CLEO Session Guide

Disclaimer: this guide is limited to technical program with abstracts and author blocks as of 15 April. For updated and complete information with special events, reference the online schedule or mobile app.

Monday, 6 May

08:00 -- 09:30
Room: W201AB
AM1A • Tools and Metrology for Fiber Communication Systems
Presider: Kerrianne Harrington; Univ. of Bath, UK

AM1A.1 • 08:00
On the effect of spatial error analysis in mode multiplexing free space optics system, Zun Htay[1], Fabio A. Barbosa[1], Filipe Ferreira[1]; *[1]Univ. College London, UK.* Spatial mode multiplexers are crucial in Space Division Multiplexing for enhancing data transmission capacity. We investigate the performance of mode selectivity telescopic free space optical system with spatial error and the effect of misfocus in utilized lenses in the system.

AM1A.2 • 08:15
Polarization-Multiplexed Fibre Spectrometer Based on Radiant Tilted Fibre Grating, Yuze Dai[1], Qingguo Song[1], Meng Zou[1], Xiangpeng Xiao[1], Weiliang Zhao[1], Qizhen Sun[1], Zhijun Yan[1]; *[1]School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China.* We have proposed a polarization-multiplexed fibre spectrometer based on Au-coated Radiant Tilted Fibre Grating (RTFG) and Faraday Rotator Mirror (FRM). The spectrometer can realize the simultaneous measurement of two orthogonal polarization with a spectra resolution of 0.086nm.

AM1A.3 • 08:30
Smart PON monitoring scheme based on FBG-array encoder, Yibo Liu[1], Xiangpeng Xiao[1], Qingguo Song[1], Weiliang Zhao[1], Qizhen Sun[1], Mengfan Cheng[1], Qi Yang[1], Zhijun Yan[1]; *[1]School of Optical and Electronic Information, Huazhong Univ. of Science and Techn., China.* We proposed and demonstrated a 4*4 FBG-array encoder to achieve 16-branch PON smart monitoring.

AM1A.4 • 08:45
Signal reconstruction in dispersion-tuned swept laser OCT using compressed sensing, Yuki Katsutani[1]; *[1]Univ. of Tokyo, Japan.* We applied compressed sensing to dispersion-tuned laser OCT. Random undersampling was achieved by making the sweep waveform nonlinear with random slope. Signal reconstruction using compressed sensing successfully reduced the data volume by 3/4.

AM1A.5 • 09:00
Real-time Monitoring of DWDM Telecom Signals with MHz Update Rate Through Frequency-to-Time Mapping, Afsaneh Shoeib[1], Manuel P. Fernández[1,2], Connor M. Rowe[1], Reza Maram[3], Pasquale Ricciardi[3], José Azaña[1]; *[1]Institut National de la Recherche Scientifique-Énergie Matériaux et Télécommunications (INRS-EMT), Canada; [2]Instituto Balseiro (UNCuyo-CNEA) & CONICET, Argentina; [3]Fonex Data Systems Inc., Canada.* We present a novel real-time optical monitoring system for spectral analysis of telecommunication signals. This allows the simultaneous high resolution tracking of multiple data stream channels over wide frequency bands at MHz update rates.

08:00 -- 10:00
Room: W201CD
SM1B • Novel Concepts in Fiber Optics
Presider: Arnaud Mussot, Université de Lille, France

SM1B.1 • 08:00
All-fiber Optical Pulse Storage Using Poled Fiber Modulators, João Manoel B. Pereira[1], Daniel Spegel-Lexne[2], Alvaro Alarcon[2], Oleksandr Tarasenko[1], Asa Claesson[1], Kenny Hey Tow[1], Walter Margulis[3], Guilherme Xavier[3]; *[1]RISE - Research Insts. of Sweden, Sweden; [2]Linkoping Univ., Sweden; [3]Fiberactivity, Brazil.* An all-fiber setup to store and retrieve light pulses using electric control is presented. The experiment is based on a Sagnac interferometer with a phase modulator fabricated using a poled fiber with internal electrodes.

SM1B.2 • 08:15
Conformal graphene directly synthesized on intracavity whispering gallery mode microresonators for GHz repetition rate mode-locked lasers, Oleksiy Kovalchuk[1,2], Sungjae Lee[1], Hyowon Moon[1,2], Andrea M. Armani[3,4], Yong Won Song[1,2]; *[1]Center for Opto-Electronic Materials and Devices, Korea Inst. of Science and Technology, Korea (the Republic of); [2]Nanoscience and Technology, Univ. of Science and Technology, Korea (the Republic of); [3]Department of Chemical Engineering and Materials Science, Univ. of Southern California, USA; [4]Ellison Inst. of Technology, USA.* We demonstrate tunable GHz-pulse fiber lasers combining spectral filtering by microsphere and mode-locking by conformal graphene homogeneously synthesized around it. Resultant pulses exceed 150 GHz with 6.1 GHz tunability through photo-thermal effect of graphene.

SM1B.3 • 08:30 (Invited)
Functionalizing Optical Fibers with 2D-Materials: Towards an Integrated Platform from Nonlinear Optics and Excitonics, Falk Eilenberger[1]; *[1]Friedrich Schiller Univ., Germany.* Abstract not available.

SM1B.4 • 09:00 (Invited)
Compact, Ultrafast Fiber Lasers for Molecular Spectroscopy and Biomedical Imaging, Dorota Stachowiak[1], Jakub Boguslawski[1], Aleksander Gluszek[1], Arkadiusz Hudzikowski[1], Karol Krzempek[1], Dorota Tomaszewska-Rolla[1], Mikolaj Krakowski[1], Alicja K. Kwasny[1], Grzegorz J. Sobon[1]; *[1]Politechnika Wroclawska, Poland.* We report the development of compact ultrafast lasers for applications in molecular spectroscopy and imaging of the human retina. The possibility of using AI-based algorithms to optimize ultrashort laser pulses will also be discussed.

08:00 -- 10:00
Room: W204AB
AM1C • Laser Systems and Diagnostics for Processing and Machining
Presider: To be Announced

AM1C.1 • 08:00 (Invited)
Femtosecond Lasers for High Productivity, David Bruneel[1], Jérôme Patars[1], Marc Decultot[1], Céline Petit[1], Anne Henrottin[1]; *[1]Lasea, Belgium.* The exponential rise of femtosecond lasers

average power are facing the limit of materials. We present solutions to manage this power and pave the way for high productivity in laser manufacturing.

AM1C.2 • 08:30
Ultrafast Quasi-Beam Shaping with Cascaded Scan Systems for Laser Materials Processing, Felix Lange[1,3], Lucas de Andrade Both[4], Markus Zecherle[1], Holger Schlüter[2], Jochen Stollenwerk[3,5], Carlo Holly[3,5]; *[1]Research and Development, Scanlab GmbH, Germany; [2]Business Development, Scanlab GmbH, Germany; [3]Chair for Technology of Optical Systems, RWTH Aachen Univ., Germany; [4]Chair for Laser Technology, RWTH Aachen Univ., Germany; [5]Fraunhofer Inst. for Laser Technology ILT, Germany.* On-the-fly adaption of laser intensity profiles is of increasing interest for laser manufacturing processes but remains challenging. An adaptable ultrafast beam shaping cascaded scan system is demonstrated, and its potential benefits are analyzed.

AM1C.3 • 08:45
Preliminary Development of Thermographic Monitoring of the Laser Remelting Process, Patrick Meyer[1], Evgueni Bordatchev[2], Remus O. Tutunea-Fatan[1]; *[1]Western Univ., Canada; [2]National Research Council of Canada, Canada.* The study focuses on the identification and analysis of the process transfer and power-area step response functions and their dependence on the applied power and exposure time.

AM1C.4 • 09:00 (Invited)
Robotic Integration of Fiber Coupled Femtosecond Lasers For Composite Surface Preparation, Jared Speltz[1]; *[1]Univ. of Dayton, USA.* Abstract not available.

AM1C.5 • 09:30
Influence of Heat Accumulation in the Laser Treatment Area on the Dynamics of LIPSS Formation for Pure Titanium and Titanium Alloy, Petr Druzhinin[1], Iana Fomicheva[3], Hans Amler[1], Gerd Leuchs[2], Silke Christiansen[2]; *[1]Photon Energy, Germany; [2]Innovations-Institut für Nanotechnologie und Korrelative Mikroskopie gGmbH, Germany; [3]Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany.* The dependences of LSFL period and the types of large LIPSS for pure titanium and titanium alloy on the amount of heat accumulation in the treatment area by a picosecond laser are presented.

AM1C.6 • 09:45
Real-time monitoring of hole evolution process in ultrafast laser drilling, Tao Sun[1], Wanqin Zhao[1], Zhengjie Fan[1], Jinge He[1], Peng Shen[1], Jianlei Cui[1], Xuesong Mei[1]; *[1]Xi'an Jiaotong Univ., China.* A real-time monitoring technique for in-situ measurement of hole depth and in-situ observation of hole evolution process using optical coherence tomography is reported, which can be used to understand and control of the manufacturing process.

08:00 -- 10:00
Room: W205AB
SM1D • Novel Fabrication of Passive Optical Components
Presider: Lan Fu; Australian National Univ., Australia

SM1D.1 • 08:00
Diffraction-free Orbital Angular Momentum Holography Enabled by an Extended Depth-of-focus Flat Lens, Dajun Lin[1], Ping Lu[1], Apratim Majumder[1], Rajesh Memon[1]; *[1]Univ. of Utah, USA.* In this paper, we apply the extended-depth-of-focus (EDOF) flat lens to holography and demonstrate a new concept of diffraction-free Orbital Angular Momentum (OAM) multiplexing holography assisted by the EDOF lens with 20 mm depth-of-field.

SM1D.2 • 08:15
Slanted Wire Diffraction Gratings Fabricated by Two-Photon Polymerization, Victoria P. Stinson[1], Uma Subash[1], Nuren Z. Shuchi[1], Menelaos Poutous[1], Tino Hofmann[1]; *[1]Univ. of North Carolina at Charlotte, USA.* Slanted wire diffraction gratings are difficult to fabricate using conventional etching approaches, due to their off-axis symmetry. In this study, we present the first fabrication of slanted wire diffraction gratings by two-photon polymerization and verify the diffractive characteristics.

SM1D.3 • 08:30
TiO_2:GeO_2 and SiO_2 Coating with Low Thermal Noise for Gravitational Wave Detectors, Aaron J. Davenport[1], Gabriele Vajente[4], Nicholas Demos[2], GariLynn Billingsly[4], Ashot Markosyan[3], Riccardo Bassiri[3], Martin M. Fejer[3], Slawek Gras[2], Matthew Evans[2], Peter Fristchel[2], Carmen Menoni[1]; *[1]Colorado State Univ., USA; [2]Massachusetts Inst. of Technology, USA; [3]Stanford Univ., USA; [4]California Inst. of Technology, USA.* TiO_2:GeO_2 alloy and SiO_2 thin film high reflector stacks with low coating thermal noise and excellent optical properties are demonstrated. The effect of design and annealing of the coatings is studied.

SM1D.4 • 08:45
High Efficiency Fiber-Chip Edge Coupler for Near-Ultraviolet (NUV) Waveband, Yuhan Du[1], Xingchen Ji[1], Weiqiang Xie[1], Meng Tian[1], Yu He[1], Yikai Su[1]; *[1]Shanghai Jiao Tong Univ., China.* We design and experimentally demonstrate an efficient fiber-chip edge coupler for NUV using symmetric double-tip taper and MMI-based coupler. We measure the coupling loss down to 2.85 dB at 407 nm on an alumina-on-insulator platform.

SM1D.5 • 09:00
Pluggable Single-Mode Chip-Chip Connections Using Facet-Attached Microlenses and Passive Mechanical Joints, Patrick Schwaab[1,2], Pascal Maier[1,2], Yiyang Bao[1,2], Stefan Singer[1], Matthias Worgull[2], Wolfgang Freude[1], Christian Koos[1,2]; *[1]Inst. of Photonics and Quantum Electronics (IPQ), KIT, Germany; [2]Inst. of Microstructure Technology (IMT), KIT, Germany.* We demonstrate low-loss single-mode chip-chip connections that combine pluggable mechanical joining elements with 3D-printed facet-attached microlenses (FaML). Our approach opens a path to flexible and simple assembly of photonic multi-chip assemblies without the need for high-precision alignment equipment.

SM1D.6 • 09:30

Temperature Sensitive Gallium Phosphide-on-Insulator Ring Resonators Enabled by Etch-n-Transfer Process, Weiren Cheng[1], Ning Ding[1], Xingyu Tang[1], Pengzhuo Wu[1], Zhaoting Geng[1], Zhenyu Liu[1], Mingjian You[1], Yi Li[1], Qianchengo Zhao[1]; *[1]Southern Univ. of Sci and Tech, China.* We report a GaP-OI resonator with a Q factor of (2.3±0.3)×10^4 and a TDWS of 53.9 pm/K, which shows great promise of the GaP-OI platform in thermal turning and optical signal processing.

SM1D.7 • 09:45

Spiropyran-doped Poly(dimethylsiloxane) Optical Waveguides for UV Sensing, Camila Zimmermann[1], Koffi N. Amouzou[1], Dipankar Sengupta[1], Aashutosh Kumar[1], Nicole R. Demarquette[1], Bora Ung[1]; *[1]École de technologie supérieure ÉTS, Canada.* Novel spiropyran-doped PDMS optical waveguides were fabricated. Their UV sensing response was investigated by monitoring changes in transmitted optical power when coupled to a 633-nm HeNe laser.

08:00 -- 10:00
Room: W205CD
SM1E • Multimode Fibers I
Presider: Ugur Tegin; Koc Universitesi, Turkey

SM1E.1 • 08:00

Delivery of Spatiotemporal Ultrafast Pulses through Multimode Optical Fibers, Daniel Cruz-Delgado[1], Jose Enrique Antonio-Lopez[1], Armando Perez Leija[1], Nicolas Fontaine[3], Stephen Eikenberry[1], Demetrios Christodoulides[2], Miguel A. Bandres[1], Rodrigo Amezcua Correa[1]; *[1]Univ. of Central Florida, CREOL, USA; [2]Univ. of Southern California, USA; [3]Bell Labs, USA.* We demonstrate how to overcome the detrimental effects caused by chromatic and modal dispersion in multimode optical fibers using tailored spatiotemporal ultrashort light pulses. Our results will enable advancements in a broad range of applications.

SM1E.2 • 08:15

Spatiotemporal mechanism of multimode fiber-based saturable absorber, Kfir Sulimany[1], Dotan Halevi[1], Omri Gat[1], Yaron Bromberg[1]; *[1]Hebrew Univ. of Jerusalem, Israel.* Nonlinear multimode interference-based saturable absorbers analysis and designs have traditionally focused on monochromatic nonlinear beam propagation. Our experimental and numerical findings suggest that spatiotemporal effects may dictate the absorber's behavior and enable their control.

SM1E.3 • 08:30 (Invited)

Nonlinear and Quantum Optics with Many Degrees of Freedom, Logan Wright[1]; *[1]Yale Univ., USA.* To enable the next generation of light-enabled applications and breakthroughs, I believe we need not only photonic hammers, but photonic hands, i.e., light which is richly, multimodally adaptable, and can be automatically tailored for applications.

SM1E.4 • 09:00

Quantum correlations in multimode nonlinear optics, Shiekh Zia Uddin[1], Jamison Sloan[1], Nicholas Rivera[1,3], Sahil Pontula[1], Yannick Salamin[1], Michael Birk[2], Pavel Sidorenko[2], Ido Kaminer[2], Marin Soljačić[1]; *[1]Massachusetts Inst. of Technology, USA; [2]Technion - Israel Inst. of*

Technology, Israel; [3]Harvard Univ., USA. We develop a framework describing quantum noise propagation in highly spatially multimode nonlinear optical systems. We predict quantum deviations of the spatial intensity noise distribution from the spatial power distribution, and observe this effect experimentally.

SM1E.5 • 09:30

Measuring the Optical Entropy of Highly Multimode Beams in Nonlinear Optical Fibers, Wasyhun Asefa Gemechu[1], Fabio Mangini[1], Mario Ferraro[1,2], Mario Zitelli[1], Yifan SUN[1], Mikhail Gervaziev[3,4], Denis S. Kharenko[3,4], Sergey Babin[3,4], Vincent Couderc[5], Fabrizio Frezza[1], Stefan Wabnitz[1,6]; *[1]DIET, Sapienza Univ. of Rome, Italy; [2]Department of Physics, Univ. of Calabria, Italy; [3]Novosibirsk State Univ., Russian Federation; [4]Inst. of Automation and Electrometry, Russian Federation; [5]XLIM - CNRS, Univ. of Limoges, France; [6]Istituto Nazionale di Ottica, CNR, Italy.* We present a direct experimental study of the evolution of the optical entropy of a multimode light beam propagating in a graded-index optical fiber.

SM1E.6 • 09:45

Nonlinearities in Tapered Multi Mode Fibers, Andrea Arduin[1], Lars Rishøj[1], Jesper Lægsgaard[1]; *[1]Danmarks Tekniske Universitet, Denmark.* We demonstrate propagation of higher order modes in fiber tapers with negligible intermodal coupling, enabling wavelength control of dispersive wave generation in a single LP0,m mode around 800nm.

08:00 -- 10:00
Room: W206A
FM1F • Quantum Emitters I
Presider: Alexander Senichev, Purdue Univ., USA

FM1F.1 • 08:00

Enhancement of non-classical radiation from quantum dots embedded within semiconductor Huygens' metasurfaces, Prasad Padmanabha Iyer[1], Samuel Prescott[2], Sadhvikas Addamane[1], Hyunseung Jung[1], Jacob Henshaw[1], Andrew Mounce[1], Willie Luk[1], Oleg Mitrofanov[2], Igal Brener[1]; *[1]Center for Integrated Nanotechnologies, Sandia National Labs, USA; [2]Univ. College London, UK.* We demonstrate position and size independent, order of magnitude increase in the collection efficiency and emission lifetime control of anti-bunched photons from local-droplet epitaxial GaAs quantum dots embedded within resonant semiconductor ($Al_{0.4}Ga_{0.6}As$) Huygens' metasurfaces.

FM1F.2 • 08:15

Co-operative and super-radiant emission from electrically-tuneable waveguide-coupled quantum dots, Dominic Hallett[1], Luke Hallacy[1], Julian Wiercinski[2], Rene Dost[1], Nick Martin[1], Moritz Cygorek[2], Erik Gauger[2], Maurice Skolnick[1], Luke Wilson[1]; *[1]Univ. of Sheffield, UK; [2]Heriot-Watt Univ., UK.* Photon-mediated interactions between emitters are a powerful resource for quantum information processing. In a waveguide these interactions lead to super-radiant emission. We demonstrate and investigate both co-operative and super-radiant emission from two waveguide-coupled quantum dots.

FM1F.3 • 08:30 (Tutorial)

Deterministic single-photon quantum hardware for scalable quantum information processing, Peter Lodahl[1]; *[1]Univ. of Copenhagen, Denmark.* Quantum dots in nanophotonic circuits realize a quantum coherent deterministic photon-emitter interface - an enabling block in quantum technology. We discuss current state-of-the-art performance of the platform including novel applications in quantum-information processing.

FM1F.4 • 09:30

Spatially Ordered and Spectrally Uniform Quantum Dot Single Photon Sources in Large Arrays for Quantum Optical Circuits, Qi Huang[1], Lucas Jordao[1], Siyuan Lu[2], Swarnabha Chattaraj[1], Jiefei Zhang[1], Anupam Madhukar[1]; *[1]Univ. of Southern California, USA; [2]IBM Thomas J. Watson Research Center, USA.* Mesa-top single quantum dots (MTSQDs) show promise as suitable single photon sources for realizing multi-source scalable quantum optical circuits. Here, large area uniformity and correlated optical and structural characteristics of these quantum dots are discussed.

FM1F.5 • 09:45

Fabrication and Characterization of a Quantum Dot Polarization Demultiplexer, William G. Eshbaugh[1,2], Ashish Chanana[2,3], Junyeob Song[2,3], Emerson Melo[2,4], Edgar Perez[2,5], Sadhvikas Addamane[6], Cori Haws[7], Luca Sapienza[9], Saimon F. Covre da Silva[8], Armando Rastelli[8], Jin-Dong Song[10], Kartik Srinivasan[2,5], Edward Flagg[1], Marcelo Davanco[2]; *[1]West Virginia Univ., USA; [2]National Inst. of Standards and Technology, USA; [3]Theiss Research, USA; [4]Univ. of Sao Paulo, Brazil; [5]Joint Quantum Inst., USA; [6]Center for Integrated Nanotechnologies, Sandia National Labs, USA; [7]Univ. of Southampton, UK; [8]Johannes Kepler Univ., Austria; [9]Cambridge Univ., UK; [10]Center for Opto-Electronic Convergence Systems, Korea Inst. of Science and Technology, Korea (the Democratic People's Republic of).* We fabricate an inversely-designed nanophotonic quantum dot polarization demultiplexer and observe the coupling of single embedded InAs quantum dot to two orthogonal output waveguides.

08:00 -- 10:00
Room: W206B
SM1G • Ranging, Calibration and Sensing
Presider: Lorenzo Hernandez; SpectraDynamics Inc., USA

SM1G.1 • 08:00

Broadband Light Beam Steering by Optical Phased Array Based on Phase-controlled Optical Frequency Comb, Takashi Kato[1,2], Kaoru Minoshima[1]; *[1]The Univ. of Electro-Communications, Japan; [2]PRESTO, JST, Japan.* The proposed method employs a broadband optical phased array with a phase-controlled optical frequency comb for scanning optical dots. Precise control of the frequency parameters of the comb eliminates the need for optical setup calibration.

SM1G.2 • 08:15

Continuous Ultraviolet to Blue-Green Astrocomb, Yuk Shan Cheng[1], Kamalesh Dadi[1], Toby Mitchell[1], Samantha Thompson[2], Nikolai Piskunov[3], Greg Blanchard-Emmerson[4], Corin Gawith[4,5], Richard A. McCracken[1], Derryck T. Reid[1]; *[1]Inst. of Photonics and Quantum Sciences, Heriot-Watt Univ., UK; [2]Cavendish Laboratory, Univ. of Cambridge, UK; [3]Department of Physics* *and Astronomy, Uppsala Univ., Sweden; [4]Covesion Ltd., UK; [5]Optoelectronics Research Centre, Univ. of Southampton, UK.* Broadband UV-green generation is achieved from a 1-GHz Ti:sapphire frequency comb using a Zn-indiffused, grating-engineered MgO:PPLN ridge waveguide. Etalon-filtering produces a 30 GHz astrocomb from 390–480 nm, with modes resolvable by an Echelle-prism spectrograph.

SM1G.3 • 08:30
Direct Laser Frequency Comb Calibration of an Astronomical Spectrograph, William Newman[1], Jamie Slattery[2], Toby Mitchell[1], Richard A. McCracken[1], Derryck T. Reid[1]; *[1]Inst. of Photonics and Quantum Sciences, Heriot-Watt Univ., UK; [2]School of Engineering and Physical Sciences, Heriot-Watt Univ., UK.* By measuring the optical frequency of an isolated astrocomb mode, we obtain the complete wavelength solution of an astronomical spectrograph with 150-MHz accuracy, eliminating the need for pre-calibration with a hollow-cathode lamp or single-frequency laser.

SM1G.4 • 08:45
Six DoF Large-scale Dimensional Metrology Using Multilateral Dual-comb Ranging, Ruilin Jiang[1]; *[1]Tsinghua Univ., China.* We developed a multilateral metrology system employing dual-comb absolute distance metrology. Using self-calibration method facilitated by the mutual-collimating method, within a 10ms averaging, it achieved micron-level precision for position and ten microradians-level precision for orientation.

SM1G.5 • 09:00
Two-Photon Dual-Comb LiDAR for Non-Cooperative Targets, Hollie Wright[1], Alexander J. Nelmes[1], Nick J. Weston[2], Derryck T. Reid[1]; *[1]Heriot-Watt Univ., UK; [2]Renishaw Plc, UK.* We demonstrate two-photon dual-comb LiDAR ranging to various non-cooperative targets using amplified detection. Although our metal targets return very weak reflections, we show measurement precisions <200 nm can be achieved with 500 ms of averaging.

SM1G.6 • 09:15
Enhanced Sensitivity of Refractive-Index-Sensing Optical Comb by Frequency Multiplication based on THz Comb, Masayuki Higaki[1], Shogo Miyamura[1], Shuji Taue[2], Yu Tokizane[1], Eiji Hase[1], Takeo Minamikawa[1], Takeshi Yasui[1]; *[1]Tokushima Univ., Japan; [2]Kochi Univ. of Technology, Japan.* Refractive-index-sensing optical comb is capable of RF-reading high-precision refractive index (RI) measurements. To amplify the RI-dependent frequency shift, we report a method for frequency multiplication of the RF sensor signal based on THz comb.

SM1G.7 • 09:30
Jones-Matrix Dual-Comb Spectroscopic Polarimetry, Hidenori Koresawa[1], Hiroki Kitahama[1], Eiji Hase[1], Yu Tokizane[1], Akifumi Asahara[2], Takeo Minamikawa[1], Kaoru Minoshima[2], Takeshi Yasui[1]; *[1]Tokushima Univ., Japan; [2]The Univ. of Electro-Communications, Japan.* We propose an innovative approach that combines dual-comb spectroscopy with polarization control pulse sequences featuring distinct polarizations and time delays. This integration enables a detailed analysis of a sample's polarization response using the Jones matrix.

SM1G.8 • 09:45
Vector Magnetometry With Spin-1 Manifold of Ultracold ^{87}Rb Atoms, Goutam Manna[1], Pratik Adhikary[1], Shubham Jaiswal[1], Saikat Ghosh[1]; *[1]Indian Inst. of Technology, Kanpur,*

India. We simultaneously store and retrieve light pulses in the long-lived ground state coherences of ^{87}Rb spin-1 manifold. The retrieved signal from this atomic interferometer can be characterised and used for vector magnetometry with high precision.

08:00 -- 10:00
Room: W207A
SM1H • New Development in Femtosecond Oscillators
Presider: Scott Domingue; Thorlabs Laser Division Boulder, USA

SM1H.1 • 08:00
Femtosecond ring-cavity Yb:YAG thin-disk oscillator with an intra-cavity peak power of 125 MW, Heyan liu[2,1], Hongwen Xuan[3], Hongshan Chen[2], Jingjie Hao[2], Qing Wang[4], Lisong Yan[2], Jinwei Zhang[2]; *[1]School of physics, Changchun Univ of Science and Technology, China; [2]School of Optics and Electronic Information, Huazhong Univ. of science and Technology, China; [3]Chinese Academy of Sciences, GBA branch of Aerospace Information Research Inst., Chinese Academy of Sciences, Guangzhou, China; [4]School of optoelectronics, Beijing Inst. of Technology, China.* We report a multi-pass ring-cavity Kerr-lens mode-locked Yb:YAG thin-disk oscillator. The output pulses had an average power of 71.5W and a pulse duration of 175 fs. The intra-cavity peak power was calculated as 125 MW.

SM1H.2 • 08:15
A 1.7 nJ 978 nm Core-Pumped All-Polarization-Maintaining Ytterbium-Doped Femtosecond Fiber Laser, Wang Weijin[1], Xiangxiang Zhou[1], Yue Zhou[1], Kun Xu[1]; *[1]State Key Laboratory of Information Photonics and Optical Communications, China.* We report a 978 nm NALM-based all-PM Yb-doped fiber laser. The pulse is compressed to 234 fs with a pulse energy of 1.7 nJ, over three times that of other all-PM 978 nm fiber lasers.

SM1H.3 • 08:30
High-energy Fiber-delivered Ultrashort Pulses on Demand, Michael J. Wahl[1], Yuanchi Qing[1], Myles Silfies[1], Thomas Allison[1]; *[1]Stony Brook Univ., USA.* We describe a nonlinear Er:doped fiber amplification scheme for producing fiber-delivered, 44 fs pulses with 100 kW peak power at arbitrary (0-60 MHz) repetition rate. Subsequent spectral broadening produces 80 THz of bandwidth.

SM1H.4 • 08:45
Ultra-Low Noise Cr:ZnS Laser Source for High Performance Dual Comb Spectroscopy, Sergey Vasilyev[1], Mike Goma[1], Igor Moskalev[1], Oleg Mishechkin[1], Yury Barnakov[1], Mike Mirov[1]; *[1]IPG Photonics Corp, USA.* We demonstrate high-power (3 W), few cycle (19 fs), fully referenced (timing jitter < 0.1 fs) optical frequency comb at the middle-IR central wavelength λ = 2.4 µm with ultra-low intensity noise (<0.1% RMS).

SM1H.5 • 09:00
24-fs pulses from a Kerr-lens mode-locked Yb:Sc_2SiO_5 laser, Zhanglang Lin[2,1], Zhiqiang Li[2], Huangjun Zeng[2], Ge Zhang[2], Lihe Zheng[3], Zhen Zhang[4], Liangbi Su[4], Shande Liu[5], Pavel Loiko[6], Xavier Mateos[7], Valentin Petrov[1], Weidong Chen[2,1]; *[1]Max Born Inst., Germany; [2]Fujian Inst. of Research on the Structure of Matter, Chinese Academy of Sciences, China; [3]Yunnan Univ., China; [4]Shanghai Inst. of Ceramics, Chinese Academy of Sciences, China; [5]Shandong*

Univ. of Science and Technology, China; [6]Université de Caen, China; [7]Universitat Rovira i Virgili, Spain. Soliton pulses as short as 24 fs are generated from a diode-pumped Kerr-lens mode-locked $Yb:Sc_2SiO_5$ laser at 1077.2 nm with an average power of 63 mW at a repetition rate of ~66.1 MHz.

SM1H.6 • 09:15
Diode-pumped sub-100-fs SESAM mode-locked Tm,Ho:CLNGG laser at 2090 nm, Anna Suzuki[1], Yicheng Wang[1], Sergei Tomilov[1], Zhongben Pan[2], Clara J. Saraceno[1]; *[1]PULS, Ruhr-Universität Bochum, Germany; [2]Key Laboratory of Laser and Infrared System of Ministry of Education, Shandong Univ., China.* We present a diode-pumped SESAM mode-locked Tm, Ho:CLNGG laser operating at 2090 nm, representing the first demonstration of an affordable diode-pumped sub-100-fs mode-locked laser in the 2-μm wavelength range.

SM1H.7 • 09:30
Broadly Tunable Continuous Wave (986-1119 nm) and Mode-Locked (1009-1061 nm) $Yb:YVO_4$ Laser, Muharrem Kilinc[1,2], Umit Demirbas[1], Jelto Thesinga[1], Martin Kellert[1], Mikhail Pergament[1], Franz Kärtner[1,2]; *[1]Center for Free-Electron Laser Science CFEL, Deutsches Elektronen-Synchrotron DESY, Germany; [2]Physics Department, Univ. of Hamburg, Germany.* We present a broadly-tunable diode-pumped $Yb:YVO_4$ laser with up to 4 W output in the 986-1119 nm range in continuous wave (CW) operation and 0.82 W output, with down to 70-fs pulses in mode-locked operation.

SM1H.8 • 09:45
1.1-GHz SESAM-Modelocked Femtosecond Yb:YLF Laser, Serdar Okuyucu[1,2], Umit Demirbas[2], Jelto Thesinga[2], Marvin Edelmann[2], Mikhail Pergament[2], Franz Kaertner[2]; *[1]Antalya Bilim Univ., Turkey; [2]UFOX, Deutsches Elektronen-Synchrotron, Germany.* We report the first GHz Yb:YLF laser generating 210 fs long pulses at 40 mW average power output from a low-cost, self-starting, single-mode diode pumped cavity with integrated relative intensity noise <0.45%.

