train From a Silica Microcomb

Presenter: Dohyeon Kwon , *Korea Advanced Institute of Science and Technology*

We characterized the timing jitter of 22-GHz pulse train from silica microcomb using self-heterodyne method. The timing jitter power spectral density at 100-kHz offset is $3.6 \times 10^{-37} \text{ s}^2/\text{Hz}$ with integrated jitter of 151-as [100 kHz–3 MHz].

Authors: Dohyeon Kwon, Korea Advanced Institute of Science and Technology / Dongin Jeong, KAIST / Igju Jeon, KAIST / In Hwan Do, KAIST / Hansuek Lee, KAIST / Jungwon Kim, Korea Advanced Institute of Science and Technology

STh1C.4

An Attosecond-Precision Balanced Linear Timing Detector

Presenter: Tong Wang, *Tianjin University*

We demonstrate a linear-optics balanced timing detection method based on an acousto-optic modulator. A timing noise floor of $\sim 1 \times 10^{-10} \text{ fs}^2/\text{Hz}$ is achieved with 1 mW average power per pulse train per photodiode.

Authors: Tong Wang, Tianjin University / Qun Ren, Tianjin University / Kemal Shafak, Cycle GmbH / Franz Kärtner, Center for Free-Electron Laser Science, DESY and Hamburg University / Ming Xin, Tianjin University

STh1C.5

Synchronization of an Optical Frequency Comb and a Microwave Oscillator With -174 dBc/Hz Noise Floor

Presenter: Changmin Ahn, *KAIST*

We demonstrate optical-microwave timing synchronization by employing electro-optic sampling-based timing detector with residual phase noise (at 8-GHz carrier) of -174.5 dBc/Hz at 100 kHz offset frequency and 88-as integrated timing jitter (over 1-MHz bandwidth).

Authors: Changmin Ahn, KAIST / Yongjin Na, KAIST / Jungwon Kim, KAIST

STh1C.6

A Photonic Heterodyne Synthesizer for Millimeter-Wave Radar

Presenter: Eric Kittlaus, *Jet Propulsion Laboratory*

We demonstrate low-phase-noise microwave synthesis from 1-104 GHz through heterodyning of miniaturized external cavity lasers. This microwave-photonic synthesizer is used to enhance the performance of a 95 GHz frequency-modulated continuous-wave radar during outdoor tests.

Authors: Eric Kittlaus, Jet Propulsion Laboratory / Danny Eliyahu, OEwaves, Inc. / Setareh Ganji, OEwaves, Inc. / Skip Williams, OEwaves, Inc. / Andrey Matsko, Jet Propulsion Laboratory / Ken Cooper, Jet Propulsion Laboratory / Siamak Forouhar, Jet Propulsion Laboratory

STh1C.7

Orbital Angular Momentum-Dependent Phase Detection Using Single-Pixel Dual-Comb Spectroscopy Towards Versatile Manipulation of Optical Vortex Light-Wave

Presenter: Akifumi Asahara , *University of Electro-Communications*

Single-pixel dual-comb spectroscopy is applied to demonstrate detection of phase spectra that depend on the OAM modes of optical vortices. The OAM-dependent phase monitoring method has a great potential as a versatile light-wave manipulation technique.

Authors: Akifumi Asahara, University of Electro-Communications / Seishiro Akiyama, University of Electro-Communications / Takuto Adachi, University of Electro-Communications / Kaoru Minoshima, University of Electro-Communications

STh1D

Quantum Science with Photons, Atoms, Ions, and Phonons

Presenter: Eisuke Abe , *RIKEN*

STh1D.1

Deterministic Generation of Entanglement in Quantum Networks by Distributed Coherent Absorption

Presenter: Anton Vetlugin , *Nanyang Technological University*

We demonstrate that coherent absorption offers a robust and efficient way to generate quantum entanglement in multi-nodal quantum networks. Proof-of principle experiment in a bi-nodal network is reported.

Authors: Anton Vetlugin, Nanyang Technological University / Ruixiang Guo, Nanyang Technological University / Cesare Soci, Nanyang Technological University / Nikolay Zheludev, University of Southampton

STh1D.2

Spectral Compression and Broadening Using Time-Varying Cavities

Presenter: Karthik Myilswamy , *Purdue University*

We propose and analyse the use of time-varying cavities for spectral compression and spectral broadening, with potential applications in quantum networking. Our time-varying cavities rely on rapid electro-optic switching of input/ output coupling.

Authors: Karthik Myilswamy, Purdue University / Andrew Weiner, Purdue University

STh1D.3

Secure High Dimensional Quantum Key Distribution Based on Wavelength-Multiplexed Time-Bin Encoding

Presenter: Xiang Cheng , *University of California Los Angeles*

We experimentally demonstrated high-dimensional quantum key distribution with wavelength-multiplexed time-bin encoding, with photon information efficiency up to 4.082 secure-key bits/photon and secure-key rate up to 237-kbit/s. Security will be verified with dual-basis Franson interferometers.

Authors:Xiang Cheng, University of California Los Angeles / Murat Can Sarihan, University of California Los Angeles / Kai-Chi Chang, University of California Los Angeles / Changchen Chen, Massachusetts Institute of Technology / Franco Wong, Massachusetts Institute of Technology / Chee Wei Wong, University of California Los Angeles

STh1D.4

(Withdrawn) Quantum Science With Tweezer Arrays

Invited

Presenter: Manuel Endres , *Caltech*

Optical tweezer arrays applied to cold neutral atoms have emerged as a versatile platform for quantum science. In particular, atom-by-atom assembly—a feedback-based scheme for entropy removal—now enables the generation of defect-free atomic arrays with flexible geometric arrangements. Such atomic arrays form the starting point for experiments in quantum simulation, metrology computing based on excitation to Rydberg states. I will give an overview of these developments and recent results.

Authors:Manuel Endres, Caltech

STh1D.5

Atomic Quantum Wires in Ising-Spin Chain Models

Presenter: Minhyuk Kim , *Korea Advanced Inst of Science & Tech*

We implement quantum wires in Rydberg atom systems to program graph-connected Ising spins. With auxiliary atoms arranged in wires, we show that non-adjacent qubits are on-demand coupled for an Ising Hamiltonian of arbitrary graph connections.

Authors:Minhyuk Kim, Korea Advanced Inst of Science & Tech / Kangheun Kim, Korea Advanced Inst of Science & Tech / Jaewook Ahn, Korea Advanced Inst of Science & Tech

STh1D.6

Strain-Mediated Energy Control of Rare-Earth Ions Toward a Highly-Coherent Hybrid Opto-Mechanical System

Presenter: Ryuichi Ohta , *NTT Basic Research Laboratories*

We demonstrate the energy modulation of Erbium ions using the vibrational strain of a mechanical resonator. This originates from the dispersive opto-mechanical interaction enabling the ions to be coherently coupled to the mechanical mode.

Authors:Ryuichi Ohta, NTT Basic Research Laboratories / Loic Herpin, NTT Basic Research Laboratories / Victor Bastidas, NTT Basic Research Laboratories / Takehiko Tawara, NTT Basic Research Laboratories / Hiroshi Yamaguchi, NTT Basic Research Laboratories / Hajime Okamoto, NTT Basic Research Laboratories

STh1D.7

Etched-Groove Focusing GaAs Surface Acoustic Wave Cavities for Enhanced Coupling to Quantum Emitters

Presenter: Poolad Imany , *National Institute of Standards and Technology*

We demonstrate focusing cavities of surface acoustic waves on gallium arsenide with quality factors reaching 20,000. These cavities can potentially enhance coupling of surface phonons to a wide variety of quantum systems, possibly enabling efficient quantum transduction.

Authors:Poolad Imany, National Institute of Standards and Technology / Zixuan Wang, National Institute of Standards and Technology / Corey McDonald, National Institute of Standards and Technology / Travis Autry, National Institute of Standards and Technology / Samuel Berweger, National Institute of Standards and Technology / Robert Boutelle, National Institute of Standards and Technology / Pavel Kabos, National Institute of Standards and Technology / Richard Mirin, National Institute of Standards and Technology / Kevin Silverman, National Institute of Standards and Technology

6:00 - 7:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - OSA Nonlinear Optics Technical Group Coffee Break

Join the OSA Nonlinear Optics Technical Group for a virtual coffee break at CLEO. This informal networking session will offer students and junior researchers a chance to connect with senior researchers in the field. Attendees will have the opportunity to move around Zoom breakout rooms to have small group discussions with their fellow nonlinear optics community members.

7:00 - 8:15 (Pacific Time (US & Canada) DST, UTC - 07:00)

STh2A

Wideband Optical Communication Systems and Amplifiers

Presider: Francesco Da Ros , *DTU Fotonik*

STh2A.1

The Benefits and Challenges in Extending Optical Fibre Transmission Bandwidth Beyond C+L Band

Invited

Presenter: Lidia Galdino , *University College London*

The practicalities in designing S+C+L optical fiber transmission bandwidth is described. With a given perspective on the present and future technologies, this paper covers the technologies that enabled a record data-rate transmission of 178Tbit/s.

Authors:Lidia Galdino, University College London

STh2A.2

Optimization of Raman Amplification Schemes for Single-Span High Data Rate Coherent Transmission Systems

Presenter: Mingming Tan , *Aston University*

We compared the transmission performances of 600Gbit/s PM-64QAM WDM signals over 75.6km of SMF using EDFA, discrete Raman, hybrid Raman/EDFA, first-order, and second-order distributed Raman amplifiers. The first-order Raman scheme delivered the best BER.

Authors:Mingming Tan, Aston University / Md Asif Iqbal, Aston University / Lukasz Krzczanowicz, Aston University / Ian Phillips, Aston University / Paul Harper, Aston University / Wlodek Forysiak, Aston University

STh2A.3

Performance Benefits Analysis of Low-Loss Hollow Core Fibre in UWB Transmission Systems

Presenter: Md Asif Iqbal , *British Telecommunications*

We analytically demonstrate the performance benefits of future low-loss HCF in long-haul, UWB (14THz in S+C+L-band) transmission compared with ultra-low-loss, large effective-area SMF using Gaussian noise (GN) model in the presence of ISRS.

Authors:Md Asif Iqbal, British Telecommunications / Neil Parkin, British Telecommunications / Andrew Lord, British Telecommunications

STh2A.4

RIN Penalty Analysis in G.654.E and G.652.D Fibres With Forward Pumped Distributed Raman Amplification

Presenter: Pratim Hazarika , *Aston University*

Relative intensity noise induced penalties were measured in G.654.E and G.652.D forward-pumped distributed Raman amplifiers. Lower signal RIN was measured in G.654.E fibre, with single-span transmission showing a Q-factor improvement of > 2.5dB over G.652.D.

Authors:Pratim Hazarika, Aston University / Md Asif Iqbal, British Telecom / Lukasz Krzczanowicz, Aston University / Wlodek Forysiak, Aston University

7:00 - 9:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FTh2P

Quantum Optomechanical Systems

Presenter: Thomas Purdy , *NIST*

FTh2P.1

Brillouin Optomechanics in Whispering-Gallery-Mode Microresonators: From Strong Coupling to Single-Phonon Addition and Subtraction

Presenter: Michael Vanner , *Imperial College London*

We experimentally explore backward Brillouin scattering with high-frequency acoustic fields for optomechanics applications. We (i) demonstrate strong coupling between the optical and acoustic fields and (ii) perform single-phonon addition and subtraction operations.

Authors:GeorgENZIAN, Imperial College London / John Price, Imperial College London / Lars Freisem, Imperial College London / Magdalena Szczykulska, University of Oxford / Joshua Nunn, University of Bath / Ian Walmsley, Imperial College London / Jonathan Silver, National Physical Laboratory / Leonardo Del Bino, National Physical Laboratory / Shuangyou Zhang, National Physical Laboratory / Pascal Del HAYE, National Physical Laboratory / Jiri Janousek, Australian National University / Ben Buchler, Australian National University / Ping Koy Lam, Australian National University / Michael Vanner, Imperial College London

FTh2P.2

Laser Refrigeration of Sodium Yttrium Fluoride Nanoparticles in a Vacuum Optical Tweezer

Presenter: Danika Luntz-Martin , *University of Rochester*

Laser refrigeration of rare-earth doped optically levitated nanoparticles allows for cooling of 42 K. Cooling is calibrated using a cryostat. Cooling efficiency decreases at pressures below 5 mbar as thermal contact with gas molecules decreases.

Authors: Danika Luntz-Martin, University of Rochester / R. Greg Felsted, University of Washington / Siamak Dadras, University of Rochester / Peter Pauzauskie, University of Washington / A. Vamivakas, University of Rochester

FTh2P.3

Towards Quantum Measurement and Control of a Nanomechanical Resonator at Room Temperature

Presenter: Sampo Saarinen , *University of Copenhagen*

We present an optomechanical platform that is expected to allow for room-temperature quantum control of a soft-clamped membrane resonator, enabled by the system's high quantum cooperativity and low cavity frequency noise.

Authors: Sampo Saarinen, University of Copenhagen / Nenad Kralj, University of Copenhagen / Yeghishe Tsaturyan, University of Chicago / Eric Langman, University of Copenhagen / Albert Schliesser, University of Copenhagen

FTh2P.4

Mechanical Bound States in the Continuum for Cavity-Less Optomechanics

Presenter: Hao Tong , *University of Illinois at Urbana-Champaign*

We demonstrate a new paradigm of phonon trapping using mechanical bound states in the continuum in slab-on-substrate phononic crystals and show its prospect for realizing quantum optomechanics without using microcavities.

Authors: Hao Tong, University of Illinois at Urbana-Champaign / Shengyan Liu, University of Illinois at Urbana-Champaign / Mengdi Zhao, University of Illinois at Urbana-Champaign / Kejie Fang, University of Illinois at Urbana-Champaign

FTh2P.5

Double Layer Photonic Crystal Membranes in AlGaAs Heterostructures for Integrated Cavity Optomechanics

Presenter: Sushanth Kini Manjeshwar , *Chalmers University of Technology*

We characterize the opto-mechanical properties of double-layer mechanical devices. These closely spaced photonic crystal membranes can exhibit photonic bound states in the continuum, which could enable the realization of a strongly coupled, integrated optomechanical system.

Authors: Sushanth Kini Manjeshwar, Chalmers University of Technology / Anastasiia Glushkova, Chalmers University of Technology / Jamie Fitzgerald, Chalmers University of Technology / Shu Min Wang, Chalmers University of Technology / Philippe Tassin, Chalmers University of Technology / Witlef Wieczorek, Chalmers University of Technology

FTh2P.6

A High Cooperativity Nano-Optomechanical System Comprised of High Stress Si₃N₄

Presenter: Mohammad Bereyhi, *Swiss Federale Institute of Technology Lausanne (EPFL)*

We report the design fabrication and characterization of a monolithic nano-optomechanical transducer comprised of high-stress Si₃N₄ featuring a one-dimensional Fabry-Pérot photonic crystal cavity ($Q \sim 10^5$) integrated with a nanobeam resonator ($Q \sim 10^6$) with optomechanical cooperativity of $C_0 = 23$.

Authors: Mohammad Bereyhi, Swiss Federale Institute of Technology Lausanne (EPFL) / Amirali Arabmoheghi, Swiss Federale Institute of Technology Lausanne (EPFL) / Nils Johan Engelsen, Swiss Federale Institute of Technology Lausanne (EPFL) / Tobias Kippenberg, Swiss Federale Institute of Technology Lausanne (EPFL)

FTh2P.7

Effects of Laser Illumination on Superconducting Circuits for Quantum Transduction

Presenter: Srujan Meesala, *California Institute of Technology*

Decoherence and noise from optical absorption in superconducting circuits hinder development of microwave to optical quantum transducers. Addressing these issues, we fabricate niobium-based resonators and qubits, and study them under laser illumination at milliKelvin temperatures.

Authors: Srujan Meesala, California Institute of Technology / Jash Banker, California Institute of Technology / Steven Wood, California Institute of Technology / Alp Sipahigil, California Institute of Technology / David Lake, California Institute of Technology / Piero Chiappina, California Institute of Technology / Andrew Beyer, Jet Propulsion Laboratory / Matthew Shaw, Jet Propulsion Laboratory / Oskar Painter, California Institute of Technology

FTh2P.8

Ultra-Coherent Fundamental Mode Mechanical Resonators Designed Using Topology Optimization

Presenter: Dennis Høj, *Technical University of Denmark*

Topology optimization has been used to optimize the quality factor \times frequency product of the fundamental mode of silicon nitride based membranes. A factor of 2.5 enhancement was experimentally demonstrated, showing the potential for topology optimization to revolutionize designs of membranes.

Authors:Dennis Høj, Technical University of Denmark / Wenjun Gao, Tongji University / Fengwen Wang, Technical University of Denmark / Ulrich Hoff, Technical University of Denmark / Ole Sigmund, Technical University of Denmark / Ulrik Andersen, Technical University of Denmark

FTh2N

Photonic Computing

Presider: Michael Brodsky , *US Army Research Laboratory*

FTh2N.1

Quantum Correlations: Communication and Computation With Photonic Systems

Invited

Presenter: Stefanie Barz , *University of Stuttgart*

Graph states are useful resources both for quantum computing and quantum communication, especially in networked settings. In this talk, I will present how photonic graph states can serve as a resource for quantum-enhanced classical computing and for multipartite quantum communication tasks.

Authors:Stefanie Barz, University of Stuttgart

FTh2N.2

Continuous Variable Cluster State Computation

Presenter: Mikkel Larsen , *Technical University of Denmark*

We demonstrate large-scale cluster state generation for quantum computation. We proceed to implement a universal Gaussian gate set by projective measurement. Finally, we show that fault-tolerant computation is possible with a reasonable squeezing threshold.

Authors:Mikkel Larsen, Technical University of Denmark / Jonas Neergaard-Nielsen, Technical University of Denmark / Ulrik Andersen, Technical University of Denmark

FTh2N.3

Teleportation-Based Photonic Quantum Computing Using a Single Controllable Qubit

Presenter: Ben Bartlett , *Stanford University*

We propose a photonic quantum computer which uses no single-photon detectors and requires minimal quantum resources: one coherently-controlled atom. Arbitrary quantum circuits are deterministically constructed from rotations teleported from the atom onto the photonic qubits.

Authors: Ben Bartlett, Stanford University / Avik Dutt, Stanford University / Shanhui Fan, Stanford University

FTh2N.4

Boosting Photonic Quantum Computation With Moderate Nonlinearity

Presenter: *Adi Pick, Weizmann Institute*

We present a new pathway towards fault-tolerant photonic quantum computing by using moderate nonlinearity to improve elementary computation operations. This improvement can lead to a three orders-of-magnitude reduction of the resource overhead in large-scale computations.

Authors: Adi Pick, Weizmann Institute / Elisha Siddiqui-Matekole, Louisiana State University / Ziv Aqua, Weizmann Institute / Gabriel Guendelman, Weizmann Institute / Ofer Firstenberg, Weizmann Institute / Jonathan Dowling, Louisiana State University / Barak Dayan, Weizmann Institute

FTh2N.5

Experimental Demonstration of Quantum Advantage for NP Verification

Presenter: *Federico Centrone, Sorbonne Université*

We showcase the power of linear optics through the implementation of a quantum protocol with coherent states. Our work provides evidence for a computational quantum advantage in the interactive setting, drawing near potentially useful applications.

Authors: Federico Centrone, Sorbonne Université / Niraj Kumar, University of Edinburgh / Eleni Diamanti, Sorbonne Université / Iordanis Kerenidis, Université de Paris

FTh2N.6

Routing Strategies for High-Fidelity, Multiplexed Quantum Networks

Presenter: *Yuan Lee, Massachusetts Institute of Technology*

We recently introduced a "quantum router" architecture that improves entanglement fidelities in chains of multiplexed repeaters. Here, we address local entanglement routing across general network graphs of routers to optimize entanglement rates and fidelities.

Authors: Yuan Lee, Massachusetts Institute of Technology / Eric Bersin, Massachusetts Institute of Technology / Wenhan Dai, Massachusetts Institute of Technology / Dirk Englund, Massachusetts Institute of Technology

FTh2N.7

Continuous-Variable Error Correction for General Gaussian Noises

Presenter: Jing Wu , *University of Arizona*

We design continuous-variable error correction codes for general correlated and heterogeneous Gaussian noises, based on Gottesman, Kiteav and Preskill states and Gaussian operations, and numerically verify the codes' performance on random samples.

Authors:Jing Wu, University of Arizona / Quntao Zhuang, University of Arizona

FTh20

Quantum Measurement I

Presenter: Michael Mazurek , *NIST Boulder*

FTh20.1

Attosecond Measurements via Quantum-Enhanced Interferometry

Presenter: Colin Lualdi , *University of Illinois at Urbana-Champaign*

We discuss achieving attosecond-level temporal resolution via Hong-Ou-Mandel interferometry using highly non-degenerate frequency-entangled photons. This approach offers robustness against dispersion and loss, and facilitates novel sensing schemes in regimes inaccessible by existing interferometers.

Authors:Colin Lualdi, University of Illinois at Urbana-Champaign / Kristina Meier, University of Illinois at Urbana-Champaign / Spencer Johnson, University of Illinois at Urbana-Champaign / Paul Kwiat, University of Illinois at Urbana-Champaign

FTh20.2

Nonlocal Sensing of Temporal Delay in Dispersive Links Using Time-Energy Entangled Photons

Presenter: Suparna Seshadri , *Purdue University*

We employ electro-optic frequency mixing to achieve precision measurement of temporal delay between dispersive fiber-optic links by taking advantage of high-dimensional frequency-bin entanglement in a nonlocal sensing geometry.

Authors:Suparna Seshadri, Purdue University / Hsuan-Hao Lu, Purdue University / Navin Lingaraju, Purdue University / Poolad Imany, National Institute of Standards and Technology / Daniel Leaird, Purdue University / Andrew Weiner, Purdue University

FTh20.3

Joint Measurement of Time-Frequency Entanglement

Presenter: Han Liu , *University of Toronto*

We report a novel method to simultaneously measure the time difference and frequency sum of two photons. This technique applied to target detection can asymptotically reduce the effect of environmental noise down to zero.

Authors:Han Liu, University of Toronto / Amr Helmy, University of Toronto

FTh20.4

Randomized Compressive State Tomography in Time and Frequency Using a Quantum Pulse Gate

Presenter: Jano Gil Lopez , *Institute for Photonic Quantum Systems (PhoQS), Paderborn University*

We discuss a randomized compressive tomography scheme that characterizes near-coherent signals of low rank in the time-frequency domain using extremely few measurements and no assumptions. Results on higher order temporal modes of the electromagnetic field are presented.

Authors:Jano Gil Lopez, Institute for Photonic Quantum Systems (PhoQS), Paderborn University / Syamsundar De, Institute for Photonic Quantum Systems (PhoQS), Paderborn University / Benjamin Brecht, Institute for Photonic Quantum Systems (PhoQS), Paderborn University / Yong Siah Teo, Seoul National University / Hyunseok Jeong, Seoul National University / Luis Lorenzo Sanchez Soto, Max-Planck-Institut für die Physik des Lichts / Christine Silberhorn, Institute for Photonic Quantum Systems (PhoQS), Paderborn University

FTh20.5

Microscopy With Undetected Photons in the mid-Infrared

Highlighted Talk

Presenter: Inna Kviatkovsky , *Humboldt University of Berlin*

We demonstrate that nonlinear interferometry with entangled photons provides a powerful and cost-effective technique for microscopy in the mid-IR, harnessing the maturity of silicon-based detection technology to allow wide-field imaging of biological samples at room-temperature.

Authors:Inna Kviatkovsky, Humboldt University of Berlin / Helen M Chrzanowski, Humboldt University of Berlin / Ellen G Avery, Charité – Universitätsmedizin Berlin / Hendrik Bartolomaeus, Charité – Universitätsmedizin Berlin / Sven Ramelow, Humboldt University of Berlin

FTh20.7

Entanglement-Enhanced Interferometry in Optical Fiber

Presenter: Gregory Krueper , *University of Colorado, Boulder*

Fiber-based interferometry with entangled photons can provide subshot-noise resolution, which is ideal for photon-starved applications. Simulations demonstrate that measurements with realistic losses and other imperfections show quantum-enhanced phase resolution for practical applications

Authors:Gregory Krueper, University of Colorado, Boulder / Robert Mellors, University of California, San Diego / Charles Yu, Lawrence Livermore National Labs / Stephen Libby, Lawrence Livermore National Labs / Michael Messerly, Lawrence Livermore National Labs / Juliet Gopinath, University of Colorado, Boulder

FTh20.6

(Withdrawn) Imaging Spatiotemporal Hong-Ou-Mandel Interference

Presenter: Fabrice Devaux , *Universite de Franche-Comte*

We report the experimental observation of a spatiotemporal Hong-Ou-Mandel interference of biphoton states of extremely high Schmidt number. Two-photon interference is evidenced by measuring momentum spatial coincidences between the pixels of the far-field images of two strongly multimode SPDC beams.

Authors:Fabrice Devaux, Universite de Franche-Comte / Alexis Mosset, Femto-st Institute / Eric Lantz, Universite de Franche-Comte

FTh2J

Complex Quantum Photonics

Presenter: Hrvoje Buljan , *Technion Israel Institute of Technology*

FTh2J.1

Frequency Bin Quantum Photonics

Invited

Presenter: Andrew Weiner , *Purdue University*

This talk provides an overview of generation, manipulation, measurement and application of high dimensional quantum states of light encoded and entangled in discrete optical frequency bins.

Authors:Andrew Weiner, Purdue University

FTh2J.2

Holography of a Photon Without its Detection

Presenter: Marta Gilaberte Basset , *Fraunhofer IOF*

Single photon holographic methods would aid several applications that raised with recent advances in quantum technologies. Our method records single photon holograms without detecting the photon itself thanks to the concept of induced coherence.

Authors: Marta Gilaberte Basset, Fraunhofer IOF / Sebastian Töpfer, Fraunhofer IOF / Juan P. Torres, ICFO / Jorge Fuenzalida, Fraunhofer IOF / Fabian Steinlechner, Fraunhofer IOF / Markus Gräfe, Fraunhofer IOF

FTh2J.3

Quantum Optics in Strongly-Driven Many-Body Systems

Presenter: Andrea Pizzi, *University of Cambridge*

We develop the quantum theory of collective light emission in strongly-driven many-body systems. We show how quantum correlations of the emitters can be transferred to the emitted light, leading to generation of non-classical many-photon states.

Authors: Andrea Pizzi, University of Cambridge / Alexey Gorlach, Technion - Israel Institute of Technology / Nicholas Rivera, Massachusetts Institute of Technology / Andreas Nunnenkamp, University of Nottingham / Ido Kaminer, Technion - Israel Institute of Technology

FTh2J.4

Generation of Topologically Protected Hyper-Entangled States

Presenter: Nicola Bergamasco, *University of Pavia*

We study spontaneous parametric down conversion in a waveguide array supporting two strongly coupled topological guided modes. Quantum correlations in the generated hyper-entangled quantum state are robust due to topological protection.

Authors: Nicola Bergamasco, University of Pavia / John Sipe, University of Toronto / Marco Liscidini, University of Pavia

FTh2J.5

Observation of PT Symmetry Breaking in two-Photon Correlations

Presenter: Friederike Klauck, *Universität Rostock*

We experimentally study the influence of PT-symmetry breaking on two-photon correlations in quasi-PT-symmetric couplers. While quantum interference is faithfully preserved in the unbroken phase, a characteristic rise of off-diagonal terms occurs beyond the exceptional point.

Authors: Friederike Klauck, Universität Rostock / Matthias Heinrich, Universität Rostock / Alexander Szameit, Universität Rostock

FTh2J.6

Encircling of Exceptional Points With Quantum Light

Presenter: QI ZHONG , *University of Central Florida*

We investigate how a non-Hermitian photonic system will respond when excited with quantum states of light after dynamically encircling an exceptional point. We find that photon transport is chiral even in the quantum domain.

Authors: QI ZHONG, University of Central Florida / Mercedeh Khajavikhan, University of Southern California / Sahin Ozdemir, Penn State University / Ramy El-Ganainy, Michigan Technological University / Demetrios Christodoulides, University of Central Florida

FTh2J.7

Photon-Pair Generation via Multiple Bound States in the Continuum in Nonlinear Metasurfaces

Presenter: Matthew Parry , *Australian National University*

We present a nonlinear metasurface with engineered symmetry facilitating an orders-of-magnitude enhancement of photon-pair generation and tunable entanglement through hyperbolic phase matching of spontaneous parametric down-conversion via multiple extended bound states in the continuum.

Authors: Matthew Parry, Australian National University / Andrea Mazzanti, Politecnico di Milano / Alexander Poddubny, ITMO / Giuseppe Della Valle, Politecnico di Milano / Dragomir Neshev, Australian National University / Andrey Sukhorukov, Australian National University

FTh2K

Strong Coupling in Excitonic and Polaritonic Systems

Presenter: Cheng Zhang

FTh2K.1

Manipulating Single Surface Plasmon Polariton via Tailored Atom-Photon Interaction

Presenter: . Rituraj , *Stanford University*

We study the interaction of a single surface plasmon polariton with a finite number of atoms and with an infinite atomic lattice. Using only two-level atoms, we achieve subscattering, superscattering, and electromagnetically induced transparency (EIT).

Authors: . Rituraj, Stanford University / Meir Orenstein, Technion – Israel Institute of Technology / Shanhui Fan, Stanford University

FTh2K.2

Plasmon-Induced Charge Transport at Transition Metal Nitride-Semiconductor Interfaces via in Situ Nanoimaging

Presenter: Min-Wen Yu , *NCTU, Taiwan*

Photoexcited Kelvin probe force microscope is used to image hot carriers excited in transition metal nitride-semiconductor heterostructures. Both hot holes and hot electron injections are revealed depending on the carrier types of the semiconductors.

Authors:Min-Wen Yu, NCTU, Taiwan / Satoshi Ishii, National Institute for Materials Science (NIMS) / Satish Shinde, National Institute for Materials Science (NIMS) / Nicholaus Tanjaya, National Institute for Materials Science (NIMS) / Kuo-Ping Chen, NCTU, Taiwan / Tadaaki Nagao, National Institute for Materials Science (NIMS)

FTh2K.3

Nonlinear Amplitude and Spectral Control in Strongly Coupled Plasmonic-Excitonic Nanostructures

Presenter: Yael Blechman , *Technion Israel Institute of Technology*

We theoretically demonstrate a tight connection between the linear response of hybrid plasmonic-excitonic metasurface modes in the strong-coupling regime and their nonlinear Four-Wave-Mixing spectral behavior, mediated by the Rabi splitting in the system.

Authors:Yael Blechman, Technion Israel Institute of Technology / Shai Tseses, Technion Israel Institute of Technology / Euclides Almedia, Queens College, the City University of New York / Guy Bartal, Technion Israel Institute of Technology

FTh2K.4

Metasurface Integrated Monolayer Exciton-Polariton

Presenter: Yueyang Chen , *University of Washington*

We demonstrate a 2D exciton-polariton system by strongly coupling atomically thin tungsten diselenide monolayer to a silicon nitride metasurface. Our platform opens the door for the future development of exciton-polariton devices by advanced meta-optical engineering.

Authors:Yueyang Chen, University of Washington / Shengnan Miao, Rensselaer Polytechnic Institute / Tianmeng Wang, Rensselaer Polytechnic Institute / Ding Zhong, University of Washington / Abhi Saxena, University of Washington / Colin Chow, University of Washington / James Whitehead, University of Washington / Dario Gerace, University of Pavia / Xiaodong Xu, University of Washington / Su-Fei Shi, Rensselaer Polytechnic Institute / Arka Majumdar, University of Washington

FTh2K.5

Strong Exciton-Photon Interactions in the van der Waals Materials Probed by Electron Beam

Invited

Presenter: Nahid Talebi , *Christian Albrechts University*

Excitons in semiconducting van der Waals materials are quasi-particles with high potential applications in optoelectronics and nonlinear physics. Here, we demonstrate strong exciton-photon interactions without the requirements for photonic cavities in Bi_2Se_3 and WSe_2 thin films.

Authors: Masoud Taleb, Christian Albrechts University / Robin Lingstaedt, Max Planck Institute for Solid State Research / Mario Hentschel, 4th Physics Institute / Harald Giessen, 4th Physics Institute / Pater van Aken, Max Planck Institute for Solid State Research / Nahid Talebi, Christian Albrechts University

FTh2K.6

Exciton Resonance Tuning in Atomically-Thin Optical Elements

Presenter: Jorik van de Groep , *Universiteit van Amsterdam*

We demonstrate accurate and dynamic control over light scattering by exciton resonances in atomically-thin optical elements by carving them directly out of monolayer WS_2 . Using ion-liquid gating we dynamically manipulate the material's exciton resonance.

Authors: Jorik van de Groep, Universiteit van Amsterdam / Jung-Hwan Song, Stanford University / Qitong Li, Stanford University / Umberto Celano, IMEC / Pieter Kik, University of Central Florida / Mark Brongersma, Stanford University

FTh2K.7

Polarization-Converting Plasmonic Nanoantennas for Light Absorption Enhancement in Anisotropic 2D Black Phosphorus

Presenter: Nima Sefidmooye Azar , *University of Melbourne*

Optical anisotropy and thinness of 2D black phosphorous (bP) lead to weak light absorption, which limits the performance of bP-based photodetectors. We demonstrate that T-shaped nanoantennas can be integrated with bP to overcome this issue.

Authors: Nima Sefidmooye Azar, University of Melbourne / James Bullock, University of Melbourne / Sivacarendran Balendhran, University of Melbourne / Hyungjin Kim, University of California, Berkeley / Ali Javey, University of California, Berkeley / Kenneth Crozier, University of Melbourne

FTh2M

Inverse Design

Presenter: Sean Molesky , *Princeton University*

FTh2M.1

Inverse Design of Relativistic Lightsail for Efficient Propulsion

Presenter: Weiliang Jin , *Stanford University*

We present a comprehensive study of photonic design of lightsails with large-scale optimization techniques. We show that the optimal structure is relatively simple, yet exhibiting nearly 50% enhancement in propulsion efficiency compared to prior studies.

Authors:Weiliang Jin, Stanford University / Wei Li, Stanford University / Meir Orenstein, Technion-Israel Institute of Technology / Shanhui Fan, Stanford University

FTh2M.2

Metasurface Design Optimization via D-Wave Based Sampling

Presenter: Blake Wilson , *National Quantum Information Science Research Center of the U.S. Department of Energy (DOE)*

The developed design framework employs the D-Wave to enable global optimization of meta-devices with complex topologies and material composition. The framework opens up the pathways to solving a broad range of highly-constrained optimization problems of nanophotonics.

Authors:Blake Wilson, National Quantum Information Science Research Center of the U.S. Department of Energy (DOE) / Zhaxylyk Kudyshev, Purdue / Alexander Kildishev, Purdue / Sabre Kais, Purdue / Vladimir Shalaev, Purdue / Alexandra Boltasseva, Purdue

FTh2M.3

Statistical Learning Multiobjective Optimization for Large-Scale Achromatic Metalens at Visible Regime

Presenter: Mahmoud Elsayy , *Université Côte d'Azur, Inria, CNRS, LJAD*

A novel computational methodology based on statistical learning multiobjective optimization is developed to optimize large-scale achromatic 3D metalenses in the visible regime. The optimized lens has a numerical aperture of 0.56 and an average focusing efficiency of 45%.

Authors:Mahmoud Elsayy, Université Côte d'Azur, Inria, CNRS, LJAD / Mickaël Binois, Université Côte d'Azur, Inria, CNRS, LJAD / Régis Duvigneau, Université Côte d'Azur, Inria, CNRS, LJAD / Stéphane Lanteri, Université Côte d'Azur, Inria, CNRS, LJAD / Patrice Genevet, CNRS, CRHEA, Université Côte d'Azur

FTh2M.4

Combined Inverse-Designed Metastructure With Tunable Couplers for Forward-Scattering Computations

Presenter: Dimitrios Tzarouchis , *University of Pennsylvania*

Here we describe a wave-based computing system for solving forward-scattering problems with arbitrary inputs, utilizing a hybrid network of inverse-designed metastructures and tunable directional couplers.

Authors:Dimitrios Tzarouchis, University of Pennsylvania / Vahid Nikkhah, University of Pennsylvania / Ahmad Hoorfar, Villanova University / Nader Engheta, University of Pennsylvania

FTh2M.5

Training Photonic Extreme Learning Machines Using Feedback Alignment

Presenter: Velat Kilic , *Johns Hopkins University*

Photonic extreme learning machines and reservoir computers enhance machine learning by efficiently mapping data to a high dimensional space. We demonstrate training the input mapping of such approaches using feedback alignment improves performance.

Authors:Velat Kilic, Johns Hopkins University / Mark Foster, Johns Hopkins University

FTh2M.6

Diffraction Characterization of Sub-Wavelength Objects With Machine Learning

Presenter: Abantika Ghosh , *University of Massachusetts Lowell*

We analyze the limits of a novel machine-learning based technique for characterization of sub-wavelength objects based on their diffractive signatures, achieving theoretical resolution of \sim wavelength/25. Experimentally, we demonstrate characterization of 120-nm objects with 850-nm light.

Authors:Abantika Ghosh, University of Massachusetts Lowell / Diane Roth, King's College London, London / Luke Nicholls, King's College London, London / William Wardley, King's College London, London / Anatoly Zayats, King's College London, London / Viktor Podolskiy, University of Massachusetts Lowell

FTh2M.7

Solving Integral Equations With Inverse-Designed Metagratings at Optical Wavelengths

Presenter: Concetto Eugenio Andrea Cordaro , *AMOLF*

Inverse designed metasurfaces can solve prescribed Fredholm integral equations at optical wavelengths. To this end, a mirror is included to provide the feedback required to perform the Neumann series that solves the equation.

Authors:Concetto Eugenio Andrea Cordaro, AMOLF / Brian Edwards, University of Pennsylvania / Vahid Nikkhah, University of Pennsylvania / Andrea Alù, City University of New York / Nader Engheta, University of Pennsylvania / Albert Polman, AMOLF

ATh2R

Ultrafast Laser-based Welding and Waveguide Writing

Presenter: Sean McDaniel , *AFRL*

ATh2R.1

Direct Laser Bonding of YAG Crystal to Aluminium Silicon Metal Alloy

Presenter: Samuel Hann , *Heriot Watt University*

We present the successful welding of undoped YAG to an aluminum silicon alloy. The laser welding parameters were optimized in terms of shear strength

Authors:Samuel Hann, Heriot Watt University / Jake Sanwell, Heriot Watt University / Richard Carter, Heriot Watt University / Ian Elder, Leonardo / Robert Lamb, Leonardo / Daniel Esser, Heriot Watt University / Duncan Hand, Heriot Watt University

ATh2R.2

Comparison of Femtosecond Laser Welding of Transparent Materials at 1030 and 515 nm

Presenter: Jie Qiao , *Rochester Institute of Technology*

A dynamic pulse propagation model is developed to compare the interaction of femtosecond pulses at 1030 nm and 515 nm with transparent materials, predicting that the shorter wavelength will lead to more effective welding.

Authors:Ryan Scott, Aktiwave LLC / Zhenhua Guo, Aktiwave LLC / Pankaj Sahoo, Aktiwave LLC / Christophe Dorrer, Aktiwave LLC / Jie Qiao, Rochester Institute of Technology

ATh2R.3

Industrializing Ultra-Short Pulsed Laser Welding

Invited

Presenter: Richard Carter , *Heriot-Watt University*

Ultra-fast laser welding promises the capability to robustly bond optical -optical or -structural components without the need for interlayers. We will present recent advances toward industrialising this process including parameters, preparations and prototyping a system

Authors:Richard Carter, Heriot-Watt University / Paulina Morawska, Heriot-Watt University / Adrian Dzipalski, Heriot-Watt University / Samuel Hann, Heriot-Watt University / Daniel Esser, Heriot-Watt University / Duncan Hand, Heriot-Watt University

ATh2R.4

Glass-to- Aluminum Joints Using Industrial Nanosecond IR Fiber Lasers

Presenter: Dimitris Alexandropoulos , *University of Patras*

We report for the first time to our knowledge nanosecond laser welding of glass to aluminum using an industrial nanosecond IR fiber laser source with weld strength of 12.01 Nmm^{-2}

Authors: Panagiotis Floropoulos, University of Patras / Vagelis Karoutsos, University of Patras / Konstantina Tourlouki, University of Patras / George Papanicolaou, University of Patras / Dimitris Alexandropoulos, University of Patras

ATh2R.5

Nonlinearity Modulated Structure in a Type-II Lithium Niobate Waveguide by Femtosecond Laser Direct Writing

Presenter: Tingge Yuan , *Shanghai Jiao Tong University*

A type-II quasi phase matched waveguide was fabricated by femtosecond laser in z-cut lithium niobate. The normalized conversion efficiency of $99.1\% \text{W}^{-1} \text{cm}^{-2}$ is obtained, corresponding to a nonlinearity modulation depth of 0.34.

Authors: Tingge Yuan, Shanghai Jiao Tong University / Xiongshuo Yan, Shanghai Jiao Tong University / Bing Zhu, Shanghai Jiao Tong University / Yuping Chen, Shanghai Jiao Tong University / Xianfeng Chen, Shanghai Jiao Tong University

ATh2R.6

Femtosecond Laser Writing of Three-Dimensional Nonlinear Photonic Structures

Invited

Presenter: Jorg Imbrock , *Westfaelische Wilhelms Univ Munster*

Nonlinear photonic structures have a modulated second order nonlinearity that allows complex phase matching processes. We give an overview of the state of the art in writing nonlinear photonic structures with femtosecond lasers.

Authors: Jorg Imbrock, Westfaelische Wilhelms Univ Munster / Haissam Hanafi, Westfaelische Wilhelms Univ Munster / Cornelia Denz, Westfaelische Wilhelms Univ Munster

ATh2S

Optical Fibers for Sensing Applications II

Presenter: Nikunj Prajapati , *College of William & Mary*

ATh2S.1

Single-Ended Self-Calibrating Raman-Based Distributed Temperature Sensing Based on Multi-Core Fiber

Presenter: Haoze Du , *Huazhong University of Science and Technology*

A multi-core fiber based single-ended self-calibrating Raman distributed temperature sensing system is proposed. A deep one-dimensional denoising convolutional neural network is employed to improve its SNR. 1.4 °C temperature uncertainty was achieved at 10km distance.

Authors:Haoze Du, Huazhong University of Science and Technology / zhongshu Zhang, Huazhong University of Science and Technology / Hao Wu, Huazhong University of Science and Technology / Ming Tang, Huazhong University of Science and Technology

ATh2S.2

a Novel Approach in Raman Temperature Sensing in Optical Fiber Based on Broadband Incident Light

Presenter: Esther Renner , *Institute of Microwaves and Photonics*

We describe a new approach in Raman temperature sensing based on broadband incident light. The reported results show the proof of concept and thus form an important basis for future distributed temperature sensing systems.

Authors:Esther Renner, Institute of Microwaves and Photonics / Lisa-Sophie Haerteis, Institute of Microwaves and Photonics / Nico Weiss, Institute of Microwaves and Photonics / Bernhard Schmauss, Institute of Microwaves and Photonics

ATh2S.3

a Concept Study on Time-Gated Raman Spectroscopy for the Process Industry

Presenter: Thomas Fritsch , *KROHNE Innovation GmbH*

A time-gated Raman spectrometer designed to meet the requirements of a hygienic industrial process analyzer is presented. It is shown that fluorescence effects can be discriminated effectively to reveal the superimposed Raman spectrum.