08:00 -- 10:00
Room: W206BC
SM1I • Advances in Integrated Photonics
Presider: Nathan Youngblood; Univ. of Pittsburgh

SM1I.1 • 08:00 (Invited)
Use of Symmetry Breaking for Design of Tunable Infrared Metamaterials, Michelle L. Povinelli[1], Bo Shrewsbury[1], Alok Ghanekar[1], Romil Audhkhasi[1], Chia Wei Hsu[1], Rehan Kapadia[1]; *[1]Univ. of Southern California, USA.* We consider a refractive index tuning scheme that breaks the symmetry within a unit cell. We reversibly create a spectral absorption peak and switch absorptivity from isotropic to directional.

SM1I.2 • 08:30
Efficient Grating Coupling for Silicon Nitride Photonics, Manuel Kohli[1], Daniel Chelladurai[1], Boris Vukovic[1], David Moor[1], Dominik Bisang[1], Killian Keller[1], Andreas Messner[1], Tatiana Buriakova[2], Michael Zervas[2], Yuriy Fedoryshyn[1], Ueli Koch[1], Juerg Leuthold[1]; *[1]Inst. of Electromagnetic Fields (IEF), ETH Zurich, Switzerland; [2]Ligentec SA, Switzerland.* Efficient

fiber-to-chip coupling is demonstrated for SiN photonics with simple and fabrication-tolerant amorphous silicon overlay gratings. This elegant approach offers coupling loss of only 0.43 dB and 1.11 dB with and without back-reflector, respectively.

SM1I.3 • 08:45
Loss Prediction and 3D Trajectory Design of Photonic Wire Bonds using Artificial Neural Networks (ANN), Yiyang Bao[1,2], Maria Paszkiewicz[3,4], Jonas Krimmer[1], Wolfgang Freude[1], Sebastian Randel[1], Carsten Rockstuhl[3,5], Christian Koos[1,2]; *[1]Inst. of Photonics and Quantum Electronics (IPQ), KIT, Germany; [2]Inst. of Microstructure Technology (IMT), KIT, Germany; [3]Inst. of Theoretical Solid State Physics (TFP), KIT, Germany; [4]Scientific Computing Center (SCC), KIT, Germany; [5]Inst. of Nanotechnology (INT), KIT, Germany.* We present an artificial-neural-network-(ANN-)driven concept for predicting transmission losses of 3D-printed freeform waveguides within a few milliseconds and with root-mean-square errors of less than 0.5 %. Our approach enables transmission-optimized trajectory design of photonic wire bonds during fabrication.

SM1I.4 • 09:00
All-optical nonlinear activation functions based on parity-time phase transition, Zheng Gong[1], Geza Kurczveil[1], Thomas V. Vaerenbergh[1], Stanley Cheung[1], Antoine Descos[1], Raymond G. Beausoleil[1]; *[1]Hewlett Packard Labs, USA.* We propose a novel parity-time (PT) symmetric device to generate nonlinear activation for optical computing. By leveraging PT phase transition, our device can realize reconfigurable all-optical activation functions featuring low thresholds and low insertion loss.

SM1I.5 • 09:15
Dynamically encircling exceptional points in a 3D photonic chip for robust all-optical logic operations, Chu Li[1,2], Meng Li[1,2], Ruiqi Wang[1,2], Yang Chen[3,4], Xifeng Ren[3,4], Linyu Yan[1,2], Qiang Li[1,2], Qihuang Gong[1,2], Yan Li[1,2]; *[1]State Key Laboratory for Artificial Microstructure and Mesoscopic Physics, School of Physics, Peking Univ., China; [2]Frontiers Science Center for Nano-Optoelectronics, Peking Univ., China; [3]CAS Key Laboratory of Quantum Information, Univ. of Science and Technology of China, China; [4]CAS Center for Excellence in Quantum Information and Quantum Physics, Univ. of Science and Technology of China, China.* We realize an on-chip eigenstate generator using a depth-varying 3D waveguide to overpass the encircling exceptional point (EEP) system. By combining two such generators, both the robust all-optical XOR and OR logic operations are achieved.

SM1I.6 • 09:30
High-power MUTC Photodiode with WR-8 Rectangular Waveguide Output, Yuxin Tian[1], Bing Xiong[1], Changzheng Sun[1], Zhibiao Hao[1], Jian Wang[1], Lai Wang[1], Yanjun Han[1], Hongtao Li[1], Lin Gan[1], Yi Luo[1]; *[1]Tsinghua Univ., China.* We present a compact modified uni-travelling-carrier (MUTC) photodiode module with WR-8 rectangular waveguide output. The packaged device exhibits a flat optoelectronic frequency response with a peak RF output power of −0.97 dBm (800 μW).

SM1I.7 • 09:45
Multi-junction type large-aperture high-speed PIN-PD and its characteristics for optical wireless communications, Toshimasa Umezawa[1], Atsushi Matsumoto[1], Atsushi Kanno[2,1], Kouichi Akahane[1], Naokatsu Yamamoto[1]; *[1]National Inst of Information & Comm Tech,*

Japan; [2]Nagoya Inst. of Technology, Japan. We propose a multi-junction type large-aperture PIN photodetectors for high-speed optical wireless communication. A tradeoff solution between a large PD and high 3-dB bandwidth was proposed and experimentally confirmed.

08:00 -- 10:00
Room: W207D
AM1J • Photonic Devices
Presider: Xinru WU; Intel Corporation, USA

AM1J.1 • 08:00
2.6um Extended InGaAs pin Photodiode With High Shunt Resistance and Improved Linearity for Spectroscopy, Arshey Patadia[1], Shankar Baliga[1], Kyle Ward[1]; *[1]Detector Group Inc., Laser Components, USA.* The extended 2.6 µm InGaAs p-i-n detector discussed, can be operated under reverse bias with guaranteed linear behavior at higher operating voltages. We demonstrate improved detection of CO_2 gas and Low-Density Polyethylene using this detector.

AM1J.2 • 08:15
Monolithically Integrated Germanium Photodiodes with Low Dark Current and High Detectivity, Vittal Prakasam[1], Sandeep Seema Saseendran[1], Aurelie Humbert[1], Isabel pintormonroy[1], Gauri Karve[1], Philippe Soussan[1], Francois Berghmans[1], Yannick Baines[1], Huaqing Qiu[1]; *[1]imec, Belgium.* Germanium photodiodes integrated via selective epitaxial growth typically have low detectivity. We demonstrate process approaches that are needed to minimize defectivity in germanium, thereby paving way towards photodiodes with low dark current and high detectivity.

AM1J.3 • 08:30
Low-loss, Nonvolatile Tuning of Bragg Structures with Sb2Se3, Nicholas A. Nobile[1], Chuanyu Lian[2,3], Hongyi Sun[2,3], Yi-Siou Huang[2,3], Brian Mills[4,5], Cosmin Popescu[4], Dennis Callahan[6], Juejun Hu[4], Carlos A. Rios Ocampo[2,3], Nathan Youngblood[1]; *[1]Electrical & Computer Engineering Department, The Univ. of Pittsburgh, USA; [2]Department of Materials Science & Engineering, Univ. of Maryland, USA; [3]Inst. for Research in Electronics and Applied Physics, Univ. of Maryland, USA; [4]Department of Materials Science & Engineering, Massachusetts Inst. of Technology, USA; [5]Draper Scholar Program, The Charles Stark Draper Laboratory, USA; [6]The Charles Stark Draper Laboratory, USA.* Sb2Se3 is used to switch between broadband transparency and enhanced index contrast in two device types leveraging Bragg gratings for tunable stop- and pass-band functionalities. Experimental results highlight fabrication challenges and efficacy of the designs.

AM1J.4 • 08:45
Monolithic Barium Titanate Modulators on Silion-on-Insulator Substrates, Zuoming Dong[2], Amogh Raju[2], Agham Posadas[1], Marc Reynaud[3], Alexander Demkov[3,1], Daniel Wasserman[2]; *[1]La Luce Cristallina Inc., USA; [2]Department of Electrical and Computer Engineering, The Univ. of Texas at Austin, USA; [3]Department of Physics, The Univ. of Texas at Austin, USA.* We demonstrate monolithic Barium Titanate (BTO) - based Mach - Zehnder Interferometers (MZIs) in thin film epitaxial BTO RF-sputtered on silicon-on-insulator substrates. A V_π L = 2.32 V.cm is reported corresponding to an effective Pockels coefficient of r_{eff} = 89 pm/V in our BTO.

AM1J.5 • 09:00

Toward very-large-scale nonvolatile electrically programmable photonic integrated circuits with deterministic multilevel operation, Rui Chen[1], Virat Tara[1], Minho Choi[1], Jayita Duta[1], Justin Sim[1], Julian Ye[1], Jiajiu Zheng[1], Zhuoran Fang[1], Arka Majumdar[1]; *[1]Univ. of Washington, USA.* We present a scalable platform for very-large-scale programmable photonics by marrying 300-mm-wafer-scale fab with in-house phase-change material integration, showcasing reversible electrical tuning. We further demonstrate a deterministic multilevel scheme with 2^N optical levels.

AM1J.6 • 09:30

Hybrid germanium-on-zinc selenide waveguides for longwave infrared integrated photonics, Chao Dong[1,2], Dingding Ren[2,3], Jens Høvik[3], Md Istiak Khan[2], Astrid Aksnes[3], Bjørn-Ove Fimland[3], David Burghoff[1,2]; *[1]The Univ. of Texas at Austin, USA; [2]Univ. of Notre Dame, USA; [3]Norwegian Univ. of Science and Technology, Norway.* We demonstrate a silicon-free germanium-on-zinc selenide (GOZ) platform for integrated longwave infrared photonics, achieving transparency from 2 µm to 14 µm and optical losses of just 1 cm−1 (at 7.8 µm).

AM1J.7 • 09:45

Graphene Photodetector for Time-of-Flight Optical Ranging Using Optoelectronic Mixing, Paul Kienitz[1], Andreas Bablich[1], Rainer Bornemann[1], Maurice Müller[1], Peter Haring Bolívar[1]; *[1]Univ. of Siegen, Germany.* A graphene optoelectronic mixer device utilizing indirect Time-of-Flight (ToF) for enhanced 3D imaging applications is presented. The prototype enables ranging up to 1 m with a mean accuracy of 25.6 mm.

08:00 -- 10:00
Room: W208
FM1K • Quantum Information Processing
Presider: Galan Moody; Univ. of California Santa Barbara, USA

FM1K.1 • 08:00 (Invited)

Fault-tolerant Quantum Computing with Photonics, Mercedes Gimeno-Segovia[1]; *[1]PsiQuantum, USA.* General-purpose fault-tolerant quantum computers will utilize millions of physical qubits, thus requiring an underlying qubit technology that can be manufactured at scale. Integrated silicon photonics is an intrinsically scalable and manufacturable platform where all necessary gates are available to manipulate qubits, encoded in photons, with very high fidelity and low noise. In this talk, we will discuss architectures for fault-tolerant quantum computing with photonics in the newly introduced fusion-based quantum computing paradigm. Fusion-based quantum computing presents a new framework for fault-tolerant quantum computation, focused on the efficient integration of quantum error correction and physical-level hardware operation. Its primitives, small, entangled resource states, and projective entangling gates make it particularly useful in an integrated photonics platform, since they can be implemented in with a modular hardware configuration, offering significant architectural simplifications and reducing requirements on physical level operations.

FM1K.2 • 08:30

A Continuous Variable Quantum Compiler, Matthew Feldman[1], Tyler Volkoff[3], Zoe Holmes[5], Seongjin Hong[1,4], Claire E. Marvinney[1], Raphael Pooser[1], Andrew Sornborger[3], Alberto M.

Marino[1,2]; *[1]Oak Ridge National Laboratory, USA; [2]Univ. of Oklahoma, USA; [3]Los Alamos National Laboratory, USA; [4]Chung-Ang Univ., Korea (the Republic of); [5]Ecole Polytechnique Fédérale de Lausanne, Switzerland.* We implement a continuous-variable quantum compiler that can learn a linear phase operation with a fourfold increase in precision and a factor of 80 reduction in time to solution when quantum resources are used.

FM1K.3 • 08:45

Programmable Quantum Photonic Networks, Natalia Herrera Valencia[1], Suraj Goel[1], Saroch Leedumrongwatthanakun[1,2], Francesco Graffitti[1], Alessandro Fedrizzi[1], Will McCutcheon[1], Mehul Malik[1]; *[1]Heriot-Watt Univ., UK; [2]Division of Physical Science, Prince of Songkla Univ., Thailand.* We implement a programmable photonic network that harnesses the large mode-mixing process inside a multi-mode fibre to distribute and swap entanglement between multiple parties.

FM1K.4 • 09:00

The minimum-error quantum estimation with multi-projector measurements, Martin Bielak[1], Dominik Koutny[1], Michal Neset[1], Miroslav Jezek[1]; *[1]Palacky Univ. Olomouc, Czechia.* Full quantum state characterization requires a tomographic procedure performed on a limited number of copies. Our experimental demonstration of one- and two-qubit overcomplete tomographic measurements (up to 400 separable projections) outperforms state-of-the-art approaches, showcasing significant error reduction.

FM1K.5 • 09:15

Realization of a Dual-Rail Photonic Cluster State, Miri Blau[1], Richard Oliver[1], Xingchen Ji[2], Michal Lipson[2,1], Alexander L. Gaeta[1,2]; *[1]Applied Physics and Applied Mathematics, Columbia Univ. of the city of NY, USA; [2]electrical engineering, Columbia Univ., USA.* We demonstrate the generation of a 4-photon, dual-rail cluster state with a lower-bound fidelity of 0.81 consisting of sequences of dual-color photon pairs. Our approach is extendable to general NxM cluster states.

FM1K.6 • 09:30

Temporal Multiplexing of Heralded Photons Based on Thin Film Lithium Niobate Photonics, Cagin Ekici[1], Yonghe Yu[1], Jeremy C. Adcock[1], Alif L. Muthali[1], Mujtaba Zahidy[1], Heyun Tan[2], Zhongjin Lin[3], Hao Li[2], Leif K. Oxenløwe[1], Xinlun Cai[2], Yunhong Ding[1]; *[1]Department of Electrical and Photonics Engineering, Technical Univ. of Denmark, Denmark; [2]State Key Laboratory of Optoelectronic Materials and Technologies, School of Electronics and Information Technology, Sun Yat-sen Univ., China; [3]Department of Electrical and Computer Engineering, The Univ. of British Columbia, Canada.* Heralded photons from a silicon source are temporally multiplexed utilizing thin film lithium niobate photonics. The time-multiplexed source, operating at a rate of R = 62.2 MHz, enhances single photon probability by 3.25 ± 0.05.

FM1K.7 • 09:45

Entanglement-induced collective many-body interference, Tommaso Faleo[1], Eric Brunner[2], Jonathan Webb[3], Alexander Pickston[3], Joseph Ho[3], Gregor Weihs[1], Andreas Buchleitner[2,4], Christoph Dittel[2,4], Gabriel Dufour[2], Alessandro Fedrizzi[3], Robert Keil[1]; *[1]Institut für Experimentalphysik, Universität Innsbruck, Austria; [2]Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, Germany; [3]Inst. of Photonics and Quantum Sciences, Heriot-Watt Univ., UK; [4]EUCOR Centre for Quantum Science and Quantum Computing, Albert-Ludwigs-Universität*

Freiburg, Germany. We introduce a novel quantum phenomenon combining entanglement and many-body interference, enabling the observation of N-particle interference while suppressing lower-order interferences. A four-photon experiment demonstrates high-visibility (nonlocal) interference patterns based on a collective four-particle phase.

08:00 -- 10:00
Room: W209A
SM1L • Integrated RF Photonics
Presider: Chaoran Huang; Chinese Univ. of Hong Kong, Hong Kong

SM1L.1 • 08:00
An Integrated Cavity Soliton based Terahertz Voltage-controlled Oscillator, Usman A. Javid[1,2], Michal Chojnacky[3,1], Kartik Srinivasan[2,1], Grégory Moille[1,2]; *[1]Univ. of Maryland at College Park, USA; [2]Microsystems and Nanotechnology Division, National Inst. of Standards and Technology (NIST), USA; [3]Sensor Science Division, National Inst. of Standards and Technology (NIST), USA.* Kerr-induced synchronization enables direct control of a soliton microcomb's repetition rate by a reference laser's frequency. We demonstrate that dynamically tuning this frequency creates a coherent RF-to-THz optical link, resulting in a voltage-controlled THz oscillator.

SM1L.2 • 08:15
Generation of low-phase noise K-band microwave signal using free-running integrated soliton microcombs, Alwaleed Aldhafeeri[1], Hsiao-Hsuan Chin[1], Tristan Melton[1], Chee Wei Wong[1]; *[1]UCLA, USA.* We demonstrate the generation of low-phase noise K-band microwave signal(-137dBc/Hz@100kHz) using an integrated Silicon-Nitride soliton microcomb with a 20 GHz free spectral range without any active stabilization of the repetition rate nor pump-cavity detuning.

SM1L.3 • 08:30 (Invited)
Photonics Integrated Circuiets for Distributed Radar Systems in Space, Valentina Gemmato[2], Gaurav Pandey[2], Luca Rinaldi[1], Claudio Porzi[2], Federico Camponeschi[2], Haris Amir[2], Salvatore Maresca[3], Antonio Malacarne[1], Manuel Reza[2], Muhammad Imran[2], Paolo Ghelfi[1], Mirco Scaffardi[1], Antonella Bogoni[1]; *[1]CNIT, Italy; [2]Scuola Superiore Sant'Anna, Italy; [3]CNR, Italy.* A hybrid photonic integrated circuit enabling distributed multiband coherent MIMO radar systems for Earth observation from space is implemented. The characterization at device-level shows performances enabling the target application

SM1L.4 • 09:00
Dark-Pulse Kerr Comb Enabled Ultrafast Terahertz Wireless Communication, Yi Zheng[1], Deming Kong[1], Shi Jia[1], Liping Zhou[2], Chengli Wang[2], Ailun Yi[2], Michael Galili[1], Toshio Morioka[1], Kresten Yvind[1], Xin Ou[2], Leif Katsuo Oxenløwe[1], Minhao Pu[1]; *[1]Technical Univ. of Denmark, Denmark; [2]Shanghai Inst. of Microsystem and Information Technology, China.* We demonstrate the first dark-pulse Kerr comb in the SiCOI platform and its application for terahertz wireless communication with 100.78 Gbit/s net rate per spatial channel over a 10-meter free space distance.

SM1L.5 • 09:30
Microwave Resonant Plasmonic Modulator for Sub-THz Receivers, Boris Vukovic[1], David Moor[1], Yuriy Fedoryshyn[1], Michael Baumann[1], Tobias Blatter[1], Daniel Chelladurai[1], Mohamed Eleraky[2], Hua Wang[2], Juerg Leuthold[1]; *[1]Inst. of Electromagnetic Fields (IEF), ETH Zurich, Switzerland; [2]Integrated Devices, Electronics, and Systems (IDEAS) Group, ETH Zurich, Switzerland.* A coplanar-waveguide-based resonator is used to enhance plasmonic modulators at 250 GHz by 5 dB with a bandwidth of 44 GHz. This impedance matching is a compact, low-complexity solution to enhance the efficiency at high modulation frequencies for sub-THz wireless communication.

SM1L.6 • 09:45
Evanescently Coupled Waveguide Uni-Travelling Carrier Photodiodes with Wide Bandwidth and High Responsivity, Mingwei Sun[1], Bing Xiong[1], Changzheng Sun[1], Zhibiao Hao[1], Jian Wang[1], Lai Wang[1], Yanjun Han[1,2], Hongtao Li[1], Lin Gan[1], Yi Luo[1,2]; *[1]Beijing National Research Centre for Information Science and Technology (BNRist), Department of Electronic Engineering, Tsinghua Univ., China; [2]Flexible Intelligent Optoelectronic Device and Technology Center, Inst. of Flexible Electronics Technology of THU, China.* Evanescently coupled waveguide uni-travelling carrier photodiodes utilizing multi-layer coupling waveguide structure has been proposed. Wide bandwidth of 120 GHz and high responsivity of 0.50 A/W at -1 V bias have been demonstrated without spot-size converters.

08:00 -- 10:00
Room: W209B
SM1M • Microcombs
Presider: Yun Zhao; Columbia Univ., USA

SM1M.1 • 08:00
Engineered Coupling Enables Octave-spanning Kerr Soliton Microcombs in Thin-Film Lithium Niobate, Yunxiang Song[1], Yaowen Hu[1], Xinrui Zhu[1], Ki Youl Yang[1], Marko Loncar[1]; *[1]Harvard Univ., USA.* We present an octave-spanning soliton microcomb in thin-film lithium niobate. The comb is connected between 126 and 252 THz, with repetition rate 491.85 GHz. Engineered coupling suppresses Raman lasing and enhances comb extraction.

SM1M.2 • 08:15
Soliton Generation in AlGaAs-On-Insulator Microresonators via Thermal Compensatio, Yanjing Zhao[1], Chaochao Ye[1], Yang Liu[1], Yueguang Zhou[1], Kresten Yvind[1], Minhao Pu[1]; *[1]Danmarks Tekniske Universitet, Denmark.* We employ the thermal compensation technique for Kerr comb generation in an AlGaAs-on-insulator microresonator and demonstrate perfect soliton crystal and multi-soliton states at room temperature.

SM1M.3 • 08:30
High *Q* Suspended AlGaAs Microresonators for Kerr Comb Generation, Yuqian Zhang[1], Changzheng Sun[1], Bing Xiong[1], Lai Wang[1], Zhibiao Hao[1], Jian Wang[1], Yanjun Han[1], Hongtao Li[1], Lin Gan[1], Yi Luo[1]; *[1]Department of Electronic Engineering, Tsinghua Univ., China.* Suspended AlGaAs microring resonators are formed by combined plasma dry etching and chemical wet etching, exhibiting an intrinsic *Q* factor exceeding 1 million. Kerr comb generation with milliwatt level pump power is recorded.

SM1M.4 • 08:45

Suppression of Microcomb Thermorefractive Noise using Kerr Induced Synchronization, Pradyoth H. Shandilya[1], Grégory Moille[2,3], Jordan R. Stone[2,3], Usman Javid[2,3], Giuseppe D'Aguanno[1], Kartik Srinivasan[2,3], Curtis R. Menyuk[1]; *[1]Computer Science and Electrical Engineering, Univ. of Maryland Baltimore County, USA; [2]Joint Quantum Inst., Univ. of Maryland, College Park, USA; [3]Microsystems and Nanotechnology Division, National Inst. of Science and Technology, USA.* Thermorefractive fluctuations, due to the small modal volume of on-chip microresonators, is one of the main noise sources in integrated frequency combs. We demonstrate that Kerr-induced synchronization suppresses such noise, regardless of the microresonator's properties.

SM1M.5 • 09:00 (Invited)

Integrated Photonics on Low-temperature ICP-PECVD Silicon Nitride, Yanfeng Zhang[1], Siyuan Yu[1]; *[1]SEIT, Sun Yat-sen Univ., China.* Novel deuterated SiNx deposited using ICP-PECVD at <300C achieves waveguide loss of <0.1dB/cm, enabling key components such as bright and dark pulse coherent optical combs and opening up new avenues for active-passive integration.

SM1M.6 • 09:30

Kerr Optical Frequency Division with SiN-based Photonics for Low Noise mmWave Generation, Shuman Sun[1], Mark W. Harrington[2], Fatemehsadat Tabatabaei[1], Samin Hanifi[1], Beichen Wang[1], Zijiao Yang[1,3], Kaikai Liu[2], Jiawei Wang[2], Ruxuan Liu[1], Jesse Morgan[1], Steven Bowers[1], Paul Morton[4], Karl D. Nelson[5], Andreas Beling[1], Daniel J. Blumenthal[2], Xu Yi[1,3]; *[1]Department of Electrical and Computer Engineering, Univ. of Virginia, USA; [2]Department of Electrical and Computer Engineering, Univ. of California Santa Barbara, USA; [3]Department of Physics, Univ. of Virginia, USA; [4]Morton Photonics, USA; [5]Honeywell International, USA.* Kerr optical frequency division is demonstrated with SiN-based reference cavity and soliton. Stable 110 GHz mmWave is generated, and the measured phase noise reaches record-low level at 10 kHz offset for integrated photonic microwave/mmWave oscillators.

SM1M.7 • 09:45

An Octave-Spanning Near-Infrared Frequency Comb Broadened by Si-SiO_2-Si Horizontal Slot Waveguide, Ryosuke Sato[1,2], Rai Kou[2], Atsushi Ishizawa[3], Noritsugu Yamamoto[2], Guangwei Cong[2], Toshiya Murai[2], Yuriko Maegami[2], Yuki Atsumi[2], Tomohiro Kita[1]; *[1]Waseda Univ., Japan; [2]Advanced Industrial Science and Technology (AIST), Japan; [3]Nihon Univ., Japan.* We have measured the coherence of supercontinuum-generated light in a Si-SiO_2-Si horizontal slot waveguide formed by μ-Transfer Printing. SNR of beat about 20 dB was observed at 1630 nm.

08:00 -- 10:00
Room: W209C
FM1N • Ultrafast and Nonlinear Phenomenon in Plasmonics and Nanophotonics
Presider: Nicolò Maccaferri; Umea Universitet, Sweden

FM1N.1 • 08:00

Ultrafast Plasmon-driven Charge and Spin Dynamics in Au-Ni Magnetoplasmonic Nanostructures, Tlek Tapani[1], Nils Henriksson[1], Thomas Deckert[4], Haifeng Lin[1], Agne

Ciuciulkaite[2], Jonas Allerbeck[3], Alba Viejo Rodríguez[4], Ornella Vaccarelli[4], Wonjung Kim[5], Heon Lee[5], Joel Kuttruff[6], Denis Garoli[7], Paolo Vavassori[8], Vassilios Kapaklis[2], Daniele Brida[4], Nicolò Maccaferri[1]; *[1]Umeå Univ., Sweden; [2]Uppsala Univ., Sweden; [3]Swiss Federal Laboratories for Materials Science and Technology, Switzerland; [4]Univ. of Luxembourg, Luxembourg; [5]Korea Univ., Korea (the Republic of); [6]Univ. of Konstanz, Germany; [7]Istituto Italiano di Tecnologia, Italy; [8]CIC nanoGUNE, Spain.* We study ultrafast charge and spin dynamics in magnetoplasmonic Au-Ni nanostructures. Experiments reveal modification of the ultrafast magnetization dynamics time induced by a strong plasmonic response, and the results are supported by numerical modelling.

FM1N.2 • 08:15

Crossover from non-thermal to thermal photoluminescence from metals excited by ultrashort light pulses, Yonatan Sivan[1], Leng Wai Un[1], Imon Kalyan[1], Kaiqiang Lin[2], John Lupton[2], Sebastian Bange[2]; *[1]Ben-Gurion Univ., Israel; [2]Regensburg Univ., Germany.* We provide a complete quantitative theory for the long-disputed effect of (nonlinear) photoluminescence from metals following pulsed illumination and use it to explain various contradicting or hard-to-explain experimental measurements.

FM1N.3 • 08:30

Time-resolved Photoemission Electron Microscopy Imaging of the Near-field Dynamics in Silver Nanowires Excited by Few-cycle Short-wave Infrared Pulses, Nelia Zaiats[1,2], Lukas Wittenbecher[1], Ivan Sytcevich[1], Chandni Babu[1], Chen Guo[1], Anne L'Huillier[1], Cord L. Arnold[1], Jan Vogelsang[1], Anders Mikkelsen[1]; *[1]Lund Univ., Sweden; [2]HELIOS Helmholtz-Lund International Graduate School, Germany.* We investigate the near-field dynamics on the femtosecond time scale in Ag nanowires, using two SWIR pulses of ~17 fs (2.3 optical cycles) with variable time delay in combination with photoemission electron microscopy.

FM1N.4 • 08:45

Observation of negative diffusion in metal films, Alexander Block[2], Renwen Yu[3], Ieng Wai Un[1], Sebin varghese[2], Matz Leibel[4], Shanhui Fan[3], Niek Hulst[4], Klaas-Jan Tielrooij[2], Yonatan Sivan[1]; *[1]Ben-Gurion Univ., Israel; [2]ICN2, Spain; [3]Stanford Univ., USA; [4]ICFO, Spain.* Using ultrafast thermo-modulation microscopy, we show that the spatio-temporal heat diffusion in gold films has an initial ps-scale, electron-dominated diffusion, followed by an *unexpected negative diffusion stage*, and only then a much slower phonon-dominated diffusion.

FM1N.5 • 09:00

Experimental observation of space time Surface plasmon polariton wave packet, Naoki Ichiji[1,2], Hibiki Kikuchi[2], Murat Yessenov[3], Kenneth L. Schepler[3], Ayman F. Abouraddy[3], Atsushi kubo[2]; *[1]Inst. of Industrial Science, Univ. of Tokyo, Japan; [2]Pure and Applied Sciences, Univ. of Tsukuba, Japan; [3]CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA.* Femtosecond space-time surface plasmon polariton wave packets, localized in all dimensions and exhibiting diffraction-free properties, have been excited on a Ag surface and their spatial fields are microscopically imaged with femtosecond time resolution.

FM1N.6 • 09:15

The nonlinear electronic, thermal and optical response of transparent conducting oxides intense illumination, Ieng Wai Un[1], Subhajit Sarkar[1], Yonatan Sivan[1]; *[1]Ben-Gurion Univ., Israel.* We describe a Boltzmann-based model for the electron dynamics and thermal and optical properties of transparent conducting oxides, and show that it explains experimental findings with no need for any ad-hoc changes used so far.

FM1N.7 • 09:30

Investigating the Origin of Optical Nonlinearity in the mid-IR Spectral Region in Heavily Doped InGaAs Nanoantennas, Andrea Rossetti[1], Thomas Deckert[1], Huatian Hu[2], Tommaso Venanzi[3], Adel Bousseksou[4], Federico De Luca[6], Valeria Giliberti[3], Raffaele Colombelli[4], Cristian Ciracì[2], Michele Ortolani[5], Daniele Brida[1]; *[1]Department of Materials Science, Univ. of Luxembourg, Luxembourg; [2]Center for Biomolecular Nanotechnologies, Istituto Italiano di Tecnologia (IIT), Italy; [3]Center for Life NanoScience, Istituto Italiano di Tecnologia (IIT), Italy; [4]Centre de Nanosciences et de Nanotechnologies, Univ. of Paris-Saclay, France; [5]Dipartimento di Fisica, Sapienza Universitá di Roma, Italy; [6]Photonics Initiative, Advanced Science Research, City Univ. of New York, USA.* We investigate the third-order nonlinear optical response of highly-doped semiconductor nanoantennas in the mid-IR spectral region at different wavelengths and doping levels. Theory and experiment identify free electrons as the main source of nonlinearity.

FM1N.8 • 09:45

Plasmonic Time-Crystals, Lior Bar Hillel[1], Yonatan Plotnik[1], Ohad Segal[1], Mordechai Segev[1]; *[1]Technion, Israel.* We study surface plasmons at the interface between a metal and a photonic time crystal. We find momentum bands separated by gaps facilitating intense amplification and high group velocity at extremely short wavelengths.

08:00 -- 10:00
Room: W209DE
SM1O • Emitters and Isolator Materials
Presider: Mo Li; Univ. of Washington, USA

SM1O.1 • 08:00

Wafer-scale thermal diffusion of titanium into sapphire substrate, Yubo Wang[1], Yu Guo[1], Jorge Holguin-Lerma[1], Mattia Vezzoli[1], Hong Tang[1]; *[1]Department of Electric Engineering, Yale Univ., USA.* We demonstrate the wafer-scale diffusion of titanium into sapphire substrates, optimizing thermal diffusion processes to yield epi-ready substrates. This platform is ideal for the monolithic integrated Ti:Sa lasers.

SM1O.2 • 08:15

Modeling and characterization of cooperative effects in ensembles of inhomogeneous solid-state emitters, Maryam Zahedian[1], Wenxin Wu[1], Qingyi Zhou[1], Matthew C. Cambria[2], Jonathan Dolde[2], Michael Titze[3], Edward S. Bielejec[3], Shimon Kolkowitz[2], Zongfu Yu[1], Jennifer Choy[1]; *[1]Department of Electrical and Computer Engineering, UW-Madison, USA; [2]Physics, Univ. of California-Berkeley, USA; [3]Sandia National Laboratory, USA.* We propose a platform for the study of collective emission in a solid-state system, consisting of silicon-vacancy (SiV) centers implanted in subwavelength ordered arrays. Numerical simulations of emitter-emitter interactions, fabrication, and preliminary characterization are presented.

SM1O.3 • 08:30

Superior AlGaN-Based Deep Ultraviolet Light-Emitting Diodes Incorporated with a Tunnel Junction Located on the N-Side of the Device, Rui Wang[1], Huabin Yu[1], Muhammad Hunain Memon[1], Wei Chen[1], Haiding Sun[1]; [1]*Univ of Science and Technology of China, China.* We propose an AlGaN-based DUV LED incorporated with a n-side located tunnel junction to reverse the carrier injection direction, which can improve the light output power and internal quantum efficiency while reducing the efficiency droop.

SM1O.4 • 08:45

Strain and Defect Contributions towards Photoluminescence in $AgScP_2S_6$, Abhishek Mukherjee[4], Damian Wlodarczyk[1], Ajeesh Somakumar[1], Piotr Sybilski[1], Morgan Blevins[4], Mark Polking[2], Michael A. Susner[3], Andrzej Suchocki[1], Svetlana Boriskina[4]; [1]*Inst. of Physics, Polish Academy of Sciences, Poland;* [2]*Lincoln Laboratory, Massachusetts Inst. of Technology, USA;* [3]*Air Force Research Laboratory, USA;* [4]*Massachusetts Inst. of Technology, USA.* We show experimentally that structural defects in metal thiophosphate $AgScP_2S_6$ are prominent in exhibiting photoluminescence, which is likely driven by the defect-state-to-bulk-band transitions and can be further tuned by temperature-induced strain gradients.

SM1O.5 • 09:00

Spectral-Polarization-Selective Magneto-Optical Effect by Al-doped 4H-SiC Device with DPP-Assisted Annealing, Haoze Du[1], Takuya Kadowaki[2], Naoya Tate[1], Tadashi Kawazoe[2], Yuji Oki[1], Motoichi Ohtsu[3], Kenshi Hayashi[1]; [1]*Graduate School and Faculty of Information Science and Electrical Engineering, Kyushu Univeristy, Japan;* [2]*Nichia Corporation, Japan;* [3]*Research Origin for Dressed Photon, Japan.* An Al-doped 4H-SiC device exhibits a large Verdet constant at a specific wavelength and polarization state via DPP-assisted annealing under the corresponding conditions. Thus, it can function as a novel MO-SLM for high-performance spectroscopic systems.

SM1O.6 • 09:15

Desensitizing Self-trapped Excitonic Emission in Bi-Ho Co-doped $Cs_2AgInCl_6$ Nanocrystals, MD Soif Ahmed[1,2], Chinmay Barman[1], Demetra Tsokkou[2], Natalie Banerji[2], Sai Santosh Kumar Raavi[1]; [1]*Department of Physics, Indian Inst. of Technology Hyderabad, India;* [2]*Department of Chemistry, Biochemistry and Pharmaceutical Sciences (DCBP), Univ. of Bern, Switzerland.* Under the excitation of 370 nm, the photophysics of Bi-Ho co-doped double perovskite nanocrystals is revealed here. Temperature-dependent photoluminescence has been studied to explore their self-trapped exciton and exciton-phonon coupling properties.

SM1O.7 • 09:30

Large Magneto-Optical Glass for Ultra-High Power Laser Isolators, Futoshi Suzuki[1], Tadahito Furuyama[1], Fumio Sato[1], Noriaki Masuda[1], Haruki Kawaguchi[2], Ryo Yasuhara[2], Shigeki Tokita[3]; [1]*Nippon Electric Glass Co., Ltd., Japan;* [2]*National Inst. for Fusion Science, Japan;* [3]*Inst. for Chemical Research, Kyoto Univ., Japan.* A new magneto-optical glass with suppressed thermally induced depolarization was developed. The glass can be manufactured in large sizes, paving the way for the development of large-diameter isolators suitable for ultra-high power lasers.

SM1O.8 • 09:45

Capillary-Interactions based Single-step and Scalable Fabrication of Gap-tuneable Mechanochromic Devices, Renu Raman R. Sahu[1], Alwar S. Ramasamy[1], Tapajyoti Das Gupta[2]; [1]*Instrumentation and Applied Physics, Indian Inst. of Science, India.* A scalable and single-step method exploiting capillary interactions for creating sub-100nm non-coalescent metallic (Ga) nanodroplets on Polydimethylsiloxane, a bio-compatible elastomeric substrate, is shown herein. It enables tuneable gap-plasmonic resonances between the nanodroplets, thus allowing mechanochromic sensing and display applications.

08:00 -- 10:00
Room: W209F
SM1P • THz Generation, Sources and Devices
Presider: Ellen Adams; TU Dresden, Helmholtz Zentrum Dresden Rossendorf

SM1P.1 • 08:00

A short review and recent upgrades at the THz light source TeraFERMI at the free-electron laser facility FERMI, Johannes Schmidt[1], Paola Di Pietro[1], Stephan Winnerl[2], Andrea Perucchi[1]; [1]*Elettra Sincrotrone Trieste, Italy;* [2]*Spectroscopy, Helmholtz-Zentrum Dresden-Rossendorf, Germany.* The THz light source TeraFERMI generates strong electric fields focusing on research of nonlinear phenomena in condensed and soft matter. We report about THz pulse properties and recent instrumental upgrades now available.

SM1P.2 • 08:30

Small-error transmission and filter operation at 300 GHz using dissipative Kerr soliton frequency comb, Ayaka Yomoda[1], Mantaro Imamura[1], Koya Tanikawa[1], Soma Kogure[1], Ryo Sugano[1], Shun Fujii[1], Satoki Kawanishi[1], Takasumi Tanabe[1]; [1]*Keio Univ., Japan.* Using a soliton microcomb, we generated 300 GHz waves and demonstrated a transmission experiment at 10 Gbit/s with an ultra-low bit-error rate of 10^{-9}. We also demonstrated a photonic filter in the 300 GHz region, which adds another functionality in the terahertz regime.

SM1P.3 • 08:45

InAs nonlinear metalens for focused terahertz pulse generation, Hyunseung Jung[2], Sadhvikas Addamane[2], Willie Luk[2], C. Thomas Harris[2], Ganapathi Subramania[2], Igal Brener[2], Oleg Mitrofanov[1,2]; [1]*Electronic and Electrical Engineering, Univ. College London, UK;* [2]*Sandia National Laboratories, USA.* We demonstrate an InAs-based terahertz (THz) metasurface emitter that can generate and focus THz pulses using a binary-phase Fresnel zone plate concept. The metalens emitter successfully generates a focused THz beam without additional THz optics.

SM1P.4 • 09:00

Identifying the optimal molecular gas in a quantum cascade laser pumped molecular laser, Paul Chevalier[1], Amaury Autric[1,4], Federico Capasso[1], Henry O. Everitt[2,3]; [1]*Harvard Univ., USA;* [2]*Duke Univ., USA;* [3]*DEVCOM Army Research Laboratory, USA;* [4]*Ecole Polytechnique, France.* We present an improved numerical model for quantum cascade laser pumped molecular lasers (QPMLs) and present predictions of QPML performance for various molecular gases such as OCS, NH_3, N_2O, CH_3F, HCN or H_2O.

SM1P.5 • 09:15

Efficient Photoconductive Switches on GaN for THz Generation, Can Uzundal[1], Qixin Feng[1], Feng Wang[1]; *[1]UC Berkeley, USA.* We demonstrate efficient generation of THz pulses (>10 pJ and >30% efficiency) in GaN photoconductive switches coupled to a strip-line waveguide. We employ a quadratic electrooptic effect of excitonic origin to probe the THz pulses.

SM1P.6 • 09:30

Broad Angle Resolver for THz Band, Yasith Amarasinghe[1], Hichem Guerboukha[2], Yaseman Shiri[2], Pernille Klarskov[1], Daniel Mittleman[2]; *[1]Department of Electrical and Computer Engineering - Electronics and Photonics, Aarhus Univ., Denmark; [2]School of Engineering, Brown Univ., USA.* We design a broad angle receiver using a leaky parallel plate waveguide by manipulating the plate separation. The device operates at 200 GHz, has a broad angle of acceptance and can resolve the received angle.

SM1P.7 • 09:45

3 THz Frequency Synthesizer with Hz Stability, Brendan M. Heffernan[1], James Greenberg[1], Antoine Rolland[1]; *[1]IMRA America, Inc., USA.* We use a 10 GHz electro-optic frequency comb and a 300 GHz dissipative Kerr soliton to synthesize a 10 MHz clock reference to 3 THz with an out-of-loop instability starting at 8×10^{-13} at 1 second.

08:00 -- 10:00
Room: W210
AM1Q • A&T Topical Review on Advanced Imaging and Microscopy 3D Biology, Neuroscience and Coherence-Domain Biophotonics I
Presider: To be Announced

AM1Q.1 • 08:00 (Invited)

Head-mounted One-photon Microscopes, Mark Schnitzer[1]; *[1]Stanford Univ., USA.* Abstract not available.

AM1Q.2 • 08:30 (Invited)

Adaptively-sampled High-speed Two-photon Microscopy, Yunyang Li[1], Shu Guo[1], Ben Mattison[1], Weijian Yang[1]; *[1]Univ. of California Davis, USA.* We demonstrate a high-speed two-photon microscope with an adaptive sampling scheme to image neuronal activity. The illumination pattern is modulated by a digital micro-mirror device so only the regions of interest are illuminated and sampled.

AM1Q.3 • 09:00 (Invited)

Ultra-broadband Femtosecond Laser Systems for Enhanced Nonlinear Microscopy Imaging, Rosa Romero[1]; *[1]Sphere Ultrafast Photonics, Portugal.* Abstract not available.

AM1Q.4 • 09:30 (Invited)

Differentiable Imaging for Slimming Optics and Maximizing Performance in cell imaging, Ni Chen[1]; *[1]Univ. of Arizona, USA.* In this talk, I will demonstrate how differentiable imaging can integrate optical systems and computational methods to simplify imaging systems and boost their capacity for cell imaging in more compact setups.

08:00 -- 10:00
Room: W211
SM1R • Atomic Clocks and Quantum Sensing
Presider: To be Announced

SM1R.1 • 08:00
Toward an Optically Pumped Magnetometer Magnetoencephalography System with Full Head Coverage, Peter D. Schwindt[1], Joonas Iivanainen[1], Tony Carter[1], Jonathan Dhombridge[1], Timothy Read[1], Bethany Little[1], David Ridley[1], Jim McKay[2], Julia Stephen[4], Samu Taulu[3], Amir Borna[1]; *[1]Sandia National Laboratories, USA; [2]Candoo Systems, Canada; [3]Inst. for Learning and Brain Sciences, Univ. of Washington, USA; [4]Mind Research Network, USA.* We are developing optically pumped magnetometers (OPMs) to perform magnetoencephalography (MEG) with human subjects. Our custom-built four-channel sensors will be installed within a magnetically shielded room to form a 108-channel full-head array.

SM1R.2 • 08:15
Optimization of an electromagnetically induced transparency (EIT)-based vector atomic magnetometer, Mario Maldonado[1], Eugeniy Mkhailov[1], Chester Zimmerman[1], Owen Rollinsowe[1], Alex Toyryla[1], Andrey Matsko[3], Irina Novikova[1], Jamie McKelvy[3], Isaac Fan[2], Ying-Ju Wang[2], John Kitching[2]; *[1]College of William & Mary, USA; [2]NIST, USA; [3]JPL, USA.* We optimize various experimental parameters to improve the sensitivity of magnetic field measurements based on lin||lin EIT resonances. We achieve scalar magnetometer sensitivity <3pT/√Hz in a 100mm^3 vapor cell, and demonstrated vector measurements capabilities.

SM1R.3 • 08:30
Ultrafast Multi-point Three-dimensional Quantum Sensing, Junchen Ye[1], Yintao Wang[2], Mingzhong Ai[1], Bingxv Chen[2], Shih-Chi Chen[2], Quan Li[1,3], Ren-Bao Liu[1,3]; *[1]Department of Physics, The Chinese Univ. of Hong Kong, Hong Kong; [2]Department of Mechanical and Automation Engineering, The Chinese Univ. of Hong Kong, Hong Kong; [3]Centre for Quantum Coherence, The Chinese Univ. of Hong Kong, Hong Kong.* We realized ultrafast three-dimensional tracking of multiple nanodiamond sensors using a digital micromirror device, and therefore achieved three-dimensional dynamical multi-point quantum sensing. This work enables a broad range of applications such as multi-point temperature monitoring in live cells.

SM1R.4 • 08:45
Electron Beam Profiling Using Coherent Atomic Magnetometry, Nicolas DeStefano[1], Todd Averett[1], Shukui Zhang[2], Alexandre Camsonne[2], Gunn Park[2], Aneesh Ramaswamy[3], Svetlana Malinovskaya[3], Irina Novikova[1], Eugeniy Mkhailov[1], Seth Aubin[1]; *[1]College of William & Mary, USA; [2]Thomas Jefferson National Accelerator Facility, USA; [3]Stevens Inst. of Technology, USA.* We reconstruct 2-D electron beam profiles using local measurements of its magnetic field via nonlinear magneto-optical polarization rotation in Rb vapor.

SM1R.5 • 09:00 (Invited)
Progress Towards an Optical Frequency Standard with $^{176}Lu^{+}$, Murray D. Barrett[1,2], Kyle J. Arnold[1], Zhao Qi[1], Zhang Zhao[1], Qin Qichen[1], Michael Kang[1], Nakarin Jayjong[1]; *[1]Center for Quantum Technologies, Singapore; [2]National Metrology Center of Singapore, Singapore.* We present our most recent comparisons demonstrating 1e-18 agreement between two lutetium clocks. Lutetium offers two transitions within the one atom that allows 1e-18 levels of

performance and we argue that the frequency ratio measured within the one apparatus provides a well-defined metric to establish the performance of remotely located systems. We discuss our efforts towards establishing this result.

SM1R.6 • 09:30
Mode-Hop-Free Tunable Chip-Scale Laser at 780 nm for Integrated Quantum Photonic and Atomic Applications, Joshua E. Castro[1], Paolo Pintus[1], Eber Nolazco[1], Theodore Morin[1], Trevor J. Steiner[1], Lillian Thiel[1], Nicholas Lewis[1], John Bowers[1], David Weld[1], Galan Moody[1]; *[1]UCSB, USA.* We report a > 100 GHz mode-hop-free tunable III-V-on-Si3N4 laser operating from 770-785 nm with < 5 kHz intrinsic linewidth. We demonstrate pumping a high-Q Si3N4 microresonator entangled-photon pair source and locking to the 87Rb D2 line.

SM1R.7 • 09:45
Tunable 778 nm Integrated Brillouin Laser Probe for a Rubidium Two-Photon Optical Atomic Clock, Andrei Isichenko[1], Andrew Kortyna[2], Nitesh Chauhan[1], Jiawei Wang[1], Mark W. Harrington[1], Judith Olson[2], Daniel J. Blumenthal[1]; *[1]UC Santa Barbara., USA; [2]Infleqtion, USA.* We demonstrate a frequency-controllable 778 nm integrated Brillouin laser with 40 Hz fundamental and 5 kHz integral linewidths maintained over >10 kHz modulation. Stabilization to a rubidium two-photon transition results in stability 2e-13 at 100s.

10:30 -- 12:30
Room: W201AB
AM2A • Fiber-based Sensing I: Acoustics Acceleration
Presider: To be Announced

AM2A.1 • 10:30
An anti-interference network of CNN-BiGRU for pipeline corrosion recognition with fiber optic DAS system, Shixiong Zhang[1], Qizhen Sun[1], Hao Li[1], Cunzheng Fan[1], Baoqiang Yan[1], Zhijun Yan[1], Zhengxuan Shi[1]; *[1]Huazhong Univ of Science and Technology, China.* An anti-interference network of CNN-BiGRU for pipeline corrosion recognition with fiber optic DAS system is proposed. The proposed model achieves the average accuracy of 83.4% between different pipelines in high-interference environment under seven corrosion degrees.

AM2A.2 • 10:45
Analysis of Acoustic Sensing via Optical Fiber Cables, Petr Dejdar[1], Ondrej Mokry[1], Martin Cizek[2], Pavel Rajmic[1], Petr Munster[1], Jiri Schimmel[1], Lenka Pravdova[2], Tomas Horvath[1], Ondrej Cip[2]; *[1]Vysoke Uceni Technicke v Brne, Czechia; [2]Inst. of Scientific Instruments of the Czech Academy of Sciences, Czechia.* We report a measurement of optical fiber cables sensitivity to acoustic waves. An anechoic room was utilized for the measurement. Several objective parameters were evaluated w.r.t. various types of optical fiber cables.

AM2A.3 • 11:00
Large Dynamic Range and High Frequency Acoustic Signal Detection with SNR Enhancement, Hongkun Zheng[1], Lingmei Ma[1], Zechao Liu[1], Caiyun Li[1], Yiyang Zhuang[1], Chen Zhu[1], Yunjiang Rao[1,2]; *[1]Research Center for Optical Fiber Sensing, Zhejiang Laboratory, China; [2]Key Laboratory of Optical Fiber Sensing and Communications, Univ. of Electronic Science and Technology of China, China.* An OPD-based demodulation method for acoustic

signal detection is proposed, breaking the limit of phase demodulation. Experiment results demonstrated superior performance at high frequency, and the SNR increases proportionally with the frequency of the signal.

AM2A.4 • 11:30
Optical fiber ferrule-top suspended optomechanical microresonators for acceleration sensing, Peng Wang[1], Taige Li[1], A. Ping Zhang[1]; [1]*Hong Kong Polytechnic Univ., Hong Kong.* A micrometer-scale optomechanical resonator suspended on optical fiber-ferrule end-face is designed for high-sensitivity acceleration sensing. An optical 3D micro-printing technology is applied to fabricate the whole structure, and its frequency response is measured in experiments.

AM2A.5 • 11:45
Ultra-Thin Fiber Accelerometer Based on Coherent Phase Detection for Testing Equipment Vibration Monitoring, Zhengxuan Shi[1], Qizhen Sun[1], Hao Li[1], Cunzheng Fan[1], Zhijun Yan[1], Yuran Tao[1]; [1]*Huazhong Univ of Science and Technology, China.* We demonstrate ultra-thin fiber accelerometers based on coherent phase detection. With ultra-thin membrane transducer design, the fiber accelerometers can realize multipoint and multi-directional vibration detection for testing equipment with an acceleration resolution of 17.7 ug/√Hz.

AM2A.6 • 12:00
Fiber Optic Hydrophone Towed Cable Shape Perception Based on Optical Frequency Domain Reflectometry, Ke Ai[1], Yuejuan Lv[1], Junfeng Chen[1], Zhengxuan Shi[1], Cunzheng Fan[1], Hao Li[1], Zhijun Yan[1], Qizhen Sun[1]; [1]*Huazhong Univ of Science and Technology, China.* A fiber optic hydrophone towed cable shape perception scheme based on OFDR is proposed and demonstrated. The maximum reconstruction error is 1.25% for the 5 m towed cable with a bending radius of 2.5 m.

AM2A.7 • 12:15
Optical Fiber Loss Distribution Measurement by Using Phase-sensitive OTDR, Hailiang Zhang[1], Hui Dong[1], Dora Juan Juan Hu[1]; [1]*Inst. for Infocomm Research(I2R), Agency for Science, Technology and Research (A*STAR), Singapore.* We propose and experimentally demonstrate fiber loss distribution measurement by using intensity-based phase-sensitive optical time domain reflectometer (PS-OTDR). There is no requirement to modify any hardware in the existing PS-OTDR interrogator.

10:30 -- 12:30
Room: W201CD
FM2B • Attosecond Electron Sources and Dynamics
Presider: To be Announced

FM2B.1 • 10:30 (Tutorial)
Attosecond Electron Microscopy and Imaging the Quantum Electron Motion in Action, Mohammed T. Hassan[1]; [1]*Univ. of Arizona, USA.* In this tutorial, I will present our development of the attosecond electron microscope, which we coined “Attomicroscopy”, by the optical laser gating approach. Moreover, I will present the attomicroscopy imaging of the quantum electron motion dynamics in graphene.

FM2B.2 • 11:30

Attosecond Electron Microscopy using Free-Electron Homodyne Detection, John H. Gaida[1,2], Hugo Lourenço-Martins[1,2], Murat Sivis[1,2], Thomas Rittmann[1,2], Armin Feist[1,2], Javier García de Abajo[3,4], Claus Ropers[1,2]; *[1]Dept. of Ultrafast Dynamics, MPI for Multidisciplinary Sciences, Germany; [2]4th Physical Inst., Univ. of Göttingen, Germany; [3]ICFO-Institut de Ciencies Fotoniques, Spain; [4]ICREA-Institució Catalana de Recerca i Estudis Avançats, Spain.* We implement attosecond electron microscopy in a TEM to measure the optical near-field of a plasmonic nanoprism with 54 as (FWHM) temporal and few-nm spatial resolution, demonstrating free-electron homodyne detection.

FM2B.3 • 11:45

Coherent Amplification in Ultrafast Electron Microscopy, Tomer Bucher[1], Harel Nahari[1], Hanan H. Sheinfux[2], Ron Ruimy[1], Arthur Niedermayr[1], Raphael Dahan[1], Yuval Adiv[1], Michael Yannai[1], Jialin Chen[1], Yaniv Kurman[1], Sang Tae Park[3], Daniel Masiel[3], Eli Janzen[4], James Edgar[4], Fabrizio Carbone[5], Guy Bartal[1], Shai Tsesses[1], Frank Koppens[6], Giovanni Vanacore[7], Ido Kaminer[1]; *[1]Technion, Israel; [2]Bar-Ilan Univ., Israel; [3]Integrated Dynamic Electron Solutions, Inc., USA; [4]Kansas State Univ., USA; [5]Passeig Lluís Companys, Spain; [6]ICFO-Institut de Ciències Fotòniques, Spain; [7]Univ. of Milano-Bicocca, Italy.* We present free-electron imaging of sub-cycle spatio-temporal dynamics of 2D polariton wavepackets, demonstrating the first simultaneous time-, space-, and phase-resolved measurement of such phenomena, and resolving their novel features like vortex-anti-vortex singularities for record-low intensities.

FM2B.4 • 12:00 (Invited)

Steering Quantum Dynamics through Electronic Entanglement in Molecules Pumped by Atto and Few Femto Second Pulses, Francoise Remacle[1]; *[1]Universite de Liege, Belgium.* Broad energy band width atto pulses excite superposition of electronic states that entangle electronic and nuclear motions. We discuss how to exploit this entanglement to steer the force on the nuclei and control chemical reactivity.

10:30 -- 12:30
Room: W204AB
AM2C • Femtosecond Laser Processing for Functional Dielectrics

Presider: To be Announced

AM2C.1 • 10:30 (Invited)

Data-driven Ultrashort Pulse Laser Processing of Glass Materials toward Stable and High-throughput Manufacturing, Aiko Narazaki[1], Takemichi Miyoshi[1,2], Hideyuki Takada[1], Dai Yoshitomi[1], Godai Miyaji[2]; *[1]Natl Inst of Adv Industrial Sci & Tech, Japan; [2]Tokyo Univ. of Agriculture and Technology, Japan.* Data-driven ultrashort pulse laser processing was demonstrated for LIPSS formation on glass materials, in which process parameters were controlled by feedback based on in-process monitoring data, effectively reducing defects and realizing stable and throughput manufacturing.

AM2C.2 • 11:00

Femtosecond Laser Based Nanostructuring in the Bulk of Fused Silica, Ernesto Gribaudo[1], Pieter Vlugter[1], Yves Bellouard[1]; *[1]EPFL, Switzerland.* We develop a femtosecond laser based fabrication technique which exploits near-field enhancement to generate selectively etchable arbitrarily long nanoplanes in the bulk of fused silica. The nanoplanes volumetric morphology and formation mechanism are investigated.

AM2C.3 • 11:15
Nano-structuring of Glass Using Femtosecond Lasers, Gong Chen[1], Jie Qiao[1]; *[1]Imaging Science, Rochester Inst. of Technology, USA.* We demonstrate nano-structuring of glass using femtosecond-laser beam figuring. We established a method for creating and eliminating periodic nanostructures. The method provides a path for using a femtosecond laser to reduce detrimental mid-spatial-frequency errors.

AM2C.4 • 11:30
Surface functionalization of glass using femtosecond laser-induced plasma, Gin Jose[1], Paramita Pal[1,2], Eric Kumi-Barimah[1], Robert Mathieson[1,3]; *[1]Univ. of Leeds, UK; [2]Univ. of Bath, UK; [3]NIQS Technology (Leeds) Ltd., UK.* Femtosecond laser-induced plasma of tellurite-based glasses is used to modify structurally the surface of silicate glasses and silica-on-silicon to engineer photonic components. The refractive index, doping, mechanical strength, and color are altered using the methodology.

AM2C.5 • 11:45
Nitrogen-vacancy center generation in diamond by fs-laser irradiation at different conditions, Lucas Nolasco[1], Sebastiao Pratavieira[1], Cleber R. Mendonca[1]; *[1]USP - Instituto de Fisica de Sao Carlos, Brazil.* A study of the fs-laser-induced generation of nitrogen-vacancy centers in diamond was performed at distinct fluences, pulse durations, and wavelengths to identify the optimal conditions for its creation, with implications for developing novel quantum technologies.

AM2C.6 • 12:00
Fs-Laser Writing of Single Nitrogen Vacancy Centers in Diamond at High-Repetition-Rate, Patrick Anderson[1], Georgios Chatzidrosos[1], Fotini Karinou[1]; *[1]Microsoft Research, UK.* We demonstrate the on-demand writing of single nitrogen vacancy (NV) centers in diamond using 125 kHz fs-laser pulses with low-latency fluorescence feedback. Such repetition-rate scaling offers a path towards high throughput and low-nitrogen substrates.

10:30 -- 12:30
Room: W205AB
SM2D • Infrared Photonic Devices and Characterization
Presider: Patrick Schwaab; Karlsruher Institut für Technologie, Germany

SM2D.1 • 10:30 (Invited)
III-V Semiconductor Nanowire Array Infrared Photodetectors by Selective Area Epitaxy, Lan Fu[1]; *[1]Australian National Univ., Australia.* In this talk, I will present our recent work on developing III-V compound semiconductor nanowire array infrared photodetectors based on different NW array material/device designs and fabrication methods, to achieve performance/functionality meeting the requirements by the future advanced photonic/optoelectronic integrated systems.

SM2D.2 • 11:00
A sub-volt near-IR lithium tantalate electro-optic modulator, Keith Powell[1], Dylan L. Renaud[1], Xudong Li[1], Daniel R. Assumpcao[1], CJ Xin[1], Neil Sinclair[1], Marko Loncar[1]; [1]*Harvard Univ., USA.* We demonstrate an integrated electro-optic Mach-Zehnder modulator in thin-film lithium tantalate at 737 nm with record low half-wave voltage length product of 0.65 Vcm. An extinction ratio of 30 dB and a detector-limited operating bandwidth of 20 GHz was measured.

SM2D.3 • 11:15
Heteroepitaxial IV-VI semiconductor mid-infrared light-emitting diodes and detectors, Leland Nordin[2,1], Jarod Meyer[1], Kunal Mukherjee[1]; [1]*Materials Science and Engineering, Stanford Univ., USA;* [2]*CREOL, Univ. of Central Florida, USA.* N-type IV-VI films are grown on p-type III-V substrates. Despite a threading dislocation density exceeding $1x10^9$ cm^{-2}, we observe mid-infrared electroluminescence and photoresponse at room temperature. These results underscore the promise of IV-VI/III-V heteroepitaxial devices.

SM2D.4 • 11:30
Niobium-Titanium Oxide (NbTiOx): a Novel High-Index Material for Visible and Near Infrared Integrated Photonics, David Irvine[1], Neil MacFarlane[1], Aaron Schreyer-Miller[1], Aaron Gibbs[1], William Houck[2], Mark Foster[1], Amy C. Foster[1]; [1]*JHU, USA;* [2]*VIAVI Solutions Inc., USA.* We demonstrate niobium-titanium oxide (NbTiOx), a sputtered metal oxide alloy, for visible and near-IR integrated photonics. In the near-IR, we achieve waveguide propagation losses <1 dB/cm and a third-order nonlinearity 8x larger than Si3N4.

SM2D.5 • 11:45
Characterization of Passivation Layer Losses using on-chip Chalcogenide Glass Resonators with Ultra-high Q-factor in the Mid-infrared Region, Daewon Suk[1], Kiyoung Ko[1], Jingyu Kim[2], Sang-Hee Ko Park[2], Rongping Wang[3,4], Duk-Yong Choi[3], Hansuek Lee[1]; [1]*Department of Physics, Korea Advanced Inst. of Science and Technology, Korea (the Republic of);* [2]*Department of Material Science and Engineering, Korea Advanced Inst. of Science and Technology, Korea (the Republic of);* [3]*Laser Physics Centre, Research School of Physics, Australian National Univ., Australia;* [4]*The Research Inst. of Advanced Technologies, Ningbo Univ., China.* We optically characterize the absorption loss and surface property of nanometer-thin Al_2O_3 and TiO_2 passivation layers using chalcogenide glass-based on-chip resonators with ultra-high Q-factor in the mid-IR region.

SM2D.6 • 12:00
***n_2* Database and New Data on Nonlinear Optical Properties in Long-Wave Infrared,** Mikhail N. Polyanskiy[1], Igor V. Pogorelsky[1], Marcus Babzien[1], Konstantin L. Vodopyanov[2], Mark A. Palmer[1]; [1]*Brookhaven National Laboratory, USA;* [2]*Univ. of Central Florida, USA.* We introduce an n_2 database within the *refractiveindex.info* database of optical constants and augment it by measuring nonlinear refraction and absorption at 9.2 μm in materials relevant for high-peak-power long-wave-infrared lasers.

SM2D.7 • 12:15
Geiger-mode Single Photon Detection at 2 μm, Daniel Herrera[1], Adam Dadey[1], Stephen March[2], Seth R. Bank[2], Joe Campbell[1]; [1]*Electrical Engineering, Univ. of Virginia, USA;* [2]*Electrical Engineering, Univ. of Texas, USA.* We report the first 2 μm Geiger-mode single photon counting results using an AlInAsSb SACM avalanche photodiode. Avalanche

probabilities greater than 90% were measured at 80 K, corresponding with single photon detection efficiencies of 12.6%.

10:30 -- 12:30
Room: W205CD
SM2E • Multimode Fibers II
Presider: Auro Perego; Aston Univ., UK

SM2E.1 • 10:30 (Invited)
Multimode Fiber as a Nanometer-accurate Metrology Sensor, Ksenia Abrashitova[1], Lyubov V. Amitonova[1,2]; [1]*ARCNL, Netherlands;* [2]*Physics and Astronomy, Vrije Universiteit Amsterdam, Netherlands.* We propose and experimentally demonstrate a multimode fiber optical displacement sensor with the resolving power of 1.8 nm, which is 670 times smaller than the diffraction limit of the optical system.