Authors:Thomas Fritsch, KROHNE Innovation GmbH / Jan Tebrügge, KROHNE Innovation GmbH / Jan Förster, KROHNE Innovation GmbH / Paul Wacker, KROHNE Innovation GmbH / Jan Rüger, Leibniz Institut für Photonische Technologien e.V. / Iwan Schie, Leibniz Institut für Photonische Technologien e.V. / Karina Weber, Leibniz Institut für Photonische Technologien e.V. / Jürgen Popp, Leibniz Institut für Photonische Technologien e.V. / Jochen Ohrem, KHS GmbH / Edwin Ostertag, Hochschule Reutlingen PA&T Center / Barbara Boldrini, Hochschule Reutlingen PA&T Center / Karsten Rebner, Hochschule Reutlingen PA&T Center / Heinrich Prüfer, SensoLogic GmbH

ATh2S.4

Slope Assisted Brillouin Optical Time Domain Analysis Using Dual Frequency Probe With Gain and Loss Spectra

Presenter: Daiki Saito , *Tokyo Univ of Agriculture and Technology*

We demonstrate a slope assisted Brillouin optical time domain analysis using dual frequency probe light amplified by Brillouin gain and attenuated by Brillouin loss, which generates linear output against temperature change.

Authors:Daiki Saito, Tokyo Univ of Agriculture and Technology / Yosuke Tanaka, Tokyo Univ of Agriculture and Technology

ATh2S.5

Active Optical Fiber Sensors Enabled by Femtosecond Laser Induced Nano-Scattering Centers

Presenter: Kehao Zhao , *University of Pittsburgh*

Intrinsic Fabry-Pérot cavity was induced in SMF-28e+ optical fiber using a femtosecond laser. In-fiber light scattered from laser-induced nanograting were used to heat fiber sensors for active sensing applications.

Authors:Kehao Zhao, University of Pittsburgh / Mohan Wang, University of Pittsburgh / Sheng Huang, University of Pittsburgh / zhaoliang peng, University of Pittsburgh / Kevin Chen, University of Pittsburgh

ATh2S.6

Long-Term Stabilities Fiber Bragg Grating (FBG) Arrays Inscribed by Femtosecond Lasers at 910°C

Presenter: Jieru Zhao , *University of Pittsburgh*

We presents experimental data of 3-week stability tests at 910°C of FBG arrays fabricated by femtosecond laser direct writing technique. We show that FBG can perform accurate temperature measurement with 1°C fluctuation at high temperatures.

Authors:Jieru Zhao, University of Pittsburgh / Kehao Zhao, University of Pittsburgh / Yuqi Li, University of Pittsburgh / Qirui Wang, University of Pittsburgh / Kevin Chen, University of Pittsburgh

ATh2S.7

Low-Cost OFDR Distributed Fiber Sensing Enabled by Fiber With Enhanced Rayleigh Backscattering

Presenter: Qirui Wang , *University of Pittsburgh*

This paper shows that a low-cost diode laser with 1-nm tuning range can perform effective optical frequency domain reflectometry distributed sensing measurement using a fiber with strong Rayleigh backscattering profile.

Authors:Qirui Wang, University of Pittsburgh / Kehao Zhao, University of Pittsburgh / Mudabbir Badar, National Energy Technology Laboratory / Ping Lu, National Energy Technology Laboratory / Jieru Zhao, University of Pittsburgh / Yuqi Li, University of Pittsburgh / Kevin Chen, University of Pittsburgh

ATh2S.8

Shape Sensing of an Epidural Needle Through a Network of Nanoparticles-Doped Optical Fibers

Presenter: Aida Amantayeva , *Nazarbayev University*

Shape reconstruction of a rigid medical needle is achieved by equipping it with optical fibers, which detect strain change in response to the needle bending. The maximum reconstruction error for small bending is 0.05 cm.

Authors:Aizhan Issatayeva, Nazarbayev University / Aida Amantayeva, Nazarbayev University / Wilfried Blanc, Université Côte d'Azur / Carlo Molardi, Nazarbayev University / Daniele Tosi, Nazarbayev University

STh2L

MIR Emitting Lasers

Presenter: Emily Sistrunk Link , *Lawrence Livermore National Laboratory*

STh2L.1

Kerr-Lens Mode-Locked Tm:(Lu,Sc)₂O₃ Ceramic Laser Generating sub-60-fs Pulses at 2.08 μm

Presenter: Valentin Petrov , *Max Born Institute*

We report on a purely Kerr-lens mode-locked Tm:(Lu,Sc)₂O₃ ceramic laser emitting at 2083 nm. Nearly Fourier-transform-limited 58-fs pulses are generated with an average output power of 220 mW at a repetition rate of 84.8 MHz.

Authors:Yongguang Zhao, Max Born Institute / Hanlin Yang, Institute of Chemical Materials / Wei Jing, Institute of Chemical Materials / Hui Huang, Institute of Chemical Materials / Jiachen Liu, Tianjin University / Zhongben Pan, Max Born Institute / Zhengping Wang, Shandong University / Xinguang Xu, Shandong University / Xavier Mateos, Universitat Rovira i Virgili / Pavel Loiko, Universite de Caen / Yicheng Wang, Max Born Institute / Li Wang, Max Born Institute / Weidong Chen, Max Born Institute / Uwe Griebner, Max Born Institute / Valentin Petrov, Max Born Institute

STh2L.2

Fully-Stabilized Mid-Infrared Optical Frequency Comb With Dynamic Offset Frequency Tuning

Presenter: Mikhail Roiz , *University of Helsinki*

We demonstrate an approach for mid-infrared frequency comb generation based on femtosecond Optical Parametric Generation seeded by a continuous-wave laser. The offset frequency can be stabilized, continuously tuned and modulated without its direct detection.

Authors: Mikhail Roiz, University of Helsinki / Krishna Kumar, University of Helsinki / Juho Karhu, University of Helsinki / Markku Vainio, University of Helsinki

STh2L.3

Multi-Branch, 1- μm -Pumped, Few-Cycle mid-IR OPA System for Nonlinear Vibrational Spectroscopy

Invited

Presenter: Zsuzsanna Heiner , *School of Analytical Sciences Adlershof*

We present a broadband vibrational sum-frequency generation spectrometer covering the 2.7-13 μm range based on the combination of an ultrafast Yb pump laser, novel wide-bandgap non-oxide crystals, and the technique of chirped sum-frequency generation.

Authors: Zsuzsanna Heiner, School of Analytical Sciences Adlershof

STh2L.4

Highly Efficient mid-Infrared Difference-Frequency Generation Based on Passively Synchronous Seeding

Presenter: Yinqi Wang , *East China Normal University*

A watt-level ultrafast mid-infrared source was implemented based on difference-frequency generation with passively synchronous seeding, which favored a much lower pumping threshold and a maximum power conversion efficiency of 77%.

Authors: Yinqi Wang, East China Normal University / Jianan Fang, East China Normal University / Ming Yan, East China Normal University / Kun Huang, East China Normal University / Heping Zeng, East China Normal University

STh2L.5

Review of Thermal Parameters of Li-Based Nonlinear Crystals for High Power 8 μm Sources

Presenter: Mark Prandolini , *Universität Hamburg*

A review of the thermal parameters of Li-based nonlinear crystals is presented and preliminary results demonstrate a 8 μm laser system with 2 μJ at 200 kHz supporting a Fourier limit of under 100 fs.

Authors: Mahesh Namboodiri, DESY / Torsten Golz, Class 5 Photonics / Jan Buss, Class 5 Photonics / Michael Schulz, Class 5 Photonics / Robert Riedel, Class 5 Photonics / Tim Laarmann, DESY / Mark Prandolini, Universität Hamburg

STh2L.6

10 μm Lasing in Multi-Atmosphere CO₂ Optically Pumped by a Tunable 4.3 μm Laser

Presenter: Dana Tovey, *UCLA*

Lasing is studied in CO₂ pumped at $\sim 4.3 \mu\text{m}$ by a tunable Fe:ZnSe laser. Gain is measured at $\sim 10 \mu\text{m}$ at pressures $\leq 12 \text{ atm}$ where gain bandwidth is broad enough for potential picosecond pulse amplification.

Authors: Dana Tovey, *UCLA* / Jeremy Pigeon, *Stony Brook University* / Sergei Tochitsky, *UCLA* / Gerhard Louwrens, *UCLA* / Ilan Ben-Zvi, *Stony Brook University* / Chan Joshi, *UCLA* / Dmitry Martyshkin, *University of Alabama at Birmingham* / Vladimir Fedorov, *University of Alabama at Birmingham* / Krishna Karki, *University of Alabama at Birmingham* / Sergey Mirov, *University of Alabama at Birmingham*

STh2L.7

45 dB Single-Stage Single-Frequency Cr:ZnSe Amplifier for 2.2-2.6 μm Spectral Range

Presenter: Viktor Smolski, *IPG Photonics Corp*

We report 45 dB single stage Cr:ZnSe amplifier operating over 2.2-2.6 μm spectral range seeded by CW Cr:ZnSe single frequency laser. The maximum output energy of 1.6 mJ was demonstrated in 25 ns pulses at 1000 Hz repetition rate.

Authors: Viktor Smolski, *IPG Photonics Corp* / Igor Moskalev, *IPG Photonics Corp* / Sergey Vasilyev, *IPG Photonics Corp* / Jeremy Peppers, *IPG Photonics Corp* / Mike Mirov, *IPG Photonics Corp* / Yury Barnakov, *IPG Photonics Corp* / Vladimir Fedorov, *IPG Photonics Corp* / Dmitry Martyshkin, *IPG Photonics Corp* / Sergey Mirov, *IPG Photonics Corp* / Valentin Gapontsev, *IPG Photonics Corporation*

STh2B

Non-linear Process Based Light and Laser Sources

Presenter: Ioan Dancus, *IFIN-HH/ELI-NP*

STh2B.1

Analysis of Pump-to-Signal Noise Transfer in Multi-Stage OPCPA

Presenter: Chengyong Feng , *University of Rochester*

Pump-to-signal noise transfer in an ultra-broadband, single-laser-pumped, two-stage nanosecond OPCPA was experimentally and numerically investigated. The dependence of signal-noise-induced, pulse-contrast degradation on both pump-seed delay and amplifier operating regime was also studied.

Authors:Chengyong Feng, University of Rochester / Richard Roides, University of Rochester / Christophe Dorrer, University of Rochester / Jake Bromage, University of Rochester

STh2B.2

Broadband Sum-Frequency Generation in a Novel Angularly Dispersed Noncollinear Geometry

Presenter: Christophe Dorrer , *Laboratory for Laser Energetics*

Broadband frequency conversion of nanosecond spectrally incoherent pulses from 1053 nm to 351 nm is demonstrated in a novel sum-frequency-generation noncollinear angularly dispersed scheme, yielding spectrally incoherent pulses with bandwidth greater than 10 THz.

Authors:Christophe Dorrer, Laboratory for Laser Energetics / Mike Spilatro, Laboratory for Laser Energetics / Ted Borger, Laboratory for Laser Energetics / Steven Herman, Laboratory for Laser Energetics / Elizabeth Hill, Laboratory for Laser Energetics

STh2B.3

Reaching the Millijoule-Regime via Ultrafast Optical Parametric Amplification – an Alternative to First Stage Regenerative Amplification Stages?

Presenter: Yannik Zobus , *Technische Universität Darmstadt*

A new ultra-high contrast uOPA module is being developed for the PHELIX- and PENELOPE frontend-chains. This module will enhance the ASE-contrast and prevent the formation of pre-pulses through a bypass of high-gain amplifiers.

Authors:Yannik Zobus, Technische Universität Darmstadt / Christian Brabetz, GSI Helmholtzzentrum für Schwerionenforschung GmbH / Ji-Ping Zou, Laboratoire pour l'utilisation des lasers intense – LULI / Vincent Bagnoud, GSI Helmholtzzentrum für Schwerionenforschung GmbH

STh2B.4

High Repetition Rate Extreme Ultraviolet Source and Terahertz Driver Laser

Presenter: Robert Riedel , *Class 5 Photonics GmbH*

A high repetition rate, optical-parametric chirped-pulse amplifier system and high-harmonic-generation source is presented for photoelectron spectroscopy experiments spanning an ultra-wide frequency range from Terahertz to the extreme-ultraviolet range between 21.7 and 50 eV.

Authors: Torsten Golz, Class 5 Photonics GmbH / Gregor Indorf, Class 5 Photonics GmbH / Mihail Petev, Class 5 Photonics GmbH / Jan Buss, Class 5 Photonics GmbH / Jan-Christoph Deinert, Helmholtz-Zentrum Dresden-Rossendorf / Ivanka Grguras, Class 5 Photonics GmbH / Michael Schulz, Class 5 Photonics GmbH / Robert Riedel, Class 5 Photonics GmbH

STh2B.5

Spatially Resolved Characterization of Partially Deuterated KDP Crystals for Parametric Amplification

Presenter: Christophe Dorrer, *Laboratory for Laser Energetics*

Local phase-matching variations in partially deuterated KDP used for broadband optical parametric chirped-pulse amplification are spatially characterized using a beam-stabilized second-harmonic generation technique applicable to large-aperture crystals.

Authors: Christophe Dorrer, Laboratory for Laser Energetics / Ildar Begishev, Laboratory for Laser Energetics / Seung-Whan Bahk, Laboratory for Laser Energetics / Jake Bromage, Laboratory for Laser Energetics

STh2B.6

(Withdrawn) Thermo-Optic Dynamics in Diamond Raman Lasers

Presenter: Seyed Abedi, *Macquarie University*

We report a multi-Watt diamond Raman laser exhibiting thermally-induced transient frequency dynamics. Prospects for a "fast" thermo-optical actuator leveraging diamond's supreme thermal conductivity are discussed.

Authors: Seyed Abedi, Macquarie University / Douglas Little, Macquarie University / Ondrej Kitzler, Macquarie University / David Spence, Macquarie University / Richard Mildren, Macquarie University

STh2B.7

Laser Frequency Drift Stabilization Using an Integrated Dual-Mode Locking Si₃N₄ Waveguide Reference Cavity

Presenter: Qiancheng Zhao, *University of California Santa Barbara*

We demonstrate an integrated Si₃N₄ waveguide resonator designed as a dual-mode locking (DML) cavity that stabilizes laser frequency to 1.7×10^{-10} Allan deviation in a 1000-second average measurement with a temperature sensitivity of 187.56 MHz/K.

Authors: Qiancheng Zhao, University of California Santa Barbara / Mark Harrington, University of California Santa Barbara / Andrei Isichenko, University of California Santa Barbara / Grant Brodnik, University of California Santa Barbara / KAIKAI LIU, University of California Santa Barbara / Ryan Behunin, Northern Arizona University / Peter Rakich, Yale University / Chad Hoyt, Honeywell Aerospace / Chad Fertig, Honeywell Aerospace / Scott Papp, National Institute of Standards and Technology / Daniel Blumenthal, University of California Santa Barbara

STh2B.8

Effect of Pump Beam on the Amplified Signal Wavefront in DKDP Optical Parametric Amplification

Presenter: Seung-Whan Bahk , *University of Rochester*

The wavefront introduced by optical parametric phase is investigated in a DKDP optical parametric amplifier by varying pump-beam amplitude and phase profiles, demonstrating their impact on the wavefront of the amplified output signal beam.

Authors: Seung-Whan Bahk, University of Rochester / Ildar Begishev, University of Rochester / Ben Webb, University of Rochester / Cheonha Jeon, University of Rochester / Richard Roides, University of Rochester / Chengyong Feng, University of Rochester / Mike Spilatro, University of Rochester / Robert Cuffney, University of Rochester / Christophe Dorrer, University of Rochester / Chad Mileham, University of Rochester / Sara Bucht, University of Rochester / Jake Bromage, University of Rochester

STh2C

Terahertz Imaging and Detection

Presenter: Rebecca Milot , *University of Warwick*

STh2C.1

Giant Enhancement of Photovoltage From InGaAs-Channel Dual-Grating-Gate HEMT THz Detector due to Nonlinear Rectification Effect at InGaAs/InAlAs Heterobarrier

Presenter: Akira Satou , *Tohoku University*

We experimentally demonstrate the photovoltage from an InGaAs-channel dual-grating-gate HEMT THz detector in the gate-readout configuration is significantly enhanced by the positive gate bias application due to the nonlinear rectification effect at the InGaAs/InAlAs heterobarrier.

Authors: Akira Satou, Tohoku University / Tomotaka Hosotani, Tohoku University / Takumi Negoro, Tohoku University / Yuma Takida, RIKEN / Hiromasa Ito, RIKEN / Hiroaki Minamide, RIKEN / Taiichi Otsuji, Tohoku University

STh2C.2

Super-Efficient Terahertz Detection Through High Switching-Contrast Plasmonic Nanocavities

Presenter: Nezh Yardimci, *Lookin, Inc.*

We present a photoconductive terahertz detector, which utilizes a plasmonic nanocavity to offer broadband terahertz detection with large signal-to-noise ratio at record-low optical pump power levels.

Authors: Nezh Yardimci, Lookin, Inc. / Deniz Turan, University of California - Los Angeles / Mona Jarrahi, University of California - Los Angeles

STh2C.3

Patch Antenna Arrays for Efficient Coupling of Terahertz Spoof Surface Plasmon Polaritons to Free Space Modes and for Substance Monitoring

Presenter: Sven Becker, *TU Kaiserslautern*

We report the implementation of compact patch antenna arrays as directive output couplers for terahertz-spoof-surface-plasmon-polaritons (SSPPs). Substances in the SSPP pathway can be detected by measurement of the radiated output power from the patch antenna.

Authors: Sven Becker, TU Kaiserslautern / Marco Rahm, TU Kaiserslautern

STh2C.4

Broadband Terahertz Time-Domain Imaging Using a Terahertz Focal-Plane Array

Presenter: Xurong Li, *UCLA*

We present a terahertz time-domain imaging modality based on a terahertz focal-plane array. The imaging system has more than a 60-dB signal-to-noise ratio and can resolve terahertz images up to 2.5 THz.

Authors: Xurong Li, UCLA / Mona Jarrahi, UCLA

STh2C.5

THz Near-Field Imaging and Spectroscopy: Technology, Capabilities and Novel Applications

Tutorial

Presenter: Oleg Mitrofanov , *University College London*

Near-field imaging and near-field spectroscopy are becoming more widely used in terahertz (THz) research, enabling new research avenues. This tutorial overviews the development of THz near-field techniques and recent key applications in research.

Authors:Oleg Mitrofanov, University College London

STh2F

Terahertz Devices and Communications

Presenter: Mattias Beck , *ETH Zurich*

STh2F.1

Nanowires: a New Horizon for Polarization-Resolved Terahertz Time-Domain Spectroscopy

Highlighted Talk

Presenter: Kun Peng , *University of Oxford*

In this study, a novel type of broadband polarization-sensitive photoconductive terahertz detectors based on crossed nanowire networks is demonstrated, enabling fast and precise polarization terahertz time-domain spectroscopy measurements.

Authors:Kun Peng, University of Oxford / Dimitars Jevtics, University of Strathclyde / Fanlu Zhang, The Australian National University / Sabrina Sterzl, University of Oxford / Djamshid Damry, University of Oxford / Mathias Rothmann, University of Oxford / Benoit Guilhabert, University of Strathclyde / Michael Strain, University of Strathclyde / Hoe Tan, The Australian National University / Laura Herz, University of Oxford / Lan Fu, The Australian National University / Martin Dawson, University of Strathclyde / Antonio Hurtado, University of Strathclyde / Chennupati Jagadish, The Australian National University / Michael Johnston, University of Oxford

STh2F.2

a Compact Terahertz Polarization Beam Splitter Based on Directional Coupler

Presenter: Wentao Deng , *Wuhan National Lab for Optoelectronics*

We demonstrate a compact terahertz polarization beam splitter based on directional coupler. The extinction ratio over 8 dB is achieved from 0.445 to 0.475 THz for both TE and TM polarizations.

Authors:Wentao Deng, Wuhan National Lab for Optoelectronics / Liao Chen, Wuhan National Lab for Optoelectronics / Ruolan wang, Wuhan National Lab for Optoelectronics / Ziwei Wang, Wuhan National Lab for Optoelectronics / Shixing Yuan, Wuhan National Lab for Optoelectronics / Yu Yu, Wuhan National Lab for Optoelectronics / Xiaojun Wu, School of Electronic and Information Engineering, Beihang University / Xinliang Zhang, Wuhan National Lab for Optoelectronics

STh2F.3

Modular 3D-Printed Plasmonic Circuits for Signal Processing in THz Communications

Presenter: Yang Cao , *Polytechnique Montreal*

THz waveguide-based integrated solutions are of great utility in Terahertz communications. In this work, we propose a new type of modular 3D-printed micro-encapsulated two-wire plasmonic waveguide components to realize reconfigurable terahertz circuits for signal processing.

Authors:Yang Cao, Polytechnique Montreal / kathirvel nallappan, Polytechnique Montreal / hichem guerboukha, Polytechnique Montreal / GUOFU XU, Polytechnique Montreal / Maksim Skorobogatiy, Polytechnique Montreal

STh2F.4

Efficient Leaky-Wave Antenna for Terahertz Wireless Communications

Presenter: Hichem Guerboukha , *Brown University*

We study the radiation properties of leaky-wave antenna at terahertz frequencies for wireless communications. We introduce a novel aperture design that increase the efficiency and directionality of the generated beams.

Authors:Hichem Guerboukha, Brown University / Rabi Shrestha, Brown University / Joshua Neronha, Brown University / Olivia Ryan, Brown University / Malachi Hornbuckle, Brown University / Zhaoji Fang, Brown University / Daniel Mittleman, Brown University

STh2F.5

Terahertz Communications Using Rod-in-air Dielectric Subwavelength Fiber

Presenter: Yang Cao , *Polytechnique Montréal*

In this work, we present an in-depth experimental and numerical study of the short-range THz communications links that use subwavelength dielectric fibers for information transmission and define main challenges and trade-offs in the link implementation.

Authors:kathirvel nallappan, Polytechnique Montréal / Yang Cao, Polytechnique Montréal / GUOFU XU, Polytechnique Montréal / hichem guerboukha, Polytechnique Montréal / chahe nerguzian, Polytechnique Montréal / Maksim Skorobogatiy, Polytechnique Montréal

STh2F.6

Integrated Terahertz Transceivers for Multi-Node Link Discovery and Localization

Presenter: Hooman Saeedi , *Princeton University*

In this work, frequency-to-space mapping principle is exploited to demonstrate simultaneous localization of multiple wireless nodes in 2D angular space in a single-shot fashion. The system is implemented on an integrated CMOS transceiver platform.

Authors:Hooman Saeedi, Princeton University / Suresh Venkatesh, Princeton University / Xuyang Lu, Princeton University / Kaushik Sengupta, Princeton University

STh2F.7

Experimental Demonstration of 8-Gbit/s QPSK Communications Using Two Multiplexed Orbital-Angular-Momentum Beams in the 0.27-0.32 THz Range

Presenter: Huibin Zhou , *University of Southern California*

We experimentally demonstrate an 8-Gbit/s QPSK communication link using two multiplexed OAM beams at ~0.30 THz frequency. By changing the frequency spacing between two lasers, such a system can be operated in the 0.27-0.33 THz range.

Authors:Huibin Zhou, University of Southern California / Xinzhou Su, University of Southern California / Amir Minoofar, University of Southern California / Runzhou Zhang, University of Southern California / Hao Song, University of Southern California / Kai Pang, University of Southern California / kaiheng zou, University of Southern California / Haoqian Song, University of Southern California / Nanzhe Hu, University of Southern California / Zhe Zhao, University of Southern California / Ahmed Almainan, University of Southern California / Shlomo Zach, Tel Aviv University / Moshe Tur, Tel Aviv University / Andreas Molisch, University of Southern California / Hirofumi Sasaki, NTT Network Innovation Laboratories / Doohwan Lee, NTT Network Innovation Laboratories / Alan Eli Willner, University of Southern California

STh2H

Integrated Photonics

Presenter: Donguk Nam , *Nanyang Technological University*

STh2H.1

InGaAsP/InP Membrane Gain Sections for III-v/SiN_x Heterogeneous Photonic Integration

Presenter: Christopher Heidelberg , *MIT Lincoln Laboratory*

We present a fabrication process for 200 nm thick InGaAsP/InP membrane gain sections ($\lambda = 1550$ nm) suitable for heterogeneous integration with SiN_x PICs. The structures exhibit desired electrical performance and support lasing.

Authors: Christopher Heidelberg, MIT Lincoln Laboratory / Christos Santis, Caltech / Jason Plant, MIT Lincoln Laboratory / Erin Morissette, MIT Lincoln Laboratory / Dave Kharas, MIT Lincoln Laboratory / Reuel Swint, MIT Lincoln Laboratory / Amnon Yariv, Caltech / Paul Juodawlkis, MIT Lincoln Laboratory

STh2H.2

InGaAs Photodiode Array on Silicon by Heteroepitaxy

Presenter: Bowen Song , *University of California Santa Barbara*

InGaAs photodiode arrays were realized on Si by heteroepitaxy, demonstrating a dark current as low as 5.71 nA at -1 V and responsivity as high as 0.64 A/W at 1550 nm and at room temperature.

Authors: Bowen Song, University of California Santa Barbara / Bei Shi, University of California Santa Barbara / Simone Brunelli, University of California Santa Barbara / Jonathan klamkin, University of California Santa Barbara

STh2H.3

Aluminum Nitride Photonics Platforms on Silicon Substrate

Presenter: Nanxi Li , *Institute of Microelectronics, A*STAR*

The CMOS-compatible AlN photonics platforms developed within Institute of Microelectronics (IME) are presented, and nonlinear index of the AlN is reported. The photonics devices demonstrated are reviewed, and the future prospective is provided.

Authors: Nanxi Li, Institute of Microelectronics, A*STAR / Chong Pei Ho, Institute of Microelectronics, A*STAR / Yanmei Cao, Singapore University of Technology and Design / Shiyang Zhu, Institute of Microelectronics, A*STAR / George Chen, Singapore University of Technology and Design / Yuan Hsing Fu, Institute of Microelectronics, A*STAR / Yao Zhu, Institute of Microelectronics, A*STAR / Dawn Tan, Singapore University of Technology and Design / Lennon Yao Ting Lee, Institute of Microelectronics, A*STAR

STh2H.4

Tuning Light-Hole Optical Transition in Highly Tensile Strained Germanium Quantum Wells

Presenter: Anis Attiaoui , *École Polytechnique de Montréal*

A new system consisting of a tensile strained Germanium quantum well was epitaxially grown on Si wafers using GeSn as barriers. The thickness of the well was modulated from 12.5nm, down to 1.5nm, and the tensile strain from 1.1% to 1.67%.

Authors:Anis Attiaoui, École Polytechnique de Montréal / Simone Assali, École Polytechnique de Montréal / Patrick Del-Vecchio, École Polytechnique de Montréal / Jerome Nicolas, École Polytechnique de Montréal / Oussama Moutanabbir, École Polytechnique de Montréal

STh2H.5

Integration of VO₂ Optical Memory on Silicon Waveguides

Presenter: Youngho Jung , *Max-Planck-Inst fur Mikrostrukturphysik*

We demonstrate VO₂ optical memory integrated onto a silicon waveguide. Optical information is stored in the bistable states of VO₂ and read out as the change in the optical transmission of the waveguide.

Authors:Youngho Jung, Max-Planck-Inst fur Mikrostrukturphysik / Hyeon Han, Max-Planck-Inst fur Mikrostrukturphysik / Stuart Parkin, Max-Planck-Inst fur Mikrostrukturphysik / Joyce Poon, Max-Planck-Inst fur Mikrostrukturphysik

STh2H.6

Low-Loss Non-Volatile Phase-Change Integrated Photonics at 1550nm and 750nm

Presenter: Zhuoran Fang , *1. Department of Electrical and Computer Engineering, University of Washington*

The phase shifting effect and low loss of Sb₂S₃ are verified experimentally for the first time on SOI and SiN integrated photonics platform using microring resonators at the telecom C-band and near visible wavelengths.

Authors:Zhuoran Fang, 1. Department of Electrical and Computer Engineering, University of Washington / Jiajiu Zheng, 1. Department of Electrical and Computer Engineering, University of Washington / Abhi Saxena, 1. Department of Electrical and Computer Engineering, University of Washington / James Whitehead, 1. Department of Electrical and Computer Engineering, University of Washington / Yueyang Chen, 1. Department of Electrical and Computer Engineering, University of Washington / Arka Majumdar, 1. Department of Electrical and Computer Engineering, University of Washington

STh2H.7

Probing the Material Loss and Optical Nonlinearity of Integrated Photonic Materials

Presenter: Maodong Gao , *California Institute of Technology*

Optical absorption and nonlinear index are important performance drivers in devices like microcombs and parametric oscillators. Here we use resonance-enhanced nonlinear spectroscopy to characterize absorption limits and nonlinear index for some integrated photonic materials.

Authors:Maodong Gao, California Institute of Technology / Qi-Fan Yang, California Institute of Technology / Qing-Xin Ji, California Institute of Technology / LUE WU, California Institute of Technology / Junqiu Liu, Swiss Federal Institute of Technology Lausanne (EPFL) / Guanhao Huang, Swiss Federal Institute of Technology Lausanne (EPFL) / Lin Chang, University of California Santa Barbara / Weiqiang Xie, University of California Santa Barbara / Boqiang Shen, California Institute of Technology / Heming Wang, California Institute of Technology / Zhiquan Yuan, California Institute of Technology / Su-Peng Yu, National Institute of Standards and Technology / Scott Papp, National Institute of Standards and Technology / Tobias Kippenberg, Swiss Federal Institute of Technology Lausanne (EPFL) / John Bowers, University of California Santa Barbara / Kerry Vahala, California Institute of Technology

STh2H.8

Low Loss Gallium Oxide Core/Silica Cladding Planar Waveguide

Presenter: SI TAN , *Cepton Technologies Inc.*

We demonstrate the fabrication and characterization of GaO_x-core/SiO₂-cladding waveguides. Propagation losses of -0.4 ± 0.1 dB/cm, -0.3 ± 0.2 dB/cm, and -2.4 ± 0.5 dB/cm are achieved for 633 nm, 1064 nm and 1550 nm. Laser-induced damage threshold of >2.5 J/cm² is achieved for a 250 fs pulse.

Authors:SI TAN, Cepton Technologies Inc. / Huiyang Deng, Stanford University / Karel Urbanek, Stanford University / Yu Miao, Stanford University / Zhixin Zhao, Stanford University / James Harris, Stanford University / Robert Byer, Stanford University

STh2I

Ultrabroadband Sources and Post Compression

Presenter: Olivier Chalus , *Thales Optronique SA*

STh2I.2

Multi-Pass Post-Compression of Ultrashort Laser Pulses at Extreme Parameter Scales

Invited

Presenter: Christoph Heyl , *Deutsches Elektronen-Synchrotron (DESY)*

This talk provides a review of laser pulse post-compression leveraged by the advent of the multi-pass spectral broadening scheme, including perspectives on expanding the limits of pulse duration and energy.

Authors: Christoph Heyl, Deutsches Elektronen-Synchrotron (DESY)

STh2I.3

Ultrafast Pulse Compression in Bulk With > 20 Times Spectral Broadening Factor From a Single Stage

Presenter: Marcus Seidel, *Deutsches Elektronen Synchrotron*

We introduce the combination of multi-*pass* cell and multi-*plate* spectral broadening. We demonstrate the compression of 110- μ J pulses from 900-fs to 60-fs in a single stage and report broadening to 38-fs transform-limit by nonlinear mode-matching.

Authors: Marcus Seidel, Deutsches Elektronen Synchrotron / Prannay Balla, Deutsches Elektronen Synchrotron / Gunnar Arisholm, FFI (Norwegian Defence Research Establishment) / Lutz Winkelmann, Deutsches Elektronen Synchrotron / Ingmar Hartl, Deutsches Elektronen Synchrotron / Christoph Heyl, Deutsches Elektronen Synchrotron

STh2I.4

GW Peak Power, sub-30-fs Pulses From Efficient Single-Stage Pulse Compressor at 400 kHz

Presenter: Alan Omar, *Ruhr-Uni Bochum*

In this work, we demonstrate the compression of 300-fs laser pulse with corresponding peak power 150 MW to 27 fs and 1 GW utilizing nonlinear spectral broadening compression in Herriott-type multipass cell.

Authors: Alan Omar, Ruhr-Uni Bochum / Shahwar Ahmed, Ruhr-Uni Bochum / martin saraceno, Ruhr-Uni Bochum / Clara Saraceno, Ruhr-Uni Bochum

STh2I.5

Intra-Burst Temporal Pulse Contrast of a High-Power Post-Compressed Picosecond Yb:YAG Laser

Presenter: Anne-Lise Viotti, *Deutsches Elektronen-Synchrotron DESY*

We report on pulse contrast characterization of the output of a gas-filled multi-pass cell employed for 20-fold compression of a high-power Yb:YAG laser. We demonstrate an energy content of 80% in the compressed fs pulse.

Authors: Anne-Lise Viotti, Deutsches Elektronen-Synchrotron DESY / Skirmantas Alisauskas, Deutsches Elektronen-Synchrotron DESY / Esmerando Escoto, Deutsches Elektronen-Synchrotron DESY / Henrik Tuennermann, Deutsches Elektronen-Synchrotron DESY / Katharina Dudde, Deutsches Elektronen-Synchrotron DESY / Marcus Seidel, Deutsches Elektronen-Synchrotron DESY / Bastian Manschwetus, Deutsches Elektronen-Synchrotron DESY / Ingmar Hartl, Deutsches Elektronen-Synchrotron DESY / Christoph Heyl, Deutsches Elektronen-Synchrotron DESY

STh2I.6

Photonic-Chip-Based Nonlinear Compression of Picosecond Pulses

Presenter: Richard Oliver, *Columbia University*

We demonstrate soliton-effect compression of picosecond pulses using ultralow loss dispersion-engineered 40-cm-long silicon-nitride nanowaveguides. We show compression by factors of 21x of 1 ps pulses using pulse energies as low as 18 pJ.

Authors: Richard Oliver, Columbia University / Yoshitomo Okawachi, Columbia University / Xingchen Ji, Columbia University / Adrea Johnson, Columbia University / Alexander Klenner, Columbia University / Michal Lipson, Columbia University / Alexander Gaeta, Columbia University

STh2I.1

Attosecond Soft x-ray Pulses for Condensed Phase Physics

Invited

Presenter: Jens Biegert, *ICFO -Institut de Ciencies Fotoniques*

I will discuss how isolated attosecond soft X-ray pulses empower real-time core-level x-ray absorption spectroscopy to provide an unconvoluted view on the interaction of charges and phonons on the example of the semimetal graphite.

Authors: Jens Biegert, *ICFO -Institut de Ciencies Fotoniques*

STh2D

Computational Microscopy

Presenter: Milad Alemohammad, *Johns Hopkins University*

STh2D.1

Computational Microscopy for Next-Generation bio-Imaging

Invited

Presenter: Shwetadwip Chowdhury , *University of Texas at Austin*

Optical microscopy is critical in bio-imaging due to its non-ionizing and high-resolution imaging capabilities. Past decades have also seen dramatic developments in computing power and data accessibility. Combined, these separate fields have spawned the field of computational microscopy, where optical systems and computational algorithms are co-designed. I will discuss my work in this field with regards to super-resolution and high-throughput imaging as well as imaging through optical scatter.

Authors: Shwetadwip Chowdhury, University of Texas at Austin

STh2D.2

High Fidelity 3D Image Synthesis With Dynamic Computer Generated Holography (DCGH)

Presenter: Vincent Curtis , *University of North Carolina-Chapel Hill*

We demonstrate a new technique for high-resolution computer-generated holography. Our method rapidly displays a sequence of engineered wavefronts optimized together to render the desired illumination pattern. Experimental results show speckle-free 3D image synthesis capabilities.

Authors: Vincent Curtis, University of North Carolina-Chapel Hill / Jiayi Xu, University of North Carolina-Chapel Hill / Nicholas Caira, University of North Carolina-Chapel Hill / Asha Gowda Sata, University of North Carolina-Chapel Hill / Nicolas Pégard, University of North Carolina-Chapel Hill

STh2D.3

Volumetric Fluorescence Microscopy Using Convolutional Recurrent Neural Networks

Presenter: Luzhe Huang , *University of California, Los Angeles*

We demonstrate a convolutional recurrent neural network-based volumetric imaging framework, termed Recurrent-MZ. Using a few 2D fluorescence microscopy images as its input, Recurrent-MZ provides a 50-fold extended depth-of-field in imaging of 3D fluorescent samples.

Authors: Luzhe Huang, University of California, Los Angeles / Yilin Luo, University of California, Los Angeles / Yair Rivenson, University of California, Los Angeles / Aydogan Ozcan, University of California, Los Angeles

STh2D.4

(Withdrawn) Optical Mesoscopy With the Mesolens

Invited

Presenter: Gail McConnell , *University of Strathclyde*

Abstract not available.

Authors:Gail McConnell, University of Strathclyde

STh2D.5

SUPPOSE Deconvolution + AI Denoising: Super-Resolving Sparse Signals Blurred and Buried in Noise

Presenter: Axel Lacapmesure , *Universidad de Buenos Aires*

The deconvolution of sparse objects images is analyzed after using the SUPPOSE algorithm and its combination with artificial intelligence denoising, showing resolutions under 100nm under high noise levels.

Authors:Axel Lacapmesure, Universidad de Buenos Aires / Micaela Toscani, Universidad de Buenos Aires / Guillermo Brinatti Vazquez, Universidad de Buenos Aires / Sandra Martinez, CONICET / Oscar Martinez, Universidad de Buenos Aires

STh2D.6

Structured Illumination Microscopy Using Coupled Nanoridge Arrays

Presenter: John Haug , *University of Notre Dame*

Structured illumination microscopy using arrays of nanoridges is investigated. A resolution of ~50 nm ($\lambda_0 = 458$ nm) is demonstrated. Compared to approaches leveraging surface-plasmon-polaritons, the coupled nanoridges improve the super-resolution by more than 10%.

Authors:John Haug, University of Notre Dame / Milan Palei, University of Notre Dame / Joshua Shrouf, University of Notre Dame / Paul Bohn, University of Notre Dame / Anthony Hoffman, University of Notre Dame

STh2G

Novel Fiber Systems and Devices

Presenter: Sonia Boscolo , *Aston University*

STh2G.1

High Dimensional Quantum Communications With Spatial Degrees of Freedom

Invited

Presenter: Davide Bacco , *DTU Fotonik*

An enlarged Hilbert space offers multiple advantages, from larger information capacity and increased noise resilience, to novel fundamental research possibilities. Here, we report our recent results related to quantum communications using high-dimensional quantum states.

Authors: Davide Bacco, DTU Fotonik / Daniele Cozzolino, DTU Fotonik / Beatrice Da Lio, DTU Fotonik / Nicola Biagi, National Institute of Optics (INO-CNR) / Yunhong Ding, DTU Fotonik / Alessandro Zavatta, National Institute of Optics (INO-CNR) / Leif Oxenløwe, DTU Fotonik

STh2G.2

Engineering Quantum States by Fiber-Based SU(1,1) Interferometers

Invited

Presenter: Xiaoying Li , *Tianjin University*

Modes of photons play essential roles in interference. Using the fiber-based nonlinear interferometry that separates the nonlinear gain control from dispersion engineering, we show a new approach of modifying the mode structure of quantum states.

Authors: Xiaoying Li, Tianjin University

STh2G.3

Generation of 70-nj and 40-fs Pulses by a Ring Mamyshev Oscillator With a Single Gain Segment

Presenter: Henry Haig , *Cornell University*

We present a ring-type Mamyshev oscillator with only one amplification stage. The design allows self-starting via modulation of the pump power, high pulse performance, and is suitable for all-fiber integration.

Authors: Henry Haig, Cornell University / Pavel Sidorenko, Cornell University / Robert Thorne, Cornell University / Frank Wise, Cornell University

STh2G.4

Sub-fs Timing Jitter of an 88 fs all-PM Fiber Integrated Ultrafast Yb NALM Oscillator

Presenter: Yuxuan Ma , *Deutsches Elektronen-Synchrotron (DESY)*

We demonstrate an all-PM fiber integrated femtosecond Yb NALM oscillator with 88 fs compressed pulse duration and sub-fs free-running timing jitter [25 kHz to 5 MHz].

Authors: Yuxuan Ma, Deutsches Elektronen-Synchrotron (DESY) / Sarper Salman, Deutsches Elektronen-Synchrotron (DESY) / Chen Li, Deutsches Elektronen-Synchrotron (DESY) / Christoph Mahnke, Deutsches Elektronen-Synchrotron (DESY) / Yi Hua, Deutsches Elektronen-Synchrotron (DESY) / Jakob Fellingner, University of Vienna / Aline Mayer, University of Vienna / Oliver Heckl, University of Vienna / Christoph Heyl, Deutsches Elektronen-Synchrotron (DESY) / Ingmar Hartl, Deutsches Elektronen-Synchrotron (DESY)

STh2G.5

Quantum Seeded Sub-20 fs Pulse Train Generation Using Transient SRS in H₂-Filled Inhibited Coupling HC-PCF

Presenter: Jim Ignacchiti , *XLIM*

We report on the generation of pulse trains from a hydrogen-filled hollow-core fiber pumped by 10 ps pulses for wave synthesis. Experimental results show ultrashort pulse trains separated by 57 fs with 20 fs duration.

Authors: Jim Ignacchiti, XLIM / David Kergoustin, XLIM / Foued Amrani, XLIM / Benoit Debord, XLIM / Frédéric Gêrôme, XLIM / Fetah Benabid, XLIM

STh2E

Frequency Combs for Open-path Sensing and Imaging

Presenter: Lucile Rutkowski , *Institute of Physics of Rennes*

STh2E.1

Towards Real-Time Hyperspectral Imaging in the Terahertz Range With THz Dual-Comb Sources

Presenter: FARID ULLAH KHAN , *Universidad Carlos III de Madrid*

We present a novel technology for real-time hyperspectral imaging in the terahertz range based on the use of a dual-comb source that promises to revolutionize most of the performance characteristics of current terahertz imaging systems.

Authors: FARID ULLAH KHAN, Universidad Carlos III de Madrid / Borja Jerez, Arquimea Centro de Investigaciones / CRISTINA Dios, Universidad Carlos III de Madrid / Ruben Criado Serrano, Arquimea Centro de Investigaciones / Pablo Acedo, Universidad Carlos III de Madrid / Pedro Martín-Mateos, Universidad Carlos III de Madrid

STh2E.2

Absolute Laser Ranging With Sub- μm Resolution From a Free-Running Dual-Comb Yb:CaF₂ Laser

Presenter: Jacob Nürnberg , *ETH Zurich*

We present absolute laser ranging with sub- μm resolution enabled by a free-running dual-comb diode-pumped Yb:CaF₂ laser. At an update rate of 952 Hz, we achieve a relative resolution of more than 10^{-6} within the ambiguity range of 1.1 m.

Authors: Jacob Nürnberg, ETH Zurich / Benjamin Willenberg, ETH Zurich / Christopher Phillips, ETH Zurich / Ursula Keller, ETH Zurich

STh2E.3

Direct Hyperspectral Dual-Comb Imaging: Ultrafine Spectral and High Temporal Resolutions

Presenter: FARID ULLAH KHAN , *Universidad Carlos III de Madrid*

Hyperspectral dual-comb imaging is based on generating two closely matched frequency combs interfering at rates that can be detected by a video camera. The system provides ultrafine spectral and high temporal resolution enabling precision spectroscopic imaging

Authors: FARID ULLAH KHAN, Universidad Carlos III de Madrid / Pedro Martín-Mateos, Universidad Carlos III de Madrid

STh2E.4

Open-Path Sensing With Frequency Combs

Tutorial

Presenter: Kevin Cossel , *NIST-Boulder*

Open-path dual-comb spectroscopy is a powerful tool for atmospheric measurements combining broad bandwidth and high spectral resolution. This talk will cover the technique as well as applications in the near- and mid-infrared spectral region.