SM2E.2 • 11:00
High-energy Spatiotemporal Self-Mode-locked Fiber Laser, Zihao Zhang[1], Yang Zhang[1], Xinghao Duan[1], Yi Zhang[1], Yue Dong[1], Junli Wang[1]; [1]*Xidian Univ., China.* We demonstrate an all-fiber spatiotemporal self-mode-locked fiber laser with 4.23 nJ high pulse energy and 74 mW low mode-locked threshold. The soliton pulse is obtained with multimode beam profiles and clear Kelly sidebands.

SM2E.3 • 11:15
Suppressing Stimulated Brillouin Scattering in Multimode Fiber Amplifier With High Beam Quality Via Full-Field Wavefront Shaping, Stefan Rothe[1], Chun-Wei Chen[1], Peyman Ahmadi[2], Kabish Wisal[3], Mert Ercan[1], A. D. Stone[3], Hui Cao[1]; [1]*Yale Univ., USA;* [2]*Coherent, USA;* [3]*Department of Physics, Yale, USA.* We propose an efficient method of maintaining high beam quality of a highly multimode fiber amplifier by full-field wavefront shaping of a coherent seed. This approach strongly suppresses the Stimulated Brillouin Scattering through multimode excitation.

SM2E.4 • 11:30
A New Method of Unidirectional Mode Cleaning in Large Core Fibers Using a Non-Hermitian Helical Perturbation, Mingshu Chen[1], Huanyu Zhou[1], Kestutis Staliunas[2,3], Almantas Galvanauskas[1]; [1]*Gerard Mourou Center for Ultrafast Optical Science, Univ. of Michigan, USA;* [2]*Departamento de Fisica, Universitat Politecnica Catalunya, Spain;* [3]*Institucion Catalana de Investigacion y Estudios Avanzados, Spain.* A large-core effectively single-mode fiber is proposed using mode cleaning by unidirectional coupling from higher-order to fundamental mode via helical non-Hermitian perturbation. Unidirectionality offers a pathway to a variety of novel large-core fiber devices.

SM2E.5 • 11:45
Suppressing Nonlinear Instabilities in Multimode Fibers via Wavefront Shaping, Kabish Wisal[1], Chun-Wei Chen[1], Peyman Ahmadi[2], Stefan Rothe[1], Hui Cao[1], A. D. Stone[1]; [1]*Yale Univ., USA;* [2]*Coherent, USA.* We demonstrate a general and powerful approach based on coherent multimode excitation to suppress various nonlinear instabilities in optical fibers, including stimulated Brillouin scattering (SBS) and transverse mode instability (TMI).

SM2E.6 • 12:00
Random laser carries complex patterns through multimode fiber via learning inverse transmission matrix, Lele Wang[1], Tiancheng Qi[1], Zhoutian Liu[1], Dan Li[1], Ping Yan[1], Qirong Xiao[1]; *[1]Tsinghua Univ., China.* We introduce random laser into a single-fiber image transmission system for the first time. High-quality transmission of complex grayscale patterns is achieved with inverse transmission matrix. It provides guidance for fiber imaging and flexible endoscopy.

SM2E.7 • 12:15
Machine-Learning-Optimized OAM Excitation in Optical Fibers, Jeffrey Demas[1], Mathilde Hary[2,3], Goery Genty[2], Siddharth Ramachandran[1]; *[1]Boston Univ., USA; [2]Photonics Laboratory, Tampere Univ., Finland; [3]Institut FEMTO-ST, Université de Franche-Comté, France.* We develop a machine learning algorithm for *in situ* control and optimization of OAM excitation in optical fibers, ensuring high-purity and low-loss coupling. The algorithm can correct intentional misalignments, as well as compensate alignment drift.

10:30 -- 12:30
Room: W206A
FM2F • Quantum Emitters II
Presider: Joseph Lukens; Arizona State Univ., USA

FM2F.1 • 10:30
Hybrid photonic integration of color centers in designer nanodiamond with SiN nanophotonic devices, Kinfung Ngan[1], Yuan Zhan[1], Constantin Dory[2], Jelena Vuckovic[2], Shuo Sun[1]; *[1]JILA, USA; [2]Stanford Univ., USA.* We developed a new technique that enables deterministic assembly of diamond color centers in a SiN photonic circuit. Using this technique, we observed Purcell enhancement of SiV centers coupled to a silicon nitride ring resonator.

FM2F.2 • 10:45 (Invited)
Nanoscale Covariance Magnetometry with Diamond Quantum Sensors, Nathalie de Leon[1]; *[1]Princeton Univ., USA.* I describe a new method for measuring two-point magnetic field correlators with nanoscale resolution using nitrogen vacancy centers in diamond.

FM2F.3 • 11:15
Site-Controlled SiN/SiO_2 Single Photon Sources Coupled to Silicon Nitride Integrated Photonics, Samuel Peana[1], Omer Yesilyurt[1], Alexander Senichev[1], Zachariah O. Martin[1], Alexei S. Lagoutchev[1], Alexander Kildishev[1], Alexandra Boltasseva[1], Vladimir M. Shalaev[1]; *[1]Purdue Univ., USA.* We demonstrate an industrially scalable fabrication process for the integration of SiN/SiO_2 single photon emitters into on-chip nanophotonic structures with sub-diffraction limited placement accuracy.

FM2F.4 • 11:30
Quantum Network Component Development on the 4H-Silicon-Carbide-on-Insulator Platform, Brett Yurash[1], Biqin Huang[1], Xiwei Bai[1], Louis Yang[1], Samuel Whiteley[1], Jason Lipton[1], Sam Rubin[1], Tong Wang[1], Shuoqin Wang[1], Jason Graetz[1], Thaddeus Ladd[1], Shanying Cui[1]; *[1]HRL Laboratories, LLC, USA.* We present our progress toward the integration of various

components needed for a quantum network node on the 4H silicon carbide on insulator photonic platform, including defects in waveguides, photonic filters, and waveguide integrated detectors.

FM2F.5 • 11:45
Site-Controlled Plasmon-Assisted Single Photon Emission in Locally Strained Few-Layer Hexagonal Boron Nitride, Mashnoon A. Sakib[1], Brandon Triplett[2,3], Naveed Hussain[1], Alexander Senichev[2,3], Xiaohui Xu[2,3], Melika Momenzadeh[1], Alexandra Boltasseva[2,3], Vladimir M. Shalaev[2,3], Maxim R. Shcherbakov[1,4]; *[1]Department of Electrical Engineering and Computer Science, Univ. of California, Irvine, USA; [2]School of Electrical and Computer Engineering, Purdue Univ., USA; [3]National Quantum Information Science Research Center of the U.S. Department of Energy (DOE), Quantum Science Center (QSC), USA; [4]Department of Materials Science and Engineering, Univ. of California, Irvine, USA.* We report on the site-controlled Purcell-enhanced quantum emitters in hexagonal boron nitride by strain-induced activation in gold-coated silicon nanoposts. The room temperature emitters show a second-order autocorrelation function value at zero time delay of down to 0.29, lifetimes shortened to 0.5 ns, and single photon emitter yield of 28%.

FM2F.6 • 12:00
Optical studies of silicon color centers and CC-LEDs for consideration as telecom quantum light sources, Nikki Ebadollahi[1,2], Joshua Pomeroy[2], Marcelo Davanco[2], Kartik Srinivasan[2], Vijin K. Veetil[3,2], Matthew Pelton[3], Pradeep N. Namboodiri[2], Aaron M. Katzenmeyer[2]; *[1]Materials Science and Engineering, Univ. of Maryland, USA; [2]NIST, USA; [3]Physics, Univ. of Maryland, Baltimore County, USA.* We synthesized and studied color centers on silicon-on-insulator wafers with photoluminescence mapping and spectroscopy and fabricated silicon W- and G- color center LEDs towards electrically-pumped single photon sources.

FM2F.7 • 12:15
New single photon source device concept based on GaAs nano-ridge engineering on silicon, Davide Colucci[1,2], Reynald Alcotte[2], Peter Swekis[2], Yves Mols[2], Tom Vandekerckhove[1], Joris Van Campenhout[2], Robert Langer[2], Geoffrey Pourtois[2], Dries Van Thourhout[1], Bernardette Kunert[2]; *[1]Ghent Univ., Belgium; [2]imec, Belgium.* InAs quantum dots embedded in GaAs are a popular choice for the development of single photon sources. Nano-ridge engineering provides a route to monolithically integrate such sources on the silicon photonics platform.

10:30 -- 12:30
Room: W206B
SM2G • Optical Frequency References and Transfer
Presider: Daniele Nicolodi; PTB, Germany

SM2G.1 • 10:30 (Invited)
Excess Noise and Photoinduced Effects in Highly Reflective Crystalline Mirror Coatings, Jialiang Yu[1], Dhruv Kedar[2], Sebastian Häfner[1], Thomas Legero[1], Sofia Herbers[1], Daniele Nicolodi[1], Chun Yu Ma[1], Fritz Riehle[1], John M. Robinson[2], Eric Oelker[2], Jun Ye[2], Uwe Sterr[1]; *[1]Physikalisch-Technische Bundesanstalt, Germany; [2]JILA, NIST and Univ. of Colorado, USA.* We performed the first direct measurement on the Brownian thermal noise of $Al_{0.92}Ga_{0.08}As$/GaAs crystalline coating within an optical interferometer at cryogenic

temperatures. In addition, we observe photoinduced effects and excess noise contributions in these crystalline coatings. Our results indicate that, despite of the low coating Brownian noise, additional noise contributions might limit the performance of these novel optical coatings.

SM2G.2 • 11:00

Compact and Thermal-Noise-Limited Optical Reference Cavity Operated in Air, Yifan Liu[1,2], Dahyeon Lee[1,2], Charles McLemore[1,2], Megan L. Kelleher[1,2], Takuma Nakamura[1,2], Naijun Jin[3], Susan Schima[2], Peter Rakich[3], Scott A. Diddams[4,2], Franklyn Quinlan[2,4]; *[1]Department of Physics, Univerisity of Colorado Boulder, USA; [2]Time and Frequency Division, National Inst. of Standards and Technology, USA; [3]Department of Applied Physics, Yale Univ., USA; [4]Electrical, Computer and Energy Engineering, Univ. of Colorado Boulder, USA.* We present a vacuum-gap, compact Fabry-Pérot ultrastable optical reference cavity that operates without a vacuum enclosure. A laser stabilized to the cavity exhibits low, thermal noise-limited phase noise and 5×10^{-14} Allan deviation at 1 second.

SM2G.3 • 11:15

A Two-Photon Rb Clock Based on Direct Comb Excitation, Dylan P. Tooley[1,3], Seth E. Erickson[3], Kushan Weerasinghe[2], Xiushan Zhu[2], Arturo Chavez-Pirson[2], R. J. Jones[3]; *[1]Physics, Univ. of Arizona, USA; [2]NP Photonics, USA; [3]College of Optical Sciences, Univ. of Arizona, USA.* An optical atomic clock based on direct comb excitation of Rb87 is demonstrated with performance rivaling similar, continuous-wave clocks. Signal to noise and systematics are shown comparable, with Allan deviations of 1.5E-13 at one second.

SM2G.4 • 11:30

Hertz-Level Linewidth Brillouin Fiber Laser Using Doubly Resonant Cavities, Jacob Lampen[1], Peng Li[1], Jie Jiang[1], Antoine Rolland[1], Martin Fermann[1]; *[1]IMRA America, USA.* We demonstrate an ultra-high Q doubly resonant cavity Brillouin fiber laser producing a stable low-noise Brillouin output with a linewidth of ~ 2.4 Hz and a stability of < 2×10^{-14} at 20 ms.

SM2G.5 • 11:45

>1.5 Octave-broad Optical Frequency Comb for Multi-clock Comparisons and Wide-band Spectral Purity Transfer, Thomas Lompe[1], Phillip Woschnik[1], Kerstin Schlichting[1], Dario Lago-Rivera[1], Yuanjie Wu[1], Tilo Steinmetz[1], Andreas Fricke[1], Marc Fischer[1], Michele Giunta[1,2], Ronald Holzwarth[1,2]; *[1]Menlo Systems GmbH, Germany; [2]Laser Spectroscopy, Max-Planck-Institut für Quantenoptik, Germany.*

We present a system composed of an Er:laser-based ultra-low-noise frequency comb seeding a custom-designed photonic-crystal fiber with 2nJ pulse energies. A supercontinuum is obtained spanning from 650nm to 2µm. System qualifications will be presented.

SM2G.6 • 12:00

Hybrid frequency locking of a coin-sized laser module using both linewidth narrowing and Doppler-free spectroscopy, Junia Nomura[1,2], Daisuke Akamatsu[2], Feng-Lei Hong[2]; *[1]Mitsubishi Electric Corporation, Japan; [2]Department of Physics, Graduate School of Engineering Science, Yokohama National Univ., Japan.* We demonstrate a hybrid frequency locking method for a broad-linewidth coin-sized laser module based on linewidth reduction using a short-path imbalance fiber interferometer and Doppler-free spectroscopy of molecular iodine.

SM2G.7 • 12:15

Modular Fiber Laser Platform for Strontium Atomic Clocks, Andrea Pertoldi[1,2], Abhilash Jha[3], Jakob M. Hauge[1], Poul Varming[1], Yeshpal Singh[3], Patrick Montague[1]; *[1]NKT Photonics A/S, Denmark; [2]Niels Bohr Inst., Univ. of Copenhagen, Denmark; [3]Univ. of Birmingham, UK.* A modular laser platform for an industry-ready strontium atomic clock is developed. Two approaches to reach strontium wavelengths based on thulium-doped fiber lasers are demonstrated, together with a full integration of the new laser system.

10:30 -- 12:30
Room: W207A
SM2H • Ultrafast Spectroscopy and Pulse Characterization for the Deep and Extreme Ultraviolet
Presider: Scott Domingue; Thorlabs Laser Division Boulder, USA

SM2H.1 • 10:30

A SPIDER Technique Based on Nonlinear Kerr Effect for Characterizing Ultrashort UV Laser Pulses, Yu-hsin Chen[1], Theodore Jones[1]; *[1]Naval Research Laboratory, USA.* We describe our measurements of nonlinear refractive index with spectral interferometry (SI) at 400 nm wavelength. We also propose a novel SPIDER apparatus based on Kerr effect for ultrafast pulse characterization at wavelengths including UV.

SM2H.2 • 10:45

Single-shot Measurements of Shaped XUV FEL Pulses with Frequency Resolved Optical Gating, Francesca A. Elverson[1], Patrick Skrodzki[1], Scheinker Alexander[1], Laura Foglia[2], David Garzella[2], Ivaylo Nikolov[2], Matteo Pancaldi[2], Emanuele Pedersoli[2], Peter Susnjar[2], Luca Giannessi[2], Miltcho Danailov[2], Flavio Capotondi[2], Filippo Bencivenga[2], Pamela R. Bowlan[1]; *[1]Los Alamos National Laboratory, USA; [2]Elettra Sincotrone Trieste, Italy.* We demonstrate work implementing auto-differentiation in the phase retrieval algorithm applied on Transient Grating (TG) XFROG traces, to measure shaped extreme-ultraviolet (XUV) Free Electron Laser pulses.

SM2H.3 • 11:00

Towards Real-Time Ultrafast Ptychography with Unsupervised Deep Learning, Carmelo Grova[1], Charles S. Bevis[1], Nicola Giani[1], Daniel E. Adams[2], Giulia F. Mancini[1], Giovanni Pellegrini[3]; *[1]Department of Physics, Laboratory for Ultrafast X-ray and Electron Microscopy (LUXEM), Univ. of Pavia, Italy; [2]Department of Physics, Colorado School of Mines, USA; [3]Department of Physics, Univ. of Pavia, Italy.* We couple an untrained neural network to a complete physical model that describes Ptychography-like image formation process. We demonstrate robustness, high fidelity, full-field image reconstruction and fast convergence with smart weight initialization.

SM2H.4 • 11:15 (Invited)

Evolution of XUV Four Wave Mixing: from Transient Grating Spectroscopy to Pulse Metrology and Polarization Control, Laura Foglia[1], Flavio Capotondi[1], Claudio Masciovecchio[1], Riccardo Mincigrucci[1], Emanuele Pedersoli[1], Filippo Bencivenga[1]; *[1]Elettra Sincrotrone Trieste, Italy.* In this talk we will review the evolution EUV transient grating spectroscopy from the pioneering results for the investigation of elastic and thermal properties of materials to its applications for pulse characterization and polarization control.

SM2H.5 • 11:45

A Flexible Beamline for Ultrafast High-Throughput Microscopy with Extreme Ultraviolet Radiation, Carmelo Grova[1], Charles S. Bevis[1], Nicola Giani[1], Daniel E. Adams[2], Cristian Svetina[3], Giulia F. Mancini[1]; *[1]Department of Physics, Laboratory for Ultrafast X-ray and Electron Microscopy (LUXEM), Univ. of Pavia, Italy; [2]Department of Physics, Colorado School of Mines, USA; [3]IMDEA Nanociencia, X-ray Wave-mixing Spectroscopies Group (X-WaveS), Spain.* We report the design of a compact beamline for Time-Resolved Ptychography driven by a 13nm and 30nm High-Harmonic Generation source. The microscope is capable of quantitative, ultrafast, full-field microscopy supporting near-wavelength spatial and sub-50fs temporal resolutions.

SM2H.6 • 12:00

Transmissive Metasurface Quarter-Wave Plate for Few-Femtosecond Pulses at Deep Ultraviolet Wavelengths, Shatha Kaassamani[1,2], Kyle Chapkin[1], Junyeob Song[1], Amit Agrawal[1], Henri Lezec[1], Wenqi Zhu[1]; *[1]National Inst. of Standards and Technology (NIST), USA; [2]Univ. of Maryland, USA.* We design and fabricate transmissive dielectric metasurfaces made of high-aspect-ratio, wide-bandgap oxide materials to achieve λ/4 retardance at deep ultraviolet wavelengths. We optimize the design towards a broadband quarter-wave plate (QWP) for few-femtosecond pulses.

SM2H.7 • 12:15

Time and Angle Resolved Photoemission Spectroscopy at 250 kHz with High-Intensity Mid-IR Excitation from an OPA at ALLS, Gaetan Jargot[1], Adrien Longa[1], Jean-Michel Parent[1], Benson Frimpong[1], François Légaré[1], Fabio Boschini[1]; *[1]INRS, Canada.* Recently, we have developed an OPA providing intense optical excitation in near- and mid-infrared region (1.7 to 8 µm) used as a pump for time- and angle-resolved photoemission (TR-ARPES). Preliminary results on Bi_2Te_3 using this end-station are presented here.

10:30 -- 12:30
Room: W206BC
SM2I • Integrated Methods
Presider: Michelle Povinelli; Univ. of Southern California, USA

SM2I.1 • 10:30

Fully Integrated Pulse Analyzer Using Silicon Photonics, Keisuke Kondo[1], Hiroki Oshima[1], Ryo Hayama[1], Okihiro Sugihara[1]; *[1]Utsunomiya Univ., Japan.* We demonstrate a fully integrated pulse analyzer fabricated using silicon photonics. The device consists of an on-chip optical correlator and micro-ring filter. Pulse measurements on a chip with very high sensitivity was demonstrated.

SM2I.2 • 10:45

Low-Temperature Sputtered Ultralow-Loss Silicon Nitride for Integrated Photonics, Shuangyou zhang[1], Toby Bi[1,2], Irina Harder[1], Olga Lohse[1], Florentina Gannott[1], Alexander Gumann[1], Eduard Butzen[1], Yaojing Zhang[1], Pascal Del'Haye[1,2]; *[1]Max-Planck-Inst Physik des Lichts, Germany; [2]Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany.* We demonstrate ultralow-loss, high-thickness silicon nitride waveguides and microresonators based on room-temperature sputtering. We reach propagation losses of 3.5 dB/m after 800 °C annealing, enabling ring resonators with optical quality factors >10 million.

SM2I.3 • 11:00
High power >1.5W tunable laser based on integrated LMA power amplifier, Neetesh Singh[1], Jan Lorenzen[1], Milan Sinobad[1], Kai Wang[2], Muharrem Kilinc[1], Henry Francis[3], Michael Geiselmann[3], Mikhail Pergament[1], Umit Demirbas[1], Sonia Garcia-Blanco[2], Franz Kaertner[1]; *[1]Deutsches Elektronen-Synchrotron (DESY), Germany; [2]Univ. of Twente, Netherlands; [3]LIGENTEC, Switzerland.* We demonstrate high power tunable laser using a CMOS-compatible integrated LMA power amplifier. We show amplified power up to 1.5 W from around 100 mW of input seed power in the wavelength window spanning from 1800 to 1900 nm.

SM2I.4 • 11:30
Broadband Terahertz Emitters from Phase-matched Lithium Niobate Photonics, Yazan Lampert[1], Amirhassan Shams-Ansari[2], Alessandro Tomasino[1], Shima Rajabali[1], Marko Loncar[2], Ileana-Cristina Benea-Chelmus[1]; *[1]EPFL, Switzerland; [2]Harvard Univ., USA.* We present emission up to 3 THz from a phase-matched terahertz-optical photonic circuit, featuring a coplanar metallic cavity traversed by an optical rib waveguide and a dipolar antenna for efficient out-coupling of terahertz waves.

SM2I.5 • 11:45
Horizontal Coupling of a Printed Passive Wedge-shaped Microdisk Resonator to Photonic Integrated Circuits, Frederik van Schoonhoven[1], Yoshitaka Tomishige[2], Alejandro Sánchez Postigo[1], Adrian Abazi[1], Jinghan Chen[2], Yuya Mikami[2], Naoya Tate[2], Yuji Oki[2], Carsten Schuck[1], Hiroaki Yoshioka[2]; *[1]Department for Quantum Technology, Univ. of Münster, Germany; [2]Kyushu Univ., Japan.* We successfully integrated a printed, wedge-shaped microdisk resonator into a photonic circuit, allowing coupling of spatially separated whispering gallery modes into an SU-8 ridge waveguide and interfacing with integrated optical circuits.

SM2I.6 • 12:00
Compact, low loss, and high-speed GeSi quantum confined stark effect electro absorption modulator, Ahmed F. Kandeel[1,2], Gaspard Hiblot[2], Yosuke Shimura[2], Clement Porret[2], Didit Yudistira[2], Javad Rahimi Vaskasi[2], Alexey Milenin[2], Chih-Kuo Tseng[2], Mathias Berciano[2], Dharmander Malik[2], Dries Van Thourhout[1,2], Maumita Chakrabarti[2], Dimitrios Velenis[2], Peter Verheyen[2], Yoojin Ban[2], Filippo Ferraro[2], Joris Van Campenhout[2]; *[1]Universiteit Gent, Belgium; [2]imec, Belgium.* We present a 50 GHz O-band GeSi quantum confined stark effect electroabsorption modulator integrated in a 300 mm Si photonics platform with improved integration flow to reduce wafer-scale insertion loss.

SM2I.7 • 12:15
Cascadable Optical Nonlinear Activation Function, Baiheng Zhao[1], Bo Wu[1], Hailong Zhou[1], Jianji Dong[1]; *[1]Wuhan National Lab for Optoelectronics, China.* We have presented an easily fabricated, cascadable optical nonlinear activation function device and developed a self-compensation scheme based on it. This approach significantly enhances the performance of optical neural networks in complex classification tasks.

10:30 -- 12:30
Room: W207D
AM2J • Silicon Photonic Devices
Presider: Xian Xiao; Hewlett Packard Enterprise, USA

AM2J.1 • 10:30
Silicon Micro-Ring Weight Stabilization with Nonlinear Self-Heating, Joshua C. Lederman[1], Simon Bilodeau[1], Eli A. Doris[1], Eric C. Blow[2,1], Bhavin J. Shastri[3], Paul Prucnal[1]; *[1]Princeton Univ., USA; [2]NEC Laboratories America, USA; [3]Queen's Univ., Canada.* Micro-ring resonators can tunably weight wavelength-division-multiplexed signals, but they face high sensitivity to temperature. In this work, we take advantage of micro-ring self-heating to experimentally stabilize a silicon micro-ring weight, nearly halving its thermal sensitivity.

AM2J.2 • 10:45
Graphene Field Effect Transistor on Silicon Nitride Devices for Near-Infrared Wavelength Tuning, Artem Vorobev[2,1], Jesus Hernan Mendoza-Castro[2,3], Simone Iadanza[1,4], Samira Jastan[1,5], Giuseppe Valerio Bianco[6], Giovanni Bruno[6], Antonella D'Orazio[2], Liam O'Faolain[1,5], Marco Grande[2]; *[1]CAPPA, Munster Technological Univ., Ireland; [2]DEI, Politecnico di Bari, Italy; [3]Inst. of Chemical Technologies and Analytics, TU Wien, Austria; [4]Laboratory of Nano and Quantum Technologies, Paul Scherrer Institut, Switzerland; [5]Tyndall National Inst., Ireland; [6]CNR-Nanotec, Department of Chemistry, Univ. of Bari, Italy.* In this work, we present the Graphene Field Effect Transistor (GFET) on Silicon Nitride waveguides for achieving the wavelength tuning in the Near-Infrared (NIR) range. The obtained Electrolyte-Graphene-Waveguide fabrication and characterization results are demonstrated.

AM2J.3 • 11:00
Experimental demonstration of adiabatic polarization splitter rotator on a monolithic silicon photonics platform, Won S. Lee[1], Yusheng Bian[1]; *[1]Globalfoundries, USA.* We experimentally showcase an adiabatic polarization-splitter-rotator on a monolithic SiPh platform with a ~-0.42dB TM insertion-loss and <0.1dB polarization-dependent-loss across the O-band, complemented by a polarization extinction surpassing 45dB.

AM2J.4 • 11:30
Highly Efficient Photonic Multiplexing Chip Using Low-Loss Silicon Nitride Recirculating Loops, Yuancheng Zhan[3,1], hui zhang[1], Andreas Burger[2], Helen Cai[1], Dario Poletti[4,2], Leong Chuan Kwek[3,2], Ai Qun Liu[1,3]; *[1]Inst. of Quantum Technology, The Hong Kong Polytechnic Univ., Hong Kong; [2]Centre for Quantum Technologies, National Univ. of Singapore, Singapore; [3]Quantum Science and Engineering Centre, Nanyang Technological Univ., Singapore; [4]Singapore Univ. of Technology and Design, Singapore.* A highly efficient photonic multiplexing chip employing recirculating loops is proposed. The chip achieves a threefold reduction in both energy and time consumption in Hamiltonian evolution and RNN training

AM2J.5 • 11:45
Minimizing polarization dependent loss for monolithic silicon photonic components and receiver circuits, Yusheng Bian[1]; *[1]GLOBALFOUNDRIES, USA.* We present recent progress in minimizing polarization-dependent-losses (PDLs) for critical SiPh components. Our link-budget analysis shows a noteworthy 1.45dB total PDL reduction for optical receiver circuits, leading to a mere 0.38dB imbalance in TE-TM-path insertion-loss.

AM2J.6 • 12:00

Low Crosstalk, Dual-polarization Dense Waveguide Array, Hong Zhang[1], Ting Li[1], Peiji Zhou[1], Xiaochuan Xu[2], Yi Zou[1]; *[1]ShanghaiTech Univ., China; [2]Harbin Inst. of Technology, Shenzhen, China.* We experimentally demonstrate a low crosstalk, dual-polarization dense waveguide array with 800 nm center-to-center separation. Crosstalk between the nearest waveguides is suppressed to below -20 dB in a bandwidth of 30 nm for both polarizations.

AM2J.7 • 12:15

Experimental demonstration of superradiance using inverse designed cw, ccw mode couplers, Andrew Tang[1], Abhi Saxena[1], Virat Tara[1], Geun Ho Ahn[2], Jelena Vuckovic[2], Arka Majumdar[1]; *[1]Univ. of Washington, USA; [2]Stanford, USA.* We demonstrate superradiance using thermo-optic tuning of coupled racetrack resonators with inverse-designed clockwise (CW), counterclockwise (CCW) mode couplers.

10:30 -- 12:30
Room: W208
FM2K • Photonics for Quantum Computational Tasks
Presider: Muneer Alshowkan; Oak Ridge National Laboratory, USA

FM2K.1 • 10:30 (Invited)

Non-Hermitian Quantum Walks, Peng Xue[1,2]; *[1]Southeast Univ. (China), China; [2]Beijing Computational Science Reseach Center, China.* With the development of non-Hermitian physics, particularly with the phenomenon of the skin effect, a series of achievements have been made in non-Hermitian quantum walks. We review the non-Bloch features of non-Hermitian walks using a universal model. We describe the experimental implementation in linear optical systems. When the boundary condition is open, the phenomenon of skin effect appears. This phenomenon goes beyond what has been known in Hermitian systems.

FM2K.2 • 11:00

Photonic Quantum Extreme Reservoir Computation, William Munro[1], Akitada Sakurai[1], Aoi Hayashi[1], Kae Nemoto[1]; *[1]Okinawa Inst of Science & Technology, Japan.* Quantum extreme reservoir computation is a resource-efficient quantum neural-network model that combines the concepts of extreme machine learning with quantum reservoir computation for classification tasks. We propose a few-photon implementation that achieves remarkably high accuracy.

FM2K.3 • 11:15

Swap test algorithm on a linear photonic chip for scalable quantum machine learning tasks, Alessio Baldazzi[1], Nicolò Leone[1], Matteo Sanna[1], Stefano Azzini[1], Lorenzo Pavesi[1]; *[1]Univ. of Trento, Italy.* We report on an integrated photonic swap test circuit. This computes the scalar product of two qubits using only linear components and path-encoding of qudits given by single photons from an attenuated laser. On a set of 3342 randomly selected couples of states, a mean error of just 0.04 with respect to the expected result is measured.

FM2K.4 • 11:30

Scalable Quantum Photonic Neural Network Processor via Cavity-Assisted Interactions, Jasvith R. Basani[1], Murphy Y. Niu[1], Edo Waks[1]; *[1]Univ. of Maryland, College Park,* *USA.* We present an integrated photonic architecture that uses a single atom trapped in a cavity for deterministic high-fidelity quantum operations. Our design is unique in providing a photon-number-selective nonlinearity, and logical operations on bosonic codes.

FM2K.5 • 11:45
A Recurrent Multiport Interferometer Architecture for Fault-Tolerant Programmable Photonics, Mihai Crisan[1], David A. Carpenter[1], Shamsul Arafin[1]; *[1]The Ohio State Univ., USA.* We propose a novel multiport interferometer architecture that uses optical recursion to mitigate hardware errors and scales as *O(N)*. We also show that it is possible to construct perfect transformations with imperfect beamsplitters meshes.

FM2K.6 • 12:00
Photon-Matter Hybrid Cluster States for Quantum Networks, Gefen Baranes[1,2], Francisco Machado[2,3], Pieter-Jan Stas[2], Aziza Suleymanzade[2], Vladan Vuletic[1], Susanne Yelin[2], Johannes Borregaard[2], Mikhail Lukin[2]; *[1]Massachusetts Inst. of Technology, USA; [2]Physics, Harvard, USA; [3]ITAMP, USA.* We introduce a general framework for information transfer using photon-matter hybrid cluster states. We develop decoding techniques that enhance loss robustness beyond conventional multiplexing and all-photonic approaches, enabling improved quantum networks protocols.

FM2K.7 • 12:15
Free-Electron Cluster States, Nimrod Slor Futterman[1], Shiran Even-Haim[1], Ethan Nussinson[1], Ron Ruimy[1], Ido Kaminer[1]; *[1]Technion - Israel Inst. of Technology, Israel.* We propose cluster states based on entangled free-electrons, controlled via free-electron interactions with ancilla qubits stored in photonic cavities or Josephson junctions, providing a novel resource for quantum electron microscopy and for measurement-based quantum simulations.