Authors: Kevin Cossel, NIST-Boulder

STh2E.5

Feedlot-Produced Ammonia Emissions Quantified Using Dual-Comb Spectroscopy

Presenter: Daniel Herman , *NIST*

Ammonia flux from a cattle feedlot is characterized using two integrated-path dual-comb spectroscopy (DCS) measurements. Precision agricultural DCS measurements over several months reveal temperature and wind dependence of the feedlot ammonia emission rates.

Authors: Daniel Herman, NIST / Lindsay Hutcherson, Kansas State University / Chinthaka Weerasekara, Kansas State University / Fabrizio Giorgetta, NIST / Kevin Cossel, NIST / Gabriel Colacion, NIST / Nathan Newbury, NIST / Stephen Welch, Kansas State University / Brett DePaola, Kansas State University / Ian Coddington, NIST / Eduardo Santos, Kansas State University / Brian Washburn, NIST

STh2Q

Quantum Technology for Fundamental Physics

Presenter: Marianna Safronova , *University of Delaware*

STh2Q.1

Characterization of a THz Electric Field Using Precision Spectroscopy of Molecular Ions

Presenter: Florin Lucian Constantin , *CNRS*

SI-traceable calibration of the amplitudes and phases of the Cartesian components of a THz electric field may be performed by comparing measurements of the lighshifts of HD^+ two-photon rovibrational transitions with molecular ion theory predictions.

Authors:Florin Lucian Constantin, CNRS

STh2Q.2

Searching for Dark Matter With an Optomechanical Accelerometer

Presenter: jack manley , *University of Delaware*

We show that a silicon nitride optomechanical membrane, acting as an accelerometer, can be used to search for dark matter.

Authors:jack manley, University of Delaware / Mitul Dey Chowdhury, University of Arizona / Daniel Grin, Haverford College / Swati Singh, University of Delaware / Dalziel Wilson, University of Arizona

STh2Q.4

MAGIS-100: Fundamental Physics With Long-Baseline Atom Interferometry

Invited

Presenter: Jason Hogan , *Stanford University*

To be provided

Authors:Jason Hogan, Stanford University

STh2Q.5

Ultra-Stable Laser System for Next-Generation Light-Pulse Atom Interferometry MAGIS-100

Presenter: Michele Giunta , *Menlo Systems GmbH*

We present a fully phase-locked comb-disciplined-laser system, conceived to operate the Matter-wave Atomic Gradiometer Interferometric Sensor (MAGIS-100). Via phase-locking to the comb, four ECDLs, and a Ti:Sapphire laser inherit the stability of an ultra-stable laser.

Authors: Michele Giunta, Menlo Systems GmbH / Manuel Brekenfeld, Menlo Systems GmbH / Maximilian Bradler, Menlo Systems GmbH / Dag Schmidt, Menlo Systems GmbH / Andreas Fricke, Menlo Systems GmbH / Maurice Lessing, Menlo Systems GmbH / Marc Fischer, Menlo Systems GmbH / Joseph Thom, M-Squared Lasers Ltd / Nils Hempler, M-Squared Lasers Ltd / Gareth Maker, M-Squared Lasers Ltd / Graeme Malcolm, M-Squared Lasers Ltd / Timothy Kovachy, Northwestern University / Jason Hogan, Stanford University / Ronald Holzwarth, Menlo Systems GmbH

STh2Q.6

Commissioning of a Highly Customized 1010 nm, ns-Pulsed, Yb-Doped Fiber Amplifier for on-Demand Single-Photon Generation

Presenter: Max Mäusezahl, 5. Physikalisches Institut and Center for Integrated Quantum Science and Technology, Universität Stuttgart

Parametric single-photon generation is a key technology for quantum-optical applications. Here we report on the development and commissioning of a highly specialized 1010 nm fiber amplifier for such a novel parametric single-photon source.

Authors: Max Mäusezahl, 5. Physikalisches Institut and Center for Integrated Quantum Science and Technology, Universität Stuttgart / Florian Christaller, 5. Physikalisches Institut and Center for Integrated Quantum Science and Technology, Universität Stuttgart / Oliver de Vries, Fraunhofer Institute for Applied Optics and Precision Engineering IOF / Marco Plötner, Fraunhofer Institute for Applied Optics and Precision Engineering IOF / Hao Zhang, State Key Laboratory of Quantum Optics and Quantum Optics Devices, Institute of Laser Spectroscopy, Shanxi University / Annika Belz, 5. Physikalisches Institut and Center for Integrated Quantum Science and Technology, Universität Stuttgart / Benjamin Heinrich, 5. Physikalisches Institut and Center for Integrated Quantum Science and Technology, Universität Stuttgart / Till Walbaum, Fraunhofer Institute for Applied Optics and Precision Engineering IOF / Thomas Schreiber, Fraunhofer Institute for Applied Optics and Precision Engineering IOF / Andreas Tünnermann, Fraunhofer Institute for Applied Optics and Precision Engineering IOF / Harald Kübler, 5. Physikalisches Institut and Center for Integrated Quantum Science and Technology, Universität Stuttgart / Robert Löw, 5. Physikalisches Institut and Center for Integrated Quantum Science and Technology, Universität Stuttgart / Tilman Pfau, 5. Physikalisches Institut and Center for Integrated Quantum Science and Technology, Universität Stuttgart

STh2Q.3

Coherent Matter-Wave Optics on Ground and in Space

Invited

Presenter: E. Rasel, Australian National University

In contrast to electro-magnetic waves, optics with deBroglie waves additionally deals with interactions in matter. We exploit these interactions in a degenerate quantum gas as an adjustable lens for coherent atom optics and achieve in this way the lowest internal kinetic energies reported so far.

Authors:E. Rasel, Australian National University

ATh2T

ATTR: Space Optics I: Free-Space Optical Communications in Orbital Platforms

Presenter: Linda Thomas , *US Naval Research Laboratory*

ATh2T.1

Optical Inter Satellite Links for Data Relay and LEO Constellations

Invited

Presenter: Frank Heine , *Tesat-Spacecom GmbH & Co KG*

Tesat-Spacecom operates Laser Communication Terminals for data relay and constellation applications since 2008. We report on the current status of the in-orbit systems and the developments for upcoming constellation programs.

Authors:Frank Heine, Tesat-Spacecom GmbH & Co KG

ATh2T.3

Network Modeling With Free Space Optical (FSO) Links

Invited

Presenter: Jeffery Weston , *US Naval Research Laboratory (NRL)*

An approach for modeling free space optical links in network emulation and simulation, initially focusing on ground to low earth orbit satellite links, including results for both unreliable communications and reliable, resilient network transport.

Authors:Jeffery Weston, US Naval Research Laboratory (NRL)

ATh2T.4

Space Qualification of Optical Inter Satellite Links

Invited

Presenter: Aaron Freeman , *General Atomics*

General Atomics Electromagnetic (GA-EMS) has completed assembly, integration, and test of a space capable optical communication terminal (OCT). The two terminals have been integrated into separate cubesats and will be launched in Summer 2021 as part of the Optical Communication Experiment (OCE) demonstration with the Space Development Agency (SDA). The as built hardware including space qualification testing in preparation for launch and on orbit demonstrations will be covered.

Authors:Aaron Freeman, General Atomics

ATH2T.2

Cost Efficient LEO-OISLs: Turning Challenges Into Opportunities

Invited

Presenter: Joachim Horwath , *Mynaric Lasercom GmbH*

The presentation focuses on the challenges involved in introducing optical links in LEO constellations at competing costs and at high volume. Firstly, the talk offers an overview of the design trades involved in coming up with a solution fulfilling the necessary requirements and then addresses the main factors involved driving the requirements. Various pros and cons are discussed and some examples are given as to which path Mynaric has chosen. Finally, the major challenges for scale production are addressed.

Authors:Joachim Horwath, Mynaric Lasercom GmbH

10:00 - 12:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

JTh3A

Joint Poster Session III

JTh3A.1

Improved Machine Learning Algorithms for Optimizing Coherent Pulse Stacking Amplification (/home/eposters/poster/?id=3518559)

Presenter: Weizhi Du , *University of Michigan*

We apply momentum stochastic parallel gradient descent (MSPGD) and policy gradient algorithms to optimize coherent pulse stacking (CPS), and demonstrate their increased effectiveness compared to traditionally used stochastic parallel gradient descent (SPGD) algorithm.

Authors:Weizhi Du, University of Michigan / Eunjeong Hyeon, University of Michigan / Zhengyu Huang, University of Michigan / Yeonjoon Cheong, University of Michigan / Siyuan Zheng, University of Michigan / Hanzhang Pei, University of Michigan / Almantas Galvanauskas, University of Michigan

JTh3A.2

Resource-Efficient Real-Time Polarization Compensation for MDI-QKD With Rejected Data (/home/eposters/poster/?id=3519873)

Presenter: Olinka Bedroya , *University of Toronto*

We propose and implement a novel polarization compensation in MDI-QKD systems using discarded bits, without reducing key-sharing cycle or demanding additional resources. Polarization drift is maintained below 0.15 rad over 40 km of fiber.

Authors:Olinka Bedroya, University of Toronto / Chenyang Li, University of Toronto / Li Qian, University of Toronto / Hoi-Kwong Lo, University of Toronto

JTh3A.3

Extraction of Coupling Coefficient for Coherent 2x1 VCSEL Array (/home/eposters/poster/?id=3520537)

Presenter: Nusrat Jahan , *UIUC*

The coupling coefficient of a 2x1 optically coherent microcavity laser array can be experimentally determined. We show the extracted coupling coefficient varies for arrays depending on in-phase or out-of-phase coherent operation, in agreement with theory.

Authors:Nusrat Jahan, UIUC / William North, UIUC / Pawel Strzebonski, UIUC / Katherine Lakomy, UIUC / Kent Choquette, UIUC

JTh3A.4

Appropriate way to Generate Enough Patterns for Single Pixel Imaging Using Multicore Fiber and Photonic Lantern (/home/eposters/poster/?id=3524043)

Presenter: Yangyang Xiang , *Beijing Univ. Posts & Telecomm.*

Numerical simulation recommends coherently illuminating multiple cores, other than increasing core number, as the way to get enough projecting patterns for high resolution single pixel imaging endoscopy using multicore fiber and photonic lantern.

Authors:Yangyang Xiang, Beijing Univ. Posts & Telecomm. / Ruoxuan Li, Beijing Univ. Posts & Telecomm. / Junhui Li, Beijing Univ. Posts & Telecomm. / Mingying Lan, Beijing Univ. Posts & Telecomm. / Li Gao, Beijing Univ. Posts & Telecomm. / Jianxin Ma, Beijing Univ. Posts & Telecomm.

JTh3A.5

Analytic Theory for Parametric Gain in Lossy Integrated Waveguides (/home/eposters/poster/?id=3520173)

Presenter: Magnus Karlsson , *Chalmers Tekniska Högskola*

We provide an accurate yet simple analytic formula for the parametric gain in phase (in-) sensitive parametric amplifiers where the waveguide loss cannot be neglected. This is of significance for integrated parametric devices.

Authors: Magnus Karlsson, Chalmers Tekniska Högskola / Jochen Schroder, Chalmers Tekniska Högskola / Peter Andrekson, Chalmers Tekniska Högskola / Ping Zhao, Chalmers Tekniska Högskola

JTh3A.6

Large Range Athermalisation of Multi-Section Surface Grating Lasers for DWDM-PONs (</home/eposters/poster/?id=3522203>)

Presenter: Dovydas Mickus , *Trinity College Dublin*

A multi-section, high order surface grating laser is continuously athermalised with wavelength variation of only ± 0.003 nm (± 375 MHz) from 20 to 102 °C. In discontinuous mode this range is extended to 116 °C.

Authors: Dovydas Mickus, Trinity College Dublin / Robert McKenna, Trinity College Dublin / John Donegan, Trinity College Dublin

JTh3A.7

Design Rules for Low Electrical Power Consumption in Nonlinear Silicon Waveguides With Active Carrier Removal (</home/eposters/poster/?id=3531064>)

Presenter: Valerio Vitali , *Optoelectronics Research Centre, University of Southampton*

We report an experimental study on p-n junction equipped silicon waveguides, presenting the optimized parameters to achieve effective nonlinear operation. A conversion efficiency of -6.8 dB with electrical power consumption of 340 mW is demonstrated.

Authors: Valerio Vitali, Optoelectronics Research Centre, University of Southampton / Hao Liu, Optoelectronics Research Centre, University of Southampton / Iosif Demirtzioglou, Optoelectronics Research Centre, University of Southampton / Cosimo Lacava, Optoelectronics Research Centre, University of Southampton / Kyle Bottrill, Optoelectronics Research Centre, University of Southampton / Xingzhao Yan, Optoelectronics Research Centre, University of Southampton / Han Du, Optoelectronics Research Centre, University of Southampton / Mehdi Banakar, Optoelectronics Research Centre, University of Southampton / Dehn Tran, Optoelectronics Research Centre, University of Southampton / Callum Littlejohns, Optoelectronics Research Centre, University of Southampton / David Thomson, Optoelectronics Research Centre, University of Southampton / Periklis Petropoulos, Optoelectronics Research Centre, University of Southampton

JTh3A.8

Thickness Identification of 2D Materials by Machine Learning Assisted Optical Microscopy (/home/e posters/poster/?id=3519004)

Presenter: Felice Gesuele , *University Federico II of Naples*

We report a rapid and cost-effective method for the identification of the thickness of two-dimensional materials. Our technique is based on the analysis of the optical contrast by means of machine learning based algorithms.

Authors:Daniele Sirico, University Federico II of Naples / Giovanni Acampora, University Federico II of Naples / Pasqualino Maddalena, University Federico II of Naples / Felice Gesuele, University Federico II of Naples

JTh3A.9

Design and Analysis of Polarization Insensitive O-Band Bulk SOA for Active-Passive Photonic Circuits (/home/e posters/poster/?id=3521812)

Presenter: Aref Rasoulzadehzali , *Technical university of Eindhoven*

We design and numerically analyze low polarization sensitive bulk-SOA in the O-band suitable for co-integration with passive waveguides/circuits. Low polarization dependent gain (<1.5dB) is achieved with 20dB average gain and 11dBm output saturation power.

Authors:Aref Rasoulzadehzali, Technical university of Eindhoven / Ripalta Stabile, Technical university of Eindhoven / Nicola Calabretta, Technical university of Eindhoven

JTh3A.10

Synchronizable, low-jitter, Picosecond Ho:Fiber NALM Oscillator for Ho:YLF Amplifier Driven Electron Acceleration (/home/e posters/poster/?id=3524958)

Presenter: Christoph Mahnke , *Deutsches Elektronen-Synchrotron DESY*

We demonstrate a 41.6 MHz, 1.3 ps, 140 pJ Ho: fiber oscillator centered at 2050 nm for seeding Ho:YLF amplifiers. RIN and timing jitter of the oscillator are characterized while comparing two commercial Tm pump lasers.

Authors:Christoph Mahnke, Deutsches Elektronen-Synchrotron DESY / Hua Yi, Deutsches Elektronen-Synchrotron DESY / Yuxuan Ma, Deutsches Elektronen-Synchrotron DESY / Sarper Salman, Deutsches Elektronen-Synchrotron DESY / Thorsten Lamb, Deutsches Elektronen-Synchrotron DESY / Sebastian Schulz, Deutsches Elektronen-Synchrotron DESY / Christoph Heyl, Deutsches Elektronen-Synchrotron DESY / Huseyin Cankaja, University of Hamburg / Ingmar Hartl, Deutsches Elektronen-Synchrotron DESY

JTh3A.11

Air-Dispersion-Corrected Dual-Comb Distance Metrology (/home/e posters/poster/?id=3525038)

Presenter: Toby Mitchell , *Heriot Watt University*

A dual-comb optical-path-difference measurement provides the group velocity of air with a fractional uncertainty of 10^{-5} , allowing the geometrical path difference to be determined without auxiliary information such as the dispersion equation for air.

Authors: Toby Mitchell, Heriot Watt University / Pablo Castro-Marin, Heriot Watt University / Jinghua Sun, Dongguan University of Technology / Derryck Reid, Heriot Watt University

JTh3A.12

Reconfigurable Nanophotonic Circuitry Enabled by Direct-Laser-Writing (/home/e posters/poster/?id=3525352)

Presenter: Helge Gehring, *Universität Münster*

Passive integrated nanophotonic circuits mass-produced by lithographic means offer limited customizability after nanofabrication. Here we present an approach for reconfiguring nanophotonic circuitry after lithography by using direct-laser-writing for application-specific tasks.

Authors: Helge Gehring, Universität Münster / Matthias Blaicher, Karlsruhe Institute of Technology / Thomas Grottke, Universität Münster / Wolfram Pernice, Universität Münster

JTh3A.13

State Tomography of Space-Time "Entangled" Ultrafast Optical Pulses (/home/e posters/poster/?id=3525525)

Presenter: Yijie Shen, *University of Southampton*

We introduce state tomography as a quantitative methodology for the characterization of ultrafast optical pulses and report on its application to the propagation of isodiffracting single-cycle toroidal pulses and non-isodiffracting wideband Laguerre-Gauss beams.

Authors: Yijie Shen, University of Southampton / Apostolos Zdagkas, University of Southampton / Shankar Pidishety, University of Southampton / Nikitas Papisimakis, University of Southampton / Nikolay Zheludev, University of Southampton

JTh3A.14

Electro-Optics of Liquid Crystals Enabled by Ferroelectric Nanoparticles: Inverse Guest-Host Effect (/home/e posters/poster/?id=3517980)

Presenter: Yuriy Garbovskiy, *Central Connecticut State University*

We report an unusual electro-optical effect, called an inverse guest-host effect, when ferroelectric nanoparticles (a guest) reorient and hold liquid crystal molecules (a host) in a direction of the orientation of nanoparticles.

Authors: Yuriy Garbovskiy, Central Connecticut State University / Alexander Emelyanenko, Lomonosov Moscow State University / Anatoliy Glushchenko, University of Colorado Colorado Springs

JTh3A.15

Self-Written Polymer Waveguide Interconnects as low-Loss and Simple Sensing Device (</home/eposters/poster/?id=3531258>)

Presenter: Axel Günther , *TU Braunschweig*

Self-written waveguides are an established solution to connect different optical elements with each other. They minimize coupling losses and enable a rigid connection. Furthermore, their characteristics enable a usage as thermal sensing element simultaneously.

Authors: Axel Günther, TU Braunschweig / Lei Zheng, Leibniz University Hannover / roopanshu Garg, Leibniz University Hannover / Murat Baran, Leibniz University Hannover / Bernhard Roth, Leibniz University Hannover / Wolfgang Kowalsky, TU Braunschweig

JTh3A.16

Visible-Wavelength Entangled Photon Source for Quantum Communication and Quantum Imaging (</home/eposters/poster/?id=3522969>)

Presenter: Adrià Sansa Perna , *Fraunhofer IOF*

We present a polarization entangled photon pair source in the visible light range (532 nm) bright enough for exploitation in quantum communication and sensing. Its suitability for low cost and low jitter detection is studied.

Authors: Adrià Sansa Perna, Fraunhofer IOF / Markus Gräfe, Fraunhofer IOF / Fabian Steinlechner, Fraunhofer IOF

JTh3A.17

All-Fiber Source and Sorter for Multimode Correlated Photons (</home/eposters/poster/?id=3523510>)

Presenter: Kfir Sulimany , *Hebrew University of Jerusalem*

We use spontaneous four wave mixing to generate multimode photon pairs in a few mode fiber. We show the photons are correlated in the fiber mode basis using an all-fiber mode sorter.

Authors: Kfir Sulimany, Hebrew University of Jerusalem / Yaron Bromberg, Hebrew University of Jerusalem

JTh3A.18

Modification of Emission Rate in Broadband Deterministic Micropillar Cavities (</home/eposters/poster/?id=3525480>)

Presenter: Laia Gines , *Stockholm University*

We investigate the efficient generation of photons in broadband deterministic quantum dot-micropillar cavities. The quantum-dot cavity coupling leads to Purcell factors above 2 for both exciton and biexciton photons.

Authors: Laia Gines, Stockholm University / Magdalena Moczala-Dusanowska, Wurzburg University / Radim Hosak, Palacky University, / Miroslav Jezek, Palacky University, / Sven Höfling, Wurzburg University / Christian Schneider, Institute of Physics, University of Oldenburg / Ana Predojevic, Stockholm University

JTh3A.20

Observation of Thermal Biphotons (</home/eposters/poster/?id=3519038>)

Presenter: Ohad Lib , *Hebrew University of Jerusalem*

We present a novel type of incoherent light, thermal biphotons, that exhibit an Hanbury Brown and Twiss peak with a different width compared to classical thermal light, leading to the breakdown of the Siegert relation.

Authors: Ohad Lib, Hebrew University of Jerusalem / Yaron Bromberg, Hebrew University of Jerusalem

JTh3A.22

?Achromatic Flat Lenses: Do They Really Improve Imaging Performance (</home/eposters/poster/?id=3517555>)

Presenter: Jacob Engelberg , *Hebrew University*

Despite the many achromatic flat lenses demonstrated in recent years, improvement in imaging performance under ambient illumination compared to conventional flat lenses has not been shown. Why is it so? Here we explain.

Authors: Jacob Engelberg, Hebrew University / Uriel Levy, Hebrew University

JTh3A.23

Understanding of Ultrafast Breathing-Like Dynamics in Ytterbium-Doped Fiber Laser (</home/eposters/poster/?id=3520326>)

Presenter: Katarzyna Krupa , *Institute of Physical Chemistry Polish Academy of Sciences*

We present experimental evidence of breathing-like dynamics in all-normal dispersion all-PM Ytterbium-doped fiber laser. The pulsation period oscillates with an increasing amplitude when pump power grows larger until a stationary dissipative soliton is formed.

Authors: Katarzyna Krupa, Institute of Physical Chemistry Polish Academy of Sciences / Tomasz Kardas, Fluence sp. z o.o. / Yuriy Stepanenko, Institute of Physical Chemistry Polish Academy of Sciences

JTh3A.24

Nano-Engineered Spatial-Light Modulators From Electro-Optic Nano-Molecules (/home/eposters/poster/?id=3522102)

Presenter: Ileana-Cristina Benea-Chelmus , *Harvard University*

We explore transduction between the radio-frequency and near-infrared domain in metasurfaces that are cross-functionalized with state-of-the-art organic nano-molecules to demonstrate multi-pixel spatial light modulators. We custom-tailor their optical, radio-frequency and electro-optic response.

Authors: Ileana-Cristina Benea-Chelmus, Harvard University / Maryna Meretska, Harvard University / Delwin Elder, University of Washington / Michele Tamagnone, Harvard University / Larry Dalton, University of Washington / Federico Capasso, Harvard University

JTh3A.25

Polarization Dependence of Laser Induced Inner-Shell Excitations (/home/eposters/poster/?id=3522229)

Presenter: Gilad Marcus , *The Hebrew University, Jerusalem*

Laser induced x-ray fluorescence were observed against laser polarization ellipticity. While emission from krypton peaks at linear polarization, a signature of recollision, emission from neon shows opposite trend. We attribute it to two competing processes.

Authors: Gilad Marcus, The Hebrew University, Jerusalem / Yunpei Deng, PSI / Zhinan Zeng, SIOM / Yinghui Zheng, SIOM / Wolfram Helml, Technische Universität Dortmund / Pavel Komm, The Hebrew University, Jerusalem / Xinhua Xie, PSI / Zoltan Filus, ELI-Alps / Mathieu Dumergue, ELI-Alps / Subhendu Subhendu, ELI-Alps / Roland Flender, ELI-Alps / Balint Kiss, ELI-Alps / Ruxin Li, SIOM

JTh3A.26

High-Purity Free-Electron Momentum States Prepared by Three-Dimensional Optical Phase Modulation (/home/eposters/poster/?id=3522311)

Presenter: Armin Feist , *University of Göttingen*

We demonstrate a laser-based and femtosecond-switchable inelastic electron beam splitter. Coherent optical phase modulation of 200-keV electrons at a thin electron-transparent membrane prepares a high-purity three-dimensional momentum superposition state, characterized in energy and momentum space.

Authors: Armin Feist, University of Göttingen / Sergey Yalunin, University of Göttingen / Sascha Schäfer, University of Oldenburg / Claus Ropers, University of Göttingen

JTh3A.27

Tunable Magneto-Optics in Hyperbolic Nanoparticles (/home/eposters/poster/?id=3522332)

Presenter: Nicolò Maccaferri , *University of Luxembourg*

We study magnetic circular dichroism of type II hyperbolic nanoparticles. Experiments and numerical simulations reveal a broadband response that is analytically described via coupling of electric and magnetic dipole modes with a static magnetic field.

Authors: Joel Kuttruff, University of Luxembourg / Alessio Gabbani, Università di Pisa / Gaia Petrucci, Università di Pisa / Yingqi Zhao, Istituto Italiano di Tecnologia / Marzia Iarossi, Istituto Italiano di Tecnologia / Esteban Pedrueza Villalmanzo, University of Gothenburg / Antonietta Parracino, CNR-Istituto di Struttura della Materia / Giuseppe Strangi, Case Western Reserve University / Alexandre Dmitriev, University of Gothenburg / Daniele Brida, University of Luxembourg / Francesco De Angelis, Istituto Italiano di Tecnologia / Francesco Pineider, Università di Pisa / Nicolò Maccaferri, University of Luxembourg

JTh3A.29

Strong Coupling Between ADT Molecules and a 2D Nanohole Ag-Grating. (/home/eposters/poster/?id=3523015)

Presenter: Ekembu Tanyi , *Oregon State University*

We demonstrate strong coupling between ADT molecules and surface plasmon polaritons supported by a 2D-nanohole Ag-gratings; observed splitting in the dispersion curve at specific k-vectors, corresponded to multiples of the grating's lattice vectors.

Authors: Ekembu Tanyi, Oregon State University / Greg Giesbers, Oregon State University / Jonathan Van Schenck, Oregon State University / Richard Puro, Oregon State University / Oksana Ostroverkhova, Oregon State University / Larry Cheng, Oregon State University

JTh3A.30

Gas Dynamics Effect on Laser Filamentation THz Sources at High Repetition Rates (/home/eposters/poster/?id=3523190)

Presenter: Christina Lanara , *IESL, FORTH*

We report on the impact of laser pulse repetition rate on two-color filamentation based terahertz sources. A 50% decrease on the terahertz energy is observed when the repetition rate increases from 0.6 to 6 kHz.

Authors: Christina Lanara, IESL, FORTH / Anastasios Koulouklidis, IESL, FORTH / Christina Daskalaki, IESL, FORTH / Vladimir Fedorov, P.N. Lebedev Physical Institute of the Russian Academy of Sciences / Stelios Tzortzakis, IESL, FORTH

JTh3A.31

Perfect Soliton Crystal in an AlN Microresonator (/home/eposters/poster/?id=3523308)

Presenter: Haizhong Weng , *Trinity College Dublin*

Near octave-spanning perfect soliton crystal (1150-2100 nm) is successfully demonstrated in an AlN microring resonator, at an on-chip power of 250 mW. A measured 60-fs ultra-short pulse confirms the high coherence of the soliton crystal.

Authors:Haizhong Weng, Trinity College Dublin / Jia liu, Huazhong University of Science and Technology / Adnan Ali Afridi, Trinity College Dublin / Jing Li, Trinity College Dublin / Jiangnan Dai, Huazhong University of Science and Technology / Yi Zhang, Huazhong University of Science and Technology / Qiaoyin Lu, Huazhong University of Science and Technology / John Donegan, Trinity College Dublin / weihua guo, Huazhong University of Science and Technology

JTh3A.32

Smith-Purcell Metasurface Lens (/home/eposters/poster/?id=3524777)

Presenter: Dolev Roitman , *Tel Aviv University*

We demonstrate focused emission of visible and near-infrared Smith-Purcell radiation by a free-electron-driven metasurface lens emitter. Our findings pave the way for free-electron light sources focusing at wavelengths lacking efficient optics.

Authors:Aviv Karnieli, Tel Aviv University / Dolev Roitman, Tel Aviv University / Matthias Liebtrau, AMOLF / Shai Tesses, Technion / Nika van Nielen, AMOLF / Albert Polman, AMOLF / Ido Kaminer, Technion / Ady Arie, Tel Aviv University

JTh3A.33

Dyakonov Surface Waves in Twisted Confined Media (/home/eposters/poster/?id=3524922)

Presenter: Dmitry Chermoshentsev , *Skolkovo Institute of Science and Technology*

We theoretically predict the existence of Dyakonov-like surface waveguide modes in the planar interfacial waveguide between two uniaxial dielectrics and Dyakonov surface cavity modes in the interface of two anisotropic dielectrics with rectangular cross-sections.

Authors:Dmitry Chermoshentsev, Skolkovo Institute of Science and Technology / Evgenii Anikin, Skolkovo Institute of Science and Technology / Sergey Dyakov, Skolkovo Institute of Science and Technology / Nikolay Gippius, Skolkovo Institute of Science and Technology

JTh3A.35

Seeded Multimode Quasi-Phase-Matching in All-Optically Poled Silicon Nitride Waveguides (/home/eposters/poster/?id=3531787)

Presenter: Ozan Yakar , *EPFL*

We demonstrate seeding-enabled all-optical poling of silicon nitride waveguides as short as 5 mm, and account for quasi-phase-matching (QPM) inside the waveguide between the fundamental mode of pump and higher order second-harmonic modes.

Authors:Ozan Yakar, EPFL / Edgars Nitiss, EPFL / Camille-Sophie Brès, EPFL

JTh3A.37

High-Power CW Optical Parametric Oscillator Design for gap-Free Wavelength Tuning Across the Visible (/home/eposters/poster/?id=3525243)

Presenter: Korbinian Hens , *Hübner GmbH & Co. KG - HÜBNER Photonics*

A tunable laser light source based on continuous-wave optical parametric oscillator technology is demonstrated to achieve output powers at the Watt-level while providing a tuning range of more than 260 nm across the visible spectrum.

Authors:Korbinian Hens, Hübner GmbH & Co. KG - HÜBNER Photonics / Jaroslaw Sperling, Hübner Photonics GmbH / Maik Schubert, Hübner GmbH & Co. KG - HÜBNER Photonics / Jens Kiessling, Fraunhofer Institute for Physical Measurement Techniques IPM

JTh3A.38

Experimental Investigation of Tunable Acousto-Optic Frequency Combs (/home/eposters/poster/?id=3525848)

Presenter: Andrey Voloshin , *Russian Quantum Center*

We demonstrate a novel approach for the generation of optical combs in frequency shifting loop based on acousto-optic interaction. This approach provides comb multiplication with different line spacing and generation of dual-comb for spectroscopy applications.

Authors:Andrey Voloshin, Russian Quantum Center / Sergey Mantsevich, M.V. Lomonosov Moscow State University

JTh3A.40

Transmission Switching of Coupled Whispering Gallery Mode Resonators on Flexible Substrates (/home/eposters/poster/?id=3521082)

Presenter: Simon Woska , *KIT, Institute of Applied Physics*

Pairs of optical Whispering Gallery Mode resonators were structured onto flexible elastomer substrates. Exploiting the substrates temperature-induced contraction, tunable coupling of the two cavities was realized and variable transmission was demonstrated via 2-fiber transmission spectroscopy.

Authors:Simon Woska, KIT, Institute of Applied Physics / Pascal Rietz, KIT, Institute of Applied Physics / Osman Karayel, KIT, Institute of Applied Physics / Heinz Kalt, KIT, Institute of Applied Physics

JTh3A.41

High Responsivity MoSe₂ Photodetector Integrated in Si₃N₄ Waveguide for Quantum Application (/home/eposters/poster/?id=3525272)

Presenter: rivka gherabli , *Hebrew University Jerusalem*

We demonstrate experimentally an integrated photoconductor for visible frequencies based on MoSe₂. We report a peak responsivity of ~30A/W for a wavelength of 780nm, which is ideal for on-chip integration with Rubidium atomic vapor.

Authors: rivka gherabli, Hebrew University Jerusalem / SITA RAMA KRISHNA INDUKURI, Hebrew University Jerusalem / Roy Zektzer, Hebrew University Jerusalem / Christian Frydendahl, Hebrew University Jerusalem / Noa Mazurski, Hebrew University Jerusalem / Uriel Levy, Hebrew University Jerusalem

JTh3A.42

Sensing Magnetic Field With Light and Nanomechanics (/home/eposters/poster/?id=3521467)

Presenter: Eric Plum , *University of Southampton*

We demonstrate an optical magnetic field sensor based on a metamaterial-microcavity. Actuation of the microcavity by the magnetic Lorentz force controls its reflectivity. Such sensors promise microscale spatial, millisecond temporal and microtesla magnetic field resolution.

Authors: Guoqiang Lan, University of Southampton / Jun-Yu Ou, University of Southampton / Eric Plum, University of Southampton

JTh3A.43

Ultra-Sensitive, Real-Time Detection of HCl Using a Transportable NICE-OHMS System (/home/eposters/poster/?id=3523040)

Presenter: Nicola Black , *National Physical Laboratory*

We report the development of a portable NICE-OHMS device with the aim of ultra-sensitive (<1 nmol/mol), real-time (<1 min) detection of HCl and monitoring of water vapor for applications in microelectronic fabrication cleanrooms.

Authors: Nicola Black, National Physical Laboratory / E. Anne Curtis, National Physical Laboratory / Gregory Walsh, National Physical Laboratory / Chris Lucas, National Physical Laboratory / Geoffrey Barwood, National Physical Laboratory

JTh3A.44

on-Chip Interferometric Random Spectrometer (IRS) (/home/eposters/poster/?id=3524799)

Presenter: Eitan Edrei , *Hebrew University of Jerusalem*

We introduce an on-chip device combining a random spectrometer with an interferometric scheme to enable higher spectral resolution measurements by more than one order of magnitude as compared to similar platforms

Authors:Eitan Edrei, Hebrew University of Jerusalem / Elam Gerstel, Hebrew University of Jerusalem / Shani Gamzu Letova, Hebrew University of Jerusalem / Uriel Levy, Hebrew University of Jerusalem

JTh3A.45

Hollow-Core Fiber Particle Tracking for Nanoparticle Size Distribution and Mixture Analysis (/home/eposters/poster/?id=3525014)

Presenter: Mona Nissen , *Leibniz Institute of Photonic Technology*

High-resolution sizing of nanoparticle ensembles is presented by employing a single antiresonant element fiber as optofluidic platform for nano-object tracking. Key are long trajectories enabled by quasi-single-mode light guidance, low image background and fluidic confinement.

Authors:Mona Nissen, Leibniz Institute of Photonic Technology / Ronny Förster, Leibniz Institute of Photonic Technology / Adrian Lorenz, Leibniz Institute of Photonic Technology / Markus Schmidt, Leibniz Institute of Photonic Technology

JTh3A.46

Mode-Locked Ho³⁺-Doped Fiber Laser With a Dumbbell-Shaped Cavity (/home/eposters/poster/?id=3525654)

Presenter: Serafima Filatova , *Prokhorov General Physics Institute RAS*

We demonstrate a mode-locked holmium-doped fiber laser with a dumbbell-shaped cavity. Unlike the ring or linear schemes, the dumbbell-shaped design is simple and doesn't contain expensive, and subject to radiation damage optical components.

Authors:Serafima Filatova, Prokhorov General Physics Institute RAS / Vladimir Kamynin, Prokhorov General Physics Institute RAS / Yuriy Gladush, Skolkovo Institute of Science and Technology Center for Photonics and Quantum Materials / Eldar Khabushev, Skolkovo Institute of Science and Technology Center for Photonics and Quantum Materials / Dmitry Krasnikov, Skolkovo Institute of Science and Technology Center for Photonics and Quantum Materials / Albert Nasibulin, Skolkovo Institute of Science and Technology Center for Photonics and Quantum Materials / Vladimir Tsvetkov, Prokhorov General Physics Institute RAS

JTh3A.47

Quantitative Analysis by Nanoelectromechanical Photothermal Infrared Spectroscopy With Picogram Sensitivity (/home/eposters/poster/?id=3527304)

Presenter: Niklas Luhmann , *ISAS - TU Wien*

We demonstrate an advanced approach for quantitative spectral analysis of volatile chemical compounds with nanoelectromechanical infrared spectroscopy. We present high resolution infrared spectra of caffeine with a sensitivity of 7 pg obtained with SiN trampoline resonators.

Authors: Niklas Luhmann, ISAS - TU Wien / Raphael Pliessnig, ISAS - TU Wien / Josiane P. Lafleur, Invisible Light Labs / Silvan Schmid, ISAS - TU Wien

JTh3A.48

Binary Phase Pupil Mask and Principal Component Analysis Image Fusion Tailored for Extended Depth-of-Field Imaging (/home/eposters/poster/?id=3518474)

Presenter: Roy Avrahamy , *Ben-Gurion University of the Negev*

Extended depth-of-field of white light illumination imaging is theoretically and experimentally demonstrated. Pupil phase mask tailoring focal chromatic dispersion is hybridized with principal component analysis fusing individual RGB images to a sharp grayscale image over extended depth-of-field.

Authors: Benny Milgrom, The Jerusalem College of Technology / Roy Avrahamy, Ben-Gurion University of the Negev / Tal David, Ben-Gurion University of the Negev

JTh3A.49

Selective BTEX Measurements Using Deep Neural Networks (/home/eposters/poster/?id=3519166)

Presenter: Mhanna Mhanna , *KAUST*

A laser sensor is developed for selective and simultaneous BTEX measurements. It is based on a DFB-ICL near 3.3 μm and deep neural networks (DNNs) to differentiate broad absorbance spectra of BTEX species.

Authors: Mhanna Mhanna, KAUST / Mohamed Sy, KAUST / Aamir Farooq, KAUST

JTh3A.50

Fabrication of Polymeric Grating Layers and Their Integration Into Optoelectronic Devices Using dip-pen Nanolithography (/home/eposters/poster/?id=3519432)

Presenter: Moshe Zohar , *Shamoon College of Engineering*

Two-dimensional optical nanostructures grating based on polymers were fabricated using dip-pen nanolithography. We investigated the influence of both the ink composition and dwell-time. Prototypes of phase masks were manufactured, and their main characteristics were analyzed.

Authors: Moshe Zohar, Shamoon College of Engineering / Roy Avrahamy, Ben-Gurion University of the Negev / Benny Milgrom, Jerusalem College of Technology / Zeev Fradkin, Shamoon College of Engineering / Mark Auslender, Ben-Gurion University of the Negev

JTh3A.51

**Multimodal Microscopy Methods for Growth Cartilage
(/home/eposters/poster/?id=3524939)**

Presenter: Fredrik Mürer , *Norwegian University of Science and Technology*

Unstained microscopy of growth cartilage microstructure is crucial for understanding bone formation and related diseases. Here, we compare imaging modalities with unconventional contrast mechanisms applied to the epiphyseal bone-cartilage interface and highlight their comparative merits.

Authors: Fredrik Mürer, Norwegian University of Science and Technology / Kim R. B. Tekseth, Norwegian University of Science and Technology / Mojde Hasanzade, University of South-Eastern Norway / Knut O. B. Schnell, Norwegian University of Science and Technology / Muhammad Nadeem Akram, University of South-Eastern Norway / Magnus B. Lilledahl, Norwegian University of Science and Technology / Kristin Olstad, Norwegian University of Life Sciences / Basab Chattopadhyay, Norwegian University of Science and Technology / Dag Werner Breiby, Norwegian University of Science and Technology

JTh3A.52

**Compact High Power OPCPA System for 2-Photon and 3-Photon in-Vivo
Brain Imaging (/home/eposters/poster/?id=3525200)**

Presenter: Michael Schulz , *Class 5 Photonics GmbH*

A compact high power OPCPA system with ultrashort pulses at wavelengths ranging from 850 to 1700 nm with single or multiple output channels is presented for 2- and 3-photon in-vivo brain imaging.

Authors: Michael Schulz, Class 5 Photonics GmbH / Torsten Golz, Class 5 Photonics GmbH / Ivanka Grguras, Class 5 Photonics GmbH / Thomas Braatz, Class 5 Photonics GmbH / Ekaterina Zapolnova, Class 5 Photonics GmbH / Jan Buss, Class 5 Photonics GmbH / Robert Riedel, Class 5 Photonics GmbH

JTh3A.53

**Ultrafast Cellular Automata Dynamics of Phase-Change Optical Response
(/home/eposters/poster/?id=3519699)**

Presenter: Kevin MacDonald , *University of Southampton*

We introduce a cellular automata methodology for studying photonics of light-induced phase transitions. Multiphysical complexity over disparate length/timescales is reduced to a simple, heuristic rule/parameter set in a model successfully describing several independent experimental datasets.

Authors: Liwei Zhang, University of Southampton / Kevin MacDonald, University of Southampton / Nikolay Zheludev, University of Southampton

JTh3A.54

**Photon-Pair Generation in Silica Microbubblersonators
(/home/eposters/poster/?id=3521801)**

Presenter: Ross Challinor , *University of Bath*

We present progress towards silica microbubble whispering gallery moderesonators as viable sources of high-quality, narrow-band single photon pairs at widely-separated wavelengths through spontaneous four-wave mixing.

Authors:Ross Challinor, University of Bath / Peter Mosley, University of Bath

JTh3A.55

**Towards Satellite-Suited Noise-Free Quantum Memories
(/home/eposters/poster/?id=3522051)**

Presenter: Luisa Esguerra Rodríguez , *German Aerospace Center*

Quantum memories on satellites will allow to circumvent transmission losses in long-distance quantum communication. We demonstrate a warm Caesium vapour memory based on EIT with an unconditional noise floor of 1.2×10^{-3} due to collision-induced fluorescence.

Authors:Luisa Esguerra Rodríguez, German Aerospace Center / Leon Meßner, German Aerospace Center / Elizabeth Robertson, German Aerospace Center / Mustafa Gündoğan, HU Berlin / Janik Wolters, German Aerospace Center

JTh3A.56

Ultrafast Charge Transfer and π -Plasmon Dynamics in Single-Walled Carbon Nanotubes (/home/eposters/poster/?id=3522918)

Presenter: Arvind Singh , *IIT Delhi Depart. of Physics DL 110 016*

Excited-state charge transfer, excitons, and π -plasmons dynamics in bi-chiral SWNTs sample has been studied. Only, the π -plasmon dynamics is affected by the sample temperature, while, all the dynamical processes remain photocarrier density-independent.

Authors:Arvind Singh, IIT Delhi Depart. of Physics DL 110 016 / Sunil Kumar, IIT Delhi Depart. of Physics DL 110 016

JTh3A.57

Layer Degree of Freedom for Ultrafast Exciton Dynamics in Transition Metal Dichalcogenides (/home/eposters/poster/?id=3524943)

Presenter: SANTU BERA , *IISER BHOPAL*

We demonstrate layer-engineered crossover of relaxation pathways from fast exciton-exciton annihilation in monolayer to slow phonon bottleneck in few-layer MoS₂. Our study reveals new, layer degree of freedom to tune ultrafast dynamics in optoelectronic applications.

Authors:SANTU BERA, IISER BHOPAL / Megha Shrivastava, IISER BHOPAL / Hanyu Zhang, National Renewable Energy Laboratory, Golden, Colorado 80401, USA / E. Miller, National Renewable Energy Laboratory, Golden, Colorado 80401, USA / Matthew Beard, National Renewable Energy Laboratory, Golden, Colorado 80401, USA / K. V. Adarsh, IISER BHOPAL

JTh3A.58

Optical Switching of Ultrafast Nonlinear Response in Few Layer ReS₂ **(/home/eposters/poster/?id=3525594)**

Presenter: Dipendranath Mandal , *IISER Bhopal*

Here we report switching of nonlinear absorption in few layer ReS₂ using single-color ultrafast pump-probe nonlinear spectroscopy. The remarkable experimental investigation addresses the insight mechanism of pulse-width dependent change from saturable to excited state absorption.

Authors:Dipendranath Mandal, IISER Bhopal / Megha Shrivastava, IISER Bhopal / Ravi Singh, IISER Bhopal / K. V. Adarsh, IISER Bhopal

JTh3A.59

Detection Techniques for Orbital Angular Momentum States **(/home/eposters/poster/?id=3522127)**

Presenter: Alessia Suprano , *Università la sapienza*

We experimentally demonstrate a machine-learning-based protocol to characterize orbital angular momentum states. Moreover, a more accurate formalization of the state engineering process allows increasing both its performance and that of a quantum state discrimination process.

Authors:Alessia Suprano, Università la sapienza / Taira Giordani, Università la sapienza / Emanuele Polino, Università la sapienza / Danilo Zia, Università la sapienza / Luca Innocenti, Queen's Univerity / Alessandro Ferraro, Queen's Univerity / Mauro Paternostro, Queen's Univerity / Nicolò Spagnolo, Università la sapienza / Fabio Sciarrino, Università la sapienza

JTh3A.60

Witnesses of Coherence and Dimension From Multiphoton **Indistinguishability Tests (/home/eposters/poster/?id=3523687)**

Presenter: Chiara Esposito , *Università degli studi di Roma Sapienza*

We experimentally demonstrate the validity of witness tests on suitable interferometers designed for the purpose. Our findings confirm the effectiveness of this novel family of witness tests for capturing the quantum properties of high-dimensional systems.

Authors:Taira Giordani, Università degli studi di Roma Sapienza / Chiara Esposito, Università degli studi di Roma Sapienza / Francesco Hoch, Università degli studi di Roma Sapienza / Nicolò Spagnolo, Università degli studi di Roma Sapienza / Fabio Sciarrino, Università degli studi di Roma Sapienza / Daniel Brod, Instituto de Física, Universidade Federal Fluminense / Ernesto Galvao, International Iberian Nanotechnology Laboratory (INL)

JTh3A.61

Global Quantum Communication With Untrusted Space-Based Networks (/home/eposters/poster/?id=3525287)

Presenter: Mustafa Gundogan , *Humboldt-Universität zu Berlin*

Most efforts in space-based global quantum communications focus on trusted networks. Here we analyse use of space-borne quantum memories and show that it provides much faster entanglement distribution rates than the existing hybrid architectures.

Authors:Mustafa Gundogan, Humboldt-Universität zu Berlin / Jasinder Sidhu, University of Strathclyde / Victoria Henderson, Humboldt-Universität zu Berlin / Luca Mazzarella, University of Strathclyde / Janik Wolters, Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) / Daniel Oi, University of Strathclyde / Markus Krutzik, Humboldt-Universität zu Berlin

JTh3A.62

Walking Solitons in Corrugated Waveguide (/home/eposters/poster/?id=3516926)

Presenter: Daria Dolinina , *ITMO University*

We study the dynamics of one-dimensional periodically modulated optical cavity driven by external coherent pump and demonstrate that because of the spontaneous symmetry breaking bifurcation in the system the walking solitons can appear.

Authors:Daria Dolinina, ITMO University / Alexey Yulin, ITMO University

JTh3A.64

Nonlinear Optics Selection Rules by Dynamical Symmetries in Synthetic Dimensions (/home/eposters/poster/?id=3518164)

Presenter: Matan Even Tzur , *Technion - Israel Institute of Technology*

We present synthetic dynamical symmetries (SDS), composed of spatial, temporal, and parameter space operations. SDSs result in a new type of selection rules in high harmonic generation (HHG) and above threshold ionization (ATI).

Authors:Matan Even Tzur, Technion – Israel Institute of Technology / Ofer Neufeld, Technion – Israel Institute of Technology / Avner Fleischer, Tel Aviv University / Oren Cohen, Technion – Israel Institute of Technology

JTh3A.65

Bound-to-Continuum Non-Perturbative Regime for an Ultrastong Light-Matter Coupling (</home/eposters/poster/?id=3518209>)

Presenter: Shima Rajabali , *ETH Zurich*

In this work, we theoretically and experimentally show that the confinement of an electromagnetic field below critical length-scales can excite high momentum matter resonances and can ultimately limit the light-matter coupling enhancement in an ultrastrong coupling regime.

Authors:Shima Rajabali, ETH Zurich / Erika Cortese, University of Southampton / Mattias Beck, ETH Zurich / Simone De Liberato, University of Southampton / Jérôme Faist, ETH Zurich / Giacomo Scalari, ETH Zurich

JTh3A.66

Fabrication of Silver Coral-Like AFM Probes for Tip-Enhanced Raman Spectroscopy by ICP-Based Approach (</home/eposters/poster/?id=3521251>)

Presenter: Angela Capaccio , *University of Naples "Federico II"*

We describe a novel approach for the fabrication of plasmonic probes designed for Tip Enhanced Raman Spectroscopy (TERS) applications, based on the nano-structuration of Ag-coated commercial AFM probes *via* Inductively Coupled Plasma (ICP) discharge. © 2020 Optical Society of America

Authors:Angela Capaccio, University of Naples "Federico II" / Giulia Rusciano, University of Naples "Federico II" / Antonio Sasso, University of Naples "Federico II"

JTh3A.67

Ultrasoft Cavities With Giant Brownian Fluctuations (</home/eposters/poster/?id=3522856>)

Presenter: Mark Douvidzon , *Technion – Israel Institute of Technolog*

Applying surfactants on submerged oil droplets permits resonators 10 orders of magnitude softer than what solids permit, with accordingly larger Brownian fluctuations. We measure a 150,000 quality factor, 6nm Brownian-fluctuation amplitude, and 155 Hz eigenfrequency.

Authors: Mark Douvidzon, Technion – Israel Institute of Technology / Udvas Chattopadhyay, Nanyang Technological University / Yidong Chong, Nanyang Technological University / Tal Carmon, Tel Aviv University

JTh3A.68

Extreme Raman Red-Shift in Nitrogen-Filled Capillary Fibers (/home/e posters/poster/?id=3525152)

Presenter: Riccardo Piccoli, *Institut National de la Recherche Scientifique*

By exploiting stimulated Raman scattering in long nitrogen-filled capillary fibers, we demonstrate continuous tunability of Yb laser systems over the 1.0-1.7 μm range, with conversion efficiency up to 82%, and an up to 10-fold pulse compression.

Authors: Riccardo Piccoli, Institut National de la Recherche Scientifique / Paolo Carpeggiani, TU Wien / Young-Gyun Jeong, Institut National de la Recherche Scientifique / Andrea Rovere, Institut National de la Recherche Scientifique / Roberto Morandotti, Institut National de la Recherche Scientifique / Giulio Coccia, TU Wien / Guangyu Fan, Institut National de la Recherche Scientifique / Edgar Kaksis, TU Wien / Audrius Pugzlys, TU Wien / Andrius Baltuska, TU Wien / Bruno Schmidt, few-cycle Inc. / Alexander Voronin, M. V. Lomonosov Moscow State University / Aleksei Zheltikov, M. V. Lomonosov Moscow State University / Luca Razzari, Institut National de la Recherche Scientifique

JTh3A.69

Bistability in Photonic Topological Insulators With Kerr Nonlinearity (/home/e posters/poster/?id=3525571)

Presenter: Ghada Alharbi, *Cardiff University*

We propose a dynamic model for photonic topological insulators (PTIs) with Kerr nonlinearity. Using the model, we demonstrate the bistability and spontaneous symmetry breaking in the Su-Schrieffer-Heeger model and two-dimensional nonlinear PTIs.

Authors: Ghada Alharbi, Cardiff University / Yongkang Gong, Cardiff University / Stephan Wong, Cardiff University / Sang Soon Oh, Cardiff University

JTh3A.70

Third Harmonic Generation From Thin Gradient Ternary Mixture Layers (/home/e posters/poster/?id=3525718)

Presenter: David Zuber, *Leibniz Universität Hannover*

By analyzing the third harmonic generation from gradient layers of the amorphous dielectric ternary mixture material $\text{Hf}_x\text{Al}_y\text{O}_z$ we are able to derive the third order nonlinear susceptibility of the material.

Authors: David Zuber, Leibniz Universität Hannover / Sven Kleinert, Leibniz Universität Hannover / Ayhan Tajalli, Deutsches Elektronen-Synchrotron DESY / Morten Steinecke, Laser Zentrum Hannover e.V / Marco Jupé, Laser Zentrum Hannover e.V / Lars Jensen, Laser Zentrum Hannover e.V / Detlev Ristau, Laser Zentrum Hannover e.V / Uwe Morgner, Leibniz Universität Hannover

JTh3A.71

Femtosecond Time-Resolved Infrared-Resonant Third-Order Sum-Frequency Spectroscopy Towards Label-Free Imaging (/home/eposters/poster/?id=3530683)

Presenter: Jizhou Wang, *Texas A&M University*

We experimentally demonstrate a time-resolved infrared-resonant third-order sum-frequency spectroscopy. This technique provides a new way to measure the dynamics of the infrared active vibrational states. It can be combined with microscopes for label-free imaging.

Authors: Jizhou Wang, Texas A&M University / Kai Wang, Texas A&M University / Yujie Shen, Texas A&M University / Zehua Han, Texas A&M University / Fu Li, Texas A&M University / Zhe He, California Institute of Technology / Dawei Wang, Zhejiang University / Alexei Sokolov, Texas A&M University / Marlan Scully, Texas A&M University

JTh3A.72

An Alignment Procedure for Off-Axis Parabola Telescopes for High-Intensity Beam Transport (/home/eposters/poster/?id=3525284)

Presenter: Jonas Ohland, *GSI-Darmstadt*

Post-compressor beam transport becomes a challenge in Chirped Pulse Amplification lasers if a surface shall be imaged. We developed an easy and repeatable alignment procedure for off-axis parabola telescopes to fit these needs.

Authors: Jonas Ohland, GSI-Darmstadt / Udo Eisenbarth, GSI-Darmstadt / Yannik Zobus, GSI-Darmstadt / Bernhard Zielbauer, GSI-Darmstadt / Vincent Bagnoud, GSI-Darmstadt

JTh3A.73

Wavelength Dependence of the low-NA Femtosecond Pulse Propagation in Bulk Silicon (/home/eposters/poster/?id=3532000)

Presenter: Roland Richter, *Norwegian Univ of Science and Technology*

We report the numerical investigations of ultrashort pulses between 1550–2350 nm propagating through silicon for an NA of 0.25. For an energy range of 1–1000 nJ it was not possible to cross the modification threshold.

Authors: Roland Richter, Norwegian Univ of Science and Technology / Vladimir Kalashnikov, Dipartimento di Ingegneria dell'Informazione / Irina Sorokina, Norwegian Univ of Science and Technology

JTh3A.74

Tailoring Optical Properties of Conductive/Dielectric Layers and Their Periodic Stacks Using DoE Method (</home/eposters/poster/?id=3520092>)

Presenter: Robert Mroczynski, *Warsaw University of Technology*

This study presents results of the optimization of optical properties of TiN and TiO_x thin films by employing Taguchi orthogonal tables approach to tune the thickness, refractive index, and transmittance level in the UV-Vis range.

Authors: Robert Mroczynski, Warsaw University of Technology

JTh3A.75

Photonic Transformers (</home/eposters/poster/?id=3522891>)

Presenter: Mark Douvidzon, *Technion – Israel Institute of Technology*

We report on transformable micro-photonic devices that change their functionality while operating. Assisted by holographic-tweezers, we gradually deform the shape of a droplet whispering-gallery cavity and split a resonant mode to a 10-GHz separated doublet.

Authors: Mark Douvidzon, Technion – Israel Institute of Technology / Shai Maayani, Technion – Israel Institute of Technology / Harel Nagar, Tel Aviv University / Tamir Admon, Tel Aviv University / Vladimir Shuvayev, Queens College of CUNY / Lan Yang, Washington University in St Louis / Lev Deych, Queens College of CUNY / Yael Roichman, Tel Aviv University / Tal Carmon, Tel Aviv University

JTh3A.76

Tailored Morphology and Optical Studies of Nanostructured InP via Facile Electroless Etching (</home/eposters/poster/?id=3523197>)

Presenter: Adel Najjar, *Department of Physics, United Arab Emirates University, Al Ain United Arab Emirates*

The fabrication of InP porous and nanowires structures were optimized using metal assisted chemical etching method. Photoluminescence measurements shows a red-shift peak compared to the as-grown sample associated with the relaxation of compressive strain.

Authors: Abdul Kareem K. Soopy, Department of Physics, United Arab Emirates University, Al Ain United Arab Emirates / Florent Ravau, Department of Physics, Khalifa University, Abu Dhabi, United Arab Emirates / Dalvaver Anjum, Department of Physics, Khalifa University, Abu Dhabi, United Arab Emirates / Adel Najar, Department of Physics, United Arab Emirates University, Al Ain United Arab Emirates

JTh3A.77

High Q-Factor Microring Resonator Using Local Oxidation of Silicon (LOCOS) and Adiabatic Geometry (</home/eposters/poster/?id=3524869>)

Presenter: Jinan Nijem , *Hebrew University*

A single mode adiabatic microring resonator fabricated using local oxidation of silicon technique (LOCOS) is proposed and demonstrated. An ultrahigh loaded Q-factor of ~1 Million with a free spectral range of 2nm is achieved.

Authors: Jinan Nijem, Hebrew University / Alex Naiman, Hebrew University / Roy Zektzer, Hebrew University / Christian Frydendahl, Hebrew University / Noa Mazurski, Hebrew University / Uriel Levy, Hebrew University

JTh3A.78

Comb Formation in Ultrathin Terahertz Quantum Cascade Ring Lasers (</home/eposters/poster/?id=3531279>)

Presenter: Michael Jaidl , *TU Wien*

We present comb formation in ring-shaped THz quantum cascade lasers. Devices are spontaneously operating in a harmonic state transiting to a dense comb regime exhibiting over 30 equidistant modes covering a bandwidth of 622 GHz.

Authors: Michael Jaidl, TU Wien / Nikola Opačak, TU Wien / Martin Kainz, TU Wien / Sebastian Schönhuber, TU Wien / Dominik Theiner, TU Wien / Benedikt Limbacher, TU Wien / Maximilian Beiser, TU Wien / Miriam Giparakis, TU Wien / Aaron Andrews, TU Wien / Gottfried Strasser, TU Wien / Juraj Darmo, TU Wien / Karl Unterrainer, TU Wien

JTh3A.79

Ultra-Compact 266-289 nm Pair Source for DIAL LIDAR Based on Hollow-Core Photonic Crystal Fiber (</home/eposters/poster/?id=3509917>)

Presenter: Matthieu Chafer , *Glophotonics*

We propose an ultra-compact double wavelength source 266-289 nm developed for DIAL LIDAR of Ozone in the troposphere thanks to a hollow-core photonic crystal fiber filled in with Deuterium.

Authors:Matthieu Chafer, GPPMM / Jonas Henrique Osorio, GPPMM, Xlim, CNRS UMR 7252, Limoges Univ / Ali Dhaybi, GPPMM, Xlim, CNRS UMR 7252, Limoges Univ / Francois Ravetta, LATMOS/IPSL, Sorbonne university / Foued Amrani, GPPMM, Xlim, CNRS UMR 7252, Limoges Univ / Benoit Debord, GPPMM, Xlim, CNRS UMR 7252, Limoges Univ / Cristelle Cailteau-Fischbach, LATMOS/IPSL, Sorbonne university / Frédéric Gérôme, GPPMM, Xlim, CNRS UMR 7252, Limoges Univ / Gérard Ancellet, LATMOS/IPSL, Sorbonne university / Fetah Benabid, GPPMM, Xlim, CNRS UMR 7252, Limoges Univ

JTh3A.80

InP Phased Array for Beam Transforming Applications (/home/e posters/poster/?id=3523043)

Presenter: Georgios Patsamanis , *Centre for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki (AUTH)*

We demonstrate an integrated InP-based phased array relying on a 1×5 splitting structure for beam transformation in WFEs. The electromagnetically calculated beam in the far-field at 1550nm presents perfect agreement with the one experimentally measured.

Authors:Georgios Patsamanis, Centre for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki (AUTH) / Dimitra Ketzaki, Centre for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki (AUTH) / Theoni Alexoudi, Centre for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki (AUTH) / Ioannis Roumpos, Centre for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki (AUTH) / Themistoklis Chrysostomidis, Centre for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki (AUTH) / Angelina Totović, Centre for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki (AUTH) / Dimitrios Chatzitheocharis, Centre for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki (AUTH) / Konstantinos Vyrsokinos, Centre for Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki (AUTH)

JTh3A.81

Simultaneous Wavelength Conversion of Multiple WDM Channels Using Silicon-Rich Nitride Waveguide (/home/e posters/poster/?id=3523074)

Presenter: Mrinmoy Roy , *Osaka University*

We propose an all-optical simultaneous wavelength conversion method using silicon-rich nitride waveguides. A successful wavelength conversion of 8-channel×64-Gb/s QPSK signals from C-band to S-band with a power penalty < 0.3 dB is demonstrated.

Authors:Mrinmoy Roy, Osaka University / Ken Mishina, Osaka University / Akihiro Maruta, Osaka University

JTh3A.82

Elimination of Second-Order Zeeman Shift in Thulium Optical Clock by Simultaneous Interrogation of two Clock Transitions (</home/eposters/poster/?id=3523802>)

Presenter: DMITRY TREGUBOV , *P.N. Lebedev Physical Institute*

We eliminate the largest systematic shift in thulium optical clock — the second-order Zeeman shift — using average frequency of two clock transitions.
This reduces the total systematic shift down to mHz level.

Authors:DMITRY TREGUBOV, P.N. Lebedev Physical Institute / Artem Golovizin, P.N. Lebedev Physical Institute / Elena Fedorova, P.N. Lebedev Physical Institute / Denis Mishin, P.N. Lebedev Physical Institute / Daniil Provorchenko, P.N. Lebedev Physical Institute / Ksenia Khabarova, P.N. Lebedev Physical Institute / Vadim Sorokin, P.N. Lebedev Physical Institute / Nikolai Kolachevsky, P.N. Lebedev Physical Institute

JTh3A.83

Towards Sub-10-fs Pulses at 1 MHz Repetition Rate From an Optical Parametric Amplifier in the Visible Spectral Range (</home/eposters/poster/?id=3525074>)

Presenter: Sven Kleinert , *Leibniz Universität Hannover*

We present a compact optical parametric amplification system operating in the visible spectral range. It delivers pulses with a Fourier-transform-limited pulse duration below 7 fs at 1 MHz repetition rate with an energy larger than 2 μ J.

Authors:Sven Kleinert, Leibniz Universität Hannover / Ayhan Tajalli, Deutsches Elektronen-Synchrotron DESY / David Zuber, Leibniz Universität Hannover / José Andrade, Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy / Uwe Morgner, Leibniz Universität Hannover

JTh3A.84

Modelling Propagation Loss of PECVD Silicon Nitride Strip Waveguides: Evaluation and Assessment of Width Dependency (</home/eposters/poster/?id=3509942>)

Presenter: Anton Buchberger , *ams AG*

Measurements of the width-dependent propagation loss of 250 nm thick silicon nitride strip waveguides at 850 nm wavelength indicate good agreement with the theoretical model. The waveguides were fabricated by plasma-enhanced chemical vapor deposition (PECVD).

Authors:Anton Buchberger, ams AG / Jozef Pulko, ams AG / Deborah Morecroft, ams AG / Omar Basso, ams AG / Jochen Kraft, ams AG / Alexander Bergmann, Graz University of Technology

JTh3A.85

Titanium Dioxide as bio-Sensor for Local Temperature Detection (/home/eposters/poster/?id=3521817)

Presenter: Raffaella Signorini , *University of Padua*

Aim of the present work is the realization of biocompatible optical thermometers. Raman measurements have been performed by exciting commercial anatase powder in the visible range, at defined temperature.

Authors:Raffaella Signorini, University of Padua / Danilo Pedron, University of Padua / Veronica Zani, University of Padua / Roberto pilot, University of Padua

JTh3A.86

Miniaturized Optical Measuring Probe for the Detection of Drop Sizes in Steam Turbines (/home/eposters/poster/?id=3522842)

Presenter: Marcel Prochnau , *Chair for Technology of Optical Systems*

The miniaturization of optical systems enables new applications. The potential of SLE to produce mechanical mounts for miniaturized optical systems will be demonstrated by an optical measuring probe for the determination of drop size distribution.

Authors:Marcel Prochnau, Chair for Technology of Optical Systems / Nicole Grubert, Chair for Technology of Optical Systems / Simon Andres, Institute of Power Plant Technology, Steam and Gas Turbines / Martin Holters, Chair for Technology of Optical Systems / Jochen Stollenwerk, Chair for Technology of Optical Systems / Peter Loosen, Chair for Technology of Optical Systems

JTh3A.87

Quality Control of Ethanol-Based Hand Sanitizer Gels in Micro-Opto-Fluidic Devices (/home/eposters/poster/?id=3523209)

Presenter: Valentina Bello , *University of Pavia*

We present a smart micro-opto-fluidic platform for quality control of ethanol-based hand sanitizer gels. Analyses rely on the study of the near infrared absorption features of fluids flowing in rectangular glass micro-capillaries with integrated reflectors.

Authors:Valentina Bello, University of Pavia / Elisabetta Bodo, University of Pavia / Sabina Merlo, University of Pavia

JTh3A.88

Ultrafast Magnetic Field-Dependent Dynamics in the High-Temperature Superconductor $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ (/home/eposters/poster/?id=3525389)

Presenter: Ashlyn Burch , *University of Alabama at Birmingham*

We performed optical-pump, terahertz-probe measurements on optimally doped $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ under an applied magnetic field. This reveals the strong interplay between magnetic and optical Cooper pair breaking that governs quasiparticle recovery dynamics in superconducting cuprates.

Authors: Ashlyn Burch, University of Alabama at Birmingham / Binod Paudel, Center for Integrated Nanotechnologies / Kyeong Kang, Center for Integrated Nanotechnologies / Min-Cheol Lee, Center for Integrated Nanotechnologies / Aiping Chen, Center for Integrated Nanotechnologies / Jian-Xin Zhu, Center for Integrated Nanotechnologies / Rohit Prasankumar, Center for Integrated Nanotechnologies / David Hilton, Baylor University

JTh3A.89

Ultrafast Currents in two-Dimensional Hexagonal Semiconductors (/home/eposters/poster/?id=3526674)

Presenter: Seyyedeh Azar Oliaei Motlagh , *Georgia State University*

In two dimensional hexagonal semiconductors, we show that an applied ultrafast strong optical pulse results in a finite conduction band population and generates both longitudinal and transverse electric currents during and after the pulse.

Authors: Seyyedeh Azar Oliaei Motlagh, Georgia State University / Vadym Apalkov, Georgia State University / Mark Stockman, Georgia State University

JTh3A.92

Temporal Modulation of Powerful Bichromatic Femtosecond Laser Pulses in Air (/home/eposters/poster/?id=3519484)

Presenter: Danas Buozius , *Laser Research Center Vilnius University*

We investigated third harmonic and terahertz radiation generation in air by bichromatic femtosecond laser pulses. Laser pulses experience a strong phase modulation and pulse splitting in air plasma, which affects third harmonic and terahertz signals

Authors: Danas Buozius, Laser Research Center Vilnius University / Virgilijus Vaicaitis, Laser Research Center Vilnius University / Viktorija Tamuliene, Laser Research Center Vilnius University

JTh3A.95

Controlled Spectral Shape and Enhanced Photoluminescence in Perovskite by Hyperbolic Metamaterial Nanocavity Arrays (/home/eposters/poster/?id=3525027)

Presenter: SITA RAMA KRISHNA INDUKURI , *Hebrew university of Jerusalem.*

We demonstrate experimentally nano-scale hyperbolic metamaterial cavities and use them to tune the spectral shape (e.g. Fano lineshape and spectral splitting) and enhance the photoluminescence from an organic-inorganic perovskite. ~80 fold enhancement is observed.

Authors:SITA RAMA KRISHNA INDUKURI, Hebrew university of Jerusalem. / Amit Kessel, Hebrew university of Jerusalem. / Christian Frydendahl, Hebrew university of Jerusalem. / Eitan Edrei, Hebrew university of Jerusalem. / Saswata Halder, Hebrew university of Jerusalem. / Noa Mazurski, Hebrew university of Jerusalem. / Uriel Levy, Hebrew university of Jerusalem.

JTh3A.96

Giant Anisotropy in sub-Micron Vapor Cells (/home/eposters/poster/?id=3525660)

Presenter: Eliran Talker , *Hebrew University of Jerusalem*

We demonstrate a giant light-induced anisotropy in sub-micron atomic vapor cells at elevated temperatures of ~250°C, showing a 1000-fold increase as compare with lower temperature ~150°C. The nanoscale thickness is crucial for observing this effect.

Authors:Eliran Talker, Hebrew University of Jerusalem / Barash Yefim, Hebrew University of Jerusalem / Noa Mazurski, Hebrew University of Jerusalem / Uriel Levy, Hebrew University of Jerusalem

JTh3A.97

Pulse Energy Enhancement via Filter Shape Optimization in an all-Fiber Mamyshev Oscillator (/home/eposters/poster/?id=3523228)

Presenter: Etienne Poeydebat , *Commissariat a l'Energie Atomique*

We report on the experimental influence of filter shape on the dynamic of an all-fiber Mamyshev oscillator. Significant variation of output pulse energy and various regimes (harmonic mode-locking, multipulses) are observed.

Authors:Etienne Poeydebat, Commissariat a l'Energie Atomique / Florent Scol, Commissariat a l'Energie Atomique / Olivier Vanvincq, PhLAM / Université Lille / Geraud Bouwmans, PhLAM / Université Lille / Emmanuel Hugonnot, Commissariat a l'Energie Atomique

JTh3A.98

Robust and Rapidly Tunable Light Source for SRS/CARS Microscopy With Extremely low-Intensity Noise (/home/eposters/poster/?id=3525731)

Presenter: Harald Giessen , *Universität Stuttgart*

We present a fully automated laser system with low-intensity noise for coherent Raman scattering microscopy, with a pulse duration of 1.2 ps, a spectral range of 1015 to 3695 cm⁻¹, and spectral resolution of <13 cm⁻¹.

Authors:Harald Giessen, Universität Stuttgart

JTh3A.99

Interference During High Harmonic Generation in Solids via Van Hove Singularity Effects (</home/eposters/poster/?id=3522775>)

Presenter: Tsuneto Kanai , *Max Planck Center for Attosecond Science*

We investigate the enhancement of high harmonics and relevant channels via the Van Hove singularity effect. The enhancement is efficient in a multi-photon regime, and the relevant quantum paths lead to interference of these channels.

Authors: Tsuneto Kanai, Max Planck Center for Attosecond Science / Yeon Lee, Max Planck Center for Attosecond Science / Dong Kim, Max Planck Center for Attosecond Science

JTh3A.102

UV Laser-Induced Spatially Selective Deep Oxidation of GaAs (</home/eposters/poster/?id=3520976>)

Presenter: Igor Salimon , *Skolkovo Institute of Science and Techno*

We show that intense laser irradiation of GaAs in ambient conditions produces a 0.5 μm thick porous oxide layer. At certain laser intensities the oxide self-organizes in submicron periodic surface structures (LIPSS).

Authors: Igor Salimon, Skolkovo Institute of Science and Techno / Aleksandr Averchenko, Skolkovo Institute of Science and Techno / Sakellaris Mailis, Skolkovo Institute of Science and Techno / Pavlos Lagoudakis, Skolkovo Institute of Science and Techno

JTh3A.103

Gauge Field Optics Using Magneto-Electric Media (</home/eposters/poster/?id=3523389>)

Presenter: Nitish Chandra , *Duke University*

A moving dielectric material at low velocities produces the same effect for light as vector potential for charged particles. We investigate the interaction of light with vortices, which can be recreated using stationary magneto-electric media.

Authors: Nitish Chandra, Duke University / Natalia Litchinitser, Duke University

JTh3A.104

Deep Learning to Accelerate Maxwell's Equations for Inverse Design of Dielectric Metasurfaces (</home/eposters/poster/?id=3523755>)

Presenter: Maksym Zhelyeznyakov , *University of Washington*

We present a data-driven forward simulation framework for the inverse design of metasurfaces that is more accurate than methods based on the local phase approximation, a factor of 10^4 times faster than mesh based solvers.

Authors: Maksym Zhelyeznyakov, University of Washington / Steven Brunton, University of Washington / Arka Majumdar, University of Washington

JTh3A.105

Microstructures With Designable Temperature-Dependent Thermal Emission (</home/eposters/poster/?id=3523765>)

Presenter: Romil Audhkhasi, *University of Southern California*

We propose gold – vanadium dioxide microstructures to achieve structurally tunable difference in thermal radiated power between low and high temperature states. We use our emitters to design metasurfaces for which the spatial emission pattern can be inverted with temperature.

Authors: Romil Audhkhasi, University of Southern California / Michelle Povinelli, University of Southern California

JTh3A.107

Reconfigurable Near-Infrared Metasurfaces Using Phase-Change Materials (</home/eposters/poster/?id=3524209>)

Presenter: Sajjad AbdollahRamezani, *Georgia Institute of Technology*

We experimentally demonstrate a tunable hybrid metasurface benefiting from phase-change materials and plasmon hybridization for non-volatile optical modulation. We also leverage machine learning algorithms to study the effect of structural parameters on the optical performance.

Authors: Sajjad AbdollahRamezani, Georgia Institute of Technology / Omid Hemmatyar, Georgia Institute of Technology / Hossein Taghinejad, Georgia Institute of Technology / Muliang Zhu, Georgia Institute of Technology / Alex Gallmon, Georgia Institute of Technology / Ali Adibi, Georgia Institute of Technology

JTh3A.108

Dynamically Tunable Hybrid Plasmonic-Dielectric Metasurfaces (</home/eposters/poster/?id=3524277>)

Presenter: Sajjad AbdollahRamezani, *Georgia Institute of Technology*

We experimentally demonstrate active modulation of amplitude/phase profiles of optical wavefronts by leveraging the interplay of surface plasmon polariton and electric/magnetic Mie resonance modes in hybrid plasmonic-dielectric metasurface platforms incorporating chalcogenide phase-change materials.

Authors: Sajjad AbdollahRamezani, Georgia Institute of Technology / Omid Hemmatyar, Georgia Institute of Technology / Hossein Taghinejad, Georgia Institute of Technology / Muliang Zhu, Georgia Institute of Technology / Alex Gallmon, Georgia Institute of Technology / Ali Adibi, Georgia Institute of Technology

JTh3A.109

Electro-Optic Tuning of non-Hermiticity in a Silicon Microring Resonator (/home/eposters/poster/?id=3524633)

Presenter: Hwaseob Lee , *University of Delaware*

We demonstrate a silicon photonic passive PT-symmetric structure operating at an exceptional point, with dynamic mode-splitting tunability enabled by a local heater.

Authors: Hwaseob Lee, University of Delaware / Anishkumar Soman, University of Delaware / Tiantian Li, University of Delaware / Thomas Kannaen, University of Delaware / Dun Mao, University of Delaware / Sahin Ozdemir, Pennsylvania State University / Tingyi Gu, University of Delaware

JTh3A.112

Gating Artefact in the Coupled-Wave-Equations Modeling of Classical and Quantum Kerr Nonlinear Effects (/home/eposters/poster/?id=3526600)

Presenter: Hossein Taheri , *University of California Riverside*

We show that the coupled-wave-equations numerical modeling of frequency combs, considered equivalent to the split-step integration of the nonlinear Schrödinger equation family, entails an inherent gating artefact capable of disguising physically unstable states as stable.

Authors: Hossein Taheri, University of California Riverside / Andrey Matsko, Jet Propulsion Laboratory / Tobias Hansson, Linköping University

JTh3A.113

Analogue Optical Simulation of the 2D Ising Model in an External Magnetic Field (/home/eposters/poster/?id=3530963)

Presenter: Aneek Biswas , *Graduate Center of the City University of New York*

We propose a method to implement a Zeeman term to the 2D-Ising Hamiltonian in the Spatial Ising Machine. An NP-complete problem of the 2D-Ising spin-glass in an external magnetic field is studied.

Authors: Aneek Biswas, Graduate Center of the City University of New York / Tommaso McPhee, City College of New York / Mohammad-Ali Miri, Graduate Center of the City University of New York / Kevin Cognee, City College of New York / Vinod Menon, Graduate Center of the City University of New York

JTh3A.114

3D Speckle Intensity Correlations in Propagation of Optical Vortex Beams (/home/eposters/poster/?id=3525365)

Presenter: Mahed Batarseh , *University of Central Florida, CREOL*

We developed an analytical model for 3D spatial cross-correlations in speckles fields generated by scattering of structured beams. Specific properties identified for different types of optical vortices can guide their use in remote sensing applications.

Authors: Cristian-Hernando Acevedo, University of Central Florida, CREOL / Mahed Batarseh, University of Central Florida, CREOL / Aristide Dogariu, University of Central Florida, CREOL

JTh3A.115

Gold Nanorod Contrast-Enhanced Molecular Imaging of Choroidal Neovascularization Using Dual Photoacoustic Ophthalmoscopy and Optical Coherence Tomography in a Rabbit Model (/home/eposters/poster/?id=3525544)

Presenter: Phuc Nguyen , *University of Michigan*

We present the potential of gold nanorods as a molecular contrast agent for multimodal photoacoustic ophthalmoscopy (PAOM) and optical coherence tomography (OCT) to visualize choroidal neovascularization in living rabbits.

Authors: Phuc Nguyen, University of Michigan / Yanxiu Liu, University of Michigan / Jessica Henry, University of Michigan / Wei Zhang, University of Michigan / Xueding Wang, University of Michigan / Yannis M. Paulus, University of Michigan

12:00 - 13:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - Dialogues on Metamaterials: Past, Present, Future

You are invited to join the OSA Photonic Metamaterials Technical Group for a special panel discussion exploring the past, present and future of metamaterials. Attendees will have the opportunity to hear from prominent members of the photonic metamaterials community as they discuss emerging, controversial, anecdotal, and active hot topics in the field. Our panelists for this event will include Andrea Alù, CUNY Advanced Science Research Center; Jennifer Dionne, Stanford University; Nader Engheta, University of Pennsylvania; Ari Sihvola, Aalto University; and Isabelle Staude, University of Jena.

12:00 - 13:30 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - What does it take to be a quantum (optical) engineer?

In the past, experience in quantum science was only suitable for a handful of academic job openings so that most career advisers recommended removing any mention of this experience from resumes. As the quantum industry is being born, there is a growing demand for qualified personnel. Who are the people who fill these jobs: engineers or scientists? What do they do? Which skills and experiences are most valuable for today's and tomorrow's workforce? Would additional training help? Who is hiring: academia, research labs, large companies, startups, or... perhaps you will identify an entrepreneurial aspiration in yourself? Most importantly, are quantum careers here to stay? Join the panel of experts with diverse backgrounds to find out.

Special Event - Publishing in 2021: challenges and solutions

Publishing is the main avenue for dissemination of novel ideas and methods, and is often used to measure the productivity of a research group. Therefore, scientific publishing is essential for both career development and successful grant applications. However, with the emergence of many new journals, as well as with the expansion of open access and for-profit publishing, the publishing landscape in optics and photonics is rapidly changing. This workshop, through interaction between the audience and a panel of relevant actors in the publication process, aims to explore the impact of publishing cost, confidentiality barriers, and impact factor, on the progress of optical science and engineering.

13:00 - 15:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FTh4M

Solid-state Qubits and Emitters

Presenter: Costanza Toninelli , *Universita degli Studi di Firenze*

FTh4M.1

Diamond Phononic Crystals With Silicon-Vacancy Centers at Cryogenic Temperatures

Presenter: Graham Joe , *Harvard University*

We fabricate phononic crystals in single-crystal diamond hosting silicon vacancy centers. We demonstrate high mechanical Q-factors ($> 10,000$) from localized 10 GHz-frequency mechanical modes in a dilution refrigerator ($T < 1K$).

Authors: Graham Joe, Harvard University / Cleaven Chia, Harvard University / Benjamin Pingault, Harvard University / Srujan Meesala, Harvard University / Michelle Chalupnik, Harvard University / Eliza Cornell, Harvard University / Daniel Assumpcao, Harvard University

FTh4M.2

Controlling Coherence Time of Silicon Vacancy Centers in Diamond Using Phononic Crystals

Presenter: Cleaven Chia , *Harvard University*

We design and fabricate phononic crystals in single-crystal diamond hosting silicon vacancy centers. The complete bandgap in the phononic crystals aims to improve coherence of optical transitions in silicon vacancy centers by suppressing phonon-driven processes

Authors: Cleaven Chia, Harvard University / Kazuhiro Kuruma, Harvard University / Benjamin Pingault, Harvard University / Marko Loncar, Harvard University

FTh4M.3

Modifying NV Center Charge States With a Few Photon IR Microcavity Fields

Presenter: Vinaya Kumar Kavatamane Rathnakara , *University of Calgary*

We report nonlinear optical modification of the charge states of NV centers in a high-Q diamond microdisk cavity through a few photon telecom wavelength intracavity field.

Authors: Vinaya Kumar Kavatamane Rathnakara, University of Calgary / Prasoon Kumar Shandilya, University of Calgary / David Lake, University of Calgary / Matthew Mitchell, University of Calgary / Denis Sukachev, University of Calgary / Paul Barclay, University of Calgary

FTh4M.4

Temperature Dependent Scaling Laws of Rydberg Excitons in Cu₂O

Presenter: HeeBong Yang , *University of Waterloo*

We measure the yellow P-exciton absorption spectra of Cu₂O via temperature-dependent spectroscopy (4-100 K). We study exciton resonance spectral properties in terms of peak energy, spectral linewidth, and oscillator strength according to well-known scaling laws.

Authors: Aaron Gross, University of Waterloo / HeeBong Yang, University of Waterloo / Daniel Kang, University of Waterloo / Yusuke Morita, University of Tokyo / Kyung-Soo Choi, University of Waterloo / Kosuke Yoshioka, University of Tokyo / Na Young Kim, University of Waterloo

FTh4M.5

Photon Statistics of Filtered Quantum Dot Resonance Fluorescence

Presenter: Alistair Brash , *University of Sheffield*

We exploit spectral filtering to modify the photon statistics of resonance fluorescence from a quantum dot, demonstrating that the observed antibunching is an interference effect and cannot be measured simultaneously with a sub-natural linewidth.

Authors: Catherine Phillips, University of Sheffield / Alistair Brash, University of Sheffield / Dara McCutcheon, University of Bristol / Jake Iles-Smith, University of Manchester / Maurice Skolnick, University of Sheffield / Mark Fox, University of Sheffield / Ahsan Nazir, University of Manchester

FTh4M.6

Tip-Enhanced Strong Coupling of Quantum Dot Single Photon Emitters

Presenter: Ben Whetten , *University of Colorado Boulder*

We demonstrate room temperature strong coupling of a single quantum emitter to a configurable plasmonic pico-cavity formed by a nano-tip. Through atomic scale control of mode volume we demonstrate switching and modulation of coupling strength.

Authors: Molly May, University of Colorado Boulder / Kyoung-Duck Park, Ulsan National Institute of Science and Technology / Ben Whetten, University of Colorado Boulder / David Fialkow, University of Maryland, Baltimore County / Jaron Kropp, University of Maryland, Baltimore County / Theodosia Gougousi, University of Maryland, Baltimore County / Matthew Pelton, University of Maryland, Baltimore County / Markus Raschke, University of Colorado Boulder

FTh4M.7

Engineering of Room Temperature Spin Defects in Hexagonal Boron Nitride

Presenter: Mehran Kianinia , *University of Technology Sydney*

We show a fabrication method based on ion implantation technique to create negatively charged boron vacancy centers in hexagonal boron nitride with optically addressable spin. Moreover, we elucidate additional optical properties of these defects.

Authors: Mehran Kianinia, University of Technology Sydney / Simon White, University of Technology Sydney / Johannes Fröch, University of Technology Sydney / Carlo Bradac, Trent University / Igor Aharonovich, University of Technology Sydney

FTh4M.8

Defect and Strain Engineering of Monolayer WSe₂ for Site-Controlled Single-Photon Emission up to 150K

Presenter: Kamyar Parto , *UC Santa Barbara*

Via a decoupled strain and defect engineering technique, a new approach for engineering site-specific single-photon emitters in WSe_2 is introduced, which enables high-yield, above 95% purity, and extended working temperatures up to 150 K.

Authors: Kamyar Parto, UC Santa Barbara / Kaustav Banerjee, UC Santa Barbara / Galan Moody, UC Santa Barbara

FTh4L

Nonlinear and THz Spectroscopy for Studying Quantum Materials

Presider: Liuyan Zhao , *University of Michigan*

FTh4L.1

Terahertz Polaronic Response of Electrons Solvated in Liquid Water

Presenter: Ahmed Ghalgaoui , *Max-Born-Institute*

Free electrons generated via high THz or near-infrared excitation of water have pronounced polaronic character which manifests in coherent oscillations of the terahertz dielectric function. The oscillation frequency scales with the electron concentration.

Authors: Ahmed Ghalgaoui, Max-Born-Institute / Benjamin Fingerhut, Max-Born-Institute / Klaus Reimann, Max-Born-Institute / Michael Woerner, Max-Born-Institute / Thomas Elsaesser, Max-Born-Institute

FTh4L.2

Two-Dimensional Terahertz Spectroscopy of Collective Excitations in Solids

Presenter: Jeremy Johnson , *Brigham Young University*

Using two-dimensional (2D) terahertz spectroscopy we investigate fundamental electronic, lattice, and spin excitations in solids, and the couplings between them.

Authors: Brittany Knighton, Brigham Young University / Megan Nielson, Brigham Young University / Lauren Davis, Brigham Young University / Aldair Alejandro, Brigham Young University / Emma Jensen, Brigham Young University / Clayton Moss, Brigham Young University / Joel Woolley, Brigham Young University / Josue Dominguez, Brigham Young University / Jeremy Johnson, Brigham Young University

FTh4L.3

Non-Perturbative Subcycle Nonlinearities of Ultrastrong Light-Matter Coupling

Presenter: Joshua Mornhinweg , *University of Regensburg*

Driving an ultrastrongly light-matter coupled system by strong, coherent THz waveforms competing with the vacuum electromagnetic field, we observe strong nonlinearities including eight-wave mixing and nonlinear polariton correlations beyond the normal-mode approximation.

Authors: Joshua Mornhinweg, University of Regensburg / Maike Halbhuber, University of Regensburg / Cristiano Ciuti, Université de Paris / Dominique Bougeard, University of Regensburg / Rupert Huber, University of Regensburg / Christoph Lange, University of Regensburg

FTh4L.5

Optical 2D Coherent Spectroscopy of Photoexcited Carriers in Methylammonium Lead Iodide Perovskite at Room Temperature

Presenter: Maria Munoz, *Florida International University*

We performed two-dimensional coherent spectroscopy of photoexcited carriers in methylammonium lead iodide perovskite at room temperature. The 2D spectra revealed the ultrafast dynamics of two resonances which can be attributed to hot carriers and excitons.

Authors: Maria Munoz, Florida International University / Hebin Li, Florida International University / Chengbin Fei, University of Miami / He Wang, University of Miami

FTh4L.6

Dipole-Dipole Interactions Between Pairs of Silicon-Vacancy Centers in Diamond

Presenter: Matthew Day, *The University of Michigan*

Silicon-vacancy centers in diamond are key candidates for future quantum telecommunications, memory, and computing applications. We report dipole-dipole interactions between distinct silicon-vacancy centers in diamond with implications for quantum sensing and information exchange between centers.