10:30 -- 12:30
Room: W209A
SM2L • Metamaterials and Nanostructures
Presider: Wenjing Liu; Peking Univ., China

SM2L.1 • 10:30
Nanophotonic Metastructures for Green-Yellow Emission from Non-Planar InGaN Quantum Wells, Stephanie C. Malek[1], Michael G. Wood[1], Courtney L. Sovinec[1], Anthony Rice[1], Stephen R. Lee[1], Elizabeth DeJong[2], Daniel Feezell[2], Darwin K. Serkland[1]; *[1]Sandia National Laboratories, USA; [2]Univ. of New Mexico, USA.* We demonstrate high-efficiency emission at wavelengths longer than 540 nm from InGaN quantum wells regrown on periodic arrays of GaN nanostructures and explore their incorporation into nanophotonic resonators for semiconductor laser development.

SM2L.2 • 10:45
On-chip meta-lens based Adaptive Integrated Photonic Imager, Jong Ryul Kim[1], Heijun Jeong[1], Tingyi Gu[1]; *[1]Univ. of Delaware, USA.* We demonstrate single-drive adaptive on-chip meta-lens imager with optimized profile for doped silicon heater and metal heaters.

SM2L.3 • 11:00
Subwavelength Fano Resonant Porous Silicon Metasurfaces for Sensing and Dynamic Structural Color, Saddam Gafsi[1], Estevao Marques Dos Santos[1], Ivan Kravchenko[2], Judson R. Ryckman[1]; *[1]Clemson Univ., USA; [2]Center for Nanophase Materials Science, Oak Ridge National Laboratory, USA.* We introduce the design, fabrication, and experimental investigation of subwavelength Fano resonant porous silicon metasurfaces functioning on the principle of guided mode resonance. These metasurfaces exhibit promise for dynamic structural coloration and sensing applications.

SM2L.4 • 11:15
Accelerated solar-blind optical communication via efficient deep ultraviolet LEDs incorporated with novel micro-trenched surface, Muhammad Hunain Memon[1], Huabin Yu[1], Wei Chen[1], Rui Wang[1], Haiding Sun[1]; *[1]School of Microelectronics, Univ. of Science and Technology of China, China.* An efficient approach to enable high-speed solar-blind optical communication by implementing micro-trenches on the surface of DUV-LEDs. Remarkably, this simple approach leads to 13.6% higher optical bandwidth and boosted data rate by 54.7%.

SM2L.5 • 11:30
Temperature dependent implantation of As-Isoelectronic Impurity in GaN Micro and Nanostructures, Aadil Waseem[1], Clarence Chan[2], Xihang Wu[1], Yujie Liu[3], Yifan Shen[3], Manos Kapritsos[3], Theodore Norris[3], Xiuling Li[1]; *[1]Electrical and Computer Engineering, Univ. of Texas at Austin, USA; [2]Department of Electrical and Computer Engineering, Holonyak Micro and Nanotechnology Laboratory, Univ. of Illinois Urbana-Champaign, USA; [3]Department of Electrical Engineering and Computer Science, Univ. of Michigan, USA.* To enhance solar photo absorption of III-N semiconductors, we demonstrate Arsenic implantation at elevated temperatures, improving doping activation and reducing crystal damage.

SM2L.6 • 11:45
Fano Resonant Thin Film Nanocavities for Hybrid Photovoltaic and Thermal Applications, Mohamed ElKabbash[1], Ran Wei[2], Chunlei Guo[2], Tianshu Xu[2]; *[1]Univ. of Arizona, USA; [2]The Inst. of Optics, Univ. of Rochester, USA.* We design and fabricate a Fano-resonant optical coating on a femtosecond laser-processed Silicon substrate, rendering it superwicking. Integrated into a hybrid photovoltaic/thermal system, it demonstrates enhanced photoelectric conversion and water sanitation efficiency.

SM2L.7 • 12:00 (Invited)
CMOS-compatible Metasurfaces Integrated with Optoelectronic Devices: Tuning Light-matter Interaction at the Nanoscale, Inga A. Fischer[1]; *[1]Brandenburgische Technische Universität, Germany.* Optical metasurfaces can be utilized to manipulate light properties in ultra-thin layers. We present recent results on integrating metallic and dielectric metasurfaces with optoelectronic devices for refractive index sensing and wavelength-selective photodetection.

10:30 -- 12:15
Room: W209B
SM2M • Integrated Photonics for Beamsteering and Beamforming
Presider: Jaime Cardenas; Univ. of Rochester, USA

SM2M.1 • 10:30
Low-Phase-Noise Frequency-Agile Hybrid Integrated Laser Offering Highly Linear Tuning for FMCW LiDAR, Huanfa Peng[1], Yung Chen[1], Ignacio Robles Lopez[1], Grigory Lihachev[2], Hao Tian[3], Andrey Voloshin[2], Johann Riemensberger[2], Pascal Maier[1], Sebastian Skacel[4], Matthias Lauermann[4], Alaina Attanasio[3], Sebastian Randel[1], Wolfgang Freude[1], Sunil A Bhave[3], Tobias J. Kippenberg[2], Christian Koos[1]; *[1]Karlsruhe Inst. of Technology, Germany; [2]Ecole Polytechnique Fédérale de Lausanne, Switzerland; [3]Purdue Univ., USA; [4]Vanguard Automation GmbH, Germany.* We demonstrate piezo-tunable hybrid integrated lasers offering linewidths below 100 Hz along with highly linear and fast frequency tuning. For a tuning range of 1 GHz, residual nonlinearities are below 0.07 %, allowing for 5 cm ranging precision in an FMCW LiDAR demonstration.

SM2M.2 • 11:00
Topological Ring Array for Light Steering, Chang Chang[1], Yuhan Sun[1], Ting Li[1], Peiji Zhou[1], Yi Zou[1]; *[1]ShanghaiTech Univ., China.* We design and experimentally verify a topological microring array. By controlling the coupling, we can tune the topological phase and guide the light along the virtue boundary between two bulks with different topological phases.

SM2M.3 • 11:15
Multibeam Optical Beamforming Demonstration of Hybrid Photonic Integrated Circuit based on a Blass Matrix, Federico Camponeschi[1], Valentina Gemmato[1], Filippo Scotti[2], Luca Rinaldi[2], Ahmad Mohammad[3], Chris Roeloffzen[3], Paul van Dijk[3], Paolo Ghelfi[2]; *[1]Scuola Superiore SantAnna, Italy; [2]CNIT, Italy; [3]Lionix, Netherlands.* This paper reports the first-ever demonstration of a multibeam optical beamforming based on a Blass matrix implemented in a hybrid photonic integrated circuit. The architecture serves as a Scan-on-Receive synthetic aperture radar for Earth observation.

SM2M.4 • 11:30
Thin film lithium niobate optical phased array for two-dimensional beam steering, Gongcheng Yue[1], Yang Li[1]; *[1]Department of Precision Instrument, Tsinghua Univ., China.* We present a 16-channel thin film lithium niobate optical phased array working at the near-infrared wavelengths. We utilize electro-optic modulation and wavelength tuning to realize beam steering of 24° and 8°, respectively, in two dimensions.

SM2M.5 • 11:45
A large-scale coherent imager with digital beamforming, Volkan Gurses[1], Debjit Sarkar[1], Aroutin Khachaturian[2,1], Reza Fatemi[3,1], Ali Hajimiri[1]; *[1]California Inst. of Technology, USA; [2]HEPT Lab, Inc., USA; [3]Google Quantum AI, USA.* We showcase a 128-element nanophotonic coherent imager with a parallelized readout. This architecture enables single-shot coherent optical imaging without the need for on-chip phase shifting and beam scanning. Using 6 elements, we demonstrate digital beamforming and coherent image reconstruction with a 1.67° beamwidth over an 8.30° field-of-view.

SM2M.6 • 12:00

Arbitrary Waveforms From a Fine-Resolution Microresonator-Based Spectral Shaper, Lucas M. Cohen[1], Kaiyi Wu[1], Karthik V. Myilswamy[1], Navin B. Lingaraju[2], Andrew M. Weiner[1]; *[1]Purdue Univ., USA; [2]The Johns Hopkins Univ. Applied Physics Laboratory, USA.* We report on a scheme for programming microresonator-based spectral pulse shapers and experimentally demonstrate it with a six-channel, sub-GHz linewidth, silicon photonic spectral shaper to generate arbitrary waveforms from optical lines of a 3 GHz electro-optic frequency comb.

10:30 -- 12:30
Room: W209C
FM2N • Topological Optics and Nonlinear Metasurfaces
Presider: Alex Song; Univ. of Sydney, Australia

FM2N.1 • 10:30 (Invited)

Metamaterials and Topology of Light, Natalia M. Litchinitser[1]; *[1]ECE Department, Duke Univ., USA.* We discuss how the synergy of two- and three-dimensional structured light and darkness, including optical vortices, knots, links, and skyrmions with nanostructured photonic media, could bring new dimensions to the science and applications of light.

FM2N.2 • 11:00

Withdrawn

FM2N.3 • 11:15

Topology of Non-Hermitian Degenerate Bands in Structural Parameter Space, Olivia Long[1], Cheng Guo[1], Shanhui Fan[1]; *[1]Stanford Univ., USA.* We achieve complex band degeneracy in a photonic crystal structure over a region of momentum space, which gives rise to polarization-independent transmission. The degeneracy manifests as a topological singularity in the structural parameter space.

FM2N.4 • 11:30

Spatially structured bound states in the continuum engineered by nonlocal metasurfaces, Adam C. Overvig[1]; *[1]Stevens Inst. of Technology, USA.* We demonstrate spatial eigenstates embedded in the continuum, exhibiting diverging Q-factor when excited by customized wavefronts. This approach expands bound states in the continuum beyond the realm of plane waves in nonlocal metasurfaces.

FM2N.5 • 12:00

Nonlinear All-Bands-Flat Floquet topological photonic insulator with ultrawide edge state continuum, Hanfa S. Song[1], Taebin Kim[1], Vien Van[1]; *[1]Univ. of Alberta, Canada.*
We demonstrate a Floquet-Lieb topological insulator with all flat bands using 2D microring lattice. An ultrawide edge mode bandwidth of 40 nm is achieved, enabling broadband frequency generation by four-wave mixing on the topological platform.

FM2N.6 • 12:15

Spaceplates at Visible Wavelengths, Masoud Pahlevaninezhad[1], Francesco Monticone[1]; *[1]Cornell Univ., USA.* Compression or removal of free-space volumes is imperative for the miniaturization of optical devices. Here, we present a design strategy to realize spaceplates with high compression factors and high transmission efficiencies in the visible spectrum.

10:30 -- 12:30
Room: W209DE
SM2O • Reconfigurable Photonics Devices
Presider: Wonkeun Chang; Nanyang Technological Univ., Singapore

SM2O.1 • 10:30 (Invited)
Direct Write and Rewrite Photonic Integrated Circuits in Phase-change Materials, Mo Li[1]; *[1]Univ. of Washington, USA.* We report direct-write and rewritable photonic circuits on a phase-change material (PCM) thin film. Complete end-to-end PICs are laser-written in one step and can be erased and rewritten, facilitating rapid design prototyping and modification.

SM2O.2 • 11:00
Reconfigurable Circular Dichroism in Wafer-scale Twisted Stacks of Aligned Carbon Nanotube and Phase Change Material Heterostructures, Jichao Fan[1], Minhan Lou[1], Ruiyang Chen[1], Nina Hong[2], Weilu Gao[1]; *[1]Univ. of Utah, USA; [2]J.A. Woollam Co., USA.* We experimentally demonstrated reconfigurable circular dichroism in wafer-scale twisted stacks of aligned carbon nanotubes and phase change material heterostructures. The structural parameters of stacks were optimized and inversely designed based on the backpropagation algorithm.

SM2O.3 • 11:15
$Ge_2Sb_2Se_4Te$ Phase Change Material Monolithic Platform for Integrated Photonics, Niloy Acharjee[1,4], Hongyi Sun[1,2], Siddhartha Ghosh[3], Carlos A. Rios Ocampo[1,2]; *[1]Inst. for Research in Electronics & Applied Physics, Univ. of Maryland, USA; [2]Department of Materials Science & Engineering, Univ. of Maryland, USA; [3]Space Systems – Northrop Grumman, USA; [4]Department of Electrical & Computer Engineering, Univ. of Maryland, USA.* We demonstrate a monolithic Ge2Sb2Se4Te platform for tunable photonic integrated circuits. We fabricated and measured various on-chip components, including waveguides with preliminary 55.7±3.65 dB/cm propagation loss. Refractive index tuning is demonstrated via post-fabrication localized crystallization.

SM2O.4 • 11:30
Controllable multi-level switching of optical phase change materials via microheater temperature profile engineering, Hongyi Sun[1], Chuanyu Lian[1,5], Francis Vásquez-Aza[2], Yi-Siou Huang[1,5], Steven Vitale[3], Ichiro Takeuchi[1], Juejun Hu[3], Nathan Youngblood[4], Georges Pavlidis[2], Carlos A. Rios Ocampo[1,5]; *[1]Department of Material Science and Engineering, Univ. of Maryland, College Park, USA; [2]Department of Mechanical Engineering, Univ. of Connecticut, USA; [3]Department of Material Science and Engineering, Massachusetts Inst. of Technology, USA; [4]Department of Electrical Engineering, Univ. of Pittsburgh, USA; [5]The Inst. for Research in Electronics and Applied Physics, Univ. of Maryland, USA.* We demonstrate doped-silicon-on-insulator microheaters with triangle-like temperature profiles. Such devices control the hotspot size and temperature and, thus, the area that undergoes amorphization or crystallization in optical phase-change materials, leading to controllable multi-level, nonvolatile response.

SM2O.5 • 11:45

Reconfigurable SiGe Waveguide Using Sb2S3 Phase-Change Material in the Mid-IR, Adam Bieganski[1,2], Marko Perestjuk[1,2], Remi Armand[1], Alberto Della Torre[1], Capucine Laprais[1], Guillaume Saint Girons[1], Vincent Reboud[3], Jean-Michel Hartmann[3], Antonin Moreau[4], Julien H. Lumeau[4], Jean-Herve Tortai[5], Arnan Mitchell[2], Thach Nguyen[2], Christelle Monat[1], Sébastien Cueff[1], Christian Grillet[1]; *[1]Ecole Centrale de Lyon, France; [2]RMIT Univ., Australia; [3]CEA-Leti, France; [4]Institut Fresnel, France; [5]LTM, France.* We study the Sb_2S_3 optical index in the mid-IR and integrate in onto a SiGe-on-Si waveguide, introducing low additional propagation loss below 1 dB/cm between 3.3 and 3.9 µm regardless of the phase.

SM2O.6 • 12:00

Waveguide Laser Fabricated in Er:YAG Ceramics by Femtosecond Direct Laser Writing, Taishi Sumiya[1], Shuntaro Tani[1], Akihiro Tsunoda[2], Masato Nakazaki[2], Yohei Kobayashi[1]; *[1]The Inst. for Solid State Physics, The Univ. of Tokyo, Japan; [2]Technology Development Center, JX Metals Corporation, Japan.* High-quality optical-graded Er-doped YAG ceramics are fabricated, and waveguide structures are written in the ceramics by femtosecond direct laser writing method. These waveguide lasers successfully lased at a wavelength of 1645 nm.

SM2O.7 • 12:15

Laser Induced Reversible Phase Transition of Sb_2S_3 for Tunable Nanophotonics, Capucine Laprais[1], Lotfi Berguiga[1], Clément Zrounba[1], Julien Bouvier[1], Nicolas Baboux[1], Guillaume Saint Girons[1], Sébastien Cueff[1]; *[1]INL, France.* We experimentally demonstrate the all-optical reversible switching of Sb_2S_3, an emerging phase change material suitable for low-loss active nanophotonics. We then propose approaches to optimize this local, multi-level and reversible phase transition using multiphysics considerations.

10:30 -- 12:30
Room: W209F
SM2P • THz Photonics, Sensing and Detection
Presider: Jens Neu; Univ. of North Texas, USA

SM2P.1 • 10:30 (Invited)

THz Topological Photonics, Ranjan Singh[1]; *[1]Nanyang Technological Univ., Singapore.* Abstract not available.

SM2P.2 • 11:00

On-chip integrated terahertz sensing platform for biomolecules, Xitan Xu[1], Yao Lu[1], Xinda Jiang[1], Qiang Wu[1], Jingjun Xu[1]; *[1]Nankai Univ., China.* We present an integrated terahertz sensing platform on lithium niobate chips, with antenna arrays that guide terahertz waves transmission and enhance interaction with biomolecules. Its sensing performance is demonstrated through spectrum and dispersion relations.

SM2P.3 • 11:15

Introducing defects in metal-wire waveguides for broadband terahertz signal processing, Mohammad Ghazialsharif[1], Junliang Dong[1], Anton Vorobiov[3], Detlef Kip[2], Roberto

Morandotti[1]; *[1]INRS, Canada; [2]Faculty of Electrical Engineering, Helmut Schmidt Univ., Germany; [3]Faculty of Electrical Engineering, Helmut Schmidt Univ., Germany.* We demonstrate a terahertz plasmonic signal processor by introducing defects into a two-wire waveguide. The defects are achieved by connecting two multiscale structures with inverted unit cells, leading to the occurrence of a transmission peak in the forbidden band.

SM2P.4 • 11:30
Novel 3D-Rectification Mechanism of Terahertz Detection in Epitaxial Graphene Channel Transistors, Koichi Tamura[1,2], Hironobu Seki[1,2], Hiroyoshi Kudo[1,2], Shinnosuke Uchigasaki[1,2], Chao Tang[1,3], Hirokazu Fukidome[1], Yuma Takida[4], Hiroaki Minamide[4], Akira Satou[1], Taiichi Otsuji[1]; *[1]RIEC, Tohoku Univ., Japan; [2]School of Engineering, Tohoku Univ., Japan; [3]Frontier Research Inst. for Interdisciplinary, Tohoku Univ., Japan; [4]RIKEN Center for Advanced Photonics, RIKEN, Japan.* We developed terahertz (THz) detectors based on a high-quality epitaxial graphene-channel transistor. The bias dependencies of the responsivity indicate the primary contributions of plasmonic and photothermoelectric rectification mechanisms and suggest a distinctive signature of the third rectification mechanism called the 3D-rectification.

SM2P.5 • 11:45
Multi-Octave THz Generation and Detection at MHz Repetition Rates using the Organic Nonlinear Crystal PNPA, Lukasz A. Sterczewski[1], Jakub Mnich[1], Jaroslaw Sotor[1]; *[1]Politechnika Wroclawska, Poland.* Generation and detection of broadband THz radiation using the PNPA ((E)-4-((4-nitrobenzylidene)amino)-N-phenyl-aniline) crystal at MHz repetition rates is demonstrated. Compatibility with nanojoule pump pulses at telecommunication wavelengths makes this medium attractive for compact THz spectrometers.

SM2P.6 • 12:00 (Invited)
Driving and Sensing Terahertz Spin and Orbital Currents, Tom S. Seifert[1]; *[1]Freie Universität Berlin, Germany.* Terahertz emission spectroscopy is a powerfull tool to observe femtosecond photocurrents. Here, we optically trigger spin and orbital angular momentum currents in magnetic heterostructures and reveal their distinct dynamics as well as their application potential.

10:30 -- 12:30
Room: W210
AM2Q • A&T Topical Review on Advanced Imaging and Microscopy 3D Biology, Neuroscience and Coherence-Domain Biophotonics II

Presider: To be Announced

AM2Q.1 • 10:30 (Invited)
A Startup Company Story: Translation of Photonic Resonator Absorption Microscopy Toward a Point of Care Product for Cancer Diagnostics, Brian Cunningham[1,2]; *[1]Atzeyo Biosensors, USA; [2]Electrical and Computer Engineering, Univ. of Illinois at Urbana-Champaign, USA.* An ultrasensitive biosensor technology with manufacturable sensors and ~$500 instrument developed in academia led to formation of a new company that aims to provide point of care cancer detection to oncologists and dentists.

AM2Q.2 • 11:00 (Invited)
Real-time In Situ Detection of Multiple Cancers Using Fiber-optics Raman Spectroscopy Systems, Frederic Leblond[1]; *[1]Polytechnique Montréal, Canada.* We present the results of multiple studies testing whether a fiber-optics Raman spectroscopy system could distinguish tumors from normal tissue in a label-free manner, including brain, breast, lung, ovaries, prostate, and soft tissue sarcomas.

AM2Q.3 • 11:30 (Invited)
Mass Photometry, Matthias F. Langhorst[1]; *[1]Carl Zeiss MicroImaging GmbH, Germany.* Abstract not available.

AM2Q.4 • 12:00 (Invited)
Medical Imaging, Lan Yang[1]; *[1]Washington Univ. in St Louis, USA.* Abstract not available.

10:30 -- 12:30
Room: W211
FM2R • Quantum-Enhanced Sensing

Presider: Nicholas Peters; Oak Ridge National Laboratory, USA

FM2R.1 • 10:30
Quantum interferometry with x-rays, Yishay Klein[1,2], Edward Strizhevsky[1], Haim Aknin[1], Moshe Deutsch[1], Eliahu Cohen[3], Avi Peer[1], Kenji Tamasaku[4], Tobias Schulli[5], Ebrahim Karimi[2], Sharon Shwartz[1]; *[1]Physics Department and Inst. of Nanotechnology and advanced Materials, Bar Ilan Univ., Israel; [2]Nexus for Quantum Technologies, Univ. of Ottawa, Canada; [3]Faculty of Engineering and Inst. of Nanotechnology and advanced Materials, Bar Ilan Univ., Israel; [4]RIKEN SPring-8 Center, Japan; [5]ESRF - The European Synchrotron, France.* We demonstrate the pioneering use of a quantum interferometer with x-rays, highlighting its effectiveness in precisely measuring the phase accumulated in opaque media. Our work uncovers novel opportunities for measuring sub-Angstrom optical-path differences.

FM2R.2 • 10:45
Quantum Enhanced Non-Interferometric Quantitative Phase Imaging, Alberto Paniate[1,2], Giuseppe Ortolano[2], Pauline Boucher[2], Carmine Napoli[2], Sarika Soman[3], Silvania F. Pereira[3],

Ivano Ruo Berchera[2], Marco Genovese[2]; [1]*DISAT, Politecnico di Torino, Italy;* [2]*Quantum metrology and nano technologies division, INRiM, Italy;* [3]*Imaging Physics Dept. Optics Research Group, Faculty of Applied Sciences, Delft Univ. of Technology, Netherlands.* We propose a technique which exploits entanglement to enhance quantitative phase retrieval of an object in a non-interferometric setting only measuring the propagated intensity pattern after interaction with the object

FM2R.3 • 11:00 (Tutorial)
Frontiers of quantum-limited and quantum-enhanced sensing, Animesh Datta[1]; [1]*Univ. of Warwick, UK.* Sensing incorporates a multitude of modalities such as microscopy, spectroscopy, interferometry, magnetometry. I will discuss some theoretical techniques and experimental tools employed to identify and approach these fundamental quantum limits.

FM2R.4 • 12:00
Unveiling the Embedded Phase in Quantum Ghost Imaging, Chané S. Moodley[2,1], Bereneice Sephton[1], Isaac Nape[1], Jason Francis[1], Andrew Forbes[1]; [1]*Univ. of the Witwatersrand, South Africa;* [2]*Research, QLab, Raphta PTY Ltd., South Africa.* We show that the necessary interference for phase retrieval in quantum ghost imaging is naturally embedded in the correlation measurements formed from traditional projective masks.

FM2R.5 • 12:15
Electron microscopy of quantum light dynamics in cavities and waveguides, Aliaksei Horlach[1], Solomon Malka[1], Ron A. Ruimy[1], Offek Tziperman[1], Aviv Karnieli[2], Ido Kaminer[1]; [1]*Technion, Israel;* [2]*Harvard Univ., USA.* We show how modulated free-electron wavepackets can extract the ultrafast dynamics of arbitrary quantum light states in nanophotonic resonators and waveguides, capturing decoherence and other interactions.

13:30 -- 15:15
Room: W201AB
AM3A • Fiber-based Sensing II: Strain Curvature
Presider: To be Announced

AM3A.1 • 13:30
Continuous Strain Profiling with Low-Coherence Brillouin Optical Correlation-Domain Reflectometry, Kohei Noda[1], Rei Sugihara[2], Shinya Sadachika[2], Atsushi Takata[3], Kentaro Nakamura[4], Gen Endo[2], Yosuke Mizuno[5], Sze Y. Set[1], Shinji Yamashita[1]; [1]*Univ. of Tokyo, Japan;* [2]*Tokyo Inst. of Technology, Japan;* [3]*Tokyo Univ. of Agriculture and Technology, Japan;* [4]*Tokyo Inst. of Technology, Japan;* [5]*Yokohama National Univ., Japan.* We experimentally measure a continuous strain distribution using low-coherence Brillouin optical correlation-domain reflectometry, which suppresses the noise caused by the sidelobes of a beat spectrum of conventional sinusoidal modulation.

AM3A.2 • 13:45
Distributed Strain Sensing by Frequency-Selective Fading in Phase-OTDR, Muhammed Kaan Yildiz[1,2], Faruk Uyar[1,2], Tolga Kartaloglu[1], Ekmel Ozbay[1,2], Ibrahim Ozdur[3]; [1]*Nanotechnology Research Center, Turkey;* [2]*Electrical and Electronics Engineering, Bilkent Univ., Turkey;* [3]*Electrical and Electronics Engineering, TOBB Univ. of Economics and*

Technology, Turkey. We demonstrate a novel approach using frequency-selective fading in phase-OTDR systems to measure dynamic strain on a fiber optic cable. We present the measurements of 200 Hz, 0.03 με strain at 2 kHz interrogation frequency.

AM3A.3 • 14:00
Distributed Curvature Sensing using BOCDA with Polarization-maintaining 1+8 Multi-Core Optical Fiber, Haoze Du[1], Shuyan Chen[1], Huan He[1], Xuchen Hua[1], Zhuyixiao Liu[1], Zhiyong Zhao[1], Ming Tang[1]; [1]*Huazhong Univ. of Sci&Tech, China.* We propose a BOCDA curvature sensor based on polarization-maintaining 1+8 multicore fiber. Thanks to the unique fiber geometry, excellent fiber self-twisting resistance is obtained, which ensures better curvature measurement accuracy.

AM3A.4 • 14:15
Multi-Event Detection in Polarization-OTDR Based on Principal Depolarization Factors, Hui Dong[1], Hailiang Zhang[1], Dora Juan Juan Hu[1]; [1]*Inst. for Infocomm Research, Singapore.* Principal depolarization factors (PDF) are demonstrated to be the local polarization parameters in single-mode fibers. Based on measurements of PDFs, polarization-OTDR with wider optical pulses has demonstrated multi-event detection for the first time.

AM3A.5 • 14:30
Design of a zero-coma image spectrometer with ultra-high resolution by using a multiple-grating-integrated module, Liang-Yao Y. Chen[1]; [1]*Optical Science and Engineering, Fudan Univ., China.* A zero-coma image spectrometer with ultra-high spectral resolution in the entire wavelength region was designed and demonstrated by using a multiple-grating-integrated module. Results show the unique merit of the spectrometer to be able for a wide range of spectral sensing and measurement applications

AM3A.6 • 14:45
Vector magnetic field sensor based on etched seven-core fiber helical long-period grating with magnetic fluid, Siyu Chen[1], Yunqi Liu[1]; [1]*Shanghai Univ., China.* We demonstrated a vector magnetic field sensor utilizing an etched seven-core fiber helical long-period grating, showcasing a high-sensitivity response of up to 10.8 nm/mT within magnetic field intensity measurement ranges from 0 to 20.7 mT.

AM3A.7 • 15:00
Withdrawn

13:30 -- 15:30
Room: W201CD
FM3B • Techniques in Attosecond Science
Presider: To be Announced

FM3B.1 • 13:30
Attosecond metrology in circular polarization, Meng Han[1]; *[1]Kansas State Univ., USA.* We experimentally demonstrate a comprehensive approach to the generation and complete characterization of elliptically to circularly polarized attosecond pulses, as well as the application in attosecond resolving photoelectron circular dichroism of chiral molecules by coincidence measurements.

FM3B.2 • 14:00
Extreme Ultraviolet Reflection Spectroscopy on Lanthanides and Actinides with a Table-top HHG Light Source, Patrick J. Skrodzki[1], Prashant Padmanabhan[1], Maksim Y. Livshits[1], Francesca A. Elverson[1], Cassandra Gates[1], Samuel M. Greer[1], Aiping Chen[1], Jacord Ward[1], Matthew Carpenter[1], Pamela R. Bowlan[1]; *[1]Los Alamos National Laboratory, USA.* A high harmonic generation light source enables a table-top apparatus for the measurement of electronic structure in lanthanide- and actinide-series compounds, which we demonstrate by measuring O- and N-edge transitions in several materials.

FM3B.3 • 14:15
Sub-2 cycle pulse compression of a 2mJ, 80W, 338fs Yb-laser, Maksym Ivanov[1,2], Marco Scaglia[1], Étienne Doiron[1], Pedram Abdolghader[1], Gabriel Tempea[1], François Légaré[2], Luca Razzari[2], Giulio Vampa[3], Bruno E. Schmidt[1]; *[1]few-cycle Inc., Canada; [2]Institut National de la Recherche Scientifique (INRS), Canada; [3]Joint Center for Extreme Photonics, Canada.* Starting from 330fs, we generate 6.1fs (1.8 cycle), 50W, 1.2mJ pulses centered at 1030nm via two subsequent hollow-core fiber compressors with a total transmission efficiency of 60%.

FM3B.4 • 14:30
Polarization Gating of High-order Harmonics with a Yb:KGW Driving Laser, Tran-Chau Truong[1], Chris Lantigua[1], Dipendra S. Khatri[1], Michael Chini[1]; *[1]Univ. of Central Florida, USA.* Yb-doped lasers are an attractive platform for attosecond science at high repetition rate. Here, we demonstrate carrier-envelope phase-dependent high-order harmonic generation using polarization gating of few-cycle pulses resulting from two-stage-fiber compression.

FM3B.5 • 14:45
Controlling High Harmonic Supercontinuum Generation with the Spectral Polarization of the Driver, Eldar Ragonis[1,2], Eran Ben-Arosh[1,2], Lev Merensky[1,2], Avner Fleischer[1,2]; *[1]Tel Aviv Univ., Israel; [2]Tel Aviv Univ. Center for Light-Matter Interactions, Israel.* A High-Harmonic-Generation (HHG) scheme offering continuous control over the bandwidth of the spectral peaks is presented. The scheme uses a vectorial two-color driver with close frequencies, generated by spectrally splitting an input laser pulse and recombining the two halves after their polarizations are made cross-elliptical counter-rotating.

FM3B.6 • 15:00 (Invited)
All-attosecond Pump-probe Spectroscopy at kHz Repetition Rate, Bernd Schuette[1], Martin Kretschmar[1], Evaldas Svirplys[1], Tobias Witting[1], Tamás Nagy[1], Marc Vrakking[1], Mikhail

Volkov[1]; [1]*Max Born Inst., Germany.* Attosecond-pump attosecond-probe spectroscopy (APAPS) promises novel insights into extremely fast electronic dynamics. Here we present a compact realization of APAPS at kHz repetition rate, providing a high stability and good statistics.

13:30 -- 15:30
Room: W204AB
AM3C • Laser-based Nanofabrication
Presider: To be Announced

AM3C.1 • 13:30 (Invited)
Fine-periodic Nanostructure Formation on Solids with Few-cycle Femtosecond Laser Pulses, Godai Miyaji[1], Yuto Iida[1], Seiya Nikaido[1], Akihiro Ishihara[1]; [1]*Tokyo Univ of Agriculture and Technology, Japan.* We have demonstrated that intense 7-fs, ~810-nm laser pulses can produce much finer periodic nanostructures on a diamond-like carbon (DLC) film, stainless steel, and gallium arsenide (GaAs) through ablation in air than those formed with intense 100-fs, ~800-nm pulses. The periodicity can be explained as arising from short-range propagating surface plasmon polaritons excited at the interface between the substrate and a thin layer of high-density electrons.