Authors: Matthew Day, The University of Michigan / Kelsey Bates, The University of Michigan / Christopher Smallwood, San Jose State University / Rachel Owen, The University of Michigan / Ronald Ulbricht, Max Planck Institute for Polymer Research / Steven Cundiff, The University of Michigan

FTh4L.7

Confined Exciton Interaction of Erbium Doped GaAs Quantum Wells Elucidated by Multidimensional Coherent Spectroscopy

Presenter: Robert Boutelle, *NIST, Boulder*

We investigate the exciton exchange interaction of erbium doped GaAs quantum well using MDCS. We observe an energy shift of $\sim 100\mu\text{eV}$ consistent with the predicted exchange energy and different pulse sequences activate specific excitonic pathways.

Authors: Robert Boutelle, NIST, Boulder / Travis Autry, NIST, Boulder / Richard Mirin, NIST, Boulder / Kevin Silverman, NIST, Boulder

FTh4L.4

Coherent Detection of Femtosecond THz Voltage Pulses and Nanoscale Carrier Dynamics in an STM Junction

Invited

Presenter: Melanie Müller, *Fritz Haber Institute of the Max Planck Society*

We demonstrate phase-resolved detection of femtosecond voltage transients in a scanning tunneling microscope (STM) induced by ultrabroadband THz pulses from a spintronic emitter, and coherently probe electron dynamics inside the photoexcited junction on the nanofemtoscale.

Authors: Melanie Müller, Fritz Haber Institute of the Max Planck Society / Natalia Martín Sabanés, IMDEA nanoscience / Faruk Krecinic, Fritz Haber Institute of the Max Planck Society / Fabian Schulz, Fritz Haber Institute of the Max Planck Society / Takashi Kumagai, Fritz Haber Institute of the Max Planck Society / Tobias Kampfrath, Freie Universität Berlin / Martin Wolf, Fritz Haber Institute of the Max Planck Society

FTh4H

Topological Photonics III

Presider: Miguel Bandres, *University of Central Florida, CREOL*

FTh4H.1

Topological Insulator Vertically-Emitting Laser Array

Highlighted Talk

Presenter: Alex Dikopoltsev, *Technion*

We present the first experimental demonstration of a topological insulator VCSEL array. Our laser consists of 30 emitters, emitting in a single frequency, displaying interference proving that the emitters act as a single laser.

Authors:Alex Dikopoltsev, Technion / Tristan Harder, Wuerzburg university / Eran Lustig, Technion / Oleg Egorov, University of Jena / Johannes Beierlein, Wuerzburg university / Adriana Wolf, Wuerzburg university / Monika Emmerling, Wuerzburg university / Christian Schneider, Wuerzburg university / Sven Höfling, Wuerzburg university / Mordechai segev, Technion / Sebastian Klemmt, Wuerzburg university

FTh4H.2

Observation of Nonlinear Corner States in a Higher-Order Photonic Topological Insulator

Presenter: Marco Kirsch , *University of Rostock*

We experimentally investigate the nonlinear Kerr dynamics in higher-order photonic topological insulators. The topologically protected corner states are robust against nonlinear perturbations and indicates its transition passage through bulk-bands by a brief intermediate delocalization.

Authors:Marco Kirsch, University of Rostock / Yiqi Zhang, Xi'an Jiaotong University / Lukas Maczewsky, University of Rostock / Sergey Ivanov, Russian Academy of Sciences / Yaroslav Kartashov, Russian Academy of Sciences / Lluís Torner, Barcelona Institute of Science and Technology / Dieter Bauer, University of Rostock / Alexander Szameit, University of Rostock / Matthias Heinrich, University of Rostock

FTh4H.3

Nonlinear Effects on Topologically Protected Linear Modes of Su-Schrieffer-Heeger Photonic Lattices

Presenter: Jianke Yang , *University of Vermont*

Effects of nonlinearity on topologically protected linear modes in photonic SSH lattices are studied theoretically and experimentally. Nonlinearity turns these linear modes into weakly nonlinear topological gap solitons that cannot sustain high powers.

Authors:Min Guo, Nankai University / Shiqi Xia, Nankai University / Nan Wang, Nankai University / Daohong Song, Nankai University / Zhigang Chen, San Francisco State University / Jianke Yang, University of Vermont

FTh4H.4

Nonlinearity-Induced Transition of Topological Corner States

Presenter: Zhichan Hu , *Nankai University*

We investigate nonlinear effects on corner modes in a two-dimensional Su-Schrieffer-Heeger-type photonic platform. Nonlinearity induces transition between corner and edge states in topologically nontrivial lattices, in contrast to facilitating bulk modes in the trivial counterparts.

Authors:Zhichan Hu, Nankai University / domenico bongiovanni, Nankai University / Dario Jukić, University of Zagreb / Daohong Song, Nankai University / Hrvoje Buljan, Department of Physics / Zhigang Chen, Nankai University

FTh4H.5

Lasing From Multipolar Modes of Topological Corner States

Presenter: HA-REEM KIM , *Korea University*

We demonstrate lasing action from corner states in nanophotonic topological structures. We identify multipole corner modes with distinct emission profiles via hyperspectral imaging and discern signatures of non-Hermitian radiative coupling of the topological states.

Authors:HA-REEM KIM, Korea University / MIN-SOO HWANG, Korea University / Daria Smirnova, Australian National University / Kwang-Yong Jeong, Korea University / Yuri Kivshar, Australian National University / Hong-Gyu Park, Korea University

FTh4H.6

Unidirectional Soliton-Like Edge Modes in Nonlinear Floquet Topological Insulators

Presenter: Sebabrata Mukherjee , *Penn State University*

We present the first realization of soliton-like unidirectional edge modes on photonic Floquet topological insulators. These nonlinear modes radiate power at a finite and controllable rate because of the intrinsic gaplessness of the topological spectrum.

Authors:Sebabrata Mukherjee, Penn State University / Mikael Rechtsman, Penn State University

FTh4H.7

Nonlinear Valley Hall Edge States in Type-II Dirac Lattices

Presenter: Yiqi Zhang , *Xi'an Jiaotong University*

We demonstrate nonlinear valley-Hall edge states (VHESs) in cw-laser-written anisotropic photonic lattices hosting type-II Dirac points. These topological gap quasi-solitons are fundamentally distinct from linear type-I VHESs and from all previously found topological solitons.

Authors:Hua Zhong, Xi'an Jiaotong University / Shiqi Xia, Nankai University / Yongdong Li, Xi'an Jiaotong University / Yiqi Zhang, Xi'an Jiaotong University / Daohong Song, Nankai University / Chuliang Liu, Nankai University / Zhigang Chen, Nankai University

FTh4I

Quantum Nanophotonics

Presider: Viktor Podolskiy , *University of Massachusetts Lowell*

FTh4I.1

Time-Resolved Second-Order Correlation Measurements of Metallic Coaxial Nanolasers Under Pulsed Optical Excitation

Presenter: AGNES GEORGE , *INRS-EMT*

We report coherent emission behavior of high- β metallic coaxial nanolasers under pulsed illumination conditions. Time-resolved photon statistical measurements show a transition from thermal to coherent emission within the envelope of the excitation pulse.

Authors:AGNES GEORGE, INRS-EMT / A Aadhi, INRS-EMT / Andrew Bruhacs, INRS-EMT / Rachel Ostic, INRS-EMT / Erin Whitby, INRS-EMT / William Hayenga, University of Central Florida / Zhiming Wang, University of Electronic Science and Technology of China / Michael Kues, Leibniz University of Hannover / Christian Reimer, Hyperlight Corporation / Mercedeh Khajavikhan, University of Central Florida / Roberto Morandotti, INRS-EMT

FTh4I.2

High-Q Localized States in Finite Extent Arrays of Mie Resonators

Presenter: Danil Kornovan , *ITMO University*

We report on the formation of high-Q localized states in finite arrays of Mie resonators overcoming the previously predicted values by at least two-orders of magnitude, which becomes possible due to destructive interference of band-edge modes.

Authors:Danil Kornovan, ITMO University / Roman Savelev, ITMO University / Yuri Kivshar, Australian National University / Mihail Petrov, ITMO University

FTh4I.3

Nitride Single Photon Sources

Invited

Presenter: Rachel Oliver , *University of Cambridge*

Nitride quantum dots promise single photon sources within a manufacturable optoelectronic technology operating at accessible temperatures. However, they also suffer from challenges, including poor spectral stability. Can non-polar nitrides solve some of these problems?

Authors:Rachel Oliver, University of Cambridge

FTh4I.4

Low Light Quantum Phase Transition in 1T-TaS₂ at Room Temperature

Presenter: Weijian Li , *Rice University*

Light-matter interaction in quantum materials presents opportunities for discovery. We observe a low-intensity light-induced phase transition in 1T-TaS₂, a quasi-2D material supporting charge-density-waves (CDW). We find that the CDW domains stack differently upon illumination.

Authors: Weijian Li, Rice University / Gururaj Naik, Rice University

FTh4I.5

Plasmonic Anderson Localization Enhances the SPP-Photon-Exciton Interaction in 2D Disordered Nanostructures

Presenter: Ruwen Peng , *Nanjing University*

We experimentally demonstrate the Anderson localization of surface plasmon polaritons (SPPs) at optical frequencies in 2D nanostructures, and further show the significant enhancement of the SPP-photon-exciton interaction in disordered silver nanoarrays combined with fluorescent dye molecules.

Authors: Ruwen Peng, Nanjing University / Yingying Zhu, Nanjing University / Cheng-Yao Li, Nanjing University / Bo Xiong, Nanjing University / Mu Wang, Nanjing University

FTh4I.6

Probing the Long-Range Transport Dynamics of Bloch Surface-Wave Polaritons by Ultrafast Microscopy

Presenter: M. Balasubrahmaniam , *Tel Aviv University*

Using time-resolved microscopy, we study the long-range transport dynamics of collective excitations in an organic Bloch surface-wave polariton system. Our measurements reveal sub-ballistic transport with transient population oscillations having a finite coherence length.

Authors: M. Balasubrahmaniam, Tel Aviv University / Arie Simkhovich, Tel Aviv University / Adina Golombek, Tel Aviv University / Tal Schwartz, Tel Aviv University

FTh4I.7

Casimir Light in Dispersive Nanophotonics

Presenter: Jamison Sloan , *Massachusetts Institute of Technology*

We present a theory of entangled photon pair emission through the dynamical Casimir effect in systems which are simultaneously dispersive and time dependent. We show surface phonon polariton emission in time-modulated polar insulators.

Authors: Jamison Sloan, Massachusetts Institute of Technology / Nicholas Rivera, Massachusetts Institute of Technology / John Joannopoulos, Massachusetts Institute of Technology / Marin Soljačić, Massachusetts Institute of Technology

FTh4K

Dynamic Metamaterials

Presenter: Xingjie Ni , *Pennsylvania State University*

FTh4K.1

Electrically Tunable Phase-Change Metasurfaces Using Transparent Conductive Oxide Microheaters

Presenter: Omid Hemmatyar , *Georgia Institute of Technology*

An electrically-tunable all-dielectric metasurface employing a phase-change material, GST, and transparent conductive indium tin oxide (ITO) is designed and experimentally demonstrated for controlling light absorption to enable multi-level electro-optic modulation with unprecedented sensitivity.

Authors:Omid Hemmatyar, Georgia Institute of Technology / Sajjad AbdollahRamezani, Georgia Institute of Technology / Hossein Taghinejad, Georgia Institute of Technology / Ali Adibi, Georgia Institute of Technology

FTh4K.2

Mechanically Reconfigurable Multi-Functional Meta-Optics

Presenter: Conner Ballew , *California Institute of Technology*

We explore mechanically reconfigurable meta-optics with switchable optical functionality. 3D-printed microwave devices featuring broadband focusing, spectral demultiplexing, and polarization splitting are measured with various reconfiguration schemes, including shearing and auxetic transformations.

Authors:Conner Ballew, California Institute of Technology / Gregory Roberts, California Institute of Technology / Philip Camayd-Muñoz, California Institute of Technology / Maximilien Debbas, California Institute of Technology / Andrei Faraon, California Institute of Technology

FTh4K.3

Tunable Transmissive THG in Silicon Metasurface Enabled by Phase Change Material

Presenter: Omar Abdelrahman Mohamed Abdelraouf , *Nanyang Technological University*

We experimentally demonstrate tunable amplitude of third harmonic generation in silicon metasurface in transmission mode using phase change material, Ge₂Sb₂Te₅, layer of thickness 5 nm only.

Authors: Omar Abdelrahman Mohamed Abdelraouf, Nanyang Technological University / Aravind P. Anthur, IMRE, ASTAR / Hailong Liu, IMRE, ASTAR / Zhaogang Dong, IMRE, ASTAR / Qian Wang, IMRE, ASTAR / Leonid Krivitsky, IMRE, ASTAR / Xiao Wang, Nanyang Technological University / Qijie Wang, Nanyang Technological University / Hong Liu, IMRE, ASTAR

FTh4K.4

2D Beam Shaping via Spatial Light Modulation and Meta-Optics

Presenter: James Whitehead, *University of Washington*

A metasurface system is proposed to perform a non-trivial 1D-to-2D optical transform. Gradient based methods for a metasurface doublet are used to optimized input-output relation yielding an effective 2D SLM from a 1D SLM

Authors: James Whitehead, University of Washington / Albert Ryou, University of Washington / Shane Colburn, University of Washington / Maksym Zhelyeznyakov, University of Washington / Arka Majumdar, University of Washington

FTh4K.5

95 MHz Bandwidth Electro-Optic Metasurfaces Based on Barium Titanate Nanocrystals

Presenter: Artemios Karvounis, *ETH Zurich*

We show that photonic metasurfaces based on barium titanate nanocrystals possess strong electro-optic response. Transmission at near infrared wavelength is controlled with low input RF signal < 3 Volts and extends close to 100 MHz.

Authors: Artemios Karvounis, ETH Zurich / Viola Vogler- Neuling, ETH Zurich / Rachel Grange, ETH Zurich

FTh4K.6

Electrically Tunable Quarter Waveplate Based on Intersubband Polaritonic Metasurfaces

Presenter: Hyeongju Chung, *UNIST*

We report electrically-tunable quarter waveplate metasurfaces composed of plasmonic gratings coupled to intersubband transitions in multiple-quantum wells. Experimentally, 0.2 μm of operating wavelength tuning near 6.4 μm wavelength was obtained applying bias voltage from -1V to -3V.

Authors: Hyeongju Chung, UNIST / Inyoung Hwang, UNIST / Jaeyeon Yu, UNIST / Jongwon Lee, UNIST / Frederic Demmerle, Walter schottky institut, Technische Universitat munchen / Gerhard Boehm, Walter schottky institut, Technische Universitat munchen / Mikhail Belkin, Walter schottky institut, Technische Universitat munchen

FTh4K.7

Dynamically Programmable Terahertz Holographic Metasurface Using CMOS IC Tiling

Presenter: Suresh Venkatesh , *Princeton University*

In this article, we design and demonstrate a multi-functional, digitally programmable metasurface at 0.3~THz fabricated using industry standard CMOS process. Each metasurface tile consists of 12 \times 12 periodic array of unit cells and later tiled to create a 2 \times 2 array.

Authors: Suresh Venkatesh, Princeton University / Xuyang Lu, Princeton University / Hooman Saeedi, Princeton University / Kaushik Sengupta, Princeton University

ATh4F

Optical Coherence Tomography and Holographic Imaging

Presenter: Utkarsh Sharma , *Catapult Sky*

ATh4F.1

Advances in Real-Time Volumetric Interoperative OCT

Invited

Presenter: Hafeez Dhalla , *Duke University*

Abstract not available.

Authors: Hafeez Dhalla, Duke University

ATh4F.2

Longitudinal 3D Visualization of Choroidal Neovascularization in a Rabbit Model Using Multimodal Photoacoustic Microscopy and Optical Coherence Tomography Molecular Imaging

Presenter: Phuc Nguyen , *University of Michigan*

This study presents novel chain-like cluster gold nanoparticles as a multimodal contrast agent for photoacoustic microscopy (PAM) and optical coherence tomography (OCT) to longitudinally visualize choroidal neovascularization in living rabbits.

Authors: Phuc Nguyen, University of Michigan / Yanxiu Liu, University of Michigan / Wei Qian, IMRA America Inc., / Bing Liu, IMRA America Inc., / Jessica Henry, University of Michigan / Wei Zhang, University of Michigan / Xueding Wang, University of Michigan / Yannis M. Paulus, University of Michigan

ATh4F.3

Bidirectional Broadband Coupler for on-Chip Interferometer Based OCT

Presenter: Shih-Hsiang Hsu , *National Taiwan Univ of Science & Tech*

A bidirectional 3-dB coupler in the interferometer based on-chip optical coherence tomography demonstrates a broad and flat 200-nm wavelength response through the particle swarm numerical optimization, which could maintain the axial resolution and sensitivity.

Authors: Benedictus Yohanes Bagus Widhianto, National Taiwan Univ of Science & Tech / Shih-Hsiang Hsu, National Taiwan Univ of Science & Tech

ATh4F.4

Applications of Artificial Intelligence in Ophthalmic Diagnostics

Invited

Presenter: Niranchana Manivannan , *Carl Zeiss Meditec, Inc.*

Artificial intelligence (AI) encompasses a wide range of techniques that enables computers to mimic human intelligence. Machine learning (ML) is a subset of AI that focuses on improving the algorithms' performance with increased exposure to data. Deep learning (DL), a type of ML technique and a way to train multi-layered neural networks, has created a wide interest in AI in past few years. In ophthalmic diagnostics, AI has applications in workflow optimization, image denoising, image reconstruction, clinical decision support for diagnosis, prediction and treatment optimization. Some of the challenges in real-world implementation of AI in ophthalmic diagnostics include the black-box nature of DL, the requirement for large annotated datasets for training, high performance hardware requirements, and emerging regulatory pathways on usage of new AI techniques. In this talk we will discuss the potential of AI to enhance clinical decision support, improve image reconstruction and denoising with specific examples from fundus imaging, optical coherence tomography (OCT), OCT angiography and visual field testing; paving the way towards advancements in hardware and software for ophthalmic diagnostic instruments.

Authors: Niranchana Manivannan, Carl Zeiss Meditec, Inc.

ATh4F.5

Deep-Learning-Enabled Holographic Polarization Microscopy

Presenter: Tairan Liu , *University of California, Los Angeles*

We present a deep learning-based holographic polarization microscopy framework that can transform amplitude and phase information of samples into birefringence retardance and orientation images using holograms collected under a single polarization state.

Authors:Tairan Liu, University of California, Los Angeles / Kevin Haan, University of California, Los Angeles / Bijie Bai, University of California, Los Angeles / Yair Rivenson, University of California, Los Angeles / Yi Luo, University of California, Los Angeles / Hongda Wang, University of California, Los Angeles / David Karalli, University of California, Los Angeles / Hongxiang Fu, University of California, Los Angeles / Yibo Zhang, University of California, Los Angeles / John FitzGerald, University of California, Los Angeles / Aydogan Ozcan, University of California, Los Angeles

ATh4F.6

Phase-Contrast-Based Holographic Quantitative Phase Imaging by Only Two Exposures

Presenter: Nathaniel Hai , *Ben Gurion University of the Negev*

Quantitative phase imaging using a new type of phase-shift holographic approach is demonstrated by capturing only two different phase-contrast images. Phase measurements with enhanced accuracy and optimal imaging characteristics for binary and biologic phase objects are provided.

Authors:Nathaniel Hai, Ben Gurion University of the Negev / Joseph Rosen, Ben Gurion University of the Negev

ATh4P

Ultrafast Laser Enabled Structures and Functional Devices

Presenter: Jie Qiao , *Rochester Institute of Technology*

ATh4P.1

High Power MEMS Planar Light Valve

Presenter: Tianbo Liu , *Silicon Light Machines*

The PLV supports modulation of over 500W of laser power for materials processing. It provides a line beam with 1088 individually addressable pixels and 200kHz switching speed. A custom optical head complements the PLV.

Authors:Tianbo Liu, Silicon Light Machines / Alex Payne, Silicon Light Machines / Jim Hunter, Silicon Light Machines / Gregory Jacob, Silicon Light Machines / Satoshi Yamashita, Silicon Light Machines / Greg Myatt, Silicon Light Machines / Lars Eng, Silicon Light Machines / Yoshimi Hashimoto, SCREEN Holdings / Hirofumi Mizuno, SCREEN Holdings / Yasumitsu Fujisawa, SCREEN Holdings / Daisuke Hishitani, SCREEN Holdings

ATh4P.2

Kilowatt Femtosecond Lasers for High Productivity

Presenter: Clemens Hoenninger , *Amplitude Systemes*

We report on kW femtosecond lasers that will enable large scale and high productivity industrial applications. Power and energy scaling is achieved by an Innoslab amplifier followed by slab-based booster amplifier stages.

Authors:Julien Pouysegur, Amplitude Systemes / Vincent Gruson, Amplitude Systemes / Denis Ferachou, Amplitude Systemes / Julien Loyez, Amplitude Systemes / Martin Delaigue, Amplitude Systemes / Alexandre Godin, Amplitude Systemes / Eric Audouard, Amplitude Systemes / Eric Mottay, Amplitude Systemes / Clemens Hoenninger, Amplitude Systemes

ATh4P.3

Applicability of Artificial Neural Network for Modeling and Prediction of the Laser Polished Surface Quality

Presenter: Honghe Wu , *National Research Council of Canada*

It was proposed and demonstrated that artificial neural network can reliably model the laser polishing of H13 tool steel and predict the polished surface topography parameters, such as areal waviness and roughness, with a probability of 80%.

Authors:Honghe Wu, National Research Council of Canada / Evgueni Bordatchev, National Research Council of Canada

ATh4P.4

Writing Photonic Components in Polymers Using Femtosecond Pulses

Presenter: Dmitrii Perevoznik , *Leibniz Universität Hannover*

Polymer waveguides are designed and fabricated through femtosecond laser writing. We optimize the structure to achieve single-mode waveguides with minimum propagation losses of 0.6 dB/cm. We also demonstrated challenging Y-splitters through this novel technique.

Authors:Dmitrii Perevoznik, Leibniz Universität Hannover / Surajit Bose, Leibniz Universität Hannover / Sven Burger, Zuse Institute Berlin / Ayhan Demircan, Leibniz Universität Hannover / Uwe Morgner, Leibniz Universität Hannover

ATh4P.5

Laser-Written Freeform Optics for in- and out-of-Focus Beam Shaping

Invited

Presenter: Natalia Trela-McDonald , *PowerPhotonic Ltd*

We present high efficiency, laser-written freeform optics used for single and multimode beam shaping. We investigate both, in focus intensity distribution and out of focus propagation properties to address requirements of material processing applications.

Authors: Natalia Trela-McDonald, PowerPhotonic Ltd / Alex Griffiths, PowerPhotonic Ltd / Gilles Diederich, PowerPhotonic Ltd / Eoin Murphy, PowerPhotonic Ltd

ATh4P.6

Ultrashort Pulse Induced Micro-Explosion Time Resolved Dynamics in Bulk UV Fused Silica

Presenter: Md Mohsinur Rahman Adnan , *The Ohio State University*

Ultrafast dynamics of ultrafast single pulse induced micro-explosions in bulk fused silica was captured using time resolved shadowgraphy. Experimental and theoretical considerations identify such micro-explosions creating warm dense matter (WDM) states.

Authors: Md Mohsinur Rahman Adnan, The Ohio State University / Abdullah AlShafey, The Ohio State University / justin twardowski, The Ohio State University / noah talisa, The Ohio State University / Michael Tripepi, The Ohio State University / Enam Chowdhury, The Ohio State University

ATh4P.7

Semi-Classical Description of Electron Dynamics in Solids Driven by Intense Laser Fields

Presenter: Mizuki TANI , *The University of Tokyo*

We propose a Vlasov-LDA-based semi-classical approach for laser-driven electron dynamics in solids. We extend the pseudo particle method to periodic systems. The computation results agree excellently with the time-dependent density functional theory and experimental results.

Authors: Mizuki TANI, The University of Tokyo / Tomohito Otobe, National Institutes for Quantum and Radiological Science and Technology / Yasushi Shinohara, The University of Tokyo / Kenichi Ishikawa, The University of Tokyo

ATh4Q

Optical Sensors

Presenter: Alexandra Artusio-Glimpse , *National Inst of Standards & Technology*

ATh4Q.1

Micropolarizer Cameras, the Journey From Specialty to Ubiquity.

Invited

Presenter: Neal Brock , *4D Technology Corporation*

Pixelated micropolarization camera technology is becoming ubiquitous. Its history and the latest developments, including fab-integrated polarizers, color and full-Stokes polarization image sensors as well as applications for the technology, will be discussed.

Authors: Neal Brock, 4D Technology Corporation

ATh4Q.2

Integrated Optical Phased Array for Temperature Sensing

Presenter: Binghui Li , *The Chinese University of Hong Kong (CUHK)*

We report a simple concept to realize an optical phased array for temperature sensing. A maximum sensitivity of 0.0132 o/K was obtained at $\lambda = 1.45 \mu\text{m}$. his work shows the promise of versatile OPA for optical sensing applications.

Authors: Binghui Li, The Chinese University of Hong Kong (CUHK) / Caiming Sun, Peng Cheng Laboratory (PCL) / hongjie wang, The Chinese University of Hong Kong (CUHK) / Xiaomin Nie, Peng Cheng Laboratory (PCL) / Zhenmin Chen, Peng Cheng Laboratory (PCL) / Aidong Zhang, The Chinese University of Hong Kong (CUHK)

ATh4Q.3

Large Dynamic Range Athermal LNOI/TiO₂ Nanobeam Electric Field Sensor

Presenter: XINYU MA , *Tsinghua University*

Integrated optical E-field sensor based on nanobeam cavity is reported. Theoretical E_{min} is 0.15 V/m. Temperature-induced resonant wavelength variation is within 3 pm/C in the range of -40 to 40 C.

Authors: XINYU MA, Tsinghua University / CHIJIE ZHUANG, Tsinghua University / RONG ZENG, Tsinghua University / Weidong Zhou, University of Texas at Arlington

ATh4Q.4

Ring-Shaped Conoscopic Holography for Distance and Tilt Measurement

Presenter: Nicole Grubert , *Chair for Technology of Optical Systems*

We present an approach for a non-contact, simultaneous tilt and distance measurement based on conoscopic holography using a ring-shaped measuring beam, where the spatial frequency and intensity of the resulting interference rings are evaluated.

Authors: Nicole Grubert, Chair for Technology of Optical Systems / Georg König, Chair for Technology of Optical Systems / Jochen Stollenwerk, Chair for Technology of Optical Systems / Peter Loosen, Chair for Technology of Optical Systems

ATh4Q.5

High-Resolution x-ray Fluorescence Imaging Using Structured Illumination

Presenter: Yishay Klein , *Bar Ilan university*

We report a proof of principle experiment demonstrating the use of structured illumination and coincidence for x-ray fluorescence imaging at very high spatial resolution and short measurement time with a conventional x-ray tube.

Authors:Yishay Klein, Bar Ilan university / Or Sefi, Bar Ilan university / Hila Schwartz, Bar Ilan university / Sharon Shwartz, Bar Ilan university

ATh4Q.6

Networked Swept-Source Raman Sensors

Highlighted Talk

Presenter: Nili Persits , *Massachusetts Institute of Technology*

Raman spectroscopy with large-area, spectrally-selective detectors and tunable lasers enables distributed chemical sensing where excitation light can be delivered via optical datacom networks. Distributed sensing over 100's of meters and multiple locations is demonstrated.

Authors:Nili Persits, Massachusetts Institute of Technology / Jaehwan Kim, Massachusetts Institute of Technology / Dodd Gray, Massachusetts Institute of Technology / Amir Atabaki, Massachusetts Institute of Technology / Rajeev Jagga Ram, Massachusetts Institute of Technology

ATh4G

Laser Diodes and Applications

Presenter: Levon Asryan , *Virginia Polytechnic Inst and State Univ*

ATh4G.1

High Power Picosecond Fiber Lasers Based on Active Tapered Double Clad Fiber Amplifiers and Gain Switched Semiconductor Laser Diode as Seed Source

Invited

Presenter: Maxim Odnoblyudov , *Peter the Great St. Petersburg Polytechn*

Detailed study of amplification of signal from gain switched laser diodes by an active tapered double clad fiber amplifiers is presented for variety of cases. We share our recent results on high output power T-DCF laser, high pulse energy T-DCF laser, amplification of narrow band signal, second harmonic generation and amplification of ps pulses at GHz repetition rate. We demonstrate over 500 W of output power, 1,15 MW of peak power and 125 uJ of pulse energy as well as over 30W of green emission when amplifying signal from gain switched LDs and show that T-DCF amplifier is a viable approach to build high power cost effective ps fiber laser with gain switched diode used as a seed source.

Authors: Maxim Odnoblyudov, Peter the Great St. Petersburg Polytechn

ATh4G.2

Optical Frequency Combs From Semiconductor Lasers: Characterization, Stabilization, and Applications

Invited

Presenter: Thomas Südmeyer, *Universite de Neuchatel*

Semiconductor disk lasers and quantum cascade lasers are two of the most promising technologies for cost-efficient, reliable, and mass-producible optical frequency combs. We discuss and compare their current status for comb operation, characterization, and stabilization.

Authors: Thomas Südmeyer, *Universite de Neuchatel*

ATh4G.3

Ultra-Narrow Linewidth GaAs-Based DBR Lasers

Presenter: Sten Wenzel, *Ferdinand-Braun-Institut*

We present a novel approach for GaAs-based DBR diode lasers with an extended cavity. The developed chips exhibit a record small 3 dB linewidth of 25 kHz @ 1 ms at the wavelength of 1064 nm.

Authors: Sten Wenzel, *Ferdinand-Braun-Institut* / Olaf Brox, *Ferdinand-Braun-Institut* / Pietro Della Casa, *Ferdinand-Braun-Institut* / Andrea Knigge, *Ferdinand-Braun-Institut* / Bassem Arar, *Ferdinand-Braun-Institut* / Sergey Nechayev, *Ferdinand-Braun-Institut* / Sabrina Kreuzmann, *Ferdinand-Braun-Institut* / Andreas Wicht, *Ferdinand-Braun-Institut*

ATh4G.4

Photonic Tuning of Silicon Ring Resonators Using an Automated Microfluidic Mixer

Presenter: Christian Carver, *Brigham Young University*

We demonstrate automated tuning of microring resonators using 3D-printed microfluidic control. We use a custom 3D-printer that is capable of printing devices with sub 10 μm features and automatic pumping, mixing, and dilution operations.

Authors: Christian Carver, Brigham Young University / Mawla Boaks, Brigham Young University / JuHang Kim, Brigham Young University / Kevin Larson, Brigham Young University / Gregory Nordin, Brigham Young University / Ryan Camacho, Brigham Young University

ATh4G.5

Enhanced Photon Absorption of Ge-on-Si Avalanche Photodiode With Photon-Trapping Microstructure

Presenter: shaoteng wu , *Nanyang Technological University*

Ge-on-Si avalanche photodiodes with photon-trapping microstructure are designed and demonstrated to enhance the optical absorption. The responsivity is enhanced by 9-20% at the wavelength of 1,500-1,550 nm at -6V with the photon-trapping structures

Authors: shaoteng wu, Nanyang Technological University / Hao Zhou, Nanyang Technological University / Lin Zhang, Nanyang Technological University / Qimiao Chen, Nanyang Technological University / Liangxing Hu, Nanyang Technological University / Chuan Seng Tan, Nanyang Technological University

ATh4G.6

A 2 x 2 Broadband Athermal Mach-Zehnder Interferometer With Sub-Wavelength Adiabatic Couplers

Presenter: Zakriya Mohammed , *New York University-Tandon School of Engineering*

An all-silicon thermally insensitive ($-1.6 \text{ pm}/^{\circ}\text{C}$) Mach-Zehnder interferometer (MZI) has been demonstrated over a broad range of 80 nm from 1540-1620 nm. The proposed MZI employs subwavelength grating (SWG) adiabatic couplers for splitting and combining.

Authors: Zakriya Mohammed, New York University-Tandon School of Engineering / Bruna Paredes, New York University-Abu Dhabi / Mahmoud Rasras, New York University-Abu Dhabi

STh4D

High Energy, High Power Lasers I

Presenter: Wei Fan , *Shanghai Inst of Optics and Fine Mech*

STh4D.1

Present Status and Future Perspectives of High Power Lasers at the NLHPLP Tutorial

Presenter: Jianqiang Zhu , *Shanghai Inst of Optics and Fine Mech*

The current developments of laser facilities at the NLHPLP are presented and the prospect of using low spatial incoherence beams to improve laser irradiation uniformity for direct-drive and indirect drive laser fusion is introduced.

Authors:Jianqiang Zhu, Shanghai Inst of Optics and Fine Mech

STh4D.2

(Withdrawn) kW Average Power Operation of 10 J, 100 Hz Conductive-Cooled Yb:YAG Active Mirror Amplifier

Presenter: Jumpei Ogino , *Inst of Laser Engineering, Osaka Univ*

We report highest power conductive-cooled Yb:YAG active-mirror amplifier (CcAMA) delivering 1 kW average power in 10 J, 100 Hz.

Authors:Jumpei Ogino, Inst of Laser Engineering, Osaka Univ / Shigeki Tokita, Inst of Laser Engineering, Osaka Univ / Shotaro Kitajima, Inst of Laser Engineering, Osaka Univ / Hidetsugu Yoshida, Inst of Laser Engineering, Osaka Univ / Zhaoyang Li, Inst of Laser Engineering, Osaka Univ / Shinji Motokoshi, Institute for Laser Technology / Noboru Morio, Inst of Laser Engineering, Osaka Univ / Koji Tsubakimoto, Inst of Laser Engineering, Osaka Univ / Kana Fujioka, Inst of Laser Engineering, Osaka Univ / Ryosuke Kodama, Inst of Laser Engineering, Osaka Univ / Junji Kawanaka, Inst of Laser Engineering, Osaka Univ

STh4D.3

1.1 J Yb:YAG Picosecond Laser at 1 kHz Repetition Rate

Presenter: Yong Wang , *Colorado State University*

We demonstrate the generation of 1.1 J pulses with a duration of 4.5 ps at 1 kHz repetition rate (1.1 kW average power) from a diode-pumped cryo-cooled chirped pulse amplification Yb:YAG laser.

Authors:Yong Wang, Colorado State University / Han Chi, Colorado State University / Cory Baumgarten, Colorado State University / Kristian Dehne, Colorado State University / Alexander Meadows, Colorado State University / Aaron Davenport, Colorado State University / Gabe Murray, Colorado State University / Brendan Reagan, Colorado State University / Carmen Menoni, Colorado State University / jorge rocca, Colorado State University

STh4D.4

1 J/ 100 Hz Cryogenically-Cooled Yb:YAG Laser Amplifier With ink-Cladding for the Suppression of Parasitic Lasing

Highlighted Talk

Presenter: Shotaro Kitajima , *ILE, Osaka University*

A stable operation of 1.1 J/100 Hz 10 ns laser pulses were achieved from a single cryogenically cooled Yb:YAG rod amplifier with ink-cladding. The efficiency and gain coefficient were 44% and 383, respectively.

Authors:Shotaro Kitajima, ILE, Osaka University / Jumpei Ogino, ILE, Osaka University / Shigeki Tokita, ILE, Osaka University / Zhaoyang Li, ILE, Osaka University / Shinji Motokoshi, Institute of Laser Technology / Noboru Morio, ILE, Osaka University / Koji Tsubakimoto, ILE, Osaka University / Hidetsugu Yoshida, ILE, Osaka University / Kana Fujioka, ILE, Osaka University / Ken-ichi Ueda, ILS, University of Electro-Communications / Ryosuke Kodama, ILE, Osaka University / Junji Kawanaka, ILE, Osaka University

STh4J

Novel Fabrication and Characterization

Presenter: Lih Lin , *University of Washington*

STh4J.1

Implosion Fabrication as a Platform for Three-Dimensional Nanophotonics

Highlighted Talk

Presenter: Brian Mills , *Massachusetts Institute of Technology*

We investigate Implosion Fabrication, a technique which prints arbitrary 3D nanostructures, as a new platform for nanophotonics. We show that optical properties of printed materials are tunable by characterizing the reflectivity of printed silver.

Authors:Brian Mills, Massachusetts Institute of Technology / Yannick Salamin, Massachusetts Institute of Technology / Gaojie Yang, Massachusetts Institute of Technology / Daniel Oran, Massachusetts Institute of Technology / Yi Sun, Massachusetts Institute of Technology / Shai Maayani, Massachusetts Institute of Technology / Steven Kooi, Institute for Soldier Nanotechnology / Amel Elawad, Massachusetts Institute of Technology / Josue Lopez, Massachusetts Institute of Technology / Corban Swain, Massachusetts Institute of Technology / Justin Beroz, Massachusetts Institute of Technology / Jamison Sloan, Massachusetts Institute of Technology / Edward Boyden, Massachusetts Institute of Technology / Marin Soljačić, Massachusetts Institute of Technology

STh4J.2

Versatile Micro-Fabricated Mirrors With Finesse >700,000

Presenter: Naijun Jin , *Yale University*

We introduce a micro-fabrication technique for high-finesse optical mirrors based on reflow and smooth reactive ion etch. These mirrors support $>700,000$ finesse with surface losses constrained to ~ 1.2 ppm.

Authors: James Hendrie, National Institute of Standards and Technology / Naijun Jin, Yale University / Charles McLemore, National Institute of Standards and Technology / Yizhi Luo, Yale University / Megan Kelleher, National Institute of Standards and Technology / David Mason, Yale University / Prashanta Kharel, Yale University / Franklyn Quinlan, National Institute of Standards and Technology / Peter Rakich, Yale University / Scott Diddams, National Institute of Standards and Technology

STh4J.3

Nanocomposite-Seeded Single-Domain Growth of Lithium Niobate Thin Films for Photonic Applications

Presenter: Robyn-Lynne Paldi, *Purdue University*

Epitaxial single-domain LiNbO_3 thin-films are realized using a novel nanocomposite seeding method. Full microstructure characterization and optical property measurement is conducted as a first step to demonstrate viability of this material for integrated photonics applications.

Authors: Robyn-Lynne Paldi, Purdue University / Arjun Aryal, University of New Mexico / Mahmoud Behzadirad, University of New Mexico / Tito Busani, University of New Mexico / Aleem Siddiqui, Sandia National Labs / Haiyan Wang, Purdue University

STh4J.4

Probing the Limits of Optical Loss in Ion-Sliced Thin-Film Lithium Niobate

Presenter: Amirhassan Shams-Ansari, *Harvard University*

We measured the absorption-limited loss at telecommunication wavelengths for thin-film lithium niobate micro-ring resonators using the Kerr-calibrated linear response technique. We find the average absorption loss-rate $\kappa_{\text{abs}}/2\pi$ to be 3.65 ± 0.70 MHz, corresponding to a Q-factor of ~ 55 Million.

Authors: Amirhassan Shams-Ansari, Harvard University / Guanhao Huang, Swiss Federal Institute of Technology Lausanne (EPFL) / Lingyan He, Hyperlight Corporation / Mikhail Churaev, Swiss Federal Institute of Technology Lausanne (EPFL) / Prashanta Kharel, Hyperlight Corporation / Zelin Tan, Swiss Federal Institute of Technology Lausanne (EPFL) / Jeffrey Holzgrafe, Harvard University / Rebecca Cheng, Harvard University / Di Zhu, Harvard University / Junqiu Liu, Swiss Federal Institute of Technology Lausanne (EPFL) / Boris Desiatov, Harvard University / Mian Zhang, Hyperlight Corporation / Tobias Kippenberg, Swiss Federal Institute of Technology Lausanne (EPFL) / Marko Loncar, Harvard University

STh4J.6

Localized Excitation of Silicon Photonic Waveguides and Measurement of Free-Carrier Lifetime and Surface Recombination Velocity

Presenter: Patrick Goley , *Georgia Institute of Technology*

A pulsed 639 nm laser is focused to strongly excite 1- μm scale lengths of silicon photonic waveguide. Extraction of the local free-carrier lifetime and recombination velocity information from time-resolved transmission of a continuous 1535 nm probe laser is presented.

Authors:Patrick Goley, Georgia Institute of Technology / Edward Preisler, Tower Semiconductor / John Cressler, Georgia Institute of Technology

STh4J.7

Deep Learning Method for Quantum Efficiency Reconstruction

Presenter: yonatan sharabi , *Technion*

We suggest a new scheme for measuring the quantum efficiency of camera sensors based on the reflection from a variable width Fabry-Perot resonator and a deep learning algorithm, outperforming standard reconstruction methods.

Authors:yonatan sharabi, Technion / Anatoly Patsyk, Technion / Ron Ziv, Technion / Mordechai segev, Technion

STh4J.5

Plasma-Free Anisotropic Etching of GaN

Presenter: Clarence Chan , *University of Illinois at Urbana-Champaign*

We demonstrate doping and growth dependent photo-enhanced metal-assisted chemical etching of homoepitaxial n-GaN on HVPE GaN substrates. Etch rate is comparable to or better than using RIE and there is no degradation of band-edge emission.

Authors:Clarence Chan, University of Illinois at Urbana-Champaign / Shunya Namiki, University of Illinois at Urbana-Champaign / Jennifer Hite, U.S. Naval Research Laboratory / Xiuling Li, University of Illinois at Urbana-Champaign

STh4O

Metastructure-Based Nanophotonic Devices

Presenter: Mo Li , *University of Washington*

STh4O.1

Long-Range and Macroscale Manipulation Enabled by Photonic Metasurfaces

Invited

Presenter: Ognjen Ilic , *University of Minnesota*

We discuss a novel mechanism to control radiation pressure by photonic metasurfaces that steer and bend light. Such a mechanism can facilitate a new approach to optical levitation and propulsion at the macro scales.

Authors:Ognjen Ilic, University of Minnesota

STh40.2

Extended Depth of Focus Metalenses for Achromatic Computational Imaging

Presenter: Luo Cheng Huang , *University of Washington*

We demonstrate high-quality, full-color imaging using extended depth of focus (EDOF) metalenses and computational reconstruction. We use rotationally symmetrical phase masks to mitigate asymmetrical artifacts found in the traditional cubic EDOF systems.

Authors:Luo Cheng Huang, University of Washington / James Whitehead, University of Washington / Shane Colburn, University of Washington / Arka Majumdar, University of Washington

STh40.3

All-Silicon, Optics-Free Microspectrometer Chip Based on Vertical Waveguide Array Pixels

Presenter: Jasper Cadusch , *University of Melbourne*

We experimentally demonstrate a nanostructured silicon microspectrometer chip that consists of 144 pixels, each comprising an array of vertical waveguides of subwavelength period. We show that both broad- and narrow-band visible spectra can be reconstructed. © 2020 The Authors

Authors:Jasper Cadusch, University of Melbourne / Jiajun Meng, University of Melbourne / Dandan Wen, University of Melbourne / Kenneth Crozier, University of Melbourne

STh40.4

Nanoscale Multiband Surface-Enhanced Raman Spectroscopy by Multiresonant Nanolaminate Plasmonics

Presenter: Meitong Nie , *Virginia Tech*

By supporting multiple hybridized plasmonic modes within individual nanocavities, metal-insulator-metal nanolaminate plasmonic nanostructures on nanopillar arrays can enable nanoscale multiband SERS with large enhancement factors ($> 10^6$) over a wide visible to near-infrared spectral range.

Authors: Meitong Nie, Virginia Tech / Yuming Zhao, Virginia Tech / Wonil Nam, Virginia Tech / Junyeob Song, Virginia Tech / Wei Zhou, Virginia Tech

STh40.5

Photonic Crystal Optical Parametric Oscillator

Presenter: Alfredo De Rossi, *Thales Research & Technology*

A 20 μ m-long Photonic Crystal cavity has been engineered to achieve triply resonant parametric interaction at telecom wavelength and operate as an optical parametric oscillator. The pump power threshold is estimated to about 50 μ W.

Authors: Gabriel Marty, Centre de Nanosciences et de Nanotechnologies, CNRS, Universit\{e} Paris Sacla / Sylvain Combri , Thales Research & Technology / Fabrice Raineri, Centre de Nanosciences et de Nanotechnologies, CNRS, Universit\{e} Paris Sacla / Alfredo De Rossi, Thales Research & Technology

STh40.6

Telecom Wavelength Carbon Nanotube Emitter Integrated in Hybrid Photonic Crystal Cavity

Presenter: Anna Ovvyan, *University of M nster*

We developed hybrid graphene-Si₃N₄ cross-bar photonic crystal cavity devices, strengthening light interaction with the coupled carbon nanotube leading to generation of an enhanced electroluminescent signal in telecom wavelength band.

Authors: Anna Ovvyan, University of M nster / Felix Pyatkov, Karlsruhe Institute of Technology / Min-Ken Li, Karlsruhe Institute of Technology / Helge Gehring, University of M nster / Fabian Beutel, University of M nster / Sandeep Kumar, Karlsruhe Institute of Technology / Ralph Krupke, Karlsruhe Institute of Technology / Wolfram Pernice, University of M nster

STh40.7

Lasing From TM Mode Photonic Crystal Nanobeam Cavity

Presenter: taesue ryu, *Kongju National University*

We demonstrated lasing from TM modes in photonic nanobeam cavities. By varying the radius of air holes, Q-factor reaches around 1,000,000. The single-mode lasing action was performed at room temperature, and confirmed by numerical results.

Authors:taesue ryu, Kongju National University / sangwoo ki, Kongju National University / jinkyu yang, Kongju National University / hwimin kim, Korea Advanced Institute of Science and Technology / yonghee lee, Korea Advanced Institute of Science and Technology

STh4N

Ultrafast Amplifiers

Presenter: Ming-wei Lin , *National Tsing Hua University*

STh4N.1

MTW-OPAL - a Technology Development Platform for Ultra-Intense All-OPCPA Systems

Invited

Presenter: Jake Bromage , *University of Rochester*

Activation results will be presented for MTW-OPAL, a new all-OPCPA laser using technologies suitable for kilojoule-femtosecond systems, highlighting 140-nm-wide amplification in DKDP to >10 J with 30% efficiency and subsequent recompression to 20 fs.

Authors: Jake Bromage, University of Rochester / Seung-Whan Bahk, University of Rochester / Ildar Begishev, University of Rochester / Sara Bucht, University of Rochester / Christophe Dorrer, University of Rochester / Chengyong Feng, University of Rochester / Brittany Hoffman, University of Rochester / Cheonha Jeon, University of Rochester / Chad Mileham, University of Rochester / James Oliver, University of Rochester / Richard Roides, University of Rochester / Milton Shoup, University of Rochester / Mike Spilatro, University of Rochester / Ben Webb, University of Rochester / Jonathan Zuegel, University of Rochester

STh4N.2

1 MHz, few-Cycle, CEP Stable OPCA With Dual Channel Output at 800 nm and 2 μ m Wavelength

Presenter: Jan Buss , *Class 5 Photonics GmbH*

A high repetition rate, optical parametric chirped-pulse amplifier (OPCPA) with dual output at 800 nm and 2 μm is presented. White light seeded, CEP stabilized pulses with 9.1 fs are achieved on less than a square-meter footprint

Authors: Thomas Braatz, Class 5 Photonics GmbH / Sebastian Starosielec, Class 5 Photonics GmbH / Ekatarina Zapolnova, Class 5 Photonics GmbH / Torsten Golz, Class 5 Photonics GmbH / Ivanka Grguras, Class 5 Photonics GmbH / Jan Buss, Class 5 Photonics GmbH / Michael Schulz, Class 5 Photonics GmbH / Robert Riedel, Class 5 Photonics GmbH

STh4N.3

Generation and Amplification of High Power Ultrafast mid-Infrared Pulses Through ZGP

Presenter: Fangjie Zhou , *University of Central Florida*

We present the generation of femtosecond pulses centered at 3 and 8 μm through a ZnGeP₂-based Optical Parametric Chirped Pulse Amplifier. The output can be used for a two-color high harmonic generation scheme

Authors: Fangjie Zhou, University of Central Florida

STh4N.4

Robust Self-Referenced Generator of Programmable Multi-Millijoule THz-Rate Bursts

Presenter: Vinzenz Stummer , *TU Wien*

We demonstrate a technique for the programmable generation and multi-millijoule amplification of ultrashort pulse bursts, which can be applied to any master-oscillator regenerative-amplifier system with very low implementation complexity and high stability in burst performance.

Authors: Vinzenz Stummer, TU Wien / Tobias Flöry, University of Vienna / Andrius Baltuska, TU Wien / Edgar Kaksis, TU Wien / Audrius Pugzlys, TU Wien

STh4N.5

High-Peak Power Polarization-Multiplexed Yb:CaF₂ Dual-Comb Solid-State Laser With 100-fs Pulse Duration

Presenter: Justinas Pupeikis , *ETH Zurich*

We demonstrate a diode-pumped Yb:CaF₂ dual-comb oscillator at 80-MHz repetition rate. The common-path polarization-multiplexed cavity delivers >2.1 W of output power in each comb with 100-fs pulse duration exceeding 230-kW peak power.

Authors: Justinas Pupeikis, ETH Zurich / Benjamin Willenberg, ETH Zurich / Carolin Bauer, ETH Zurich / Christopher Phillips, ETH Zurich / Ursula Keller, ETH Zurich

STh4N.6

Nonlinear Fiber Amplifier for Intensity-Noise Reduction to the Shot-Noise Limit

Presenter: Marvin Edelmann , *Center for Free-Electron Laser Science*

We demonstrate an all-PM fiber amplifier for intensity-noise reduction of pulsed input signals. Based on the nonlinear phase difference accumulation of copropagating orthogonal polarization modes in a PM-fiber, shot-noise limited noise reduction is verified.

Authors:Marvin Edelmann, Center for Free-Electron Laser Science / Yi Hua, Center for Free-Electron Laser Science / Kemal Shafak, Cycle GmbH / Franz Kärtner, Center for Free-Electron Laser Science

STh4N.7

Generation of 95 fs mid-IR Pulses With 1.8 W Average Power Using an Er:ZrF₄ Fiber Mode-Locked Oscillator and a Nonlinear Amplifier

Presenter: Yifan Cui , *University of Michigan*

Ultrashort mid-IR pulse train with 95 fs pulse width, 37.4 nJ pulse energy and 1.8 W average power was generated at ~2.85 μm from a simple Er:ZrF₄ fiber nonlinear amplifier seeded by a mode-locked oscillator.

Authors:Yifan Cui, University of Michigan / Weizhi Du, University of Michigan / Mingshu Chen, University of Michigan / Almantas Galvanauskas, University of Michigan

STh4B

Novel Photonics

Presenter: Alan Wang , *Oregon State University*

STh4B.1

Machine Learning and Inverse Design for High Performance Nanophotonics: Some Perspectives

Invited

Presenter: Dan-Xia Xu , *National Research Council Canada*

We review current trends in machine learning (ML) photonic design, highlight our own effort in using ML dimensionality reduction to tackle complex design problems, and present an efficient approach in generating robust topological inverse designs.

Authors:Dan-Xia Xu, National Research Council Canada

STh4B.2

Photonic Modal Circulator Using Dynamic Modulation With Mirror Symmetry

Presenter: Jiahui Wang , *Stanford University*

We show that a modal circulator can be achieved in a dynamically-modulated structure that preserves mirror symmetry. Such circulators can be implemented using only a single standing-wave modulator, which greatly simplifies the design of on-chip non-reciprocal devices based on dynamic modulations.

Authors: Jiahui Wang, Stanford University / Jason Herrmann, Stanford University / Jeremy Witmer, Stanford University / Amir Safavi-Naeini, Stanford University / Shanhui Fan, Stanford University

STh4B.3

Residual Amplitude Modulation Reduction in Integrated Indium Phosphide Phase Modulators

Presenter: Victoria Rosborough , *University of California, Santa Barbara*

A novel indium phosphide Mach-Zehnder interferometer with directional couplers was realized to compensate residual amplitude modulation in integrated phase modulators. The change in transmission for π phase shift was reduced from 3.85 dB to 1.98 dB.

Authors: Victoria Rosborough, University of California, Santa Barbara / Joseph Fridlander, University of California, Santa Barbara / Fengqiao Sang, University of California, Santa Barbara / Fabrizio Gambini, University of California, Santa Barbara / Simone Brunelli, University of California, Santa Barbara / Jeffrey Chen, NASA Goddard Space Flight Center / Stephan Kawa, NASA Goddard Space Flight Center / Kenji Numata, NASA Goddard Space Flight Center / Mark Stephen, NASA Goddard Space Flight Center / Larry Coldren, University of California, Santa Barbara / Jonathan Klamkin, University of California, Santa Barbara

STh4B.4

Electro Optical Waveguide Based on Embedded Double-Monolayer Graphene Capacitor

Presenter: JHONATTAN CORDOBA RAMIREZ , *Federal University of Minas Gerais*

We report design, fabrication, and characterization of an electro-optical waveguide with embedded double-layer graphene capacitor. Optical absorption change of 15 dB/(cm-V) over 1546-1556 nm wavelength range was demonstrated based on the electrical Fermi level control.

Authors: JHONATTAN CORDOBA RAMIREZ, Federal University of Minas Gerais / Nadir Dagli, University of California at Santa Barbara

STh4B.5

On-Chip Electrically Driven 780 nm Frequency-Shifting Optical Isolation

Presenter: Josephine Melia , *University of Illinois at Urbana-Champaign*

We demonstrate a 780 nm frequency-shifting optical isolator in a silicon nitride and aluminum nitride integrated photonics platform. The device uses non-reciprocity in a racetrack resonator through the action of electrically driven Rayleigh acoustic waves.

Authors: Donggyu Sohn, University of Illinois at Urbana-Champaign / Josephine Melia, University of Illinois at Urbana-Champaign / Soonwook Kim, University of Illinois at Urbana-Champaign / Oğulcan Örsel, University of Illinois at Urbana-Champaign / Gaurav Bahl, University of Illinois at Urbana-Champaign

STh4B.6

Very High-Q Photonic Microdisk Resonator in an air-Clad, Thin-Film SiN at Near-Visible Wavelengths

Presenter: Ali Eshaghian Dorche , *Georgia Institute of Technology*

Very high-Q photonic microdisk resonators in an air-clad thin-film SiN platform at near-visible wavelengths is demonstrated. The high Qs enabled by fabrication optimization result in better coherent interaction with atoms.

Authors: Ali Eshaghian Dorche, Georgia Institute of Technology / Chandra Raman, Georgia Institute of Technology / Ali Adibi, Georgia Institute of Technology

STh4B.7

Monolithic Amorphous Hybrid Plasmonic Circuits

Presenter: Charles Lin , *University of Toronto*

We experimentally demonstrated a versatile and amorphous-based plasmonic waveguide architecture, enabling micro-ring resonators with record Purcell factor of 81241, modulator with record <1 dB insertion loss, and photodetector with record -54 dBm sensitivity

Authors: Charles Lin, University of Toronto / PoHan Chang, University of Toronto / Amr Helmy, University of Toronto

STh4A

Precision Spectroscopy and Miniaturization Technology

Presenter: Franklyn Quinlan , *National Inst of Standards & Technology*

STh4A.1

Centimeter-Scale, Rigidly Held, Thermal Noise-Limited Optical Cavity for Mobile Applications

Presenter: Megan Kelleher , *NIST*

We present a rigidly held 6.3 mm-long, 6 mL-volume optical reference cavity. A laser stabilized to the cavity supports thermal noise-limited phase noise near -160 dBc/Hz at 1 kHz offset on a 10 GHz carrier.

Authors: Megan Kelleher, NIST / Takuma Nakamura, NIST / Josue Davila-Rodriguez, NIST / Charles McLemore, NIST / James Hendrie, NIST / Scott Diddams, NIST / Franklyn Quinlan, NIST

STh4A.2

Chip Scale Optical Pumping Using Atomic Cladded Tapered Nano Waveguides With Buffer gas

Presenter: Roy Zektzer , *The hebrew university of Jerusalem*

We experimentally demonstrate chip-scale optical pumping of Rubidium vapor based on novel atomic-cladded tapered nano-waveguides with different buffer-gas pressures. Precise control over the interaction volume and coupling enables the optimization of the atomic polarization

Authors: Roy Zektzer, The hebrew university of Jerusalem / Elran Talker, The hebrew university of Jerusalem / Noa Mazurski, The hebrew university of Jerusalem / Barash Yefim, The hebrew university of Jerusalem / Uriel Levy, The hebrew university of Jerusalem

STh4A.3

Precision Measurements With Optical Frequency Combs: From Absolute Frequencies to Two-Way Time Transfer

Invited

Presenter: Holly Leopardi , *Space Dynamics Laboratory*

I will present an overview of applications demonstrating the power and versatility of optical frequency combs including absolute atomic frequency and ratio measurements as well as two-way optical time and frequency transfer.

Authors: Holly Leopardi, Space Dynamics Laboratory

STh4A.4

Differential Spectroscopy of Atomic Clocks for Improved Measurement Instability

Presenter: Nicholas Nardelli , *NIST*

Using frequency comb mediated phase-coherent and synchronous clock comparisons we demonstrate close to a factor of 10 improvement in short-term measurement instability, $s_y(t) < 2 \times 10^{-16}$ @ 1s averaging, between ^{171}Yb and $^{27}\text{Al}^+$ optical clocks.

Authors: Nicholas Nardelli, NIST / Xiaogang Zhang, NIST / Ethan Clements, NIST / May Kim, NIST / Youssef Hassan, NIST / William McGrew, NIST / Kyle Beloy, NIST / Andrew Ludlow, NIST / David Leibbrandt, NIST / David Hume, NIST / Tara Fortier, NIST

STh4A.5

Demonstration of an Integrated Nanophotonic Chip-Scale Alkali Vapor Magnetometer Using Inverse Design

Presenter: Yoel Sebbag, *The Hebrew University of Jerusalem*

We demonstrate an integrated alkali-based magnetometer with micrometer-scale spatial resolution. The device consists of an inverse designed polarimeter and a 30 μm long miniaturized Rb vapor cell. It shows a magnetic sensitivity of $700 \text{ pT}/\sqrt{\text{Hz}}$.

Authors: Yoel Sebbag, The Hebrew University of Jerusalem / Elran Talker, The Hebrew University of Jerusalem / Alex Naiman, The Hebrew University of Jerusalem / Barash Yefim, The Hebrew University of Jerusalem / Uriel Levy, The Hebrew University of Jerusalem

STh4A.6

Laser Cooling Using Metasurface-Enabled Beam Shaping

Presenter: William McGehee, *NIST*

We present laser cooling of atomic Rb using a metasurface optic for beam shaping and polarization control. This technology will enable miniaturized quantum devices and calibration-free sensors utilizing the properties of cold atoms.

Authors: William McGehee, NIST / Wenqi Zhu, NIST / Daniel Barker, NIST / Daron Westly, NIST / Alexander Yulaev, NIST / Nikolai Klimov, NIST / Amit Agrawal, NIST / Stephen Eckel, NIST / Vladimir Aksyuk, NIST / Jabez McClelland, NIST

STh4A.7

Multi-Beam Integration for on-Chip Quantum Devices

Presenter: Chad Ropp, *National Institute of Standards and Technology*

We photonically generate 12 free-space well-collimated beams at 461 nm and 689 nm wavelengths with customized beam profiles and emission angles needed for a Sr MOT. The device advanced photonics interfaces for atomic physics.

Authors: Chad Ropp, National Institute of Standards and Technology / Alexander Yulaev, National Institute of Standards and Technology / Wenqi Zhu, National Institute of Standards and Technology / Daron Westly, National Institute of Standards and Technology / Gregory Simelgor, National Institute of Standards and Technology / Amit Agrawal, National Institute of Standards and Technology / Scott Papp, National Institute of Standards and Technology / Vladimir Aksyuk, National Institute of Standards and Technology

JTh4C

Special Symposium - Super Symposium on Advances in Quantum Technologies: Quantum Lidars and Super Resolution

Presider: Zeev Zalevsky , *Bar-Ilan University*

JTh4C.1

Sensing Vector and OAM Modes From the Randomly Scattered Light Fields

Invited

Presenter: Rakesh Singh , *Indian Institute of Technology (BHU)*

Propagation of light through random scattering medium scrambles information and generates randomness. This paper covers some of our works towards measuring incident light modes from the random pattern.

Authors:Rakesh Singh, Indian Institute of Technology (BHU)

JTh4C.2

Phase-Insensitive Target Detection and Ranging Aided by Continuous-Wave Photon-Pair Sources

Presenter: Han Liu , *University of Toronto*

We demonstrate 26.3dB performance enhancement of phase-insensitive target detection and ranging resolution $\approx 5\text{cm}$ using continuous-wave photon pairs. The receiver operating characteristic analysis shows a detection-time reduction of 57 for fixed false-positive (10^{-6}) and detection rates.

Authors:Han Liu, University of Toronto / Amr Helmy, University of Toronto

JTh4C.3

Entanglement-Assisted Absorption Spectroscopy

Presenter: Haowei Shi , *University of Arizona*

We propose a practical transmitter-receiver system that exploits entanglement to achieve a provable quantum advantage over all spectrometers based on classical sources. The quantum advantage is robust against noise and loss.

Authors:Haowei Shi, University of Arizona / Zheshen Zhang, University of Arizona / Stefano Pirandola, University of York / Quntao Zhuang, University of Arizona

JTh4C.4

Sub-ps Resolution Time-Correlated Single Photon Counting Through Time Magnification

Presenter: Bowen Li , *University of Colorado, Boulder*

500-fs temporal resolution is achieved in time-correlated single photon counting for the first time with the assistance of a fiber parametric time magnifier. Time-of-flight depth imaging of a glass sample is demonstrated with 75- μm resolution.

Authors: Bowen Li, University of Colorado, Boulder / Jan Bartos, University of Colorado, Boulder / Yijun Xie, University of Colorado, Boulder / Shu-wei Huang, University of Colorado, Boulder

JTh4C.5

Machine Learning Assisted Quantum Super-Resolution Microscopy

Presenter: Zhaxylyk Kudyshev , *Purdue*

A machine learning assisted framework significantly speeds up image acquisition in super-resolution microscopy based on photon antibunching. The technique is compatible with a CW excitation regime and applicable to a wide range of quantum emitters.

Authors: Zhaxylyk Kudyshev, Purdue / Demid Sychev, Purdue / Zachariah Martin, Purdue / Simeon Bogdanov, University of Illinois at Urbana-Champaign / Xiaohui Xu, Purdue / Alexander Kildishev, Purdue / Alexandra Boltasseva, Purdue / Vladimir Shalaev, Purdue

JTh4C.6

The Advantages of Photon Number Resolution for Ranging and LiDAR Applications

Invited

Presenter: Hagai Eisenberg , *Hebrew University of Jerusalem*

By using photon number resolution capabilities we demonstrate optical sensing at extremely low signal vs. dominant background levels scenarios. The combination of LiDAR and compressed sensing technologies enhances the signal to noise ratio even further.

Authors: Hagai Eisenberg, Hebrew University of Jerusalem / Yoni Sher, Hebrew University of Jerusalem / Daniel Istrate, Hebrew University of Jerusalem / Lior Cohen, Hebrew University of Jerusalem / Michael Levin, Hebrew University of Jerusalem

ATh4E

Optical Energy Conversion and Radiative Cooling

Presenter: Daniel Law , *The Boeing Company*

ATh4E.1

Power Beaming for Deep Space and Permanently Shadowed Regions

Invited

Presenter: Jonathan Grandidier , *Jet Propulsion Laboratory*

Power beaming involves the wireless transfer of power, and could provide a revolutionary new way to power spacecraft and vehicles operating in difficult to access regions such as permanently shadowed regions (PSR).

Authors:Jonathan Grandidier, Jet Propulsion Laboratory

ATh4E.2

Design of Nighttime Power Generation System to Optimally Utilize Outer Space Darkness

Presenter: Lingling Fan , *Stanford University*

We present a systematic optimization of nighttime thermoelectric power generation system utilizing radiative cooling. We show that an electrical power density $> 2\text{W/m}^2$ two orders of magnitude higher than previous works, is achievable using existing technologies.

Authors:Lingling Fan, Stanford University / Wei Li, Stanford University / Weiliang Jin, Stanford University / Meir Orenstein, Technion / Shanhui Fan, Stanford University

ATh4E.3

A Triple-Mode Mid-Infrared Modulator for All-Surface Radiative Thermal Management

Presenter: Po-Chun Hsu , *Duke University*

We demonstrate a mid-infrared modulator that can switch among reflectance, emittance, and transmittance by mechanical actuation. The triple-mode modulation allows heating/cooling for objects with all emissivity, thereby increase the versatility of radiative heat management.

Authors:Haoming Fang, Duke University / Wanrong Xie, Duke University / Xiuqiang Li, Duke University / Kebin Fan, Duke University / Yi-Ting Lai, Duke University / Bowen Sun, Duke University / Shulin Bai, Duke University / Willie Padilla, Duke University / Po-Chun Hsu, Duke University

ATh4E.4

Design, Fabrication, Measurement, and Applications of High-Performance Thermophotovoltaic

Invited

Presenter: Brendan Kayes , *Antora Energy*

Dr. Kayes will review the requirements for high-efficiency thermophotovoltaic devices, and explore how these attributes can be realized with thin-film III/V devices with highly-reflective back contacts.

Authors:Brendan Kayes, Antora Energy

ATh4E.5

Passive Radiative Cooling for the Temperature and Efficiency Control of Photovoltaics

Presenter: George Perrakis , *Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology-Hellas (FORTH)*

We present a radiative cooling approach for photovoltaic cells' temperature and efficiency evaluation. We derive the maximum temperature-drop requirements and apply the approach in a nano-micro-grating remarkably enhancing both thermal radiation emission and solar absorption.

Authors:George Perrakis, Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology-Hellas (FORTH) / Anna Tasolamprou, Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology-Hellas (FORTH) / George Kenanakis, Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology-Hellas (FORTH) / Eleftherios Economou, Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology-Hellas (FORTH) / Stelios Tzortzakis, Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology-Hellas (FORTH) / Maria Kafesaki, Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology-Hellas (FORTH)

ATh4E.6

Inverse Design Inspired VO₂ Smart Window Film

Presenter: Hassna Ouassal , *Washington State University*

Inspired from inverse design methodology, a smart window film is designed utilizing VO₂ material. The structure enables high visible, low near infrared transmittance and high visible and near infrared transmittance at high and low temperatures, respectively.

Authors:Hassna Ouassal, Washington State University / Han Ren, Washington State University / Steve Rebollo, Applied Materials Division, Argonne National Laboratory / Jie Li, Applied Materials Division, Argonne National Laboratory / Bayaner Arigong, Washington State University

ATh4R

ATTR: Space Optics II: Astronomical Imaging

Presenter: Jennifer Wiseman , *NASA Goddard Space Flight Center*

ATh4R.1

The James Webb Space Telescope and Beyond: Cross-Cutting Optics Innovations in NASA Space Science Missions

Invited

Presenter: Mark Clampin , *NASA Goddard Space Flight Center*

The Hubble Space Telescope is entering its fourth decade of science operations and continues to have a major impact on astronomy and astrophysics. The James Webb Space Telescope (JWST) is expected to have a similar ground-breaking impact as its predecessor, and its launch rapidly approaches. I will discuss the optical design of JWST and review its capabilities. In the broad context of JWST's design, I will review the innovations required for the next generation of large space telescopes currently under consideration by the National Academy for Astro2020, and the science goals that drives the. I will also look further into the future to consider the possibilities offered by new disruptive optical technologies for future NASA missions.

Authors:Mark Clampin, NASA Goddard Space Flight Center

ATh4R.2

Worlds Beyond: Detecting and Characterizing Exoplanets With Precision Technology

Invited

Presenter: Dimitri Mawet , *California Institute of Technology*

This talk will review the state of the art of exoplanet direct detection and characterization using high contrast imaging techniques and technologies, which hold the promise to unveil the fundamental properties of these alien worlds.

Authors:Dimitri Mawet, California Institute of Technology

ATh4R.3

Imaging a Black Hole With the Event Horizon Telescope

Invited

Presenter: Shep Doeleman , *Harvard University*

Until recently, no one had ever seen what a black hole actually looked like. Einstein's theories predict that a distant observer should see a ring of light encircling the black hole, which forms when radiation emitted by infalling hot gas is lensed by the extreme gravity near the event horizon. The Event Horizon Telescope (EHT) is a global array of radio dishes, linked together by a network of atomic clocks to form an Earth-sized virtual telescope that can resolve the nearest supermassive black holes where this ring feature may be measured. On April 10th, 2019, the EHT project reported success: we have imaged a black hole, and have seen the predicted strong gravitational lensing that confirms the theory of General Relativity at the boundary of a black hole. This talk will cover how this was accomplished, details of the first results, as well as future directions that will enable real-time black hole movies.

Authors:Shep Doeleman, Harvard University

ATh4R.4

The Universe in High Energy: X-Ray Optics for Space Telescopes

Invited

Presenter: Kristin Madsen , *NASA Goddard Space Flight Center*

In this talk, I will review the technology that enables the observation of the X-ray sky and discuss what kind of astrophysics phenomena we investigate and what we have learned.

Authors:Kristin Madsen, NASA Goddard Space Flight Center

20:00 - 22:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

STh5B

2D Materials and Topological Photonics

Presenter: Michael Duncan , *The Optical Society*

STh5B.1

Platform for Electrically Reconfigurable Ring Resonator Based on TMD-Graphene Composite Waveguides

Presenter: Ipshita Datta , *Columbia University*

We show a platform for electrically tuning the degree of coupling in micro-ring resonators from the under-coupled to the over-coupled regime, based on graphene-TMD composite waveguides.

Authors:Ipshita Datta, Columbia University / Oscar Jimenez Gordillo, Columbia University / Sang Hoon Chae, Columbia University / James Hone, Columbia University / Michal Lipson, Columbia University

STh5B.2

High-Performance Silicon/Graphene Photodetector Employing Double Slot Structure

Presenter: Siqi Yan , *DTU Fotonik*

We demonstrate an integrated silicon/graphene photodetector, consisting of plasmonic slot and silicon slot waveguides, with the responsivity higher than 600 mA/W and the bandwidth larger than 40 GHz.

Authors:Siqi Yan, DTU Fotonik / Yan Zuo, DTU Fotonik / Sanshui Xiao, DTU Fotonik / Leif Oxenløwe, DTU Fotonik / Yunhong Ding, DTU Fotonik

STh5B.3

Broadband Photodetection of MoS₂/p-Ge/n-Ge Bipolar Heterojunction Phototransistor

Presenter: Youngseo Park , *Ajou University*

MoS₂/p-Ge/n-Ge bipolar heterojunction phototransistor is fabricated, which can detect from VIS to NIR. The responsivities are 35.21 and 133.56 A/W at 466 and 1550 nm, respectively. Photocurrent amplification of BHP, 6 times larger than photocurrent of p-Ge/n-Ge and p-Ge/MoS₂ photodiodes.

Authors: Youngseo Park, Ajou University / Au Jin Hwang, Ajou University / Chanho Lee, Soongsil University / Geonwook Yoo, Soongsil University / Junseok Heo, Ajou University

STh5B.4

Gate-CONTROLLED Schottky HETEROJUNCTIONS PHOTODETECTOR BASED ON GRAPHENE-SILICON-GRAPHENE

Presenter: Fengsong Qian, *Beijing University of Technology*

We report a graphene-silicon-graphene-based photodetector with two opposite Schottky heterojunctions. Through the tuning of gate voltage, the device can obtain high photoconductivity gain and achieve excellent optical detection performance.

Authors: Fengsong Qian, Beijing University of Technology / Liangchen Hu, Beijing University of Technology / Qihua Wang, Beijing University of Technology / Jie Sun, Beijing University of Technology / Yiyang Xie, Beijing University of Technology / Chen Xu, Beijing University of Technology

STh5B.5

High Responsivity GaAs Photodiodes With Self-Embedded Graphene Quantum Dots Through one-Step Chemical Etching

Presenter: Hsien-Chih Huang, *University of Illinois Urbana-Champaign*

GaAs photodiodes with self-embedded graphene quantum dots and antireflection texture are formed by one-step etching. An enhancement of photocurrent and photoresponsivity (9.31 mA/W) by ~22X and ~25X, respectively, with respect to the planar counterpart is demonstrated.

Authors: Hsien-Chih Huang, University of Illinois Urbana-Champaign / Shunya Namiki, University of Illinois Urbana-Champaign / Julio Soares, University of Illinois Urbana-Champaign / Xihang Wu, University of Illinois Urbana-Champaign / Jeong Dong Kim, University of Illinois Urbana-Champaign / Bill Jiang, University of Illinois Urbana-Champaign / Vaanchit Srikumar, University of Illinois Urbana-Champaign / Xiuling Li, University of Illinois Urbana-Champaign

STh5B.6

Long-Range Propagation of Indirect Excitons in MoSe₂/WSe₂ van der Waals Heterostructure

Presenter: Lewis Fowler-Gerace, *University of California, San Diego*

We realize long-range propagation of indirect excitons in a MoSe₂/WSe₂ heterostructure. The data show that the long-range propagation of indirect excitons is possible in van der Waals heterostructures with the predicted moiré superlattice potentials.

Authors: Lewis Fowler-Gerace, University of California, San Diego / Darius Choksy, University of California, San Diego / Leonid Butov, University of California, San Diego

STh5B.7

Broadband Power Coupling and Splitting in Photonic Thouless Pump Systems

Presenter: Lu Sun , *Shanghai Jiao Tong University*

By utilizing the topological transport property of Thouless pump, we experimentally demonstrate the broadband optical power coupling and splitting on the silicon photonic platform in the telecom band.

Authors: Lu Sun, Shanghai Jiao Tong University / Hongwei Wang, Shanghai Jiao Tong University / Yong Zhang, Shanghai Jiao Tong University / Yikai Su, Shanghai Jiao Tong University

STh5B.8

Topology-Controlled Polarized Photoluminescence From Rare-Earth Doped Nanocrystals

Presenter: Aditya Tripathi , *Australian National University*

We show topology-controlled polarization of photoluminescence from rare-earth doped nanocrystals using disorder-immune zigzag arrays of dielectric nanoparticles. Topological control is verified by comparing emission from nanocrystals deposited on trivial and nontrivial arrays of nanoparticles.

Authors: Aditya Tripathi, Australian National University / Sergey Kruk, Australian National University / Yunfei Shang, University of Technology / Jiajia Zhou, University of Technology / Ivan Kravchenko, Oak Ridge National Laboratory / Yuri Kivshar, Australian National University

STh5A

Nonlinear Fiber Optics and Mid-IR Generation

Presenter: Martin Rochette , *McGill University*

STh5A.1

Four-Octave-Spanning Mid-Infrared Supercontinuum Generation in a Gas-Filled Hollow-Core Fiber

Presenter: ANG DENG , *Nanyang Technological University*

We demonstrate the generation of multi-octave-spanning supercontinuum in a gas-filled hollow-core fiber that extends into the mid-infrared. This is achieved by pumping the system with high-energy ultrashort pulses centered at 2 μm wavelength.

Authors: ANG DENG, Nanyang Technological University / Gavara Trivikramarao, Nanyang Technological University / Muhammad Rosdi Abu Hassan, Nanyang Technological University / Yuhao Jin, Nanyang Technological University / Qi jie Wang, Nanyang Technological University / Wonkeun Chang, Nanyang Technological University

STh5A.2

Soliton Self-Frequency Shift in a Passive Silica Fiber With Conversion Efficiency of 84.6%

Presenter: Md Hosne Shamim, *McGill University*

We demonstrate the highest energy conversion efficiency of 84.6% from a soliton self-frequency shift system based on a passive silica fiber. The soliton is tunable over 310 nm in the spectral range 1.96-2.27 μm .

Authors: Md Hosne Shamim, McGill University / Imtiaz Alamgir, McGill University / Martin Rochette, McGill University

STh5A.3

Stimulated Raman Scattering in a Tapered Submicron Silicon Core Fiber

Presenter: Meng Huang, *University of Southampton*

Raman scattering is observed for the first time in a tapered silicon core fibre. Both spontaneous and stimulated effects are presented, with a gain up to 0.8 dB achieved with a 58.5 mW telecom pump.

Authors: Meng Huang, University of Southampton / Haonan Ren, University of Southampton / Li Shen, University of Southampton / Dong Wu, University of Southampton / Shiyu Sun, University of Southampton / Thomas Hawkins, Clemson University / John Ballato, Clemson University / Ursula Gibson, Norwegian University of Science and Technology / Anna Peacock, University of Southampton

STh5A.4

Characteristics of Spectral Peaking in Coherent Supercontinuum Generation

Presenter: Norihiko Nishizawa, *Nagoya University*

Spectral peaking during supercontinuum generation in normal dispersive highly nonlinear fiber was investigated both numerically and experimentally. Sharp multiple spectral peaks were generated stably with 290 GHz frequency interval, and low noise properties were confirmed.

Authors: Norihiko Nishizawa, Nagoya University / Masahito Yamanaka, Nagoya University

STh5A.5

Development of Supercontinuum Laser Source for 2 μm OCT With Tm-Ho co-Doped Ultrashort Pulse Fiber Laser Using Single Wall Carbon Nanotube

Presenter: Junya Yamamoto , *Nagoya University*

Highly efficient Tm-Ho co-doped ultrashort pulse fiber laser operating at 1.9 μm was developed using single wall carbon nanotube. Wideband supercontinuum at 2.0 μm was generated and high-resolution OCT imaging of human tooth was demonstrated.

Authors:Junya Yamamoto, Nagoya University / Masahito Yamanaka, Nagoya University / Ying Zhou, AIST / Takeshi Saitoh, AIST / Youichi Sakakibara, AIST / Norihiko Nishizawa, Nagoya University

STh5A.6

Mid-Infrared Soliton Self-Frequency Shift Using Ultra-low Pump Pulse Energy

Presenter: Imtiaz Alamgir , *McGill University*

We generate Raman solitons tunable within the spectral range of 2.0-2.6 μm from an ultralow pump pulse energy of 64 pJ. This is the lowest pump energy ever used to obtain wideband soliton shift.

Authors:Imtiaz Alamgir, McGill University / Md Hosne Shamim, McGill University / Wagner Correr, Laval University / Younès Messaddeq, Laval University / Martin Rochette, McGill University

STh5A.7

Sub-Picosecond Fiber Laser at 3.5 μm

Presenter: Nathaniel Bawden , *The University of Adelaide*

We report the first sub-picosecond pulses from a fiber laser with a directly generated emission beyond 3.0 μm . The 3.5 μm dual-wavelength pumped system is mode-locked via nonlinear polarisation rotation, producing 1.3 nJ pulses lasting 830 fs.

Authors:Nathaniel Bawden, The University of Adelaide / Ori Henderson-Sapir, The University of Adelaide / Stuart Jackson, Macquarie University / David Ottaway, The University of Adelaide

STh5A.8

First Order FBGs in InF₃ Fibre Inscribed by Interferometry Technique and UV-fs-Laser

Presenter: Ismael Chiamenti , *Leibniz Institute of Photonic Technology, Leibniz-IPHT*

First order FBGs were inscribed in InF₃ fibre by UV-fs-laser and interferometry technique. The spectral quality and good thermal stability of the gratings will contribute to the development of Mid-IR all-fibre laser technology.

Authors: Ismael Chiamanti, Leibniz Institute of Photonic Technology, Leibniz-IPHT / Tino Elsmann, Leibniz Institute of Photonic Technology, Leibniz-IPHT / Aaron Reupert, Otto Schott Institute for Materials Research, Friedrich Schiller University / Oguzhan Kara, Leibniz Institute of Photonic Technology, Leibniz-IPHT / Martin Becker, Leibniz Institute of Photonic Technology, Leibniz-IPHT / Lothar Wondraczek, Otto Schott Institute for Materials Research, Friedrich Schiller University / Maria Chernysheva, Leibniz Institute of Photonic Technology, Leibniz-IPHT

Friday, 14 May

4:00 - 6:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FF1A

Postdeadline Papers Presentation I

Presider: Viktor Podolskiy , *University of Massachusetts Lowell*

FF1A.1

100 keV Electron Beam Generation by Direct Laser Acceleration Using Longitudinal Electric Fields

Presenter: Jeffrey Powell , *INRS-EMT*

We report the generation of a 100 keV electron beam by direct laser acceleration using longitudinal electric fields in low-density gas. This configuration is a viable pathway for ultrafast electron experiments and relativistic electron production.

Authors: Jeffrey Powell, INRS-EMT / Stephane Payeur, INRS-EMT / Sylvain Fourmaux, INRS-EMT / Heide Ibrahim, INRS-EMT / Jean Claude Kieffer, INRS-EMT / Steve MacLean, INRS-EMT / Francois Legare, INRS-EMT

FF1A.2

Necklace High Harmonic Generation for Low-Divergence, Soft X-Ray Harmonic Combs With Tunable Line Spacing

Presenter: Nathan Brooks , *University of Colorado at Boulder JILA*

By driving high-harmonics with necklace laser beams, we produce combs with tunable frequency content and spacing, up to the soft x-ray region. The emitted harmonics also exhibit distinct spatial profiles and lower divergence than Gaussian-driven harmonics.

Authors: Nathan Brooks, University of Colorado at Boulder JILA / Laura Rego Cabezas, University of Salamanca / Quynh Nguyen, University of Colorado at Boulder JILA / Julio San Román, University of Salamanca / Iona Binnie, University of Colorado at Boulder JILA / Luis Plaja, University of Salamanca / Carlos Hernández-García, University of Salamanca / Henry Kapteyn, University of Colorado at Boulder JILA / Margaret Murnane, University of Colorado at Boulder JILA

FF1A.3

Second-Harmonic-Generation Circular Dichroism in Dielectric Nanoantenna Dimers

Presenter: Elizaveta Melik-Gaykazyan , *Australian National University*

We demonstrate experimentally the second-harmonic generation circular dichroism in a dimer of two identical AlGaAs nanoantennas attributed to the hybridization of electric and magnetic Mie-type multipolar optical modes of the nanoantennas

Authors: Elizaveta Melik-Gaykazyan, Australian National University / Kristina Frizyuk, ITMO University / Jae-Hyuck Choi, University of Southern California / Mihail Petrov, ITMO University / Hong-Gyu Park, Korea University / Yuri Kivshar, Australian National University

FF1A.4

Deep Nonlinear Optical Neural Networks Using Physics-Aware Training

Presenter: Tatsuhiro Onodera, *Cornell University*

We experimentally demonstrate deep nonlinear optical neural networks using a universal algorithm for backpropagating through arbitrary physical input-output transformations. Ultrafast second harmonic generation and other diverse processes are trained to perform image and audio classification.

Authors: Logan Wright, Cornell University / Tatsuhiro Onodera, Cornell University / Martin Stein, Cornell University / Tianyu Wang, Cornell University / Darren Schachter, Cornell University / Zoey Hu, Cornell University / Peter McMahon, Cornell University

FF1A.5

Tuning Metastable Light-Induced Superconductivity in K_3C_{60} With a Hybrid CO_2 -Ti:Sapphire Laser

Presenter: Matthias Budden, *Max Planck Institute for the Structure and Dynamics of Matter*

High power mid-infrared light pulses of tunable pulse length were generated to stabilize light-induced superconductivity in K_3C_{60} for nanoseconds. This metastable state showed a vanishing electrical resistance at five times the material's equilibrium critical temperature.

Authors: Matthias Budden, Max Planck Institute for the Structure and Dynamics of Matter / Thomas Gebert, Max Planck Institute for the Structure and Dynamics of Matter / Michele Buzzi, Max Planck Institute for the Structure and Dynamics of Matter / Gregor Jotzu, Max Planck Institute for the Structure and Dynamics of Matter / Eryin Wang, Max Planck Institute for the Structure and Dynamics of Matter / Toru Matsuyama, Max Planck Institute for the Structure and Dynamics of Matter / Guido Meier, Max Planck Institute for the Structure and Dynamics of Matter / Yannis Laplace, Max Planck Institute for the Structure and Dynamics of Matter / Daniele Pontiroli, Università degli Studi di Parma / Mauro Riccò, Università degli Studi di Parma / Frank Schlawin, University of Oxford / Dieter Jaksch, University of Oxford / Andrea Cavalleri, Max Planck Institute for the Structure and Dynamics of Matter

FF1A.6

Optomechanical Quantum Teleportation

Presenter: Niccolo Fiaschi, *TU Delft*

Quantum teleportation is a key component in long distance quantum communication protocols. Here we demonstrate quantum teleportation of a polarization-encoded optical input state onto the joint state of a pair of nanomechanical resonators.

Authors: Niccolo Fiaschi, TU Delft / Bas Hensen, TU Delft / andreas wallucks, TU Delft / rodrigo benevides, TU Delft / Jie Li, TU Delft / Thiago Alegre, University of Campinas / Simon Gröblacher, TU Delft

FF1A.7

High-Dimensional Energy-Time Entanglement Distribution via a Biphoton Frequency Comb

Presenter: KAI-CHI CHANG, *UCLA*

We report the first high-dimensional energy-time entanglement distribution with a singly-resonant biphoton frequency comb, demonstrating time-frequency Franson interferences with high visibility, and establishing a high-dimensional entanglement link.

Authors: KAI-CHI CHANG, *UCLA* / Xiang Cheng, *UCLA* / Murat Can Sarihan, *UCLA* / Franco Wong, *MIT* / Jeffrey Shapiro, *MIT* / Chee Wei Wong, *UCLA*

FF1A.8

Imprinting the Quantum Statistics of Photons on Free Electrons

Presenter: Raphael dahan, *Technion – Israel Institute of Technology*

: We observe for the first time the breakdown of the wave nature of light in free-electron–light interactions. Our experiment demonstrates a new way of measuring quantum states of light using high-precision electron energy spectroscopy.

Authors: Raphael dahan, *Technion – Israel Institute of Technology* / Alexey Gorlach, *Technion – Israel Institute of Technology* / urs Haeusler, Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Staudtstraße 1, 91058 Erlangen, Germany / Ori Eyal, *Technion – Israel Institute of Technology* / Peyman Yousefi, Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Staudtstraße 1, 91058 Erlangen, Germany / Mordechai segev, *Technion – Israel Institute of Technology* / Ady Arie, *Tel Aviv University* / Gadi Eisenstein, *Technion – Israel Institute of Technology* / Peter Hommelhoff, Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Staudtstraße 1, 91058 Erlangen, Germany / Ido Kaminer, *Technion – Israel Institute of Technology*

SF1B

Postdeadline Papers Presentation II

Presider: Clara Saraceno, *Ruhr Universität Bochum*

SF1B.1

Efficient Ultra-Broadband Optical Parametric Generation With Picojoule Pulse Energies

Presenter: Nayara Jornod , *Stanford University*

We demonstrate high-gain optical parametric generation in dispersion-engineered PPLN nanowaveguides with picojoules of pump pulse energy. When driven with >10 pJ, the generated signal exceeds 10% conversion efficiency and broadens to span an octave of bandwidth.