AM3C.2 • 14:00 (Invited)
Optimize the Interconnect: Joint Laser and Chemistry Development for PCB Via Drilling, Geoff Lott[1]; [1]*Electro Scientific Industries, USA.* We present early results from MKS Instruments' "Optimize the Interconnect" initiative, leveraging the unique combination of ESI's via drilling expertise and Atotech's industry-leading chemistry solutions to develop global process optimizations for the PCB industry.

AM3C.3 • 14:30
Stealth dicing of silicon wafer using 1-µm femtosecond laser pulses, Gholamreza Shayeganrad[1], Jongki Kim[1,2], Tim Lee[1], Martynas Beresna[1], Gilberto Brambilla[1], Johan Nilsson[1], Yongmin Jung[1]; [1]*Univ. of Southampton, UK;* [2]*Mechatronics Technology Research Center, Samsung Display Co. Ltd., Samsung-ro, Giheung-gu, Yongin-si, Korea (the Republic of).* We demonstrate that counterintuitively, silicon wafer stealth dicing can be performed with femtosecond laser pulses at 1030-nm, where linear absorption predominates. A 1.3-NA oil-immersion objective mitigated plasma defocusing and delocalization before the focal point.

AM3C.4 • 14:45
On the correlation between femtosecond laser-induced defects taxonomy and localized accelerated chemical etching in fused silica, Vinod Parmar[1,2], Nadège Ollier[3], Yves Bellouard[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland;* [2]*Micro and Nano Optics Centre (µ-NOC), CSIR-Central Scientific Instruments Organisation (CSIR-CSIO), India;* [3]*Laboratoire des Solides Irradiés, Ecole Polytechnique-CEA-CNRS, France.* The non-ablative interaction of femtosecond laser pulses with fused silica leads to defects creation in fused silica. Here, we report on the correlation between defects and localized accelerated etching, that enables three-dimensional manufacturing process.

AM3C.5 • 15:00

Fabrication of ZnO Quantum Dot Doped Polymer Nanostructures using Two-photon Lithography, Ajinkya B. Palwe[1], Gaurav P. Singh[1], Arun Jaiswal[2], Sweta Rani[1], Soumi Mukherjee[1], Sonu Kumar Singh[1], Shobha Shukla[1], Sumit Saxena[1]; *[1]IIT, Bombay, India; [2]Univ. of Sydney, Australia.* We demonstrate the fabrication of ZnO doped polymer nanostructures using two-photon lithography. These nanostructures offer a versatile platform with enhanced properties, valuable for various applications spanning electronics, sensing, biomedical, and energy

AM3C.6 • 15:15

Low-power laser coloration by oxidation and deformation of self-assembled AL-PS nanosphere arrays, Maxim Elizarov[1], Ning Li[1], Fei Xiang[1], Andrea Fratalocchi[1]; *[1]KAUST, Saudi Arabia.* We introduce an approach for low-power (10 mW), high-resolution (33k DPI), wide-gamut laser coloration on a pre-processed metamaterial of self-assembled nanoparticles. Controllable material oxidation and deformation allows optical response tuning by CW laser.

13:30 -- 15:30
Room: W205AB
JM3D • Symposium: Solution-Processable Photonics: From Materials and Concepts to Practical Devices I
Presider: Clement Livache; LANL / Ecole polytechnique, France

JM3D.1 • 13:30 (Invited)

Next Generation Silicon Photonics, Michal Lipson[1]; *[1]Columbia Univ., USA.* Abstract not available.

JM3D.2 • 14:00 (Invited)

Fundamental and Applied Aspects of Colloidal Quantum Dot Laser Diodes, Victor I. Klimov[1]; *[1]Los Alamos National Laboratory, USA.* Colloidal quantum dot laser diodes have been pursued for ease of integration with on-chip photonics. Here we discuss recent progress and present challenges in the quantum dot lasing field with focus on electrically driven devices.

JM3D.3 • 14:30 (Invited)

Progress Toward Halide Perovskite Laser Diodes, Barry P. Rand[1]; *[1]Princeton Univ., USA.* We are exploring halide perovskite LEDs under high current densities (kA/cm^2). Low electrical and thermal conductivities lead to Joule heating and voltage-induced electrochemical interface reactions, which present substantial challenges to operation at these conditions.

JM3D.4 • 15:00 (Invited)

Withdrawn

13:30 -- 15:30
Room: W205CD
SM3E • Multimodal Microscopy for Biophotonics
Presider: Hatice Ceylan Koydemir; Texas A&M Univ., USA

SM3E.1 • 13:30 (Tutorial)
Multi-modal Optical Imaging and Sensing Platforms for Deep Tissue Biological and Chemical Analysis, Aniruddha Ray[1]; *[1]Univ. of Toledo, USA.* Here, we will explore different deep-tissue optical imaging modalities, including multiphoton fluorescence and photoacoustics, integrated with nanotechnology, to extract vital information including chemical analytes, biomarkers and structural properties that holds significant biomedical importance.

SM3E.2 • 14:30
Foveation for Enhancing Deep Tissue Imaging, Muralidhar Madabhushi Balaji[1], Danyal Ahsanullah[1], Prasanna Rangarajan[1]; *[1]Southern Methodist Univ., USA.* The work proposed in this submission combines ideas from the operation of human visual systems and computational imaging to optimally allocate sampling resources and improve the sampling density of diffuse optical imaging methods.

SM3E.3 • 14:45
Raman-shifting of Microjoule-Energy, 300-fs Pulses in the Anomalous-Dispersion Regime in N2-Filled Hollow Fiber, Yishai Eisenberg[1], Yi-Hao Chen[1], Henry Haig[1], Jose Enrique Antonio-Lopez[2], Rodrigo Amezcua Correa[2], Frank Wise[1]; *[1]Cornell Univ., USA; [2]CREOL, USA.* We study the evolution of 300-fs pulses at 1030 nm in anti-resonant fiber hollow-core fiber filled with N2 in the anomalous-dispersion regime. Experimental results are compared to numerical simulations.

SM3E.4 • 15:00 (Invited)
Uncovering Brain Tissue Architecture with Super-resolution Light Microscopy, Johann Danzl[1]; *[1]ISTA, Austria.* Abstract not available.

13:30 -- 15:30
Room: W206A
FM3F • Quantum Interfaces in Diamond
Presider: Sean Blakley; US Army Research Laboratory

FM3F.1 • 13:30
Quantum Non-linear Optics with a Diamond Tin-Vacancy Center in a Fiber-based Microcavity, Yanik Herrmann[1], Julius Fischer[1], Julia M. Brevoord[1], Colin Sauerzapf[1], Leonardo G. C. Wienhoven[1], Laurens J. Feije[1], Matteo Pasini[1], Martin Eschen[1,2], Maximilian Ruf[1], Matthew J. Weaver[1], Ronald Hanson[1]; *[1]QuTech, TU Delft, Netherlands; [2]Netherlands Organisation for Applied Scientific Research (TNO), Netherlands.* We demonstrate coherent coupling of a single diamond Tin-Vacancy center to a fiber-based microcavity, showing a cavity transmission dip of 50 % on resonance, and altered photon statistics in cavity transmission.

FM3F.2 • 13:45

Improving the Optical Coherence of Diamond Tin-Vacancy Centers by Heralded Initialization, Julia M. Brevoord[1], Lorenzo De Santis[1], Takashi Yamamoto[1], Matteo Pasini[1], Nina Codreanu[1], Tim Turan[1], Hans Beukers[1], Christopher Waas[1], Ronald Hanson[1]; *[1]Technical Univ. of Delft, Netherlands.* We demonstrate heralded initialization of charge state and optical transition frequency of diamond tin-vacancy centers, using (off-)resonant lasers, photon detection and real-time logic. Using this, we show frequency tunability >100 MHz and strongly improved optical coherence.

FM3F.3 • 14:00

Quantum network nodes based on diamond photonic nanostructures, Nina Codreanu[2], Matteo Pasini[2], Tim Turan[2], Lorenzo De Santis[2], Maximilian Ruf[2], Hans Beukers[2], Christopher Waas[2], Caroline Smulders[2], Julia M. Brevoord[2], Simon Groblacher[1], Ronald Hanson[2]; *[1]Department of Quantum Nanoscience and Kavli Inst. of Nanoscience, Delft Univ. of Technology, Netherlands; [2]QuTech and Kavli Inst. of Nanoscience, Delft Univ. of Technology, Netherlands.* We present our optimized diamond fabrication process based on quasi-isotropic crystal-plane-dependent reactive-ion-etching at low and high temperature plasma regime. We demonstrate successful integration of SnV centers in diamond waveguides showing quantum non-linear effects. We report on our latest results on all-diamond photonic crystal cavities.

FM3F.4 • 14:15

Investigation of Efficient Microwave Control of Unstrained Negatively Charged Group-IV Color Centers in Diamond, Gregor Pieplow[1], Mohamed Belhassen[1], Tim Schroder[1]; *[1]Humboldt Univ. Berlin, Germany.* This work theoretically investigates the microwave control of group-IV color centers. We find that heavy vacancies such as the tin and lead vacancy can be efficiently controlled without external strain.

FM3F.5 • 14:30

Negative Thermal Expansion in Diamond Probed using the Zero-Phonon Line of Silicon Vacancy Color Centers, Stephen Revesz[1], Adolfo Misiara Lincheta[1], John B. Abraham[2], Edward S. Bielejec[3], Hebin Li[1], Michael Titze[3]; *[1]Florida International Univ., USA; [2]The Univ. of Missouri–Kansas City, USA; [3]Sandia National Laboratories, USA.* We probed the negative thermal expansion of diamond via optical detection of ion beam implanted charged silicon vacancy centers and demonstrate optical stability across 5 orders of magnitude implantation fluence.

FM3F.6 • 14:45

Optimizing Fermi Level Engineering for Single Neutral Silicon Vacancy Centers in Diamond, Arunava Das[1], Sounak Mukherjee[1], Zi-Huai Zhang[1], Andrew Edmonds[2], Nicola Palmer[2], Rajesh Patel[2], Matthew Markham[2], Nathalie de Leon[1]; *[1]Princeton Univ., USA; [2]Element 6, UK.* We use Fourier transform infrared spectroscopy (FTIR) and photoluminescence spectroscopy to characterize boron and nitrogen concentrations needed for the stabilization of neutral silicon vacancy centers (SiV^0) in Si-implanted diamonds co-doped with boron and nitrogen.

FM3F.7 • 15:00 (Invited)

Diamond Photonic Crystals: from X-band Optomechanics to Nonlinear Optics, Paul E. Barclay[1]; *[1]Department of Physics and Astronomy, Univ. of Calgary, Canada.* Diamond photonic crystals confine intense optical fields to nanoscale volumes. This enables coherent phonon-photon coupling to resonances with frequencies above 12 GHz, and observation of nonlinear optical effects influenced by diamond lattice defects.

13:30 -- 15:30
Room: W206B
SM3G • Integrated Photonic Devices

Presider: Huanfa Peng; Karlsruhe Inst. of Technology, Germany

SM3G.1 • 13:30
Multi-Color Solitons in Coupled-Ring Microresonators, Maodong Gao[1], Jinhao Ge[1], Zhiquan Yuan[1], Yan Yu[1], Joel Guo[2], Warren Jin[2,3], Jin-Yu Liu[1], Qingxin Ji[1], Avi Feshali[3], Mario Paniccia[3], John Bowers[2], Kerry Vahala[1]; *[1]California Inst. of Technology, USA; [2]ECE Department, Univ. of California Santa Barbara, USA; [3]Anello Photonics, USA.* Multi-color co-propagating and counter-propagating solitons are generated using a coupled-ring microresonator in the ultra-low-loss Si_3N_4 platform. Soliton spectra and beatnotes are measured and potential applications are discussed.

SM3G.2 • 13:45
Lithography-free Reconfigurable Integrated Photonics, Tianwei Wu[1], Marco Menarini[1], Zihe Gao[1], Liang Feng[1]; *[1]Univ. of Pennsylvania, USA.* We report an unprecedented lithography-free paradigm for an integrated photonic processor, which establishes remarkable field programmability and functionality from a global perspective, enabling accurate multiply–accumulate operations and in-situ training of optical neural networks.

SM3G.3 • 14:00
Microring Modulation-and-Weight Banks, Weipeng Zhang[1], Jiawei Zhang[1], Joshua Lederman[1], Bhavin Shastri[2], Paul Prucnal[1]; *[1]Princeton Univ., USA; [2]Queen's Univ., Canada.* For photonic neural networks, we propose a novel microring bank with carrier-effect and thermal dual-tunability, which can 1) combine modulating and weighting for saved space, 2) improve tuning efficiency, and 3) inherit WDM-enabled scalability.

SM3G.4 • 14:15
Transfer Printing of GaAs-based Amplifiers on a-Si:H Waveguides for Evanescently-Coupled Light Amplification in the Near-Infrared Band, Konstantinos Akritidis[1,3], Maximilien Billet[1,4], Max Kiewiet[1,4], Jörg Fricke[2], Hans Wenzel[2], Jan-Philipp Koester[2], Andrea Knigge[2], Pieter Neutens[3], Roelof Jansen[3], Joost Brouckaert[3], Pol Van Dorpe[3], Markus Weyers[2], Bart Kuyken[1,4]; *[1]Photonics Research Group (UGent-imec), Belgium; [2]Ferdinand-Braun-Institut (FBH), Germany; [3]IMEC, Belgium; [4]Center for Nano- and Biophotonics, Ghent Univ., Belgium.* We demonstrate 7-dB light amplification at 921 nm by transfer-printing a GaAs-based amplifier on a a-Si:H waveguide. This paves the way towards the development of evanescently-coupled integrated laser systems on SiN emitting in the near-infrared.

SM3G.5 • 14:30 (Invited)
Flexible Integrated Photonic Devices and Applications, Yingchun Wu[1,2], Renjie Tang[2], Ye Luo[2], Jiang h. Wu[2], Jialing Jian[2], Kangjian Bao[2], Zongxi Li[2], Chunlei Sun[2], Hongtao Lin[3], Lan Li[2]; *[1]Zhejiang Univ., China; [2]Key Laboratory of 3D Micro/Nano Fabrication and Characterization*

of Zhejiang Province, School of Engineering, Westlake Univ., China; [3]College of Information Science and Electronic Engineering, Zhejiang Univ., China. This paper covers our recent progress in flexible integrated photonics devices based on cascaded microcavities for high spatial resolution, quasi-distributed strain and temperature sensing, and integration possibility of on-chip photodetection and spectroscopy for enhanced functionality.

SM3G.6 • 15:00
High Performance In-Line Er-Doped Waveguide Amplifiers Using Room Temperature Sputtered Er:TeO_2 Thin Film, Yile Zhong[1], Kunlun Yan[1], Steve Madden[1]; *[1]Australian National Univ., Australia.* Monolithic integrated Er-doped waveguide amplifiers with more than 10 dB net fibre-to-fibre gain under 1480 nm pumping are demonstrated, paving the road for room temperature sputtered Er:TeO_2 thin film to CMOS-compatible integrated photonics.

SM3G.7 • 15:15
Mode-folded phase shifter based Reconfigurable Optical Switch with 0.6V cm Vπ L on Thin-film lithium niobate for Channel Scalable Optical Interconnects, Xinyi Wang[1], Jiangbing Du[1], Jiacheng Liu[1], Ke Xu[2], Zuyuan He[1]; *[1]State Key Laboratory of Advanced Optical Communication Systems and Networks, Shanghai Jiao Tong Univ., China; [2]Department of Electronic and Information Engineering, Harbin Inst. of Technology (Shenzhen), China.* A reconfigurable optical switch based on mode-folded phase shifter over LNOI is experimentally demonstrated with high switching efficiency of 0.72-V cm Vπ L. The switching is intrinsically fast with channel number scalability covering 1-8 channels.

13:30 -- 15:30
Room: W207A
AM3H • A&T Topical Review on Frequency Comb Spectroscopy: From the VUV to THz I
Presider: Oliver Heckl; Universitat Wien, Austria

AM3H.1 • 13:30 (Invited)
Ultraviolet Dual-comb Spectroscopy, Nathalie Picqué[1,2]; *[1]Max-Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany; [2]Max-Planck Inst. of Quantum Optics, Germany.* Extending interferometry with two frequency combs to the short-wavelength range holds much promise. Innovative strategies to overcome the challenges related to the low power and high noise of UV combs and first results are presented.

AM3H.2 • 14:00 (Invited)
Broadband Frequency Combs for Applications in Quantum Technology and Spectroscopy, Richard Zeltner[1], Thomas Lompe[1], Kerstin Schlichting[1], Phillip Woschnik[1], Andreas Fricke[1], Dag Schmidt[1], Michele Giunta[1,2], Arne Kordts[1], Ignacio Baldoni[1], Tilo Steinmetz[1], Yuanjie Wu[1], Marc Fischer[1], Ronald Holzwarth[1,2]; *[1]Menlo Systems GmbH, Germany; [2]Max Planck Inst. for Quantum Optics, Germany.* We report recent advancements in the realization of optical frequency combs with broad spectral coverage, ranging from the visible into the NIR-spectral range, for applications in quantum technologies and spectroscopy.

AM3H.3 • 14:30 (Invited)
Ultra-low Loss Photonics for Optical Amplification, Frequency Comb Generation, and Frequency-agile Low Noise Lasers, Johann Riemensberger[1]; *[1]Department of Electronic*

Systems, Norwegian Univ. of Science and Technology, Norway. Photonic integrated circuits based on silicon nitride empower optical systems through the means to amplify optical light either parametrically, through rare-earth ion doping, or hybrid integration with optical gain media to generate optical frequency combs and for applications ranging from laser ranging, spectroscopy, and sensing.

AM3H.4 • 15:00 (Invited)
K2 Photonics: Simple, Yet High-performance Dual-Comb Light Sources, Justinas Pupeikis[2,1], Benjamin Willenberg[2,1], Lukas Lang[2,1], Ursula Keller[1]; *[1]ETH Zurich, Switzerland; [2]K2 Photonics AG, Switzerland.* The development of single-cavity dual-comb lasers has advanced significantly, bringing the promise of affordable dual-comb light sources closer to practical reality. Addressing the growing demand for simpler and more compact solutions, these lasers stand to revolutionize dual-comb applications in various domains. This presentation will delve into recent breakthroughs, critically examine the potential and challenges of single-cavity designs, and explore their prospective wide-ranging impact.

13:30 -- 15:30
Room: W206BC
SM3I • Hollow Core Fibers
Presider: To be Announced

SM3I.1 • 13:30 (Invited)
Hollow-Core Optical Fibers as Optofluidic Microreactors, Tijmen G. Euser[1]; *[1]NanoPhotonics Centre, Cavendish Laboratory, Department of Physics, Univ. of Cambridge, UK. Optofluidic hollow-core fibers uniquely guide light at the center of a long microfluidic channel. We use fiber-enhanced absorption-, fluorescence-, and Raman spectroscopy to monitor liquid-phase chemistry. My talk will highlight recent applications in photocatalysis and battery science.*

SM3I.2 • 14:00
Multi Kilowatt-Class Single-Mode Laser Transmission at 38 GHz Linewidth Through a 100 m Antiresonant Hollow-Core Fiber, Matthew A. Cooper[1], Timothy Bate[1], Joseph Wahlen[1], Stephanos Yerolatsitis[1], Jose Enrique Antonio-Lopez[1], Axel Schulzgen[1], Rodrigo Amezcua Correa[1]; *[1]Univ. of Central Florida, USA.* We demonstrate the transmission of 1.8 kW 38 GHz linewidth laser at 1080 nm through a 100 m AR-HCF, maintaining 95\% efficiency, near-diffraction-limited beam quality, and no measurable stimulated Brillouin scattering response. Our results also highlight a potential path for high-efficiency multi-kW CW Raman lasing.

SM3I.3 • 14:15
1-MHz 500-nJ Mamyshev Oscillator with Hollow Core Fiber, Jikun Yan[1], Duanyang Xu[1], Hans Christian Mulvad[1], Yongmin Jung[1], Francesco Poletti[1], David J. Richardson[1], Lin Xu[1]; *[1]Univ. of Southampton, UK.* We present the development of a Mamyshev oscillator (MO) operating at 1040 nm with a low repetition rate of 1.18 MHz enabled by a hollow core fiber. The MO produces ultrashort pulses with a maximum pulse energy of 514 nJ and a minimum de-chirped pulse width of 46 fs.

SM3I.4 • 14:30 (Invited)

Harnessing Cladding-wall Resonances in Antiresonant Fibers for Hollow-core Fiberized Devices and Mid-infrared Light Sources, Wonkeun Chang[1], Charu Goel[1], Trivikramarao Gavara[1], Yuixi Wang[1], Kevin Hean[1], Ang Deng[1], Daiqi Xiong[1], Ruhai Bai[1], Seongwoo Yoo[2]; *[1]Nanyang Technological Univ., Singapore; [2]Univ. of Glasgow, UK.* Antiresonant hollow-core fibers exhibit high-loss bands due to mode coupling in the hollow core and cladding wall. Leveraging on this, we present novel hollow-core fiberized devices such as spectral filters and polarizers. Also, the rapid variation of dispersion around these resonances can be harnessed to generate femtosecond pulses in the mid-infrared range at unprecedented pulse energies, offering a new approach for powerful mid-infrared light sources.

SM3I.5 • 15:00

Backscattering in Antiresonant Hollow Core Fibers: from Air Scattering to Surface Scattering, Xuhao Wei[1], Natalie V. Wheeler[1], Shahab B. Gorajoobi[2], Seyed R. Sandoghchi[2], Francesco Poletti[1,2], Radan Slavík[1]; *[1]Univ. of Southampton, UK; [2]Microsoft, UK.* We use a custom-developed high-sensitivity optical time domain reflectometer to monitor evacuation of an antiresonant hollow core fiber. While initially backscattering from the air-filled core is dominant, as gas pressure reduces, surface-related backscattering is measured.

SM3I.6 • 15:15

Artificial Neural Network Assisted Hollow-Core Antiresonant Fiber Design for Supercontinuum Generation, Mulaine Shih[1,2], Heidi Nelson-Quillin[1,2], Kerry Garrett[1,2], Eleanor Coyle[1,2], Ray Secondo[1,2], Christian Keyser[3], Matthew Mills[1], Eric S. Harper[1]; *[1]Air Force Research Laboratory, USA; [2]Azimuth Corporation, USA; [3]Air Force Research Lab, USA.* We investigated the nonlinear Raman-Kerr effect of methane in hollow core antiresonant fibers and used ANNs to correlate fiber geometry to simulated spectra, allowing for the rapid design of supercontinuum-generating optical fibers.

13:30 -- 15:30
Room: W207D
AM3J • Integrated Laser and LIDAR
Presider: Weidong Zhou; Univ. of Texas at Arlington, USA

AM3J.1 • 13:30

Integrated photonic millimeter-wave radar based on thin-film lithium niobate, Sha Zhu[1,2], Yiwen Zhang[2], Jiaxue Feng[1], Yongji Wang[3], Kunpeng Zhai[4], Hanke Feng[2], Edwin Yue-Bun Pun[2], Ning Hua Zhu[4], Cheng Wang[2]; *[1]Beijing Univ. of Technology, China; [2]Department of Electrical Engineering & State Key Laboratory of Terahertz and Millimeter Waves, City Univ. of Hong Kong, Hong Kong; [3]Department of Chemistry, City Univ. of Hong Kong, Hong Kong; [4]State Key Laboratory on Integrated Optoelectronics, Inst. of Semiconductors, Chinese Academy of Sciences, Hong Kong.* We report an integrated photonic radar operating in the mmWave V band (40-50 GHz) based on a 4-inch wafer-scale thin-film lithium niobite (TFLN) technology, achieving multi-target ranging and inverse synthetic aperture radar imaging with centimeter-resolution.

AM3J.2 • 13:45

Full C-band tunable integrated Erbium lasers via wafer-scale fabrication, Xinru Ji[1], Yang Liu[1], Zheru Qiu[1], Anat Siddharth[1], Rui N. Wang[1], Taegon Kim[2], Joe Olson[2], Tobias J. Kippenberg[1]; *[1]Ecole Polytechnique Federale de Lausanne, Switzerland; [2]Applied Materials, USA.* We demonstrate an integrated Erbium-based tunable laser using wafer-scale fabrication and ion implantation of silicon nitride photonic integrated circuits, and achieve single-frequency lasing tunable from 1530~nm to 1575~nm covering the entire optical C-band.

AM3J.3 • 14:00

Frequency-agile Hybrid Integrated Laser at Sub-micron Spectral Range for Coherent Sensing and Quantum Applications, Vladimir Shadymov[1,2], Andrea Bancora[1,2], Anat Siddharth[2,3], Alaina Attanasio[4], Rui N. Wang[2,3], Johann Riemensberger[1,2], Hao Tian[4], Sunil A Bhave[4], Andrey Voloshin[1,2], Tobias J. Kippenberg[2,3]; *[1]DeepLight SA, Switzerland; [2]Inst. of Physics, Swiss Federal Inst. of Technology Lausanne (EPFL), Switzerland; [3]Center of Quantum Science and Engineering (EPFL), Switzerland; [4]OxideMEMS Lab, Purdue Univ., USA.* We demonstrate a hybrid integrated low-noise laser based on a 900 nm laser diode self-injection locked to a microresonator with MEMS actuators exhibiting a frequency actuation bandwidth >10 MHz and a tuning efficiency >30 MHz/V.

AM3J.4 • 14:15

Integrated Femtosecond Pulse Amplifier, Mahmoud Gaafar[1], Markus ludwig[1], Kai Wang[2], Thibault Wildi[1], Thibault Voumard[1], Henry Francis[3], Jan Lorenzen[1], Milan Sinobad[1], Michael Geiselmann[3], Pascal Del'Haye[4], Toby Bi[4], Shuangyou Zhang[4], Sonia Garcia-Blanco[2], Franz Kärtner[1], Neetesh Singh[1], Tobias Herr[1]; *[1]Deutsches Elektronen-Synchrotron DESY, Germany; [2]Univ. of Twente, Netherlands; [3]LIGENTEC SA, Swaziland; [4]Max-Planck Inst. for the Science of Light, Germany.* We demonstrate for the first-time femtosecond pulse amplification in a CMOS-compatible photonic chip. We report >50-fold amplification of 1GHz-repetition rate chirped femtosecond pulses to 800 W of on-chip peak power with 116 fs pulse duration.

AM3J.5 • 14:30

Sub-MHz linewidth, FMCW photonic integrated blue laser, Anat Siddharth[1], Thomas Wunderer[2], Xinru Ji[1], Sunil A Bhave[3], Tobias J. Kippenberg[1]; *[1]Ecole Polytechnique Federale de Lausanne, Switzerland; [2]Palo Alto Research Centre, USA; [3]Purdue Univ., USA.* We demonstrate for the first time a frequency-modulated continuous wave photonic integrated blue laser with sub-MHz linewidth. The laser exhibits frequency excursion greater than 900 MHz at up to 1 MHz triangular chirp rate with a nonlinearity of less than 1.5%.

AM3J.6 • 15:00

Compact Coherent Photonic Crystal Surface-Emitting Laser Arrays, Chhabindra Gautam[1], Mingsen Pan[1,2], Yudong Chen[1], Thomas Rotter[3], Ganesh Balakrishnan[3], Weidong Zhou[1]; *[1]Department of Electrical Engineering, Univ. of Texas at Arlington, USA; [2]Semergytech Inc., USA; [3]Department of Electrical and Computer Engineering, Univ. of New Mexico, USA.* We report a novel coherent beam combining design with passively coupled PCSEL array. Experimental results of our fabricated GaAs-based arrays show high beam quality, linewidth, and coherency.

AM3J.7 • 15:15

Amplitude-Invariant Phase Shifter Based on Carrier-Injection Mechanism for Optical Phased Array, Qiqi Yuan[1], Xu Weihan[1], Ran Shihuan[1], Yang Yunhong[1], Liangjun Lu[1,2], Jianping Chen[1,2], Linjie Zhou[1,2]; *[1]Shanghai Jiao Tong Univ., China; [2]SJTU-Pinghu Inst. of Intelligent Optoelectronics, China.* We present an amplitude-invariant phase shifter based on a PIN diode embedded in a Mach-Zehnder Interferometer for optical phased arrays. The dynamic power contrast is lower than 0.42 dB over a π phase shift.

13:30 -- 15:30
Room: W208
FM3K • Quantum Secure Communications
Presider: Bill Munro; Okinawa Inst. of Science and Technology

FM3K.1 • 13:30

A Scalable Entanglement-Based Distributed Multi-User QKD System for Networks, Jakob Kaltwasser[1], Maximilian Tippmann[1], Florian Niederschuh[1], Till Dolejsky[1], Maximilian Mengler[1], Joschka Seip[1], Erik Fitzke[1], Thomas Walther[1]; *[1]Technische Universität Darmstadt, Germany.* We report on the progress of our time-bin coding quantum key distribution network. We demonstrate its flexible operation, detector time multiplexing to reduce the number of detectors, and a key exchange with spatially separated parties.

FM3K.2 • 13:45

Withdrawn

FM3K.3 • 14:00

Inter-pulse intensity correlation in gain-switched semiconductor laser for quantum key distribution, Yuan-Fei Gao[1], Tao Wang[1,2], Yixin Wang[2], Zhiliang Yuan[1]; *[1]Beijing Academy of Quantum Information Sciences, China; [2]State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ. of Posts and Telecommunications, China.* We investigated the intensity fluctuation and correlation between adjacent pulses in experiments. Strong intensity fluctuation and negative correlation were observed under low driving currents. Through simulation with rate equations, we confirmed the fluctuation resulted from an instability of GSSL at high repetition frequency.

FM3K.4 • 14:15

Networked multi-user continuous-variable quantum key distribution using squeezed state, Yiming Bian[1], Song Yu[1], Yichen Zhang[1]; *[1]Beijing Univ. of Posts &Telecomm., China.* We report a continuous-variable quantum key distribution protocol with high resistance to channel loss and excess noise by using a squeezed state source and multiple homodyne detectors.

FM3K.5 • 14:30

Exploring The Potential of Probabilistic Shaping Technique in Quantum Key Distribution Systems, Emanuele P. Parente[1], Michele Notarnicola[2,3], Stefano Olivares[2,3], Enrico Forestieri[1], Luca Potì[1,4], Marco Secondini[1]; *[1]Scuola Superiore Sant'Anna, Italy; [2]Università degli studi di Milano, Italy; [3]INFN, Italy; [4]CNIT, Italy.* We investigated the role of probabilistic shaping in the optimization of the secure key rate of a continuous variable quantum key distribution system with discrete modulation in both homodyne and heterodyne scheme.

FM3K.6 • 14:45

Quantum digital signatures over entanglement-based deployed campus network, Joseph C. Chapman[1], Muneer Alshowkan[1], Bing Qi[1,2], Nicholas A. Peters[1]; *[1]Oak Ridge National Laboratory, USA; [2]New York Univ. Shanghai, China.* The quantum digital signature protocol offers a replacement for aspects of public-key digital signatures. Here, we demonstrate and characterize hardware to implement entanglement-based quantum digital signatures over our campus network, validating use in deployed fiber.

FM3K.7 • 15:00 (Invited)

Spatial and Temporal Quantum Correlations: Photonic Experiments in Quantum Foundations, Quantum Information Processing and Secure Quantum Communications, Urbasi Sinha[1]; *[1]Light and Matter Physics, Raman Research Inst., India.* We discuss photonic experiments that harness spatial as well as temporal quantum correlations to demonstrate breakthrough results in semi device independent random number generation, higher dimensional entanglement quantification and quantum foundations.

13:30 -- 15:30
Room: W209A
FM3L • Metasurfaces and Advanced Metamaterials
Presider: Sui Yang; Arizona State Univ., USA

FM3L.1 • 13:30

Free-Space Ultrahigh-Q Mode Resonances at Visible Wavelength with an Etch-Free Metasurface, Jie Fang[1], Rui Chen[1], David Sharp[2], Chris Munley[2], Arka Majumdar[1,2]; *[1]Department of Electrical and Computer Engineering, Univ. of Washington, USA; [2]Department of Physics, Univ. of Washington, USA.* We experimentally demonstrate a free-space resonance quality (Q) factor of 2.09×10^4 at 778 nm wavelength with an etch-free metasurface. The guided-mode-resonance nature is studied via energy-momentum spectroscopy, showing the full-visible-spectrum accessibility of our ultrahigh-Q resonances.

FM3L.2 • 13:45

Freeform High-Q Metasurfaces Enabled by Tailored Optical Nearfields, You Zhou[1], Yixuan Shao[1], Tianxiang Dai[1], Chenkai Mao[1], Jonathan A. Fan[1]; *[1]Stanford Univ., USA.* We present a new concept in freeform photonic optimization in which resonances in metasurfaces are directly engineered using the adjoint variables method. We apply this strategy for designing nonlocal, chiral metasurfaces with high quality factors.

FM3L.3 • 14:00

Steering Loss With Hyperbolic Shear Metasurfaces, Enrico Maria Renzi[1,2], Emanuele Galiffi[1], Xiang Ni[3], Andrea Alù[1,2]; *[1]Photonics Initiative, Advanced Science Research Center, City Univ. of New York, USA; [2]Physics Program, The Graduate Center, City Univ. of New York, USA; [3]School of Physics and Electronics, Central South Univ., China.* We introduce metasurfaces supporting hyperbolic surface waves with strong axial dispersion and asymmetric loss distribution stemming from microscopic shear phenomena. Their features offer enhanced broadband light matter interactions and inherent resilience to material loss.

FM3L.4 • 14:30

Dual Focus Wavefront Tilting Silicon Nitride Metalens Manufactured using Deep-Ultraviolet Scanner Lithography, David De Vocht[1], Alonso Millán-Mejía[2], Angel Savov[2], Yuqing Jiao[1], Erwin Bente[1]; *[1]Technische Universiteit Eindhoven, Netherlands; [2]SMART Photonics, Netherlands.* We demonstrate advanced Silicon Nitride metalenses manufactured using 193 nm scanner lithography. The metalens have overlapping focal points for two incident beams angled at ±5° distant at 10 mm, relevant for gas sensing and metrology.

FM3L.5 • 14:45

Disordered Hyperuniform Metamaterials in the Mid-Infrared, Manuel Gallego[1], Sara Kacmoli[1], Yezhezi Zhang[2], Michael Klatt[3], Claire Gmachl[1]; *[1]Princeton Univ., USA; [2]Cruise LLC, USA; [3]German Aerospace Center (DLR), Germany.* We designed and demonstrate a hole-based disordered hyperuniform metamaterial with potential for image edge detection, exhibiting a band-gap at λ=12.0μm with 10% width appearing as an enhanced reflectance region in measurements independent of sample orientation.

FM3L.6 • 15:00

The Broadband Enhanced Chirality Revealed by Broken L-Shape Metamaterial Platform, Ufuk Kilic[1], Mathew Hilfiker[2,1], Shawn Wimer[1], Alexander Ruder[1], Sema G.Kilic[1], Christos Argyropoulos[1,4], Eva Schubert[1], Mathias Schubert[1,3]; *[1]Department of Electrical and Computer Engineering, Univ. of Nebraska-Lincoln, USA; [2]Onto Innovation Inc., USA; [3]NanoLund, Lund Univ., Sweden; [4]Department of Electrical Engineering, The Pennsylvania State Univ., USA.* We experimentally demonstrate and theoretically verify spectrally controllable, extremely large, broadband chiroptical response from three-dimensional all-dielectric broken L-shape, so-called *nano-boomenrang* metamaterial platforms. This innovative structure holds immense potential for seamless integration into on-chip photonic device applications.

FM3L.7 • 15:15

Broadband, high-efficiency metasurfaces using dispersion-engineered nanostructures, Wei Ting Chen[1], Joon-Suh Park[1], Justin Marchioni[1,2], Sophia Millay[1,3], Kerolos M. Yousef[1], Federico Capasso[1]; *[1]Harvard Univ., USA; [2]Univ. of Waterloo, Canada; [3]Department of Physics, Williams College, USA.* A set of nanostructures capable of creating high-efficiency, broadband metasurfaces for visible wavelengths is presented. Utilizing structure-induced dispersion engineering, we show that anisotropic-shaped nanostructures are effective building blocks for crafting broadband, polarization-insensitive, and efficient metasurfaces.

13:30 -- 15:30
Room: W209B
SM3M • Quantum and Photonic Computing I
Presider: Jianwei Wang; Peking Univ., China

SM3M.1 • 13:30

Error calibration for on-chip diffractive optical neural networks with Low-Rank Adaptation, Yuyao Huang[1], Tingzhao Fu[1], Honghao Huang[1], Run Sun[1], Wencan Liu[1], Sigang Yang[1], Hongwei Chen[1]; *[1]Tsinghua Univ., China.* We present a Low-Rank Adaptation algorithm for error calibration in on-chip diffractive optical neural networks (DONNs), achieving a 73% improvement of accuracy in MNIST image classification compared to non-calibrated ones.

SM3M.2 • 13:45
Efficient Hardware Configuration Method for Photonic Neural Network with Genetic Algorithm, Zichao Zhao[1], Bei Chen[2], Haoran Ma[1], ZIyi Fu[1], Zeyu Yu[1], Yuehai Wang[1], Jianyi Yang[1]; [1]*Zhejiang Univ., China;* [2]*Key Laboratory of Optoelectronic Materials and Devices, Inst. of Semiconductors, Chinese Academy of Sciences, China.* The component imprecisions set obstacles for the implementation of on-chip photonic neural networks (PNNs). In this work, an efficient configuration method based on the genetic algorithm (GA) is proposed and applied for PNNs. Great con vergence abilities are experimentally presented through performing complex-valued PNNs with two photonic chips.

SM3M.3 • 14:00
Silicon Integrated Photonic-Electronic Multiply-Accumulate Neurons, Ioannis Roumpos[1], Lorenzo De Marinis[2], Peter Kincaid[2], Emilio Paolini[2], Stefanos Kovaios[1], Apostolos Tsakyridis[1], Miltiadis Moralis-Pegios[1], Mathias Berciano[3], Filippo Ferraro[3], Ashwyn Srinivasan[3,4], Marianna Pantouvaki[3,5], Giampiero Contestabile[2], Konstantinos Vyrsokinos[1], Nikos Pleros[1]; [1]*Arstotle Univ. of Thessaloniki, Greece;* [2]*Scuola Superiore Sant'Anna, Italy;* [3]*Imec, Belgium;* [4]*Xanadu Quantum Technologies, Canada;* [5]*Microsoft Research Center, UK.* We experimentally demonstrate an EAM-based photonic-electronic multiply-accumulate neuron that performs inference in a health monitoring task with 1350 trainable parameters, achieving an f1 score of 85.9 % at 10 Gbaud compute rate.

SM3M.4 • 14:15
Training Photonic Neural Networks with Dual Backpropagation, Xing Lin[1,3], Ziyang Zheng[1,2], Zhengyang Duan[1], Hang Chen[1], Rui Yang[2], Sheng Gao[1], Haiou Zhang[1], Hongkai Xiong[2]; [1]*Department of Electronic Engineering, Tsinghua Univ., China;* [2]*Department of Electronic Engineering, Shanghai Jiao Tong Univ., China;* [3]*Beijing National Research Center for Information Science and Technology, Tsinghua Univ., China.* We report dual backpropagation training for end-to-end optimizing photonic neural networks (PNNs). We demonstrate the effectiveness of the proposed method by using diffractive and interference-based PNNs on image classification tasks under significant systematic errors.

SM3M.5 • 14:30 (Invited)
Scaling Photonic Quantum Computing, Blair Morrison[1]; [1]*Xanadu, Canada.* We will report on progress of device and system level demonstrators across multiple integrated photonic platforms.

13:30 -- 15:30
Room: W209C
SM3N • Nonlinear Integrated Photonics I
Presider: Nathaniel Kinsey

SM3N.1 • 13:30 (Invited)
Nonlinear Integrated Photonic Material Platforms, Amy C. Foster[1]; [1]*Johns Hopkins Univ., USA.* Absract not available.

SM3N.2 • 14:00

Passive On-Chip Nonlinear Optical Isolators with Built-in Laser Stabilization, Alexander D. White[1], Geun Ho Ahn[1], Kasper S. Van Gasse[1], Richard Luhtaru[1], Joel Guo[2], Theodore Morin[2], Lin Chang[2], John Bowers[2], Jelena Vuckovic[1]; *[1]Stanford, USA; [2]UCSB, USA.* We demonstrate fully passive optical isolators in silicon nitride nanophotonics using the intrinsic Kerr nonlinearity. These devices serve to both stabilize and isolate on-chip lasers, reducing the linewidth of DFB lasers by orders of magnitude.

SM3N.3 • 14:15

Parasitic loss by a cutoff waveguide and its impact on wide-band nonlinear integrated microresonator photonics, Yi Sun[1,2], Daniel Pimbi[2], Xiyuan Lu[1,2], Kartik Srinivasan[1,2]; *[1]Microsystems and Nanotechnology Division, NIST, USA; [2]Joint Quantum Inst., Univ. of Maryland, USA.* We examine a non-intuitive loss channel where a cutoff waveguide induces parasitic loss in a microring resonator. This loss at telecom wavelengths limits the spectral extent of green light generation in microresonator optical parametric oscillators.

SM3N.4 • 14:30

Overcoming Thermal Effects with Kerr Soliton Combs in Compact Photonic Structures, Garrett J. Beals[1], Yun Zhao[1], Karl J. McNulty[1], Sai Kanth Dacha[1], Michal Lipson[1], Alexander L. Gaeta[1]; *[1]Columbia Univ., USA.* We demonstrate strong thermal effects in the soliton state in a 16-GHz free-spectral range compact spiral microresonator by measuring a thermal-induced bistability and show ultralow-noise operation can be achieved via operation at the quiet point.

SM3N.5 • 14:45

Mid-IR Supercontinuum Generation in a Birefringent SiGe Waveguide with Selectable Dispersion Regime, Adam Bieganski[1,2], Alberto Della Torre[1], Remi Armand[1], Marko Perestjuk[1], Vincent Reboud[3], Jean-Michel Hartmann[3], Arnan Mitchell[2], Thach Nguyen[2], Sébastien Cueff[1], Christelle Monat[1], Christian Grillet[1]; *[1]Ecole Centrale de Lyon, France; [2]RMIT Univ., Australia; [3]CEA LETI, France.* We showcase pulse spectral broadening by pumping a birefringent SiGe-on-Si waveguide at 3.9 µm wavelength. By changing the pump polarization, we alter the waveguide’s dispersion regime and therefore the properties of generated spectra.

SM3N.6 • 15:00

Broadband and high-gain traveling-wave optical parametric amplification in a Gallium Phosphide photonic integrated circuit, Johann Riemensberger[4,2], Nikolai Kuznetsov[1,2], Alberto Nardi[1,3], Alisa Davydova[1,2], Paul Seidler[3], Tobias J. Kippenberg[1,2]; *[1]Inst. of Physics, Swiss Federal Inst. of Technology (EPFL), Switzerland; [2]Center of Quantum Science and Technology (EPFL), Switzerland; [3]IBM Research Europe, Switzerland; [4]Department of Electronic Systems, Norwegian Univ. of Science and Technology, Norway.* We demonstrate continuous-wave parametric amplifier with a 140~nm gain bandwidth spanning the optical S,C, and L-bands and up to 25 dB off-chip net-gain in a dispersion engineered gallium phosphide-on-insulator (GaPOI) waveguide with up to 160~mW output power.

13:30 -- 15:30
Room: W209DE
FM3O • Plasmonic Nanophotonic Metasurfaces
Presider: Abdoulaye Ndao

FM3O.1 • 13:30
Polarization tomography of photon pairs emitted by nonlinear metasurfaces with quasi-bound states in the continuum resonances, Jiho Noh[1,2], Tomás Santiago-Cruz[3,4], Sylvain D. Gennaro[1,2], Vitaliy Sultanov[3,4], Igal Brener[1,2], Maria Chekhova[3,4]; *[1]Sandia National Laboratories, USA; [2]Center for Integrated Nanotechnologies, Sandia National Laboratories, USA; [3]Max-Planck-Inst Physik des Lichts, Germany; [4]FAU Erlangen-Nürnberg, Germany.* We use complete polarization tomography of photon pairs generated in semiconductor metasurfaces via spontaneous parametric down-conversion to show how bound states in the continuum resonances affect the polarization state of the emitted photons.

FM3O.2 • 13:45
Compact, single-shot digital holography for quantitative phase imaging enabled by a single-layer dielectric metasurface, Jyoti Sardana[1], Shital Devinder[1], Wenqi Zhu[2], Amit Agrawal[2], Joby Joseph[1]; *[1]Indian Inst. of Technology Delhi, India; [2]National Inst. of Standards and Technology, USA.* We propose ultra-compact, highly stable interferometer based on single-layer dielectric metasurface for common path off-axis digital holography. The metasurface interferometric imaging system could provide birefringence properties of anisotropic test samples from quantitative phase analysis.

FM3O.3 • 14:00 (Invited)
Polarization Manipulation and Multiplexing via Optical Metasurfaces: from Classical to Quantum, Ruwen Peng[1], Yongmin Liu[2], Mu Wang[1,3]; *[1]Nanjing Univ., China; [2]Northeastern Univ., USA; [3]American Physical Society, USA.* We present our recent studies on polarization manipulation and multiplexing with optical metasurfaces from classical to quantum regimes. The approaches achieve potential applications in high-capacity optical displays, data storage, information encryption, and quantum information networks.

FM3O.4 • 14:30
Absorbing Perfectly at the Ultimate Thickness Limit, Zarko Sakotic[1], Woo Je Chang[1], Alexander Ware[1], Michelle L. Povinelli[2], Thomas Truskett[1], Delia Milliron[1], Daniel Wasserman[1]; *[1]Univ. of Texas at Austin, USA; [2]Univ. of Southern California, USA.* We present an analytical framework for design of perfect absorbers at the ultimate thickness limit, across different materials, wavelengths, and quality factors. Experimentally, we demonstrate scalable and versatile ultrathin mid-IR absorbers leveraging monolayer nanocrystal arrays.

FM3O.5 • 14:45
Ultrafast non-reciprocal spin resonances in frustrated plasmonic metasurfaces, Luis Martinez[2], Ryan Khan[1], Ezra Bussmann[1], Remi Dingreville[1], Tzu-Ming Lu[1], Prashant Padmanabhan[2], Prasad Padmanabha Iyer[1]; *[1]Center for Integrated Nanotechnologies, Sandia National Labs, USA; [2]Center for Integrated Nanotechnologies, Los Alamos National Lab, USA.* We demonstrate non-reciprocal spin resonance evolution on picosecond time scales via the time resolved magneto-optic Kerr effect at the plasmonic (metal-insulator-metal) resonant wavelength of a frustrated Kagome-type Nickel spin-ice metasurface

FM3O.6 • 15:00
Expanding Entanglement Using Metasurfaces, Liat Nemirovsky Levy[1], Amit Kam[1], Mordechai Segev[1], Guy Bartal[1]; *[1]Technion, Israel.* We propose a metasurface-based scheme to expand the polarization entanglement between two photons. Our approach increases entanglement entropy, expanding the biphoton state into a hyperentangled state with polarization and orbital angular momentum entanglement.

FM3O.7 • 15:15
Deep Q Reinforcement Learning Based Multi-Objective Optimization of Metasurfaces For Sensing Application, Abdullah Bin Shams[1], A Abdur Rahman Akib[2], J Stewart Aitchison[1]; *[1]Univ. of Toronto, Canada; [2]Electrical and Electronic Engineering, Islamic Univ. of Technology, Bangladesh.* We propose a Deep Q-learning based multi-objective optimization of metasurfaces using Reinforcement Learning and optimized a Si-nano-split-ring with a quality factor of 156,400, sensitivity of 400 nm/RIU, and figure-of-merit of 40,000/RIU suitable for sensing applications.

13:30 -- 15:30
Room: W209F
SM3P • THz Spectroscopy and Imaging
Presider: Tal Ellenbogen; Tel Aviv Univ., Israel

SM3P.1 • 13:30 (Tutorial)
Optical Pump Terahertz Probe: A Contact-Free Technique to Measure Ultrafast Photoconductivity in Emerging Materials, Jens Neu[1]; *[1]Physics, Univ. of North Texas (UNT), USA.* I will present the basic concepts of Terahertz Time Domain Spectroscopy in combination with fs-laser pulse excitation of emerging materials, OPTP. I will highlight temporal resolution and emphasize how OPTP enhances our understanding of photoconductivity.

SM3P.2 • 14:30
Superspectroscopy: 100-fold enhancement in THz time-domain imaging contrast via superoscillating waveform shaping, Peisong Peng[1], Dustin R. Lindberg[1], Gerard McCaul[1], Denys I. Bondar[1], Diyar Talbayev[1]; *[1]Tulane Univ., USA.* We demonstrate, with both numerical simulation and experiment, that of all the waveforms that can exist in a band-limited system, superoscillation provides the best contrast for distinguishing optically similar substances.

SM3P.3 • 14:45
Unidirectional image magnification and demagnification using pyramid diffractive optical networks, Bijie Bai[1], Xilin Yang[1], Tianyi Gan[1], Jingxi Li[1], Deniz Mengu[1], Mona Jarrahi[1], Aydogan Ozcan[1]; *[1]Univ. of California Los Angeles, USA.* We introduce a pyramid-structured deep diffractive optical network (P-D^{2}NN) design that performs unidirectional image magnification and demagnification using reduced degrees of freedom. Experimental validation at terahertz spectrum demonstrates the efficacy of this design strategy.

SM3P.4 • 15:00 (Invited)
Dynamics of Hydration Water in Protein Condensates, Ellen M. Adams[1,2]; *[1]Excellence Cluster Physics of Life, TU Dresden, Germany; [2]Helmholtz Zentrum Dresden Rossendorf,*

Germany. Biomolecular condensates are membrane-less organelles formed via liquid-liquid phase separation of intrinsically disordered proteins. Here, THz spectroscopy is utilized to reveal the structure and dynamics of hydration water in these liquid-like protein environments.

13:30 -- 15:30
Room: W210
SM3Q • Controlled Continuum Generation with Novel Media and Light Sources
Presider: Mario Ferraro; Univ degli Studi di Roma La Sapienza, Italy

SM3Q.1 • 13:30
9.1-fs pulse generation from 10 nJ Yb-fiber laser with cascaded nonlinear pulse compression, Donguhn Kang[1], Toshio Otsu[1], Shuntaro Tani[1], Yohei Kobayashi[1]; *[1]The Inst. for Solid State Physics, The Univ. of Tokyo, Japan.* We achieved a pulse duration of 9.1 fs at 10 nJ pulse energy by adopting a two-stage nonlinear pulse compression scheme with single-mode fibers at a 90 MHz repetition rate.

SM3Q.2 • 13:45
Long-wave-infrared pulse generation in H2-filled hollow-core fiber, Yi-Hao Chen[1], Frank Wise[1]; *[1]Applied Physics, Cornell Univ., USA.* We present a two-color and two-pulse approach to femtosecond pulse generation at long-wave-infrared wavelengths in H2-filled hollow-core fiber. It numerically produces 88-fs pulses at 12 μm with 48% quantum efficiency.

SM3Q.3 • 14:00
Solid-State Self-Steepening Enhanced Flat White Light, Shaobo Fang[1,2], Yuzhe Liu[1,2], Zhidong Chen[1,2], Senchi Yang[1,2]; *[1]Inst. of Physics, CAS, China; [2]School of Physical Sciences, Univ. of Chinese Academy of Sciences, China.* We generated intense near-two-octave spanning supercontinuum by self-steepening enhanced cascade process in solids. The output spectrum covered from 510 nm to 1450 nm with an ultra-flat-plateau, which supporting 0.8-cycle 2.7-fs TL pulse.

SM3Q.4 • 14:15
All-silica fiber laser emitting two-octave frequency combs, Yanyan Zhang[1], Sida Xing[2]; *[1]Northwestern Polytechnical Univ.Northwestern Polytechnical Univ., China; [2]Shanghai Inst. of Optics and Fine Mechanics, China.* We describe the conditions for generating multi-octave frequency combs in all-silica-fiber configuration. Experimental demonstration of a 200 MHz frequency comb covering 0.8 μm to 3.5 μm with a smooth mid-infrared part proved its validity.

SM3Q.5 • 14:30 (Invited)
Soliton Self-Mode Conversion in Stable Multimode Fibers, Havva Begüm Kabagöz[1]; *[1]The Division of Physics, Mathematics and Astronomy, LIGO Livingston - Caltech, USA.* We identify the source of SSMC, then experimentally compare control methods for desirable outcomes, such as continuous wavelength tuning over ~150 nm, and multi-color time-synchronized output; lastly propose long-pulse seeding to obtain >MW peak power.

SM3Q.6 • 15:00

Soliton Pulse Compression in Lithium Niobate Nanophotonics, Robert M. Gray[1], Thomas Zacharias[1], Rahul Chawlani[1], Luis Ledezma[1], Ryoto Sekine[1], James Williams[1], Alireza Marandi[1]; *[1]California Inst. of Technology, USA.* We show that soliton pulse compression in lithium niobate nanophotonics can enable formation of few-cycle pulses. We experimentally confirm such nonlinear dynamics and measure chirped 44-fs output pulses consistent with numerical simulations.

SM3Q.7 • 15:15
Highly Stable and Gapless sub-5-fs Pulses Close to the Bandwidth Limit from a Compact Er:fiber Laser System, Philipp Sterk[1], Sarah R. Hutter[1], Alfred Leitenstorfer[1]; *[1]Univ. of Konstanz, Germany.* A smooth and octave-spanning spectrum derived from Er:fiber technology is compressed to 4.92 fs. Intensity fluctuations across the entire supercontinuum are below 1.5% and quantum-limited in the center.

13:30 -- 15:30
Room: W211
FM3R • Techniques for Quantum Spectroscopy
Presider: David Meyer; US Army Research Laboratory

FM3R.1 • 13:30
Molecular Complex Dieletric Functions via Spectrally-Resolved Hong-Ou-Mandel Interference, Andrew H. Proppe[1,2], Kyle Jordan[1,2], Jeff S. Lundeen[2,1], Benjamin J. Sussman[3,1]; *[1]Joint Centre for Extreme Photonics, Canada; [2]Physics, Univ. of Ottawa, Canada; [3]National Research Council of Canada, Canada.* We present results on the use of spectrally-resolved Hong-Ou-Mandel interference for use in precision spectroscopy. Our scheme allows for simultaneous measurement of a sample's absorption and phase spectra while reducing the effects of shot noise.

FM3R.2 • 13:45
Fourier-limited Optical Transitions of Single Molecules at an Interface, Masoud Mirzaei[1,2], Alexey Shkarin[1], Johannes Zirkelbach[1], Ashley J. Shin[1], Burak Gurlek[1], Tobias Utikal[1], Stephan Götzinger[1,3], Vahid Sandoghdar[1,2]; *[1]Max Planck Inst. for the Science of Light, Germany; [2]Department of Physics, Friedrich Alexander Univ. Erlangen-Nuremberg, Germany; [3]Department of Physics and Graduate School in Advanced Optical Technologies (SAOT), Friedrich Alexander Univ. Erlangen-Nuremberg, Germany.* We present the first report of Fourier-limited optical transition of a quantum emitter placed at an interface.

FM3R.3 • 14:00
Quantum-Enhanced Microscopy Using Electron Number Pulses, Ethan Nussinson[1], Shiran Even-Haim[1], Rotem Elimelech[1], Ron Ruimy[1], Yonatan Israel[1,2], Ido Kaminer[1]; *[1]Faculty of Electrical & Computer Engineering, Faculty of Physics and Solid State Inst., Technion - Israel Inst. of Technology, Israel; [2]School of Physics and Astronomy, Faculty of Exact Sciences, Tel Aviv Univ., Israel.* We propose a quantum phase estimation protocol in electron microscopy and holography, breaking the shot-noise limit despite the intrinsic Poisson-statistics of electron sources. This surprising capability is enabled by non-destructive measurements heralding number-state electron pulses.

FM3R.4 • 14:15
Optimal Continuous Dynamical Decoupling in *N*-type Atomic Ensemble Quantum Memories, Tegan Loveridge[1,2], Kai Shinbrough[1,2], Virginia O. Lorenz[1,2]; *[1]Department of Physics, Univ. of Illinois Urbana-Champaign, USA; [2]IQUIST, Univ. of Illinois Urbana-Champaign, USA.* We simulate *N*-type quantum memory in atomic ensembles with a high-lying sensor state in the regime of continuous dynamical decoupling. We find order-of-magnitude memory lifetime enhancements for realistic experimental parameters.

FM3R.5 • 14:30
Rydberg Excitation Efficiency in Nitric Oxide Using a Three Photon Excitation Scheme, Fabian Munkes[1], Patrick Kaspar[1], Alexander Trachtmann[1], Yannick Schellander[2], Florian Anschütz[1], Ettore Eder[1], Lars Baumgärtner[3], Philipp Hengel[3], Jens Anders[3], Robert Löw[1], Tilman Pfau[1], Harald Kübler[1]; *[1]5th Inst. of Physics, Univ. of Stuttgart, Germany; [2]Inst. for Large Area Microelectronics, Univ. of Stuttgart, Germany; [3]Inst. of Smart Sensors, Univ. of Stuttgart, Germany.* We proposed a working principle for a trace–gas sensor for nitric oxide based on an electronic readout. Here, we report on the parameter sweet spots of pressure, electric field and laser intensities.

FM3R.6 • 14:45
A High Intensity Cold Atom Source, Jeremy Glick[1,2], William Huntington[2], Daniel Heinzen[2]; *[1]DEVCOM Army Research Laboratory, USA; [2]Physics, The Univ. of Texas at Austin, USA.* A method for producing a high intensity cold atomic beam is discussed. The method is based on post-nozzle seeding of lithium into a supersonic helium jet.

FM3R.7 • 15:00
Controlling the Spontaneous Emission Rate by Preparation of Photonic Time-Crystal, Mark Lyubarov[1], Mordechai Segev[1]; *[1]Technion, Israel.* We show that the spontaneous emission rate (SER) in Photonic Time-Crystals (PTC) can be controlled by how we initiate the temporal modulation. Starting modulation abruptly or adiabatically either increases or drops SER near momentum bandgaps.

FM3R.8 • 15:15
Realization of an inherent time crystal in an ensemble of erbium atoms, Yuhui Chen[1], Xiangdong Zhang[1]; *[1]Beijing Inst. of Technology, China.* Time crystals exhibit spontaneous breakdown of time symmetry. However, previous realization of time crystals relying on external periodicity. Here, we demonstrate that many-body interactions can give rise to an inherent time crystalline phase.

16:00 -- 18:00
Room: W201AB
AM4A • Advanced Imaging Techniques Microscopy and 3D Surface Metrology
Presider: Jasper Drisko; Lightwave Logic, Inc., USA

AM4A.1 • 16:00
Highly Enhanced Pattern Recognition with a Balanced Joint Transform Correlator, Julian Gamboa[1], Tabassom Hamidfar[1], Xi Shen[1], Shamima A. Mitu[1], Selim M. Shahriar[1]; *[1]Northwestern Univ., USA.* We describe an opto-electronic balanced joint transform

correlator that optimizes the dynamic range of the output spatial light modulator to improve by several orders of magnitude the signal to noise ratio for pattern recognition.

AM4A.2 • 16:30
Applications of Hadamard-Multiplexed Fluorescence Imaging using a Hyperspectral Camera, Emma X. Abbey[1], Oren G. Katz[1], Travis Ferguson[2], Sarah-Johanna Klose[3], Chris Pruefert[1], Hans-Peter Loock[1]; *[1]Univ. of Victoria, Canada; [2]Queen's Univ., Canada; [3]Leibniz Inst. for Plasma Science and Technology, Germany.* We present a hyperspectral fluorescence imaging system based on a Hadamard-multiplexed light source for monitoring spatially inhomogeneous reactions through time and correctly identifying fluorescent components in complex mixtures.

AM4A.3 • 16:45
Rare Earth based luminescent compounds for forensics applications: from gunshot residues to chameleon thin films, Rodrigo Galvão[1]; *[1]Perícia Forense do Estado do Ceará, Brazil.* A microspectrometer was used to analyze Rare Earth marked gunshot residues and chameleon thin films. The equipment allowed for fast, and non destructive assessment of the fluorescence emission, thus being of particular interest for forensics.

AM4A.4 • 17:00
Photon Counting for Enhanced Resolution Spatial Frequency Modulation Imaging, Daniel W. Scarbrough[1], Randy Bartels[2], Jeff Squier[1]; *[1]Colorado School of Mines, USA; [2]Morgridge Inst. for Research, USA.* Multiphoton, single pixel detection, spatial frequency modulation imaging (SPIFI) is demonstrated in a photon counting regime for the first time by using custom multi-threaded software, enabling second harmonic generation (SHG) 4th order enhanced images.

AM4A.5 • 17:15
Enhancing Coherent Super-Oscillation Microscopy using Deconvolution of Complex Fields, Yitian Liu[1], Haitang Yang[1], George Eleftheriades[1]; *[1]The Edward S. Rogers Sr. Department of Electrical and Computer Engineering, Univ. of Toronto, Canada.* We demonstrate a coherent super-oscillation (SO) microscopy imaging system based on the phase-shifting interferometry (PSI) technique, which is implemented without additional optics in the setup. With the Wiener filter deconvolution, we extended the limit of resolution with coherent illumination by a factor of 1.4 over the diffraction limit.

AM4A.6 • 17:30
Ultra-Compact Computed Tomography Snapshot Spectral Light-Field Imaging Based on Parallelized Metasurfaces, Kaiyang Ding[1,2], Ming Wang[1], Zhenxiang Shi[1], Taize An[1], Xiaojun Liang[2], Kai Ni[1], Zhou Qian[1], Xiaohao Wang[1,2]; *[1]Tsinghua Univ., China; [2]Peng Cheng Laboratory, China.* We present a parallelized metasurfaces approach for ultra-compact computed tomography snapshot spectral light-field imaging in place of conventional bulky or time-sensitive systems with a single shot to acquire four-dimensional spatial-spectral and depth data.

AM4A.7 • 17:45
Nanoscale analytics with AFM probe-assisted techniques: s-SNOM, nano-FTIR, AFM-IR, TERS, Artem Danilov[1], Tobias Gokus[2], Andreas J. Huber[2]; *[1]Attocube systems Inc., USA; [2]Nanoscale Analytics, Attocube systems AG, Germany.* s-SNOM allows to overcome the diffraction limit of conventional light microscopy or spectroscopy enabling optical measurements

at a spatial resolution of 10 nm, not only at IR frequencies but also in the whole spectral range from visible to terahertz.

16:00 -- 18:00
Room: W201CD
FM4B • Short-wavelength Quantum Photonics (Joint FS3+FS7)
Presider: To be Announced

FM4B.1 • 16:00
New Horizons in SPDC X-ray Imaging, Justin C. Goodrich[1], Ryan Mahon[1], Joseph Hanrahan[1], Monika Dziubelski[1], Raphael A. Abrahao[1], Sanjit Karmakar[2], Kazimierz Gofron[3], Thomas A. Caswell[1], Daniel Allan[1], Lonny Berman[1], Andrei Fluerasu[1], Andrei Nomerotski[2], Cinzia DaVia[2,4], Sean McSweeney[1]; *[1]Brookhaven National Laboratory, USA; [2]Stony Brook Univ., USA; [3]Oak Ridge National Laboratory, USA; [4]The Univ. of Manchester, UK.* The SPDC of X-rays via nonlinear Bragg diffraction from a diamond crystal is explored at a synchrotron light source. In this report we share, to the best of our knowledge, our record detection of SPDC X-rays along with imaging applications.