Authors: Nayara Jornod, Stanford University / Marc Jankowski, Stanford University / Carsten Langrock, Stanford University / Boris Desiatov, Harvard University / Alireza Marandi, California Institute of Technology / Marko Loncar, Harvard University / Martin Fejer, Stanford University

SF1B.2

Ultrashort Green Laser Pulse Amplification in Praseodymium Doped LiYF₄ Crystal Pumped by InGaN Based Laser Diodes

Presenter: Hiroyuki Yada , *IMRA America inc.*

A green laser pulse (peak wavelength of 522.4 nm) was amplified as 12.5 times from 0.1 to 1.25 μ J in a regenerative amplifier using a Pr³⁺:LiYF₄ crystal pumped by InGaN based laser diodes.

Authors: Hiroyuki Yada, IMRA America inc. / Yuki Ichikawa, IMRA America inc.

SF1B.3

Terahertz Generation in Thin-Film Lithium Niobate Platform

Presenter: Alexa Herter , *ETH*

We demonstrate spectrally and temporally tailored terahertz radiation from optical rectification of 100 pJ femtosecond pulses in low-loss thin-film lithium niobate waveguides that are co-integrated with terahertz antennas. A maximal emission frequency of 440 GHz is achieved.

Authors: Alexa Herter, ETH / Amirhassan Shams-Ansari, Harvard University / Francesca Fabiana Settembrini, ETH / Hana Warner, Harvard University / Jérôme Faist, ETH / Marko Loncar, Harvard University / Ileana Benea-Chelms, Harvard University

SF1B.4

Two Gigahertz Femtosecond Cr:ZnS Oscillator at 2.4 μ m With 0.8-W Average Output Power

Presenter: Ajanta Barh , *ETH Zürich, Ultrafast Laser Physics*

We present a SESAM mode-locked self-starting Cr:ZnS oscillator delivering ~ 255 fs transform limited pulses at record high repetition rate above 2 GHz with average output power of 0.8 W at 2.4 μm .

Authors: Ajanta Barh, ETH Zürich, Ultrafast Laser Physics / Behçet Özgür Alaydin, ETH Zürich, Ultrafast Laser Physics / Jonas Heidrich, ETH Zürich, Ultrafast Laser Physics / Marco Gaulke, ETH Zürich, Ultrafast Laser Physics / Matthias Golling, ETH Zürich, Ultrafast Laser Physics / Christopher Phillips, ETH Zürich, Ultrafast Laser Physics / Ursula Keller, ETH Zürich, Ultrafast Laser Physics

SF1B.5

Femtosecond Pulses From a mid-Infrared Quantum Cascade Laser

Presenter: Philipp Täschler, *ETH*

We report on the formation of near-transform-limited sub-picosecond pulses from a mid-infrared quantum cascade laser with several Watts of peak power. These pulses are characterized using coherent beatnote interferometry, optical sampling and an interferometric autocorrelation technique.

Authors: Philipp Täschler, *ETH* / Mathieu Bertrand, *ETH* / Barbara Schneider, *ETH* / Matthew Singleton, *ETH* / Pierre Jouy, *ETH* / Matthias Beck, *ETH* / Jérôme Faist, *ETH*

SF1B.6

Narrow Linewidth, Widely Tunable Integrated Lasers From Visible to Near-IR

Presenter: Mateus Corato Zanarella, *Columbia University*

We demonstrate a chip-scale platform for narrow-linewidth lasers, tunable across the whole spectrum from blue to near-IR. We show powers up to 10mW, intrinsic linewidth <8kHz, tuning up to 12nm and SMSRs up to 38dB.

Authors: Mateus Corato Zanarella, *Columbia University* / Andres Gil-Molina, *Columbia University* / Min Chul Shin, *Columbia University* / Xingchen Ji, *Columbia University* / Aseema Mohanty, *Tufts University* / Michal Lipson, *Columbia University*

SF1B.7

High Temperature Reliable Epitaxially Grown Quantum dot Lasers on (001) Si With Record Performance

Presenter: Chen Shang, *University of California Santa Barbara*

We report a novel solution to the high temperature reliability of InAs quantum dot lasers grown on (001) Si. Negligible degradation was observed after 1800 h aging, giving an extrapolated lifetime of two million hours.

Authors:Chen Shang, University of California Santa Barbara / Eamonn Hughes, University of California Santa Barbara / Yating Wan, University of California Santa Barbara / Mario Dumont, University of California Santa Barbara / Rosalyn Koscica, University of California Santa Barbara / Jenny Selvidge, University of California Santa Barbara / Robert Herrick, Intel Corp. / Arthur Gossard, University of California Santa Barbara / Kunal Mukherjee, Stanford University / John Bowers, University of California Santa Barbara

SF1C

Postdeadline Papers Presentation III

Presider: Qiaoqiang Gan , *State University of New York at Buffalo*

SF1C.1

2- μ m-Band Coherent Transmission of Nyquist-WDM 16-QAM Signal by on-Chip Spectral Translation

Presenter: Deming Kong , *Technical University of Denmark*

We propose and demonstrate the first low-latency 2- μ m-band coherent N-WDM transmission by on-chip spectral translation of 4 \times 32-Gbaud 16-QAM signals with 33-GHz spacing. 318.25 Gbit/s net-rate is achieved with error-free performance after 1.15-km hollow-core fiber transmission.

Authors:Deming Kong, Technical University of Denmark / Yong Liu, Technical University of Denmark / Zhengqi Ren, University of Southampton / Yongmin Jung, University of Southampton / Chanju Kim, Technical University of Denmark / Yong Chen, University of Southampton / Natalie Wheeler, University of Southampton / Minhao Pu, Technical University of Denmark / Kresten Yvind, Technical University of Denmark / Michael Galili, Technical University of Denmark / Leif Oxenløwe, Technical University of Denmark / David Richardson, University of Southampton / Hao Hu, Technical University of Denmark

SF1C.2

High-Throughput, Multimode Spectroscopy Using Cross-Dispersive Serpentine Integrated Grating Arrays

Presenter: Nathan Dostart , *NASA Langley Research Center*

We demonstrate a high-resolution, crossed-dispersion integrated photonic spectrometer capable of high-extend, multimode operation. The first experimental single-mode design achieves record performance per volume with 1.5 GHz resolution and 13 THz bandwidth in a 0.5 mm² footprint.

Authors: Nathan Dostart, NASA Langley Research Center / Michael Brand, University of Colorado Boulder / Bohan Zhang, Boston University / Milos Popovic, Boston University / Kelvin Wagner, University of Colorado Boulder

SF1C.3

A High-Speed Micro-Ring Modulator for Next Generation Energy-Efficient Optical Networks Beyond 100 Gbaud

Presenter: Meer Nazmus Sakib , *Intel Labs- Photonics Research*

We demonstrate a silicon micro-ring modulator supporting 128 Gb/s NRZ modulation with SNR=5.2, ER=3.8dB, 0.8 V_{pp} drive swing, and 5.3 fJ/bit power consumption. We have also achieved 192 Gb/s PAM-4 modulation with TDECQ of 2.5dB.

Authors: Meer Nazmus Sakib, Intel Labs- Photonics Research / Peicheng Liao, Intel Labs- Photonics Research / Chaoxuan Ma, Intel Labs- Photonics Research / Ranjeet Kumar, Intel Labs- Photonics Research / Duanni Huang, Intel Labs- Photonics Research / Guan-lin Su, Intel Labs- Photonics Research / Xinru Xu, Intel Labs- Photonics Research / Saeed Fatholouloumi, Intel Corporation / Haisheng Rong, Intel Labs- Photonics Research

SF1C.4

Magnetic-Free Nitride Optical Isolator on Chip

Presenter: Hao Tian , *Purdue University*

We demonstrated a magnetic-free optical isolator for Si₃N₄ photonics using AlN piezoelectric actuators. Maximum of 10 dB isolation and <1 dB insertion loss is achieved under 100 mW RF power applied at each actuator.

Authors: Hao Tian, Purdue University / Junqiu Liu, EPFL / Anat Siddharth, EPFL / Rui Wang, EPFL / Terence Blésin, EPFL / Jijun He, EPFL / Tobias Kippenberg, EPFL / sunil bhav, Purdue University

SF1C.5

Ultralow-Loss Meter-Long Dispersion-Engineered Silicon Nitride Waveguides

Presenter: Zhichao Ye , *Chalmers University of Technology*

We demonstrate dispersion-engineered meter-long silicon nitride waveguides with record-low loss of 1.4 dB/m. Based on these, we demonstrate continuous-wave-pumped optical parametric amplification for the first time in an integrated Kerr nonlinear waveguide.

Authors:Zhichao Ye, Chalmers University of Technology / Ping Zhao, Chalmers University of Technology / Krishna Twayana, Chalmers University of Technology / Magnus Karlsson, Chalmers University of Technology / Peter Andrekson, Chalmers University of Technology / Victor Torres-Company, Chalmers University of Technology

SF1C.6

Integrated Thin-Film Lithium Niobate Non-Reciprocal Circulator

Presenter: Jason Herrmann , *Stanford University*

We demonstrate an integrated electro-optic frequency circulator on thin-film lithium niobate. Our device operates at telecommunications wavelengths, exhibiting frequency conversion and isolation of 37.3 dB, with insertion loss of 3.8 dB.

Authors:Jason Herrmann, Stanford University / Vahid Ansari, Stanford University / Jiahui Wang, Stanford University / Jeremy Witmer, Stanford University / Shanhui Fan, Stanford University / Amir Safavi-Naeini, Stanford University

SF1C.7

100 dB/cm Broadband Optical Parametric Amplification in Dispersion Engineered Nanophotonic Lithium Niobate Waveguides

Presenter: Luis Ledezma , *California Institute of Technology*

We demonstrate phase-sensitive amplification and confirm a gain exceeding 100 dB/cm on a dispersion-engineered thin-film lithium niobate waveguide, using less than 20 pJ of pump energy, and exhibiting a gain bandwidth larger than 600 nm around 2.09 μm .

Authors:Luis Ledezma, California Institute of Technology / Ryoto Sekine, California Institute of Technology / Qiushi Guo, California Institute of Technology / Rajveer Nehra, California Institute of Technology / Saman Jahani, California Institute of Technology / Alireza Marandi, California Institute of Technology

7:00 - 8:45 (Pacific Time (US & Canada) DST, UTC - 07:00)

SF2D

Optical Communication Systems and Subsystems

Presenter: Fotini Karinou , *Microsoft Research Ltd*

SF2D.1

Petabit per Second Data Transmission Using an Integrated Optical Frequency Comb and Multicore Fiber

Invited

Presenter: Michael Galili , *Technical University of Denmark*

We will discuss recent work demonstrating an integrated optical frequency comb enabling multicore fiber transmission with an aggregate data rate in excess of a petabit per second. We will discuss creation and stabilization of the frequency comb, electro-optic modulation to modify the comb line spacing and the use of spatial multiplexing in multicore fiber.

Authors:Michael Galili, Technical University of Denmark / Deming Kong, Technical University of Denmark / Asbjørn Jørgensen, Copenhagen University / Martin Henriksen, Copenhagen University / Frederik Klejs, Technical University of Denmark / Zhichao Ye, Chalmers University of Technology / Òskar Helgason, Chalmers University of Technology / Henrik Hansen, Technical University of Denmark / Hao Hu, Technical University of Denmark / Metodi Yankov, Technical University of Denmark / Søren Forchhammer, Technical University of Denmark / Peter Andrekson, Chalmers University of Technology / Anders Larsson, Chalmers University of Technology / Magnus Karlsson, Chalmers University of Technology / Jochen Schroder, Chalmers University of Technology / Yusuke Sasaki, Fujikura Ltd. / Kazuhiko Aikawa, Fujikura Ltd. / Jan Thomsen, Copenhagen University / Toshio Morioka, Technical University of Denmark / Victor Torres-Company, Chalmers University of Technology / Leif Oxenløwe, Technical University of Denmark

SF2D.2

Semiconductor Optical Amplifier (SOA) Integrated Electroabsorption Modulator (EAM) for Dispersion and Amplitude Compensation in Long-Distance Optical Fiber Transmission

Presenter: Yi-jen Chiu , *National Sun Yat-Sen University*

A negative frequency chirp- and amplitude- compensation in long-distance optical fiber transmission by using SOA-integrated EAM have been demonstrated. Data transmission of 36Gb/s 16-QAM OFDM signal with 10.5GHz bandwidth over a 100km single mode fiber.

Authors:Yi-jen Chiu, National Sun Yat-Sen University / Rih-You Chen, National Sun Yat-Sen University

SF2D.3

Modified Widely Linear Filter for Simultaneous Multi-Impairment Compensation

Presenter: Rekha Yadav , *IIT Madras*

We present a modified widely linear single-tap blind equalizer for the joint multi-impairment compensation of polarization mixing, IQ Imbalance and transceiver phase noise, analyze its performance through simulation and experiments for 32Gbaud PM-16QAM transmission.

Authors: Rekha Yadav, IIT Madras / Lakshmi Narayanan Venkatasubramani, IIT Madras / R David Koilpillai, IIT Madras / D. Venkitesh, IIT Madras

SF2D.4

on the Impact of Probabilistic Shaping Rates to the Decision-Based Phase Noise Mitigation

Presenter: Zexin Chen , *Huazhong University of Science and Technology*

We investigate how shaping rates of probabilistic shaping quadrature amplitude modulation (PS-QAM) affect the performance decision-based phase noise mitigation, and propose a modified BPS algorithm with experimental verifications for 24/32-Gbaud PS-64QAM and 28-Gbaud PS-16QAM.

Authors: Zexin Chen, Huazhong University of Science and Technology / Ming Tang, Huazhong University of Science and Technology / Songnian FU, Guangdong Key Laboratory of Optoelectronic Information Technology / Yuncai Wang, Guangdong Key Laboratory of Optoelectronic Information Technology / Yuwen Qin, Guangdong Key Laboratory of Optoelectronic Information Technology

SF2D.5

a Hybrid PGS LDPC-Coded Scheme for PM-16QAM Modulation in 140 km DWDM Metro Network Communication

Presenter: Xiao Han , *University of Arizona*

We implement a hybrid probabilistic-geometric shaping (PGS) LDPC-coded PM-16QAM in a 140 km DWDM metro-network-communication link. We experimentally demonstrate that hybrid PGS LDPC-coded-modulation scheme can provide 0.95 dB improvement over corresponding uniform-distribution-based scheme.

Authors: Xiao Han, University of Arizona / Ivan Djordjevic, University of Arizona / Aleksandra Jovanovic, University of Niš

SF2D.6

Experimental Demonstration of Bandwidth-Efficient and Low-Complexity Mobile Fronthaul Transmissions Utilizing Digital Orthogonal Filtering-Enabled Channel Aggregation

Presenter: Mingliang Deng , *CQUPT*

We experimentally demonstrate bandwidth-efficient and low-complexity mobile fronthaul transmissions, where 24 20MHz LTE signals are aggregated via digital orthogonal filtering, achieving an average EVM of 2.8% and 31dB loss budget for a 6km SSMF link.

Authors: Mingliang Deng, CQUPT / Timera Mamadou, CQUPT / Qianwu Zhang, Shanghai University / Zhibo Xing, CQUPT / Zhirui Luo, CQUPT / Le Wang, CQUPT

7:00 - 9:00 (Pacific Time (US & Canada) DST, UTC - 07:00)

FF2J

Quantum Networks

Presenter: Polina Sharapova , *University of Paderborn*

FF2J.1

Quantum Computation and Networking

Tutorial

Presenter: Kae Nemoto , *National Institute of Informatics*

In quantum ICT, computation and networking are closely related, much more than in conventional ICT case. In this tutorial we revisit some different network aspects in quantum computation and discuss new quantum network applications.

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Authors: Kae Nemoto, National Institute of Informatics

FF2J.2

Quantum Network Aggregation

Presenter: William Munro , *NTT Basic Research Laboratories*

We introduce the concept of quantum network aggregation where the multiplexing of independent quantum channels allows us to protect the transmission of information between users on that network – even when that network has limited resources.

Authors: William Munro, NTT Basic Research Laboratories / Nicolo Lo Piparo, National Institute of Informatics / Kae Nemoto, National Institute of Informatics

FF2J.3

Experimental Violation of N-Locality in a Star Quantum Network

Presenter: Davide Poderini , *Sapienza University of Rome*

Using a flexible and scalable photonic platform, we implement a star-shaped quantum network with five nodes and truly independent sources, and we violate a n -locality inequality to device-independently witness nonlocal correlations in the whole network.

Authors: Davide Poderini, Sapienza University of Rome / Iris Agresti, Sapienza University of Rome / Guglielmo Marchese, Sapienza University of Rome / Emanuele Polino, Sapienza University of Rome / Taira Giordani, Sapienza University of Rome / Alessia Suprano, Sapienza University of Rome / Mauro Valeri, Sapienza University of Rome / Giorgio Milani, Sapienza University of Rome / Nicolò Spagnolo, Sapienza University of Rome / Gonzalo Carvacho, Sapienza University of Rome / Rafael Chaves, International Institute of Physics / Fabio Sciarrino, Sapienza University of Rome

FF2J.4

A Reconfigurable Quantum Local Area Network Over Deployed Fiber

Presenter: Muneer Alshowkan, *Oak Ridge National Laboratory*

We demonstrate a three-node telecom quantum local area network over deployed fiber. It has eight independent entanglement channels which are dynamically reconfigurable. We successfully show entanglement demand balancing across the network and quantify its quality.

Authors: Muneer Alshowkan, Oak Ridge National Laboratory / Brian Williams, Oak Ridge National Laboratory / Philip Evans, Oak Ridge National Laboratory / Nageswara Rao, Oak Ridge National Laboratory / Emma Simmerman, Oak Ridge National Laboratory / Navin Lingaraju, Purdue University / Hsuan-Hao Lu, Purdue University / Andrew Weiner, Purdue University / Nicholas Peters, Oak Ridge National Laboratory / Joseph Lukens, Oak Ridge National Laboratory

FF2J.5

Experimental Quantum Conference key Agreement

Presenter: Joseph Ho, *Heriot-Watt University*

We report a proof-of-principle demonstration of four-party quantum conference agreement using photonic GHZ (Greenberger-Horne-Zeilinger) states transmitted in fiber. Our results demonstrate the viability of multi-user entangled-based quantum key distribution beyond the two-party paradigm.

Authors: Joseph Ho, Heriot-Watt University / Massimiliano Proietti, Heriot-Watt University / Federico Grasselli, Heinrich-Heine-Universität Düsseldorf / Peter Barrow, Heriot-Watt University / Mehul Malik, Heriot-Watt University / Alessandro Fedrizzi, Heriot-Watt University

FF2I

Quantum Measurement II

Presenter: Timon Schapeler, *University of Paderborn*

FF2I.1

Phase Tomography of Spontaneously Emitted Photon-Pairs

Presenter: Imad Faruque , *University of Bristol*

We have directly measured the joint spectral phase of spontaneously emitted photon-pairs for the first time. We have devised a novel tomographic method using quantum interference of bi-photon functions. This method can potentially be used for quantum sensing.

Authors:Imad Faruque, University of Bristol / Ben Burrige, University of Bristol / Massimo Borghi, University of Bristol / Jorge Barreto, University of Bristol / John Rarity, University of Bristol

FF2I.2

Quantum State Tomography of an on-Chip Polarization-Spatial Qubit SWAP Gate

Presenter: Xiang Cheng , *University of California Los Angeles*

We experimentally demonstrate a chip-scale polarization to spatial-momentum qubit SWAP gate. High fidelity of the SWAP gate operation is confirmed by quantum state tomography, with average gate fidelity up to 97.30%.

Authors:Xiang Cheng, University of California Los Angeles / Zhenda Xie, University of California Los Angeles / KAI-CHI CHANG, University of California Los Angeles / Murat Sarihan, University of California Los Angeles / Yoo Seung Lee, University of California Los Angeles / Abhinav Kumar Vinod, University of California Los Angeles / Yongnan Li, Nankai University / Xinan Xu, Columbia University / Serdar Kocaman, Middle East Technical University / Mingbin Yu, Institute of Microelectronics / Dim-Lee Kwong, Institute of Microelectronics / Jeffrey Shapiro, Massachusetts Institute of Technology / Franco Wong, Massachusetts Institute of Technology / Chee Wei Wong, University of California Los Angeles

FF2I.3

Broadband Mid-IR Spectroscopy With Near-IR Grating Spectrometers

Presenter: Paul Kaufmann , *Humboldt-Universität zu Berlin*

We demonstrate fast, mid-infrared (3.2-4.3 μm) spectroscopy with high resolution (1.5 cm^{-1}) based on nonlinear interferometry with undetected photons using a commercial, Si-CCD based grating spectrometer.

Authors:Paul Kaufmann, Humboldt-Universität zu Berlin / Helen M Chrzanowski, Humboldt-Universität zu Berlin / Aron Vanselow, Inria Paris / Sven Ramelow, Humboldt-Universität zu Berlin

FF2I.4

Ultrafast non-Destructive Measurement of the Quantum State of Light With Free Electrons

Presenter: Aliaksei Horlach , *Technion*

We demonstrate that free electrons can be used as ultrafast non-destructive photon detectors. Particularly, we show how one can measure photon statistics, temporal coherence, and implement full quantum state tomography using free electrons.

Authors:Aliaksei Horlach, Technion / Aviv Karnieli, Tel Aviv University / Raphael Dahan, Technion / Eliahu Cohen, Bar-Ilan University / Avi Pe'er, Bar-Ilan University / Ido Kaminer, Technion

FF21.5

Shaping Quantum Photonic States Using Free Electrons

Presenter: Adi Ben Hayun , *Technion Israel Institute of Technology*

We propose a new scheme for creating desired quantum photonic states using interactions of free electrons with optical cavities. We show how the choice of the initial electron state controls the resulting quantum light state.

Authors:Adi Ben Hayun, Technion Israel Institute of Technology / Ori Reinhardt, Technion Israel Institute of Technology / Jonathan Nemirovsky, Technion Israel Institute of Technology / Aviv Karnieli, Tel Aviv University / Nicholas Rivera, Massachusetts Institute of Technology / Ido Kaminer, Technion Israel Institute of Technology

FF21.6

Efficient Interaction of X-ray Single Photons With a Beam Splitter

Presenter: Edward Strizhevsky , *Bar-Ilan University*

We demonstrate efficient interaction of hard x-ray single photons with a beam splitter for the first time and use it to show the nonclassical behavior of x-ray heralded photons.

Authors:Edward Strizhevsky, Bar-Ilan University / Denis Borodin, Bar-Ilan University / Aviad Schori, Bar-Ilan University / Sonia Francoual, DESY / Ralf Roehlsberger, DESY / Sharon Schwartz, Bar-Ilan University

FF21.7

Experimental Shot-by-Shot Estimation of Quantum Measurement Accuracy

Presenter: N. Fajar R. Annafianto , *NIST*

We show the direct correspondence between Bayesian probabilities obtained by the adaptive quantum measurement and experimentally observed Kholmogorov probabilities. We demonstrate the single-“shot” accuracy estimation for every individual quantum measurement outcome using these Bayesian probabilities.

Authors:N. Fajar R. Annafianto, NIST / Ivan Burenkov, Joint Quantum Institute / M.V. Jabir, NIST / Abdella Battou, NIST / Sergey Polyakov, NIST

FF21.8

ANTI Hong-Ou-Mandel Interference on a Lossy Beamsplitter

Presenter: Anton Vetlugin , *Nanyang Technological University*

We experimentally demonstrate for the first time that, in contrast to classical Hong-Ou-Mandel experiment performed with a dissipation-free beamsplitter, pairs of photons with fermionic spatial wavefunction 'coalesce' while bosonic pairs anti-coalesce on a lossy beamsplitter.

Authors:Anton Vetlugin, Nanyang Technological University / Ruixiang Guo, Nanyang Technological University / Cesare Soci, Nanyang Technological University / Nikolay Zheludev, University of Southampton

FF2L

Ultrafast and out-of-equilibrium dynamics in strongly correlated electron systems

Presenter: Liuyan Zhao , *University of Michigan*

FF2L.1

Super-Resolution Momentum-Comb Spectroscopy of Quantum-Material Bands

Presenter: Markus Borsch , *University of Michigan*

Our theory--experiment comparison discovers crystal-momentum combs, electronic interferences in momentum space, in harmonic sideband emission and demonstrates how the comb lines assign electronic bands of quantum materials with super-resolution.

Authors:Markus Borsch, University of Michigan / Christoph Schmid, University of Regensburg / Leonard Weigl, University of Regensburg / Stefan Schlauderer, University of Regensburg / Christoph Lange, University of Regensburg / Johannes Steiner, University of Marburg / Stephan Koch, University of Marburg / Rupert Huber, University of Regensburg / Mackillo Kira, University of Michigan

FF2L.2

Ultrafast Signatures of Spin and Orbital Order in the Antiferromagnetic Mott Insulator Sr_2CrO_4

Presenter: Min-Cheol Lee , *LOS ALAMOS NATIONAL LABORATORY*

We used femtosecond time-resolved optical spectroscopy to study ultrafast dynamics of photoexcited carriers in the antiferromagnetic Mott insulator Sr_2CrO_4 , revealing distinct time-domain signatures of different spin and orbital orders.

Authors: Min-Cheol Lee, LOS ALAMOS NATIONAL LABORATORY / Connor Occhialini, MIT / Jiarui Li, MIT / Zhihai Zhu, Chinese Academy of Sciences / La Moyne Mix, LOS ALAMOS NATIONAL LABORATORY / Dmitry Yarotski, LOS ALAMOS NATIONAL LABORATORY / Riccardo Comin, MIT / Rohit Prasankumar, LOS ALAMOS NATIONAL LABORATORY

FF2L.3

Theoretical Understanding of Photon Spectroscopies in Correlated Materials Out of Equilibrium

Tutorial

Presenter: Tom Devereaux, *Stanford University*

To be provided

Authors: Tom Devereaux, *Stanford University*

FF2L.4

Ultrafast Photo-Induced Melting of the Trimer Superstructure in TaTe_2

Presenter: Khalid Siddiqui, *Lawrence Berkeley National Laboratory*

We report the first ultrafast study of TaTe_2 , utilizing MeV-scale ultrafast electron diffraction to reveal rapid photo-induced melting of its low-temperature trimer superstructure. Density-functional calculations indicate intra-trimer charge transfer as a trigger of this transformation.

Authors: Khalid Siddiqui, Lawrence Berkeley National Laboratory / Daniel Durham, Lawrence Berkeley National Laboratory / Frederick Cropp, University of California, Los Angeles / Sangeeta Rajpurohit, Lawrence Berkeley National Laboratory / Colin Ophus, Lawrence Berkeley National Laboratory / Yanglin Zhu, Pennsylvania State University / Johan Carlström, Lawrence Berkeley National Laboratory / Camille Stavrakas, Lawrence Berkeley National Laboratory / Zhiqiang Mao, Pennsylvania State University / Archana Raja, Lawrence Berkeley National Laboratory / Pietro Musumeci, University of California, Los Angeles / Liang Tan, Lawrence Berkeley National Laboratory / Andrew Minor, Lawrence Berkeley National Laboratory / Daniele Filippetto, Lawrence Berkeley National Laboratory, / Robert Kaindl, Lawrence Berkeley National Laboratory

FF2L.5

BaFe_2As_2 Investigated by Pump-Probe Spectroscopy Under High Pressures

Presenter: Ivan Fotev, *Helmholtz-Zentrum Dresden-Rossendorf*

We utilize pump-probe spectroscopy at pressures in the GPa range to measure the quasiparticle relaxation dynamics of BaFe₂As₂. The results reveal the pressure dependences of the spin-density wave condensate energy and the photoexcited quasiparticle lifetimes.

Authors: Ivan Fotev, Helmholtz-Zentrum Dresden-Rossendorf / Saicharan Aswartham, Leibniz Institute for Solid State and Materials Research Dresden / Bernd Büchner, Leibniz Institute for Solid State and Materials Research Dresden / Harald Schneider, Helmholtz-Zentrum Dresden-Rossendorf / Manfred Helm, Helmholtz-Zentrum Dresden-Rossendorf / Alexej Pashkin, Helmholtz-Zentrum Dresden-Rossendorf

FF2H

Temporal Photonics

Presenter: Alexander Szameit, *Universität Rostock*

FF2H.1

Towards Photonic Time-Crystals: Observation of a Femtosecond Time-Boundary in the Refractive Index

Presenter: Eran Lustig, *Technion Israel Institute of Technology*

We demonstrate experimentally a time-boundary for photons in a dielectric medium, analogous to a spatial boundary. Such abrupt temporal changes in the permittivity are necessary for observing time-reflections, photonic time-crystals and momentum bandgaps.

Authors: Eran Lustig, Technion Israel Institute of Technology / Soham Saha, Purdue University / Eliyahu Bordo, Technion Israel Institute of Technology / Clayton DeVault, Harvard University / Sarah Chowdhury, Purdue University / Yonatan Sharabi, Technion Israel Institute of Technology / Alexandra Boltasseva, Purdue University / Oren Cohen, Technion Israel Institute of Technology / Vladimir Shalaev, Purdue University / Mordechai segev, Technion Israel Institute of Technology

FF2H.2

Accelerating and Decelerating Space-Time Wave Packets in Free Space

Presenter: Murat Yessenov, *University of Central Florida, CREOL*

We show that endowing an optical field with precise spatio-temporal structure enables the realization of large axial acceleration and deceleration in free space. We experimentally demonstrate group velocity changes $\sim c$ over a propagation distance ~ 20 mm.

Authors: Murat Yessenov, University of Central Florida, CREOL / Ayman Abouraddy, University of Central Florida, CREOL

FF2H.3

Demonstration of the Space-Time Talbot Effect

Presenter: Layton Hall , *University of Central Florida, CREOL*

We demonstrate self-imaging in space and time of a discretized spatio-temporal optical field lattice in which the diffraction and dispersion lengths, and thus the spatial and temporal Talbot lengths, are intrinsically equal.

Authors:Layton Hall, University of Central Florida, CREOL / Murat Yessenov, University of Central Florida, CREOL / Sergey Ponomarenko, Dalhousie University / Ayman Abouraddy, University of Central Florida, CREOL

FF2H.4

Propagation-Invariant Space-Time Wave Packets From Free Electron Radiation

Presenter: Yi Ji Tan , *Institute of Microelectronics*

We present Smith-Purcell radiation as a promising platform for the generation of space-time wave packets that are ultra-broadband and highly tunable from terahertz to X-ray frequencies.

Authors:Yi Ji Tan, Institute of Microelectronics / Liangjie Wong, Nanyang Technological University

FF2H.5

Light Emission by Free Electrons in Photonic Time-Crystals

Presenter: Alex Dikopoltsev , *Technion*

We study emission of electrons moving in photonic time-crystals, and find exponentially enhanced Cherenkov emission in the momentum gap drawing energy from the modulation, and suppressed emission in the opposite direction due to avoided crossing.

Authors:Alex Dikopoltsev, Technion / Yonatan Sharabi, Technion / Yaakov Lumer, Technion / Mark Lyubarov, Technion / Shai Tseses, Technion / Eran Lustig, Technion / Ido Kaminer, Technion / Mordechai segev, Technion

FF2H.6

Time Lens Induced by Optical Pushbroom Effect

Presenter: Mahmoud Gaafar , *Hamburg University of technology*

We show analytically and by numerical simulation an on-chip time lens based on the optical pushbroom effect. Furthermore, we demonstrate this effect inside a silicon Bragg grating waveguide. The presented effect can be utilized to compress signals in time and space.

Authors:Mahmoud Gaafar, Hamburg University of technology / Hagen Renner, Hamburg University of technology / Manfred Eich, Hamburg University of technology / alexander petrov, Hamburg University of technology

FF2H.7

Amplified Spontaneous Emission and Lasing in Photonic Time-Crystals

Presenter: Mark Lyubarov , *Technion*

We find that the spontaneous emission in the momentum bandgap of photonic time-crystals is amplified exponentially by the periodic modulation. When inserted in a resonator - it can give rise to lasing without threshold.

Authors:Mark Lyubarov, Technion / Yaakov Lumer, Technion / Alex Dikopoltsev, Technion / Eran Lustig, Technion / Yonatan Sharabi, Technion / Mordechai segev, Technion

FF2H.8

Photonic Topological Dissipation in Time-Multiplexed Resonator Networks

Presenter: Christian Leefmans , *California Institute of Technology*

We utilize dissipatively coupled, time-multiplexed photonic resonator networks to demonstrate topologically nontrivial behaviors in the dissipation of one- and two- dimensional lattices. We present edge state and band structure measurements of the these networks.

Authors:Christian Leefmans, California Institute of Technology / Avik Dutt, Stanford University / James Williams, California Institute of Technology / Luqi Yuan, Shanghai Jiao Tong University / Midya Parto, California Institute of Technology / Franco Nori, RIKEN Cluster for Pioneering Research / Shanhui Fan, Stanford University / Alireza Marandi, California Institute of Technology

FF2K

Novel Tools for Ultrafast Science - Structured Light and Waveform Synthesis

Presenter: Alexandra Landsman , *ETH Zurich*

FF2K.1

Controlling the Temporal Evolution of Spin and Orbital Angular Momentum in Ultrashort Light Pulses

Invited

Presenter: Laura Rego Cabezas , *Grupo de Investigación en Aplicaciones del Láser y Fotónica, Universidad de Salamanca*

We present the generation of extreme-ultraviolet beams with a spin or orbital angular momentum that changes along time. Their angular momentum is controlled by taking advantage of the properties of the high-order harmonic generation process.

Authors: Laura Rego Cabezas, Grupo de Investigación en Aplicaciones del Láser y Fotónica, Universidad de Salamanca

FF2K.2

Observation of Toroidal Light Pulses

Presenter: Apostolos Zdagkas, *University of Southampton*

We report on the observation of optical and terahertz non-transverse, non-separable electromagnetic pulses of toroidal topology that are propagating counterparts of the localized toroidal dipoles launched from toroidal emitter metasurfaces excited by conventional laser pulses.

Authors: Apostolos Zdagkas, University of Southampton / Yijie Shen, University of Southampton / Shankar Pidishety, University of Southampton / Cormac McDonnell, Tel-Aviv University / Junhong Deng, Southern University of Science and Technology / Guixin Li, Southern University of Science and Technology / Nikitas Papisimakis, University of Southampton / Tal Ellenbogen, Tel-Aviv University / Nikolay Zheludev, University of Southampton

FF2K.3

Ultrafast Optical Rotation: Highly Sensitive Enantio-Discrimination With Controlled Few-Cycle Optical Pulses

Presenter: David Ayuso, *Max-Born-Institut*

We introduce *ultrafast optical rotation*: a highly efficient method for chiral discrimination using few-cycle pulses. Sub-cycle optical control enables full control over the enantio-sensitive response of matter in a molecule-specific manner and on ultrafast timescales.

Authors: David Ayuso, Max-Born-Institut / Andres Ordonez, Max-Born-Institut / Misha Ivanov, Max-Born-Institut / Olga Smirnova, Max-Born-Institut

FF2K.4

Reconfigurable Semiconductor Currents Driven by Ultrafast Coherent Control With Structured Light

Invited

Presenter: Shawn Sederberg, *University of Ottawa*

We apply femtosecond pulses with vectorized or structured spatial modes to coherent control of currents. We excite and measure complex and reconfigurable current patterns in a semiconductor, with an emphasis on generating magnetic fields.

Authors: Shawn Sederberg, University of Ottawa / Kamalesh Jana, University of Ottawa / Katherine Herperger, University of Ottawa / Paul Corkum, University of Ottawa

FF2K.5

Soft X-ray Attosecond Control via Parametric Waveform Synthesis

Presenter: Miguel Silva Toledo, *Deutsches Elektronen-Synchrotron DESY*

Soft X-ray high-harmonic continua reaching 0.2 keV are observed in neon at 300 mbar, using tailored fields from a parametric waveform synthesizer. Waveform-controlled continua show signatures of isolated attosecond pulse generation with distinct spectral envelopes.

Authors: Miguel Silva Toledo, Deutsches Elektronen-Synchrotron DESY / Fabian Scheiba, Deutsches Elektronen-Synchrotron DESY / Roland Mainz, Deutsches Elektronen-Synchrotron DESY / Yudong Yang, Deutsches Elektronen-Synchrotron DESY / Giovanni Cirimi, Deutsches Elektronen-Synchrotron DESY / Giulio Rossi, Deutsches Elektronen-Synchrotron DESY / Franz Kärtner, Deutsches Elektronen-Synchrotron DESY

FF2K.6

1.1-GW 213-as Soft-x ray Isolated Attosecond Pulse Created by a Fully Stabilized 50-mJ Three-Channel Optical Waveform Synthesizer

Presenter: Bing Xue, *RIKEN*

A GW-scale isolated attosecond pulse is demonstrated by a fully stabilized 50-mJ three-channel waveform synthesizers. Isolated pulse duration with 213-as, 0.24- μ J is experimentally characterized by the FROG-CRAB method with a 10-Hz repetition rate.

Authors: Bing Xue, RIKEN / Katsumi Midorikawa, RIKEN / Eiji Takahashi, RIKEN

AF2Q

New Technologies for Optical Imaging and Sensing

Presenter: Muhammad Al-Qaisi, *Alcon Laboratories*

AF2Q.1

Multimodal Multiphoton Microscopy for Protein Crystal Detection Based on two-Color Ultrafast Fiber Laser Source

Presenter: HSIANG-YU CHUNG, *Center for Free-Electron Laser Science, DESY*

We demonstrate label-free multiphoton microscopy including harmonic generation and three-photon excitation fluorescence to score protein crystals based on a novel fiber laser source that emits femtosecond pulses at 775 nm and 1300 nm.

Authors:HSIANG-YU CHUNG, Center for Free-Electron Laser Science, DESY / Qing-di Cheng, University of Hamburg, Laboratory for Structural Biology of Infection and Inflammation / Robin Schubert, University of Hamburg, Laboratory for Structural Biology of Infection and Inflammation / Shih-Hsuan Chia, Center for Free-Electron Laser Science, DESY / Franz Kärtner, Center for Free-Electron Laser Science, DESY / Guoqing Chang, Chinese Academy of Sciences / Christian Betzel, University of Hamburg, Laboratory for Structural Biology of Infection and Inflammation

AF2Q.2

Double-Clad Hollow-Core Photonic Crystal Fiber for Nonlinear Optical Imaging

Presenter: Frédéric Delahaye , *Glophotonics*

We report on simultaneous CARS and two-photon excited fluorescence imaging using tailored double-clad hypocycloid core-contour Kagome fiber optimized for broad bandwidth low-loss, high bioimaging collection efficiency and reduced bend loss sensitivity.

Authors:Frédéric Delahaye, Glophotonics / Frédéric Gêrôme, Glophotonics / Foued Amrani, Glophotonics / Angelika Unterhuber, University of Vienna / Kostiantyn Vasko, GPPMM, XLIM, UMR 7252 Univ. de Limoges / Benoit Debord, GPPMM, XLIM, UMR 7252 Univ. de Limoges / Marco Andreana, University of Vienna / Fetah Benabid, Glophotonics

AF2Q.3

a Novel Fiber-Optic Confocal Laser Caliper Approach for Non-Contact Optical Characterization of Silk Fibroin Thin Films Created by Riboflavin Photo-Crosslinking

Presenter: Xin Tan , *FDA/CDRH/OSEL/DBP*

Silk fibroin with its attractive combination of advanced properties is promising for regenerative treatments of corneal disorders. Novel photonics is used to characterize the thickness and refractive index of silk fibroin thin films photo-crosslinked with a natural photosensitizer Riboflavin.

Authors:Xin Tan, FDA/CDRH/OSEL/DBP / Daniel Hammer, FDA/CDRH/OSEL/DBP / Ilko Ilev, FDA/CDRH/OSEL/DBP

AF2Q.4

Real-Time Bio Particle Flow Analysis Platform Based on FPGA Integrated Optofluidic ARROW Devices

Presenter: Mohammad Julker Neyen Sampad , *University of California, Santa Cruz*

Programmable, fast electronic tools are integrated with optofluidic sensors for live analysis of fluorescence signals from single particles flowing through a fluidic channel. We demonstrate real-time, high-accuracy identification of targets and determination of analyte concentration.

Authors: Mohammad Julker Neyen Sampad, University of California, Santa Cruz / Md Nafiz Amin, University of California, Santa Cruz / Gopikrishnan Gopalakrishnan Meena, University of California, Santa Cruz / Aaron Hawkins, Brigham Young University / Holger Schmidt, University of California, Santa Cruz

AF2Q.5

Label-Free Ratiometric Monitoring of Interferon Gamma Dynamics With Spectrally Filtered Si Photodiode Pairs

Presenter: Zheshun Xiong, *UMass Amherst*

We report a label-free ratiometric interferon gamma (IFN- γ) sensor based on spectrally filtered Si photodiode (PD) pairs anchored with aptamer probes. Our sensor can rapidly detect two-color fluorescence change resulting from the aptamer-IFN- γ binding events.

Authors: Zheshun Xiong, UMass Amherst / Kewei Ren, UMass Amherst / Matthew Donnelly, UMass Amherst / Mingxu You, UMass Amherst / Guangyu Xu, UMass Amherst

AF2Q.6

Optical Nanosensors in the Near-Infrared Spectral Window

Presenter: Gili Bisker, *Tel Aviv University*

We report the discovery of tailored functionalization of single-walled carbon nanotubes, which renders them near-infrared optical sensors for proteins. Our results open new avenues for synthetic recognition of macromolecules with optical signal transduction.

Authors: Gili Bisker, Tel Aviv University

AF2Q.7

MEMS FTIR Parallel Spectrometer for Non-Invasive Skin Biochemistry Analysis

Presenter: Abdelrahman Salem, *Ain Shams University*

MEMS FTIR parallel-core spectrometer is presented for biochemistry analysis. The fabricated chip comprising 2 interferometers shows an SNR of about 1000:1 on the human skin using diffuse reflectance interface and a single photodetector.

Authors: Abdelrahman Salem, Ain Shams University / Alaa Fathy, Ain Shams University / Ahmed Othman, Ain Shams University / Yasser Sabry, Ain Shams University / Diaa Khalil, Ain Shams University

AF2Q.8

Low-Power, Thin and Flexible, Stacked Digital LC Lens for Adaptive Contact Lens System With Enhanced Tunability

Presenter: Aishwaryadev Banerjee , *University of Utah*

Abstract: By stacking multiple thin and flexible LC based lenses, we experimentally demonstrate a low-power adaptive optical system with enhanced focusing tunability that is suitable for integration with a smart contact lens system.

Authors:Aishwaryadev Banerjee, University of Utah / Chayanjit Ghosh, University of Utah / Mohit Karkhanis, University of Utah / Erfan Pourshaban, University of Utah / hanseup Kim, University of Utah / Carlos Mastrangelo, University of Utah

AF2R

Visible Lasers and Integrated Technology

Presenter: Liam O'Faolain

AF2R.1

(Withdrawn) Red Laser Diodes and Arrays for Display and Printing Applications

Invited

Presenter: Petteri Uusimaa , *Modulight Inc.*

To be provided

Authors:Petteri Uusimaa, Modulight Inc.

AF2R.2

Integration Technologies for Silicon Photonics Packaging

Invited

Presenter: Geert Van Steenberge , *Ghent University-imec*

Novel building blocks for silicon photonics packaging will be introduced, including aerosol-jet printed interconnects for dense 2.5D electronic-photonics integration, ultrafast laser written glass interposers for fiber coupling, and laser-induced forward-transfer printed micro-lenses for expanded beam coupling.

Authors:Geert Van Steenberge, Ghent University-imec / Jeroen Missinne, Ghent University-imec / Marie-Aline Mattelin, Ghent University-imec / Viktor Geudens, Ghent University-imec / Andres Desmet, Ghent University-imec / Tom Sterken, Ghent University-imec

AF2R.4

Spectral Linewidth Narrowing of two Broad Area Blue Laser Diode (445nm) With a Common External Cavity

Presenter: Parashu Nyaupane , *CREOL, College of Optics and Photonics,*

Two watt-level broad area laser diodes (BALD) were simultaneously locked into a common external cavity made using a surface grating in Littrow configuration and the spectral linewidth of the combined laser beam was narrowed down from over a nm to 15 pm (FWHM).

Authors:Parashu Nyaupane, CREOL, College of Optics and Photonics, / Yehuda Braiman, CREOL, College of Optics and Photonics, / Patrick L. LiKamWa, CREOL, College of Optics and Photonics,

AF2R.5

Nonlinear Characterization of Laser Processed Polysilicon Waveguides for Integrated Photonics

Presenter: Stuart MacFarquhar , *University of Southampton*

Polycrystalline silicon offers the full complement of functionality required for integrated optoelectronic systems, including nonlinear optical processing. We report low loss laser-crystallized polycrystalline silicon waveguides with nonlinear coefficients equivalent to those of crystalline silicon.

Authors:Stuart MacFarquhar, University of Southampton / Ozan Aktas, University of Southampton / SweZin Oo, University of Southampton / Antulio Tarazona, University of Southampton / Harold Chong, University of Southampton / Anna Peacock, University of Southampton

AF2R.6

Suppression of Efficiency Droop by Inserting a Thin Undoped AlGa_N Layer Into Each Quantum Barrier in AlGa_N-Based Deep-Ultraviolet Light-Emitting Diode

Presenter: Jia Hongfeng , *University of Science and Technology of China*

We propose a DUV LED device architecture with band-engineered quantum barriers (QBs) to "serve" as an alternative approach to suppress the electron leakage and facilitate the electron and hole injection efficiency for efficient radiative recombination.

Authors:Jia Hongfeng, University of Science and Technology of China / Huabin Yu, University of Science and Technology of China / Zhongjie Ren, University of California San Diego / Chong Xing, University of Science and Technology of China / Zhongling Liu, University of Science and Technology of China / Yang Kang, University of Science and Technology of China / Haiding Sun, University of Science and Technology of China

High Energy, High Power Lasers II

Presider: Lynda Busse , *US Naval Research Laboratory*

SF2N.1

Demonstration of a Kilowatt Average Power, 1 Joule, Green Laser

Presenter: Han Chi , *Colorado State University*

A 1.04 J, $\lambda=515$ nm laser at 1 kHz repetition rate was demonstrated by frequency doubling 1.2 J, temporally shaped square 2 ns pulses from a cryogenically cooled Yb:YAG laser in LBO crystals.

Authors:Han Chi, Colorado State University / Yong Wang, Colorado State University / Aaron Davenport, Colorado State University / Carmen Menoni, Colorado State University / jorge rocca, Colorado State University

SF2N.2

High Repetition-Rate Terawatt Diode Pumped Laser

Presenter: Antoine Courjaud , *Amplitude Laser*

We report a diode-pumped laser delivering 518mJ and 435fs pulse duration at 50Hz repetition rate, corresponding to 1.2 Terawatt peak power. The pulse is 3% close to TF limit, and the Strehl ratio is 0.91.

Authors:Antoine Courjaud, Amplitude Laser / Emilien Gontier, Amplitude Laser / Arnaud Mortz, Amplitude Laser / Jean-Gabriel Brisset, Amplitude Laser / Magali Durand, Amplitude Laser / Pierre Sevillano, Amplitude Laser / abdelhak Saci, Amplitude Laser

SF2N.3

Robust Metasurfaces With Tailored Graded Index for High Power Laser Applications

Invited

Presenter: Nathan Ray , *Lawrence Livermore National Laboratory*

Solid-state diffusional dewetting is utilized to produce randomly oriented ensembles of nanoparticles on large scales, which then function as dry etching masks for generation of durable metasurfaces for antireflective and metaoptics applications

Authors:Nathan Ray, Lawrence Livermore National Laboratory / Jae Hyuck Yoo, Lawrence Livermore National Laboratory / Hoang Nguyen, Lawrence Livermore National Laboratory / Michael Johnson, Lawrence Livermore National Laboratory / Salmaan Baxamusa, Lawrence Livermore National Laboratory / Selim Elhadj, Lawrence Livermore National Laboratory / Eyal Feigenbaum, Lawrence Livermore National Laboratory

SF2N.4

Revisiting Temperature-Dependent Spectroscopy of Yb:YLF

Presenter: Stefan Püschel , *Leibniz Institut für Kristallzüchtung*

We propose a new model for the temperature-dependent lifetime of Yb:YLF based on Boltzmann population of the upper Stark levels. Temperature-dependent spectroscopy enables to re-evaluate the potential of Yb:YLF for laser cooling.

Authors:Stefan Püschel, Leibniz Institut für Kristallzüchtung / Sascha Kalusniak, Leibniz Institut für Kristallzüchtung / Christian Kraenkel, Leibniz Institut für Kristallzüchtung / Hiroki Tanaka, Leibniz Institut für Kristallzüchtung

SF2N.5

High Average Power and High Energy Yb:YLF Cryogenic Amplifiers

Presenter: Mikhail Pergament , *Center for Free Electron Laser Science*

We present initial results from a high-power and high energy sub-ps cryogenic Yb:YLF amplifier chain centered around 1018.5 nm. We have so far achieved average powers above 90-W and pulse energies up to 305 mJ.

Authors:Mikhail Pergament, Center for Free Electron Laser Science / Umit Demirbas, Center for Free Electron Laser Science / Martin Kellert, Center for Free Electron Laser Science / Yizhou Liu, University of Hamburg / Jelto Thesinga, Center for Free Electron Laser Science / Huseyin Cankaya, Center for Free Electron Laser Science / Yi Hua, Center for Free Electron Laser Science / Luis Zapata, Center for Free Electron Laser Science / Franz Kärtner, Center for Free Electron Laser Science

SF2N.6

1.2 TW Laser Amplifier for High Harmonic Generation and Laser Plasma Acceleration Experiments at 1kHz Repetition Rate

Presenter: Christian Greb , *Research Center Jülich*

We present the main parameters of the 1.2 TW Ti:Sapphire laser amplifier system operating at 1 kHz. The high quality beam output allows generation of linearly- and circularly polarized photons in the extreme ultraviolet range.

Authors:Christian Greb, Research Center Jülich / Roman Adam, Research Center Jülich / Olivier Chalus, Thales LAS France / Gilles Rey, Thales LAS France / Sarah Heidtfeld, Research Center Jülich / Zahra Chitgar, Research Center Jülich GmbH / Paul Gibbon, Research Center Jülich GmbH / Fangzhou Wang, Research Center Jülich / Derang Cao, Qingdao University / Markus Büscher, Research Center Jülich / Claus Schneider, Research Center Jülich

SF2N.7

the All Diode Pumped, Yb³⁺ Based, 10 J, 10 Hz, Sub-Picosecond CPA Laser of the Petawatt-Field-Synthesizer

Presenter: Mathias Krüger , *Max-Planck-Institut für Quantenoptik*

We present the laboratory performance and key technologies of the all diode pumped, Yb³⁺ based, 10 J, 10 Hz, sub-picosecond CPA laser chain that was developed to pump the picosecond OPCPA stages of the Petawatt-Field-Synthesizer.

Authors: Mathias Krüger, Max-Planck-Institut für Quantenoptik / Andreas Münzer, Ludwig-Maximilians-Universität München / Alexander Kessel, Ludwig-Maximilians-Universität München / Vyacheslav Leshchenko, Ludwig-Maximilians-Universität München / Ferenc Krausz, Max-Planck-Institut für Quantenoptik / Stefan Karsch, Max-Planck-Institut für Quantenoptik

SF2F

Ultrafast Lasers

Presenter: Ann Coleman, *University of Texas at Arlington*

SF2F.1

Electrically Injection-Locked Quantum Dash Frequency-Modulated Comb

Presenter: dominik auth, *TU Darmstadt*

Inter-mode beat frequency tuning of a frequency-modulated quantum dash comb laser by electrical injection locking over 1.8 MHz is presented. Experiments are supported by a coupled oscillator model extended with a noise term.

Authors: Marcus Ossiander, Harvard University / dominik auth, TU Darmstadt / Johannes Hillbrand, TU Wien / Quentin Gaimard, Centre de Nanosciences et de Nanotechnologies / Dmitry Kazakov, Harvard University / Marco Piccardo, Harvard University / Abderrahim Ramdane, Centre de Nanosciences et de Nanotechnologies / Federico Capasso, Harvard University / Benedikt Schwarz, TU Wien / Stefan Breuer, Harvard University

SF2F.2

Comb Injection Into a Single-Mode Laser

Presenter: dominik auth, *Technische Universität Darmstadt*

Temporally- and spectrally-resolved phase and intensity emission characterization of amplitude-modulated optical frequency comb generation and phase noise transfer of an initially single mode laser by optical comb injection locking is presented.

Authors: dominik auth, Technische Universität Darmstadt / Jan Lautenschläger, Technische Universität Darmstadt / Christoph Weber, Technische Universität Darmstadt / Dmitry Kazakov, Harvard University / Marco Piccardo, Harvard University / Andreas Klehr, FBH / Andrea Knigge, FBH / Johannes Hillbrand, TU Wien / Benedikt Schwarz, TU Wien / Federico Capasso, Harvard University / Stefan Breuer, Technische Universität Darmstadt

SF2F.3

Ultra-Stable 25.5 GHz Quantum dot Mode-Locked Frequency Comb Operating up to 120 °C

Presenter: Shujie Pan , *University College London*

We report a frequency comb source based on a quantum dot mode-locked laser that generates a frequency comb with a stable 25.5 GHz mode spacing over an ultra-broad temperature range of 20 °C - 120 °C.

Authors: Shujie Pan, University College London / Jianou Huang, Eindhoven University of Technology / Zichuan Zhou, University College London / Zhixin Liu, University College London / Lalitha Ponnampalam, University College London / Zizhuo Liu, University College London / Mingchu Tang, University College London / Mu-Chieh Lo, University College London / Zizheng Cao, Eindhoven University of Technology / Alwyn Seeds, University College London / Huiyun Liu, University College London / Siming Chen, University College London

SF2F.4

Amplitude- and Frequency-Modulated Comb Laser With sub-kHz RF Beat Note Line Width

Presenter: Leonard Wegert , *Technische Universität Darmstadt*

Frequency- and amplitude-modulated comb generation on demand by a quantum dot laser are presented. Combs are centered at 1265 nm (7900 cm⁻¹). Temporally-, spectrally- and frequency-resolved emission characteristics are reported.

Authors: Leonard Wegert, Technische Universität Darmstadt / dominik auth, Technische Universität Darmstadt / Christoph Weber, Technische Universität Darmstadt / Dmitry Kazakov, Harvard University / Marco Piccardo, Harvard University / Johannes Hillbrand, TU Wien / Benedikt Schwarz, TU Wien / Federico Capasso, Harvard University / Stefan Breuer, Technische Universität Darmstadt

SF2F.5

Approaching 200 fs, Using Dispersion Engineering, in Passively Mode-Locked Bragg Waveguide Laser Structures

Presenter: Bilal Janjua , *University of Toronto*

We demonstrate a passively mode-locked semiconductor Bragg waveguide laser which exhibit pulse widths down to 211 fs at 64 GHz. The dispersion of Bragg waveguides enables this new record, especially for emission around 785 nm.

Authors: Bilal Janjua, University of Toronto / Meng lu, University of Toronto / Zhizhong Yan, University of Toronto / Paul Charles, University of Toronto / Eric Chen, University of Toronto / Amr Helmy, University of Toronto

SF2F.6

50Gbps Single Mode 1060nm Intracavity Metal Aperture VCSEL With Transverse Resonance

Presenter: Hameeda Ragab , *Tokyo Institute of Technology*

We demonstrate 1060nm intracavity metal-aperture VCSELs with 50Gbps high-speed modulations in single-mode operations. The intracavity metal-aperture causes the transverse resonance which provides the modulation bandwidth-enhancement to go beyond the limit of relaxation oscillation frequencies.

Authors:Hameeda Ragab, Tokyo Institute of Technology / AHMED HASSAN, Tokyo Institute of Technology / XIAODONG GU, Tokyo Institute of Technology / Satoshi Shinada, National Institute of Information and Communications Technology / Moustafa Ahmed, Minia University / Fumio Koyama, Tokyo Institute of Technology

SF2F.7

Exploring New Ultrafast Operation Regimes in Quantum Dot Lasers and Amplifiers

Invited

Presenter: Maria Ana Cataluna , *Heriot-Watt University*

We will present our recent results, harnessing the flexibility of quantum dot materials towards the development of increasingly versatile regimes of ultrashort pulse generation and amplification in edge-emitting devices.

Authors:Maria Ana Cataluna, Heriot-Watt University / Adam Forrest, Heriot-Watt University / Ana Filipa Ribeiro, Heriot-Watt University / Stephanie White, IOP Publishing / Michel Krakowski, III-V Lab / Paolo Bardella, Politecnico di Torino

SF2O

Integrated Nonlinear Photonics

Presenter: Katia Shtyrkova , *MIT Lincoln Laboratory*

SF20.1

Milliwatt Threshold Ultra-Low Linewidth Photonic Integrated Si₃N₄ Brillouin Laser

Presenter: KAIKAI LIU , *University of California at Santa Barbara*

We report a 1.35 mW threshold Brillouin laser with measured 0.47 Hz fundamental and 525 Hz integral linewidths using a 422 Million intrinsic Q Si₃N₄ resonator.

Authors:KAIKAI LIU, University of California at Santa Barbara / Matthew Puckett, Honeywell International / Mark Harrington, University of California at Santa Barbara / Grant Brodnik, University of California at Santa Barbara / Qiancheng Zhao, University of California at Santa Barbara / Nitesh Chauhan, University of California at Santa Barbara / Jiawei Wang, University of California at Santa Barbara / Ryan Behunin, Northern Arizona University / Karl Nelson, Honeywell International / Daniel Blumenthal, University of California at Santa Barbara

SF20.2

Towards Milli-Hertz Laser Frequency Noise on a Chip

Presenter: LUE WU , *California Institute of Technology*

A fundamental frequency noise of 9 mHz*Hz/Hz is demonstrated in an on-chip Brillouin laser. The noise measurement uses the frequency discrimination method enhanced by cross-correlator. The results set new performance targets for chip-based laser platforms.

Authors:Heming Wang, California Institute of Technology / LUE WU, California Institute of Technology / Zhiquan Yuan, California Institute of Technology / Kerry Vahala, California Institute of Technology

SF20.3

Progress in Nonlinear Integrated Photonics Based on Thin-Film Lithium Niobate

Invited

Presenter: Sasan Fathpour , *CREOL, University of Central Florida*

Lithium niobate has been rejuvenated for integrated photonics by development of thin-film wafers of the material on silicon substrates. Recent advancement of devices and circuits demonstrated on this maturing platform for nonlinear-optical applications is reviewed.

Authors:Sasan Fathpour, CREOL, University of Central Florida

SF20.4

Broadband UV-Vis Frequency Combs From High-Harmonic Generation in Quasi-Phase-Matched Waveguides

Presenter: Jay Rutledge , *Stony Brook University*

We report efficient, phase-coherent high-harmonic generation in chirped periodically poled lithium niobate waveguides pumped with a watt-scale 3 micron frequency comb. Simulations support a mechanism of cascaded quadratic nonlinearity and provide insight into spectral optimization.

Authors: Jay Rutledge, Stony Brook University / Anthony Catanese, Stony Brook University / Dan Hickstein, National Institute of Standards and Technology / Thomas Allison, Stony Brook University / Scott Diddams, National Institute of Standards and Technology / Abijith Kowligy, National Institute of Standards and Technology

SF20.5

11× Temporal Compression in an Ultra-Silicon-Rich Nitride Chip

Presenter: Ju Won Choi, *Singapore Univ. of Technology & Design*

Strong temporal compression in an integrated ultra-silicon-rich nitride temporal compressor consisting of separate nonlinear and anomalously dispersive stages is demonstrated. 11× compression of 5.8ps pulses at a low input peak power of 13.3W and 9.4× increase in the pulse peak power is achieved.

Authors: Ju Won Choi, Singapore Univ. of Technology & Design / Byoung Uk Sohn, Singapore Univ. of Technology & Design / George Chen, Singapore Univ. of Technology & Design / Doris Ng, A*STAR Institute of Microelectronics / Anuradha Agarwal, Massachusetts Institute of Technology / Lionel Kimerling, Massachusetts Institute of Technology / Dawn Tan, Singapore Univ. of Technology & Design

SF20.6

Optical Parametric Amplification in Silicon Nitride Waveguides for Coherent Raman Imaging

Presenter: Niklas Lüpken, *University of Münster*

Waveguide-based optical parametric amplification by stimulated four-wave mixing in silicon nitride waveguides is presented. The high nonlinearity leads to reduced necessary pump energies and waveguide length. The light source was applied for narrowband Raman imaging.

Authors: Niklas Lüpken, University of Münster / Thomas Würthwein, University of Münster / Klaus-J. Boller, University of Twente / Carsten Fallnich, University of Münster

SF20.7

Enhanced Kerr Nonlinear Performance in Graphene Oxide-Coated Silicon and Silicon Nitride Waveguides

Presenter: David Moss, *Swinburne University of Technology*

Graphene oxide films are integrated with silicon and silicon nitride waveguides to demonstrate enhanced Kerr nonlinearity. Self-phase modulation with a broadening factor of 4.34 and four-wave mixing with ~9.1 dB conversion efficiency improvement are achieved.

Authors: David Moss, Swinburne University of Technology / yuning zhang, Swinburne University of Technology / jia yang wu, Swinburne University of Technology / yunyi yang, Swinburne University of Technology / Yang Qu, Swinburne University of Technology / linnan jia, Swinburne University of Technology / Baohua Jia, Swinburne University of Technology / Christelle Monat, Ecole Centrale de Lyon / christian grilllet, Ecole Centrale de Lyon

SF2B

Design and Fabrication Techniques for Photonic Integrated Circuits

Presenter: Wim Bogaerts , *Universiteit Gent*

SF2B.1

Photonic Integration – From Switching to Computing

Invited

Presenter: Odile Liboiron-Ladouceur , *McGill University*

A mesh of interferometers can be arranged to route an optical signal or linearly transform an optical input vector. The talk discusses how Mach-Zehnder based switches became key in optical processors.

Authors: Odile Liboiron-Ladouceur, McGill University

SF2B.2

Ultra-Broadband and Low-Loss 16 × 16 SiPh Switch

Presenter: Alok Das , *McGill University*

A 16×16 SiPh thermo-optic switch provides 100 nm of bandwidth, at most 8 dB in crosstalk, and 3.8 dB loss for the longest path. At 10 Gb/s, this energy-efficient switch consumes less than 7 pJ/bit.

Authors: Alok Das, McGill University / Guowu Zhang, McGill University / Odile Liboiron-Ladouceur, McGill University

SF2B.3

Ultra-Broadband Nanophotonics via Adaptive Inverse Design

Presenter: Ziwei Zhu , *Columbia University*

We present an inverse design method for achieving unprecedented performance and ultra wide bandwidth based on direct adaptive refinement of the device geometry. We experimentally demonstrate a 90/10 splitter with more than 200 nm bandwidth.

Authors:Ziwei Zhu, Columbia University / Utsav Dave, Columbia University / Michal Lipson, Columbia University / Changxi Zheng, Columbia University

SF2B.4

Inverse Design of Visible Integrated Photonics for an Ultracold Strontium Optical Clock

Presenter: Grisha Spektor , *Colorado University*

We demonstrate visible integrated photonics, using an inverse-design approach. Tantalum-pentoxide nanophotonics offers <2 dB/cm waveguide loss across 450-2000 nm range. We create a suite of passives, including arbitrary-polarization grating sources for a Sr optical clock.

Authors:Grisha Spektor, Colorado University / David Carlson, National Institute of Standards and Technology / Zachary Newman, National Institute of Standards and Technology / Jinhie Lee Skarda, Stanford University / Neil Sapra, Stanford University / Logan Su, Stanford University / Yee Ming Tso, Colorado University / Sindhu Jammi, National Institute of Standards and Technology / Andrew Ferdinand, National Institute of Standards and Technology / will lunden, Vector Atomic / Martin Boyd, Vector Atomic / Kartik Srinivasan, National institute of Standards and Technology / Chad Ropp, National institute of Standards and Technology / Amit Agrawal, National institute of Standards and Technology / Vladimir Aksyuk, National institute of Standards and Technology / Jelena Vuckovic, Stanford University / Scott Papp, Colorado University

SF2B.5

Ultra-low-Loss Photonic Circuits With Integrated Quantum dot Single-Photon Sources

Presenter: Ashish Chanana , *National Inst of Standards & Technology*

We demonstrate hybrid quantum photonic circuits comprising Si₃N₄ waveguides featuring losses in the dB/m range, with directly integrated quantum dot based single-photon sources.

Authors:Hugo Larocque, Massachussetts Institute of Technology / Renan Moreira, UCSB / Biswarup Guha, National Inst of Standards & Technology / Ashish Chanana, National Inst of Standards & Technology / Jin Dong Song, Korea Institute of Science and Technology / Jacques Carolan, Massachussetts Institute of Technology / Dirk Englund, Massachussetts Institute of Technology / Daniel Blumenthal, UCSB / Kartik Srinivasan, National Inst of Standards & Technology / Marcelo Davanco, National Inst of Standards & Technology

SF2B.6

Hybrid Photonic Integration: From High-Speed Communications to THz Signal Processing

Invited

Presenter: Christian Koos , *Karlsruhe Institute of Technology KIT*

Hybrid photonic integration combines the strengths of complementary materials while maintaining the scalability of monolithic approaches. This talk gives an overview on our work on hybrid photonic circuits and their applications in optical communications and THz signal processing.

Authors:Christian Koos, Karlsruhe Institute of Technology KIT

SF2A

Emerging Photonic Materials

Presider: Harish Subbaraman , *Boise State University*

SF2A.1

Simultaneous Second and Third Harmonic Generation in Gallium Phosphide Microdisk Resonators

Presenter: Blaine McLaughlin , *University of Calgary*

Gallium phosphide is a nonlinear crystal of growing importance for integrated photonics. We observe and characterize a simultaneous second harmonic generation and third harmonic generation in a gallium phosphide microdisk for the first time.

Authors:Blaine McLaughlin, University of Calgary / David Lake, University of Calgary / Matthew Mitchell, University of Calgary / Paul Barclay, University of Calgary

SF2A.2

Hybrid Aluminum Nitride Integration on Silicon Nitride Photonic Circuits

Presenter: Menno Poot , *TU München*

We demonstrate sputtering of high-quality aluminum nitride films onto prefabricated silicon nitride photonic circuits, simplifying their nanofabrication. Hybrid microring devices show reduced bending loss and low propagation losses, enabling future on-chip quantum optics experiments.

Authors:Giulio Terrasanta, TU München / Manuel Müller, Walther-Meißner-Institut / Timo Sommer, TU München / Mathias Althammer, Walther-Meißner-Institut / Menno Poot, TU München

SF2A.3

Dual-Layer Thick LPCVD SiN Waveguides for low-Loss Photonics on 200 mm Wafers

Presenter: Aleksandrs Marinins , *imec*

We demonstrate 800 nm thick low-loss dual-layer LPCVD SiN optical waveguides with tunable profile shape to engineer modal properties. We achieved <10 dB/m loss at 1550 nm wavelength and nearly lossless vertical transitions between waveguides.

Authors: Aleksandrs Marinins, imec / Jon Kjellman, imec / Charles Caër, imec / Tangla David, imec / Xavier Rottenberg, imec / Roelof Jansen, imec / Philippe Soussan, imec

SF2A.4

Impact of Stoichiometric Silicon Nitride Growth Conditions on Dispersion and Broadband Kerr Microcombs in the Near-Visible

Presenter: Gregory Moille , *Joint Quantum Institute*

We consider the impact of precursor gas ratio on nominally stoichiometric silicon nitride films, and show how it has a significant impact on microresonator integrated dispersion and broadband comb generation in the near-visible.

Authors: Gregory Moille, Joint Quantum Institute / Daron Westly, National Institute of Standards and Technology / Edgar Perez, Joint Quantum Institute / Ashutosh Rao, University of Maryland / Xiyuan Lu, University of Maryland / Kartik Srinivasan, Joint Quantum Institute

SF2A.5

Integrated Photonic Neural Networks Using Phase-Change Materials

Tutorial

Presenter: Mo Li , *University of Washington*

This tutorial will review the recent research progress in using phase-change materials in integrated photonics for optical neural networks and provide a perspective of future larger-scale integration.

Authors: Mo Li, University of Washington

SF2M

Femtosecond Oscillators

Presider: Lúcia Saito

SF2M.1

SESAM Mode-Locked High-Power sub-100-fs Cr:ZnS Oscillator at 2.37 μm

Highlighted Talk

Presenter: Ajanta Barh , *ETH Zurich*

We present a SESAM mode-locked self-starting Cr:ZnS oscillator operating at 2.37 μm , producing record low 80 fs transform limited pulses (bandwidth 71 nm) at average output power of 0.8 W from a 250 MHz cavity.

Authors: Ajanta Barh, ETH Zurich / Behçet Özgür Alaydin, ETH Zurich / Jonas Heidrich, ETH Zurich / Marco Gaulke, ETH Zurich / Matthias Golling, ETH Zurich / Christopher Phillips, ETH Zurich / Ursula Keller, ETH Zurich

SF2M.2

Silicate Bonding of Sapphire to SESAMs: SESAMs With Tunable Thermal Lensing for High-Power Lasers

Presenter: Lukas Lang , *ETH Zurich - Inst. of Quantum El.*

We demonstrate for the first time silicate bonding of a SESAM to a sapphire superstrate to control the sign and magnitude of the SESAMs thermal lensing. We demonstrate mode-locking in a 233-W average-power thin-disk laser.

Authors: Lukas Lang, ETH Zurich - Inst. of Quantum El. / Francesco Saltarelli, ETH Zurich - Inst. of Quantum El. / Gregoire Lacaillle, University of Glasgow / Sheila Rowan, University of Glasgow / James Hough, University of Glasgow / Ivan Graumann, ETH Zurich - Inst. of Quantum El. / Christopher Phillips, ETH Zurich - Inst. of Quantum El. / Ursula Keller, ETH Zurich - Inst. of Quantum El.

SF2M.3

SESAM-Modelocked Ho:YAG Thin-Disk Laser With 40.5 W of Average Power

Presenter: Sergei Tomilov , *Ruhr-Universität Bochum*

We demonstrate a SESAM, soliton-modelocked, Ho:YAG thin-disk oscillator with 40.5 W of average power, 1.66ps-long pulses at a pulse energy of 0.78 μJ , representing the highest average power so far demonstrated from an oscillator in the 2 μm wavelength region.

Authors: Sergei Tomilov, Ruhr-Universität Bochum / Martin Hoffmann, Ruhr-Universität Bochum / Jonas Heidrich, ETH Zürich / Behçet Özgür Alaydin, ETH Zürich / Matthias Golling, ETH Zürich / Yicheng Wang, Ruhr-Universität Bochum / Ursula Keller, ETH Zürich / Clara Saraceno, Ruhr-Universität Bochum

SF2M.4

69 W Average Power sub-100-fs Yb:YAG Thin-Disk Laser

Presenter: Julian Fischer , *Time and Frequency Laboratory*

Operating in a regime of strong self-phase-modulation, 84-fs pulses are generated with 42-MW peak power and 12% efficiency from Yb:YAG. We demonstrate a 3x higher average power than any previous sub-100-fs laser oscillator.

Authors: Julian Fischer, Time and Frequency Laboratory / Jakub Drs, Time and Frequency Laboratory / Norbert Modsching, Time and Frequency Laboratory / François Labaye, Time and Frequency Laboratory / Valentin J. Wittwer, Time and Frequency Laboratory / Thomas Südmeyer, Time and Frequency Laboratory

SF2M.5

Yb-Doped Laser Oscillator Generating 22-fs Pulses at 0.73 W

Presenter: François Labaye , *Universite de Neuchatel*

A novel pumping approach for Yb-doped gain materials enables a Kerr-lens mode-locked Yb-CALGO laser to overcome previous bandwidth limitations and to generate 22 fs pulses with an average power of 729 mW and 25% optical-to-optical efficiency.

Authors: François Labaye, Universite de Neuchatel / Valentin J. Wittwer, Universite de Neuchatel / Marin Hamrouni, Universite de Neuchatel / Norbert Modsching, Universite de Neuchatel / Eric Cormier, Laboratoire Photonique, Numérique et Nanosciences / Thomas Südmeyer, Universite de Neuchatel

SF2M.6

Combined Gain Media 60 fs Kerr-Lens Mode-Locked Laser Based on Tm:Lu₂O₃ and Tm:Sc₂O₃

Presenter: Anna Suzuki , *ILS, UEC*

We present a combined gain media Kerr-lens mode-locked laser based on Tm-doped sesquioxide materials. Pulses as short as 60 fs were obtained with an average output power of 52 mW at 2.1 μm.

Authors: Anna Suzuki, ILS, UEC / Christian Kraenkel, ZLM-K, IKZ / Masaki Tokurakawa, ILS, UEC

SF2M.7

Octave-Spanning Polycrystalline Cr:ZnS Laser

Presenter: Sergey Vasilyev , *IPG Photonics SETC*

We report the first femtosecond polycrystalline Cr:ZnS oscillator with an octave-spanning spectrum. Average power of the laser is 1.4 W at the mid-IR central wavelength 2.4 μm and the pulse repetition frequency 79 MHz.

Authors: Sergey Vasilyev, IPG Photonics SETC / Igor Moskalev, IPG Photonics SETC / Viktor Smolski, IPG Photonics SETC / Jeremy Peppers, IPG Photonics SETC / Mike Mirov, IPG Photonics SETC / Yury Barnakov, IPG Photonics SETC / Vladimir Fedorov, IPG Photonics SETC / Dmitry Martyshkin, IPG Photonics SETC / Sergey Mirov, IPG Photonics SETC / Valentin Gapontsev, IPG Photonics Corp

SF2P

Optical Clocks and the Future of Time

Presenter: Ladan Arissian , *National Research Council Canada*

SF2P.1

Consequences and Perspectives of the Revised SI for Optical Metrology

Invited

Presenter: Tara Liebisch , *Physikalisch-Technische Bundesanstalt*

The revised SI, which came into force on May 20th, 2019, bases the system of units on fixed numerical values of constants of nature, so-called "defining constants". An overview of the changes implemented by the revised SI will be presented with an emphasis on the consequences for the unit candela and the unit second; namely, the realization of a traceable, quantum-based candela and a possible redefinition of the unit second. Prospects of time scales and time and frequency transfer will be given.

Authors: Tara Liebisch, Physikalisch-Technische Bundesanstalt

SF2P.2

Brillouin Laser Stabilization to a Single ion

Presenter: William Loh , *Massachusetts Inst of Tech Lincoln Lab*

We stabilize a 20-Hz linewidth fiber-cavity stimulated Brillouin scattering (SBS) laser to an Sr⁺ ion in the demonstration of an optical atomic clock.

Authors: William Loh, Massachusetts Inst of Tech Lincoln Lab / Jules Stuart, Massachusetts Inst of Tech Lincoln Lab / David Reens, Massachusetts Inst of Tech Lincoln Lab / Colin Bruzewicz, Massachusetts Inst of Tech Lincoln Lab / Danielle Braje, Massachusetts Inst of Tech Lincoln Lab / John Chiaverini, Massachusetts Inst of Tech Lincoln Lab / Paul Juodawlkis, Massachusetts Inst of Tech Lincoln Lab / Jeremy Sage, Massachusetts Inst of Tech Lincoln Lab / Robert McConnell, Massachusetts Inst of Tech Lincoln Lab

SF2P.3

871nm Ultra-Narrow-Linewidth Laser for Yb⁺ Clock

Presenter: Yu-Hung Lai, *OEwaves Inc*

We demonstrated a miniaturized 871 nm semiconductor laser optically injection locked to a whisper-gallery-mode resonator demonstrating Hertz-level instantaneous linewidth for Yb⁺ clock applications. The laser linewidth and short term drift are suppressed by over 10000x.

Authors: Yu-Hung Lai, *OEwaves Inc* / Stuart Love, *OEwaves Inc* / Anatoliy Savchenkov, *OEwaves Inc* / Danny Eliyahu, *OEwaves Inc* / Robert Moss, *OEwaves Inc* / Lute Maleki, *OEwaves Inc*

SF2P.4

Prospects for Optical Timekeeping

Tutorial

Presenter: Jeff Sherman, *National Inst of Standards & Technology*

Optical atomic frequency references are now comparable with uncertainty below that of practical realizations of the SI second. But challenges remain! What is the current outlook for realizing optical timekeeping?

Authors: Jeff Sherman, *National Inst of Standards & Technology*

JF2E

Special Symposium - Super Symposium on Advances in Quantum Technologies: Microwave-to-optical Quantum Interconnects

President: Alp Sipahigil

JF2E.1

Unpacking low-Noise Microwave-to-Optical Transducers.

Invited

Presenter: Robert Stockill , *Technische Universiteit Delft*

Noiseless, efficient transduction between microwave-frequency and telecom-wavelength photons can enable long-distance optical links between microwave-frequency qubits. We explore such transducers by realizing piezo-electric and opto-mechanical interfaces to a GHz-frequency nanoscale mechanical resonator. We demonstrate high-cooperativity optomechanical interaction, while ensuring noise contributions remain below a single excitation of the mechanical intermediary.

Authors:Robert Stockill, Technische Universiteit Delft

JF2E.2

An Efficient Microwave-Optical Interconnect via Mechanical Motion

Invited

Presenter: Cindy Regal , *University of Colorado at Boulder JILA*

We realize an efficient link between microwave and optical signals via motion of a micromechanical SiN membrane. We are studying paths to reducing the device noise, including use of electro-optic correlations to address thermal noise.

Authors:Cindy Regal, University of Colorado at Boulder JILA / Benjamin Brubaker, University of Colorado at Boulder JILA / Andrew Higginbotham, IST Austria / Jonathan Kindem, University of Colorado at Boulder JILA / Maxwell Urmey, University of Colorado at Boulder JILA / Peter Burns, University of Colorado at Boulder JILA / Sarang Mittal, University of Colorado at Boulder JILA / Luca Talamo, University of Colorado at Boulder JILA / Kazemi Adachi, University of Colorado at Boulder JILA / Graeme Smith, University of Colorado at Boulder JILA / Konrad Lehnert, University of Colorado at Boulder JILA

JF2E.3

Lithium Niobate Based Quantum Interconnect

Invited

Presenter: Marko Loncar , *Harvard University*

To be provided

Authors:Marko Loncar, Harvard University

JF2E.4

PORT: Piezoelectric Optical Resonant Transducer

Invited

Presenter: sunil bhawe , *Purdue University*

Microwave frequency stress-optic modulation up to 9 GHz of silicon nitride microring is achieved by exciting bulk acoustic waves piezoelectrically. The acoustic waves are confined tightly in the oxide cladding which enhances the acoustic energy density, modulation efficiency, and opens up opportunities for PORT in chip-scale frequency combs, LIDAR and microwave-to-optical conversion.

Authors: sunil bhawe, Purdue University

JF2G

Quantum Computing with Trapped Ions - Implementations & Funding

Presenter: Wilhelm Kaenders , *TOPTICA Photonics Inc*

JF2G.5

A Venture Capital Perspective on Quantum Computing

Invited

Presenter: David Moehring , *Cambium Capital*

I will present our investment thesis on quantum computing from the perspective of venture capital, and how it differs from government funding.

Authors: David Moehring, Cambium Capital

JF2G.1

Building Practical Quantum Computers With Trapped Ions

Invited

Presenter: Winfried Hensinger , *University of Sussex*

I will discuss progress in building practical trapped ion quantum computers. The machines we develop are based on the use of global microwave fields where voltages are applied to a microchip to execute quantum gates.

Authors: Winfried Hensinger, University of Sussex

JF2G.2

Direct Observation of Trapped ion Micromotion and Multi-Qubits State With a TimePix3cam Single-Photon Sensitive Camera.

Presenter: LIUDMILA ZHUKAS , *University of Washington*

Here we demonstrate the use of Tpx3cam, a novel single-photon sensitive camera, in trapped ion experiments. We perform detection of multiple-qubit state as well as observation of micromotion in a linear ion chain.

Authors:LIUDMILA ZHUKAS, University of Washington / Maverick Millican, University of Washington / Svihra Peter, Czech Technical University / Andrei Nomerotski, Brookhaven National Laboratory / Boris Blinov, University of Washington

JF2G.3

Design and Fabrication of Silicon Gratings for the Optical Addressing of Trapped Ion Qubits

Presenter: Yu Dian Lim , *Nanyang Technological University*

Grating couplers are fabricated for the optical addressing of trapped ion qubits, where their respective feasibility is evaluated. From the obtained results, optical addressing of 1 to 2 ions is possible along various axes.

Authors:Yu Dian Lim, Nanyang Technological University / Hong Yu Li, Agency for Science, Technology and Research / Peng Zhao, Nanyang Technological University / Jing Tao, Nanyang Technological University / Guidoni Luca, Université Paris Diderot / Chuan Seng Tan, Nanyang Technological University

JF2G.4

NISQ Ion-Trap Quantum Computers

Invited

Presenter: Kristin Beck , *Lawrence Livermore National Laboratory*

Trapped atomic ions are a leading platform for quantum computing. In this talk, I will introduce the platform, present recent algorithm demonstrations, and describe new directions in device design.

LLNL-ABS-816872

Authors:Kristin Beck, Lawrence Livermore National Laboratory

AF2C

A&TTR on Millimeter Wave Over Fiber for Fronthauling of 5G and Beyond

Presenter: SIMRANJIT SUMAN

AF2C.1

Digital Predistortion Algorithm of Advance Coherent Modulation Schemes Enabling Radio Over Fiber for Access Networks

Invited

Presenter: Ahmad Atieh , *Optiwave Systems Inc*

Digital predistortion algorithms are demonstrated for 5G back-bone optical systems employing 64-QAM and 256-QAM advance modulation formats. The performance of the digitally linearized systems is compared experimentally and using simulation with standard coherent transmission systems.

Authors:Ahmad Atieh, Optiwave Systems Inc

AF2C.2

(Withdrawn) Title to be Announced

Invited

Presenter: Ben Edmond , *Connected2Fiber, Inc*

Abstract not available.

Authors:Ben Edmond, Connected2Fiber, Inc

AF2C.3

Millimeter-Wave Over Fiber for 5G and Beyond

Invited

Presenter: Dalma Novak , *Octane Wireless*

We describe some recent developments in millimeter-wave over fiber technologies that can support the distribution of broadband wireless signals in 5G+ networks. The challenges associated with their efficient integration in a converged wireless/optical network are also discussed.

Authors:Dalma Novak, Octane Wireless / Rodney Waterhouse, Octane Wireless

AF2C.4

Neuromorphic Silicon Photonics and Applications

Invited

Presenter: Paul Prucnal , *Princeton University*

The growth of AI computing has been closely correlated with hardware innovations. After GPUs were first used in machine learning in 2009, the computational and data requirements for new AI algorithms have been doubling every 4 months. Realizing the potential environmental and energy impact of this rampant growth, the industry accelerated the call for more efficient algorithms and hardware alike. This has motivated the creation of the field of neuromorphic photonics. Here, we would like to focus on specific advantages of photonic implementation of neural networks, e.g. well known high bandwidth and parallelism. One very promising advantage, often overlooked, is latency. Neuromorphic photonics can take a trained low-speed neural network and offer a very low and deterministic processing latency, on the order of nanoseconds, when implemented in hardware. A low latency processor is crucial in applications such as high-speed feedback control and real-time RF processing.

Authors: Paul Prucnal, Princeton University / Thomas Ferreira de Lima, Princeton University / Bhavin Shastri, Queen's University

AF2S

ATTR: Space Optics III: Earth Remote Sensing

Presenter: Michael Mielke , *Headwall Photonics Inc*

AF2S.1

MERLIN – a Remote Sensing LIDAR Mission Dedicated to Atmospheric Methane Based on a new Generation of Laser Transmitters for Space Applications

Invited

Presenter: Markus Bode , *Airbus Defence and Space GmbH*

The Methane Remote Sensing LIDAR Mission (MERLIN) is a Franco-German cooperation focused on global measurement of the spatial and temporal gradients of atmospheric Methane based on a new generation of Laser Transmitters for Space Applications.

Authors: Markus Bode, Airbus Defence and Space GmbH / C. Wührer, Airbus Defence and Space GmbH / C. Kühl, Airbus Defence and Space GmbH / P. Bartsch, Airbus Defence and Space GmbH / B. Gronloh, Fraunhofer Institute for Laser Technology / M. Livrozet, Fraunhofer Institute for Laser Technology / D. Hoffmann, Fraunhofer Institute for Laser Technology

AF2S.2

ATLID Atmospheric Lidar Characterization and Performance

Invited

Presenter: Paolo Bravetti , *Airbus Italia S.p.A.*

ATLID, the atmospheric backscatter Lidar instrument of the EarthCARE mission and its diode pumped solid-state laser are presented, with a focus on its design, performance and characterization.

Authors: Paolo Bravetti, Airbus Italia S.p.A.

AF2S.3

Aeolus Wind Lidar Mission Laser Transmitter Achieving 4 Billion Shots in Flight: a Legacy for Future Space UV Laser Generations

Invited

Presenter: Alberto Cosentino , *LEONARDO*

The UV Aladin Laser Transmitter inside the Aeolus mission is the first operating in Space since more than 2,5 years. This unique experience is the base for improved Lasers of future Space Lidar Instruments/Missions

Authors: Alberto Cosentino, LEONARDO

AF2S.4

Space Optics in ESA Earth Observation Programmes

Invited

Presenter: Arnaud Hélière , *European Space Agency*

ESA Earth Observation programme consists in 3 main line of missions, Earth Explorers Research and Science missions, missions as part of the Copernicus programme and meteorology missions developed with Eumetsat. The presentation will give an overview and focus on space optics and technologies involved in some of the optical instruments embarked on those missions.

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Authors: Arnaud Hélière, European Space Agency

10:00 - 11:30 (Pacific Time (US & Canada) DST, UTC - 07:00)

JF3A

Joint Plenary Session II

JF3A.1

Harnessing Attosecond Quantum Technologies

Plenary

Presenter: Margaret Murnane , *University of Colorado at Boulder*

High harmonic quantum light sources provide an exquisite ability to harness and control short wavelength light, with unprecedented control over the spectral, temporal, polarization and orbital angular momentum waveforms. These represent the most-complex coherent electromagnetic fields ever created, controlled on sub-Å spatial scales and sub-attosecond temporal scales, from the UV to the keV photon energy region.

Authors: Margaret Murnane, University of Colorado at Boulder

Jf3A.2

Diversity, Equity and Inclusion Talk: Inclusify 2021

Plenary

Presenter: Stefanie Johnson, *University of Colorado at Boulder*

This talk demonstrates the nature of unconscious bias in a visceral way and then provides simple, research-based practices that interrupt bias and improve decision-making. The talk then moves to a focus on how to be proactively inclusive. Most leaders want to be inclusive but just don't know what steps to take to get there. I will explain what it takes to make people feel included by digging into our two most basic human needs: to be unique and to belong.

Authors: Stefanie Johnson, University of Colorado at Boulder

14:00 - 15:30 (Pacific Time (US & Canada) DST, UTC - 07:00)

Special Event - How can CLEO improve inclusion at its meeting?

While CLEO is committed to improving diversity at its meeting, inclusion is the key to fostering and maintaining vitality in our diverse community. By bringing together experts in diversity, and diverse members of our and other communities, this workshop seeks to understand, hear and learn about what actions the conference can take to improve inclusivity. This workshop is open to all CLEO attendees and it values ALL opinions on the subject. Finally, ideas from this workshop will be used by CLEO's Diversity and Inclusion (D&I) Taskforce to help expand its efforts in D&I.