FM4B.2 • 16:15
Observation of X-ray Photon Pairs with a Pixelated Detector, Edward Strizhevsky[1], Yishay Klein[1,2], Robert Hartmann[3], Sonia Francoual[4], Tobias Schulli[5], Tao Zhou[5], Ayush Sharma[4], Ullrich Pietsch[6], Lothar Strüder[3,6], Davide Altamura[7], Cinzia Giannini[7], Mohammad Shokr[8], Sharon Shwartz[1]; *[1]Bar-Ilan Univ., Israel; [2]Nexus for Quantum Technologies, Univ. of Ottawa, Canada; [3]PNSensor GmbH, Germany; [4]Deutsches Elektronen-Synchrotron DESY, Germany; [5]ESRF — The European Synchrotron, France; [6]Physics Department, Univ. of Siegen, Germany; [7]Istituto di Cristallografia - Consiglio Nazionale delle Ricerche (IC−CNR), Italy; [8]European XFEL GmbH, Germany.* We showcase the application of a 2-dimensional detector for observing energy and momentum-correlated x-ray pairs. This detector introduces novel possibilities for applications in quantum x-ray optics.

FM4B.3 • 16:30
High Harmonic Generation by Bright Squeezed Vacuum, Andrei Rasputnyi[1,2], Michael Birk[3,4], Zhaopin Chen[3], Oren Cohen[3], Michael Krueger[3], Ido Kaminer[4], Maria Chekhova[1,2], Francesco Tani[1]; *[1]Max Planck Inst. for the Science of Light, Germany; [2]Friedrich-Alexander Universitat Erlangen-Nurnberg, Germany; [3]Physics Department and Solid-State Inst., Technion – Israel Inst. of Technology, Israel; [4]Department of Electrical and Computer Engineering and Solid State Inst., Technion – Israel Inst. of Technology, Israel.* We present the first observation of non-perturbative high-harmonic generation driven by nonclassical light, namely bright squeezed vacuum. Compared to classical light, bright squeezed vacuum leads to higher efficiency, different power scaling, and unique photon-number distributions.

FM4B.4 • 16:45
Entangled Photon Pair Emission from X-ray Free Electron Lasers, Linfeng Zhang[1], Chengyin Wu[1], Haitan Xu[2,3], Zheng Li[1,4]; *[1]State Key Laboratory for Mesoscopic Physics and Collaborative Innovation Center of Quantum Matter, School of Physics, Peking Univ., China; [2]School of Materials Science and Intelligent Engineering, Nanjing Univ., China; [3]Shishan Laboratory, Nanjing Univ., China; [4]Collaborative Innovation Center of Extreme Optics, Shanxi*

Univ., China. We investigate and characterize entangled x-ray photon pair emissions from microbunched electron pulses in free electron laser (FEL) with a quantum electrodynamics theory and numerical calculations, following our work [Phys.Rev.Lett. 131, 073601 (2023)].

FM4B.5 • 17:00
Electron-Heralded Quantum X-ray Source, Xihang Shi[1], Ron Ruimy[1], Amnon Balanov[1], Ido Kaminer[1]; *[1]Technion-Israel Inst. of Technology, Israel.* We present a concept for creating quantum X-ray radiation heralded by free electrons, showing conditions for squeezed vacuum and Schrodinger cat states of X-rays, created by post-selected pre-bunched electrons.

16:00 -- 18:00
Room: W204AB
SM4C • Quasi-particles and Low-dimensional Materials
Presider: Craig Zuhlke; Univ. of Nebraska Lincoln, USA

SM4C.1 • 16:00 (Tutorial)
Advanced Ultrafast Probes of 2D and Quantum Materials, Robert A. Kaindl[1]; *[1]Arizona State Univ., USA.* Rapid progress in ultrafast THz, electron, and Xray sources is enabling new views of non-equilibrium physics. I will discuss the development and application of tailored probes of transient electronic and structural dynamics in quantum materials.

SM4C.2 • 17:00
Electrical Control of Spin-Polarized Exciton Polaritons in Perovskite Metasurfaces, Yutao Wang[1], Giorgio Adamo[1], Son Tung Ha[2], Jingyi Tian[1], Cesare Soci[1]; *[1]Nanyang Technological Univ., Singapore; [2]Agency of science, technology and research, Singapore.* We report spin-polarized electroluminescence emission from exciton polaritons in light-emitting perovskite metatransistors with broken C_2 symmetry. The spin state of the polariton can be electrically selected by controlling charge injection into the device.

SM4C.3 • 17:15
Exciton–Polaritons Generated from Strong Coupling between CdSe Nanoplatelets and a Fabry–Pérot Cavity, Ovishek Morshed[1], Mitesh Amin[1], Rob Collison[1], Nicole M. B. Cogan[1], Eric R. Koessler[1], Trevor M. Tumiel[1], Farwa Awan[1], William Girten[1], Lele Mathis[2], Teri W. Odom[2], Pengfei Huo[1], Nick Vamivakas[1], Todd D. Krauss[1]; *[1]Univ. of Rochester, USA; [2]Northwestern Univ., USA.* Exciton–polaritons generated from strong coupling between CdSe nanoplatelets with confined photons in a Fabry–Pérot cavity are studied via angle-resolved spectroscopy. Their room-temperature existence and interesting photophysics hold promise for manipulating chemical reactions.

SM4C.4 • 17:30
Direct imprint of topologically protected polarization textures of optical skyrmions onto a material, Rihito Tamura[1], Praveen Kumar[2], A. Srinivasa Rao[1,3], Katsuhiko Miyamoto[1,3], Takashige Omatsua[1,3]; *[1]Chiba Univ., Japan; [2]Indian Inst. of Technology, India; [3]Molecular Chirality Research Center, Japan.* We demonstrate the direct imprint of the topologically protected polarization textures of Néel-, and anti-optical skyrmions, onto a material as a photo-induced surface relief, manifesting the exotic light-matter interaction with topologically protected quasiparticles of light.

16:00 -- 18:00
Room: W205AB
JM4D • Symposium: Solution-Processable Photonics: From Materials and Concepts to Practical Devices II
Presider: Clement Livache; LANL / Ecole Polytechnique, France

JM4D.1 • 16:00 (Invited)
Withdrawn

JM4D.2 • 16:30 (Invited)
Building Solution-Processible Lasers by Decoupling the Optical Material from the Integrated Platform, Ivo Tanghe[1], Margarita Samoli[1], Amelia Waters[2], Jiamin Huang[2], Korneel Molkens[1], Servet Ataberk Cayan[1], Tom Vandekerckhove[1], Fatemeh Abbasi[1], Mikhail Zamkov[2], Zeger Hens[1], Dries Van Thourhout[1], Pieter Geiregat[1]; *[1]Univ. Ghent, Belgium; [2]Bowling Green State Univ., USA.* Integrated lasers using solution-processible semiconductors have seen a surge in demonstrations. This talk delves into a specific design on an integrated silicon platform, facilitating smooth demonstrations of lasing when new materials are synthesized.

JM4D.3 • 17:00 (Invited)
Nanophotonics Applied to the Design of Nanocrystal Based Infrared Sensor, Emmanuel Lhuillier[1], Tung H. Dang[1], Adrien Khalili[1], David Darson[2], Pierre Potet[3], Angela Vasanelli[2]; *[1]Institut des NanoSciences de Paris, France; [2]ENS, France; [3]New Imaging Technologies, France.* Talk discusses implementation of HgTe nanocrystals for infrared imager and how introduction of nanophotonic structure can enhance performances

JM4D.4 • 17:30 (Invited)
Colloidal Quantum Dots as Sources of Single Photons, Andrew H. Proppe[2,1], David B. Berkinsky[2], Shinae Jun[3], Bawendi Moungi[2]; *[1]Univ. of Ottawa & NRC, Canada; [2]Chemistry, Massachusetts Inst. of Technology, USA; [3]Samsung Advanced Inst. of Technology, Korea (the Republic of).* I will discuss the progress, prospects, and challenges of using colloidal quantum dots – specifically core-shell-shell InP/ZnSe/ZnS dots and metal halide perovskite $CsPbBr_3$ dots – as single-photon emitters.

16:00 -- 18:00
Room: W205CD
SM4E • Biophotonic Devices and Sensing
Presider: Kenneth Kin-Yip Wong; Univ. of Hong Kong, Hong Kong

SM4E.1 • 16:00
Stimulated Raman Scattering Microscopy with a Widely Tunable Fiber Optical Parametric Oscillator and Ti:sapphire Laser, Shun Takahashi[1], Kenichi Oguchi[2], Kento Kamei[3], Takaha Mizuguchi[2], Spencer J. Spratt[2], Yasuyuki Ozeki[1,2]; *[1]Department of Electrical Engineering and Information Systems, The Univ. of Tokyo, Japan; [2]Research Center for Advanced Science and Technology, The Univ. of Tokyo, Japan; [3]Department of Electrical and Electronic Engineering, The Univ. of Tokyo, Japan.* We present a widely tunable fiber optical parametric oscillator with a

tuning range of 1470 cm^{-1}. By synchronizing it with a Ti:sapphire laser, we succeed in stimulated Raman scattering imaging across the broad spectral range.

SM4E.2 • 16:15 (Invited)
Utilizing K-means Clustering on Hyperspectral DO-SRS Images of the Mouse Hippocampus, Lingyan Shi[1], Jorge I. Villazon[1]; *[1]Univ. of California San Diego, USA.* Stimulated Raman spectroscopy with deuterium oxide (DO-SRS) allows for metabolic imaging of biomolecule synthesis. Through clustering analysis on the Raman C-H stretching and C-D bands, we can distinguish mouse hippocampal regions based on metabolic activity.

SM4E.3 • 16:45
Phase-Change-Material Trimmed, Fixed-Wavelength Slow Wave Michelson Interferometer Sensors for Low-Cost Chem-Bio Sensing Applications, Jianhao Shen[1], Asela Perera[1], Daniel Donnelly[1], Swapnajit Chakravarty[1]; *[1]Univ. of Dayton, USA.* We experimentally demonstrated compact Michelson interferometer sensors with slow wave enhanced phase sensitivity 277,750 rad/RIU-cm. We overcome fabrication imperfections by actively tuning interferometer fringes using phase change materials for fixed wavelength low-cost chem-bio sensors on-chip.

SM4E.4 • 17:00
Ultra-sensitive Biomolecule Detection using a Metamaterial Absorber Inducing Strong Coupling, Mingyun Kim[1], Dohyun Kang[2], JooYun Jung[2], Jongwon Lee[1]; *[1]UNIST, Korea (the Republic of); [2]KIMM, Korea (the Republic of).* We present a mid-infrared immunoassay biosensor using surface-enhanced infrared absorption spectroscopy. The biosensor leverages a coupled harmonic oscillation model for analysis. With an aptamer-based immunoassay, it attains a limit of detection as 267.4 pM.

SM4E.5 • 17:15
Following in van Leeuwenhoek's Footsteps – Subwavelength Imaging by Contact Ball Lenses, Vasily N. Astratov[1], Amstrong Jean[1], Dipendra Paudel[1], Alexey V. Maslov[2]; *[1]Univ of North Carolina at Charlotte, USA; [2]Univ. of Nizhny Novgorod, Russian Federation.* It is shown that the ball lenses placed in contact with the samples provide micron-scale resolution over millimeter-scale field-of-view in cellphone-based microscopy. It is shown that they significantly enhance the resolution of fluorescent confocal microscopy.

SM4E.6 • 17:30
In Vivo Discontinuity Third-Harmonic-Generation Microscopy for Label-Free Imaging of Human Intraepidermal Nerve Fibers, Pei-Jhe Wu[1,2], Chi-Chao Chao[3,1], Yi-Hua Liao[3,1], Wen-Ying Lin[3,1], Sung-Tsang Hsieh[1,3], Wei-Zen Sun[3,1], Chi-Kuang Sun[1]; *[1]National Taiwan Univ., Taiwan; [2]mesoView Ltd., Taiwan; [3]National Taiwan Univ. Hospital, Taiwan.* Here we introduce discontinuity third-harmonic-generation microscopy, a noninvasive clinical imaging methodology offering three-dimensional visualization of free intraepidermal nerve endings. It provides a label-free imaging solution for diagnosing small fiber neuropathy at the point of care.

16:00 -- 18:00
Room: W206A
FM4F • Interfacing and Control for Single Emitter Quantum Systems
Presider: Kevin Cox; US Army Research Laboratory, USA

FM4F.1 • 16:00
Red-detuned Excitation of a Quantum Emitter via the SUPER Scheme, Yusuf Karli[1], Florian Kappe[1], Vikas Remesh[1], Thomas K. Bracht[2], Armando Rastelli[3], Doris E. Reiter[2], Gregor Weihs[1]; *[1]Inst. für Experimentalphysik, Universität Innsbruck, Austria; [2]Condensed Matter Theory, Department of Physics, TU Dortmund, Germany; [3]Inst. of Semiconductor and Solid State Physics, Johannes Kepler Univ., Austria.* This study presents the innovative "Swing-UP of quantum EmitteR" (SUPER) scheme, employing a unique red-detuned two-color excitation to generate high-quality single-photons from semiconductor quantum dots.

FM4F.2 • 16:15
Coherent excitation of a tin-vacancy color center with the SUPER scheme, Cem Guney Torun[2], Mustafa Gökçe[2], Thomas K. Bracht[3], Mariano Isaza Monsalve[1], Sarah Benbouabdellah[2], Özgün O. Nacitarhan[2], Marco E. Stucki[2,4], Gregor Pieplow[2], Tommaso Pregnolato[2,4], Joseph H. Munns[2], Doris E. Reiter[5], Tim Schroder[2,4]; *[1]Humboldt Universität zu Berlin, Germany; [2]Inst. of Physics, Humboldt Univ. of Berlin, Germany; [3]Inst. of Solid State Theory, Univ. of Münster, Germany; [4]Ferdinand-Braun-Inst., Germany; [5]Faculty of Physics, Technical Univ. Dortmund, Germany.* We apply the novel coherent excitation scheme SUPER for the first time to a diamond color center using pulses detuned from the transition. This approach perspectively enables spectral filtering of the excitation field.

FM4F.3 • 16:30
Fully Integrated Gated InAs Quantum Dots with Surface Acoustic Wave Cavities, Zixuan Wang[1,2], Ryan A. DeCrescent[2], Poolad Imany[1,2], Joseph T. Bush[1,2], Richard P. Mirin[2], Kevin L. Silverman[2]; *[1]Physics, Univ. of Colorado at Boulder, USA; [2]National Inst. of Standards and Technology, Boulder, USA.* We demonstrate a fully integrated opto-mechanical system with gated InAs quantum dots and surface acoustic wave cavities. This system shows narrow optical linewidths of 640 MHz while maintaining excellent mechanical quality factors of 20,000.

FM4F.4 • 17:00
Observation of Depth-Dependent Modification in Local Density of States in Shallow Color Centers in Diamond, Maryam Zahedian[3], Ricardo Vidrio[1], Shimon Kolkowitz[4,2], Jennifer Choy[3]; *[1]Engineering Physics, Univ. of Wisconsin Madison, USA; [2]Physics, Univ. of California, Berkeley, USA; [3]Electrical and Computer Engineering, Univ. of Wisconsin-Madison, USA; [4]Physics, Univ. of Wisconsin-Madison, USA.* This study presents a non-destructive depth characterization method for nitrogen-vacancy (NV) centers in diamond. Through experimental validation, a numerical model is established, correlating the radiative lifetime of NVs with depth, essential for optimizing applications like magnetic sensing.

FM4F.5 • 17:15
An Experimental Platform to Control Solid-State Spin Systems with Engineered Electron Beams, Dominic Catanzaro[1], Jakob Grzesik[1], Charles Roques-Carmes[1], Kenneth J. Leedle[1], Dylan Black[1], Olav Solgaard[1], Jelena Vuckovic[1]; *[1]Stanford Univ., USA.* We have built an experimental platform to study and control interactions between modulated free-electron beams

and microwave spins. Our platform relies on optical readout of spin states in nitrogen vacancy centers in diamond.

FM4F.6 • 17:30

Selective anti-Stokes excitation of a single defect center in hexagonal boron nitride, Yudai Okashiro[1], Hideaki Takashima[2,1], Konosuke Shimazaki[1], Kazuki Suzuki[1], Yu Mukai[1], Igor Aharonovich[3], Shigeki Takeuchi[1]; [1]*Graduate School of Engineering, Kyoto Univ., Japan;* [2]*Chitose Insitute of Science and Technology, Japan;* [3]*Univ. of Technology Sydney, Australia.* The suppression of short-wavelength emission and the appearance of an anti-bunching dip in the second-order correlation function ($g^2(0) = 0.4$) are realized by exciting hexagonal boron nitride (hBN) nanoflakes with multiple defects via anti-Stokes excitation.

FM4F.7 • 17:45

Signatures of dynamically dressed states, Katarina Boos[1], Sang Kyu Kim[1], Thomas Bracht[2], Friedrich Sbresny[1], Jan Kaspari[2], Moritz Cygorek[3], William Rauhaus[1], Carolin Calcagno[1], Jonathan Finley[1], Doris E. Reiter[2], Kai Müller[1]; [1]*TU Munich, Germany;* [2]*TU Dortmund, Germany;* [3]*Heriot-Watt Univ., UK.* We present the observation of the complete resonance fluorescence emission spectrum of a single quantum two-level system driven by finite Gaussian pulses, consisting of the long-predicted characteristic Mollow triplet with multiple sidebands.

16:00 -- 18:00
Room: W206B
SM4G • Heterogeneous Integration
Presider: Lan Li; Westlake Univ., China

SM4G.1 • 16:00

Graphene/silicon heterojunction enabling reconfigurable phase-relevant optical activation function, Chuyu Zhong[1,2], Kun Liao[3], Maoliang Wei[2], Hui Ma[2], Xiaoyong Hu[3], Hongtao Lin[2]; [1]*College of Integrated Circuits and Optoelectronic Chips, Shenzhen Technology Univ., China;* [2]*College of Information Science and Electronic Engineering, Zhejiang Univ., China;* [3]*School of Physics, Peking Univ., China.* Dual-functional graphene/silicon heterojunctions in microring resonators enabled highly reconfigurable optical activation function devices with phase activation. Special nonlinear functions are fed into a complex-valued ONN to challenge image recognition tasks, showing improved results.

SM4G.2 • 16:15

Harmonic mode locked InP/LiNbO3 microcomb laser, Zhengdong Gao[1], Jingwei Ling[1], Shixin Xue[1], Qili Hu[1], Kaibo Zhang[1], Usman A. Javid[1], Raymond L. Rios[1], Jeremy Staffa[1], Qiang Lin[1]; [1]*Univ. of Rochester, USA.* We demonstrate a chip-scale InP/LiNbO3 mode-locked microcomb laser. This device demonstrates programmable mode-locking capabilities at various higher harmonics of the laser cavity's free spectral range.

SM4G.3 • 16:30 (Invited)

Polaritons and Nanophotonics Applications in Earth-Abundant Layered Materials, Ingrid D. Barcelos[1]; [1]*Brazilian Synchrotron Light Laboratory, Brazil.* We provide an overview for studying nano-optics of 2D natural phyllosilicates and briefly update applications that combine natural minerals, graphene, and phyllosilicate layers into functional heterostructures.

SM4G.4 • 17:00

Aluminum Nitride Ring Resonator-Coupled Spin Defects in Hexagonal Boron Nitride for Integrated Quantum Photonics, Henry C. Roberts[1], Aadil Waseem[1], Scott A. Wicker[1], Hamza Abudayyeh[2,3], Dong Seob Kim[2,3], Zhida Liu[2,3], Steven Randolph[4], Xiaoqin Li[2,3], Xiuling Li[1]; *[1]Microelectronics Research Center, The Univ. of Texas at Austin, USA; [2]Department of Physics and Center for Complex Quantum Systems, The Univ. of Texas at Austin, USA; [3]Center for Dynamics and Control of Materials and Texas Materials Inst., The Univ. of Texas at Austin, USA; [4]Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, USA.* We report a new approach to generate waveguide-coupled emission from deterministically implanted boron vacancy spin defects in hBN using single-crystal AlN-on-sapphire ring resonators. This facilitates the eventual development of hBN-based integrated quantum technologies.

SM4G.5 • 17:15

Hybrid integrated GaSb/Si_3N_4 DBR lasers with >30 mW output power and >50 nm wavelength coverage, Chunfan Zhu[1], Zhengqi Geng[2], Jincheng Wei[1], Chengao Yang[2], Zhichuan Niu[2], Ruijun Wang[1], Siyuan Yu[1]; *[1]Sun Yat-sen Univ., China; [2]Inst. of Semiconductors,Chinese Academy of Sciences, China.* We demonstrate hybrid integrated lasers based on a GaSb-based gain chip coupled to a silicon nitride photonic integrated circuit containing Bragg grating posts. The lasers exhibit output power >30 mW and >50 nm wavelength coverage.

SM4G.6 • 17:30

Substrate-inverted Multi-Material Integration Technology (SuMMIT), Luigi Ranno[1], Jia Xu Brian Sia[1,2], Khoi Phuong Dao[1], Juejun Hu[1,3]; *[1]Department of Materials Science and Engineering, Massachusetts Inst. of Technology, USA; [2]School of Electrical and Electronic Engineering, Nanyang Technological Univ., Singapore; [3]Materials Research Laboratory, Massachusetts Inst. of Technology, USA.* Contemporary silicon photonic heterogeneous integration has indicated a series of challenges. Through the strategic consolidation of foundry-level silicon photonics, and hybrid Cu bonding techniques, we propose SuMMIT, where wafer-scale multi-material integration challenges can be overcome.

SM4G.7 • 17:45

High Performance Folded Thin-Film Lithium Niobate Modulators on Quartz Substrate Fabricated by Photolithography, Yongqian Tang[1], Heng Li[1], Quanan Chen[2], Xiangyang Dai[2], Qiaoyin Lu[1], Mingzhi Lu[2], Weihua Guo[1]; *[1]Huazhong Univ. of Science and Techn, China; [2]Ningbo ORI-CHIP Optoelectronics Technology Co. Ltd., China.* We report a high-performance folded thin-film lithium-niobate modulator through photolithography. The fabricated modulator exhibits the V_π of 1.85V and extinction-ratio ~25dB under P_π~17mW with the smooth EE response and EO bandwidth higher than 67GHz.

16:00 -- 18:00
Room: W207A
AM4H • A&T Topical Review on Frequency Comb Spectroscopy: From the VUV to THz II
Presider: Konstantin Vodopyanov; Univ. of Central Florida, CREOL, USA

AM4H.1 • 16:00 (Invited)
Single-comb Tooth Resolution Direct Frequency Comb Spectroscopy Methods, Gianluca Galzerano[1]; [1]*Ist di Fotonica e Nanotecnologie - CNR, Italy.* A detailed review of the different methods of direct-frequency-comb-spectroscopy with single comb tooth resolution is reported.

AM4H.2 • 16:30 (Invited)
Albatross: Charting New Horizons in Infrared Spectroscopy, Nathalie Lenke[1,2], Philipp Rosenberger[1], Sebastian Gröbmeyer[1,3], Aleksandar Sebesta[1,4]; [1]*PULSED GmbH, Germany;* [2]*Max-Planck-Institut für Quantenoptik, Germany;* [3]*Ludwig-Maximilians-Universität München, Germany;* [4]*Center for Molecular Fingerprinting, Hungary.* With albatross, we showcase a compact infrared light source capable of producing single-cycle pulses with exceptional waveform stability. The efficient generation of multi-octave-spanning mid-infrared light is a remarkable illustration of its potential for infrared spectroscopy.

AM4H.3 • 17:00 (Invited)
Chasing Systematic Errors in Dual Comb Spectroscopy, Jérôme Genest[1], Mathieu Walsh[1], Ian Coddington[2], Nathan Malarich[2], Kevin Cossel[2]; [1]*Université Laval, Canada;* [2]*NIST, USA.* Dual comb spectroscopy is currently limited by systematic errors, at the ~1% level in spectral transmittance. Understanding and mitigating these errors is essential for greenhouse gases quantification as well as for improving spectroscopic databases

AM4H.4 • 17:30 (Invited)
Comb-locked Frequency-swept Optical Synthesizer for Precision Spectroscopy, Thomas A. Puppe[1], Sebastian Mueller[1], Wilhelm Kaenders[1]; [1]*TOPTICA Photonics AG, Germany.* The comb-locked frequency-swept optical synthesizer enables optical metrology based on a phase-coherent widely-tuneable single mode laser source with unprecedented performance in terms of tuning speed and frequency accuracy. The technology and applications are discussed.

16:00 -- 18:00
Room: W206BC
SM4I • Mode-Locked Fiber Lasers
Presider: Grzegorz Sobon; Politechnika Wroclawska, Poland

SM4I.1 • 16:00 (Invited)
Instability-driven Mode-locking Mechanisms in Tm-doped Fibre Lasers, Dennis C. Kirsch[1], Maria Chernysheva[1]; [1]*Leibniz Inst. of Photonic Technology, Germany.* I will discuss the pathways towards the implementation of efficient instability-driven mode-locking mechanisms, such as self-starting Mamyshev resonators. Such laser systems leverage the nonlinear and dispersive phenomena in the laser cavity to achieve laser generation with a broad wavelength tuneability range and a variety of ultrashort pulse generation regimes, which are not impaired by the limitations on laser stability or power performance and can be translated to other wavelength ranges.

SM4I.2 • 16:30
Neodymium-Doped Mamyshev Oscillator at 920 nm, Vincent Boulanger[1,2], Michel Olivier[3], François Trépanier[4], Michel Piché[1,2]; [1]*COPL, Canada;* [2]*Université Laval, Canada;* [3]*Cégep Garneau, Canada;* [4]*TeraXion, Canada.* We present an all-fiber linear Mamyshev oscillator

enabled by fiber Bragg gratings and a W-type neodymium-doped fiber. The self-starting oscillator yields 6-nJ pulses compressible to 80-fs at 920 nm with a 20 MHz repetition rate.

SM4I.3 • 16:45
783-MHz fundamental repetition rate CNT mode-locked all Er-doped fiber ring laser, Maolin Dai[1], Bowen Liu[1], Yifan Ma[1], Takuma Shirahata[1], Ruoao Yang[2], Zhigang Zhang[2], Sze Y. Set[1], Shinji Yamashita[1]; *[1]The Univ. of Tokyo, Japan; [2]Peking Univ., China.* We realize 783-MHz fundamental repetition rate in a carbon-nanotubes (CNT) mode-locked Er-doped fiber ring laser with all active fibers. The proposed laser self-starts mode-locking at 108-mW pump power and delivers 623-fs pulses directly.

SM4I.4 • 17:00
Pump-controlled mode-locking switching in an all-polarization-maintaining fiber laser, Maolin Dai[1], Bowen Liu[1], Guanyu Ye[1], Yifan Ma[1], Naoki Yamaguchi[1], Takuma Shirahata[1], Sze Y. Set[1], Shinji Yamashita[1]; *[1]The Univ. of Tokyo, Japan.* We demonstrate the pump-controlled mode-locking switching in an all-polarization-maintaining, CNT-mode-locked fiber laser. By simply changing the injected pump power, the mode-locking can be switched between two wavelengths, or built up at both wavelengths.

SM4I.5 • 17:15
Generation of harmonic mode-locking in an all-PM Tm-doped fiber laser via linear-cavity interferometric NPE, Siwei Peng[1], Chuangkai Li[1], Xuanyi Liu[2], H. Y. Fu[2], Qian Li[1]; *[1]School of Electronic and Computer Engineering, Peking Univ., China; [2]Tsinghua Shenzhen International Graduate School, Tsinghua Univ., China.* We demonstrate an all-polarization-maintaining Tm-doped fiber laser mode-locked by linear-cavity interferometric NPE, achieving robust 3rd-order harmonic mode-locking at 1934 nm with a pulse duration of ~720 fs and a repetition rate of 36 MHz.

SM4I.6 • 17:30
L-band tunable mode-locked fiber laser achieving up to 19 kHz wavelength sweeping rate, Guanyu YE[1], Kin K. Chow[2], Bowen Liu[1], Yifan Ma[1], Maolin Dai[1], Takuma Shirahata[1], Shinji Yamashita[1], Sze Y. Set[1]; *[1]The Univ. of Tokyo, Japan; [2]Engineering, Manchester Metropolitan Univ., UK.* For the first time, we introduce a rapid wavelength-swept L-band tunable mode-locked fiber laser, boasting an exceptional wavelength sweeping rate of up to 19 kHz, enabled by external modulation of the pump current.

SM4I.7 • 17:45
Real-time observation of transient single pulse during the mode-locked build-up dynamics, Dmitrii Stoliarov[3], Igor Kudelin[2,1], Aleksandr Koviarov[3], Edik Rafailov[3]; *[1]Univ. of Colorado at Boulder, USA; [2]Time and Frequency Division, National Inst. of Standards and Technology, USA; [3]Aston Univ., UK.* This study explores pulse dynamics in all – polarization-maintaining (PM) dispersion-managed, mode-locked fiber laser using the Time-Stretch Dispersive Fourier Transform (TS-DFT), focusing on single dissipative soliton generation across time and frequency domains.

16:00 -- 18:00
Room: W207D
AM4J • High-Speed Modulators
Presider: Xinru WU; Intel Corporation, USA

AM4J.1 • 16:00
Foundry Manufactured 6-bit Resolution, 150µm Long Slow-Light Electro-Optic Modulator for On-Chip Photonic Tensor Computing, Meng Zhang[1], Amir Begović[1], Dennis Yin[2], Nicholas Gangi[1], Jiaqi Gu[2], Rena Huang[1]; *[1]Rensselaer Polytechnic Inst., USA; [2]Arizona State Univ., USA.* We demonstrate 6-bit DAC resolution with an ultra-compact slow-light electro-optic modulator. The 10x modulation length reduction enables 31x compute density, 1.17x energy efficiency, and 36.1x energy efficiency per unit area for photonic tensor computing.

AM4J.2 • 16:15
A Weak DC-Drift Silicon/Lithium Niobate Heterogeneous Integrated Electro-Optical Modulator, Zhuoyun Li[1,2], Yang Chen[1], Shuxiao Wang[1], Mingbin Yu[3,4], Xin Ou[1], Yan Cai[1,4]; *[1]State Key Laboratory of Functional Materials for Informatics, Shanghai Inst. of Microsystem and Information Technology, Chinese Academy of Sciences, China; [2]Univ. of the Chinese Academy of Sciences, China; [3]Shanghai Mingkun Semiconductor Co., Ltd., China; [4]Shanghai Industrial Technology Research Inst., China.* We demonstrate weak DC-drift Mach-Zehnder modulators based on wafer-scale heterogeneous integrated Silicon/Lithium niobate platform and exhibit a stable Vpi.L of 2.9 V.cm, and data transmission rate up to 176 Gbit/s for four-level pulse amplitude modulation.

AM4J.3 • 16:30
PAM-4 optical transmission beyond 224 Gbps based on an ultrahigh-bandwidth slow-light silicon modulator, Changhao Han[1,2], jun qin[3], Qipeng Yang[1], Zhao Zheng[1], Haowen Shu[1], Yunhao Zhang[4], Yichen Wu[1], Yu Sun[3], Junde Lu[3], Yan Zhou[5], Zhangfeng Ge[5], Lei Wang[4], Zhixue He[4], Shaohua Yu[1,4], Weiwei Hu[1], Chao Peng[1], John Bowers[2], Xingjun Wang[1]; *[1]School of Electronics, Peking Univ., China; [2]Department of Electrical and Computer Engineering, Univ. of California, Santa Barbara, USA; [3]Beijing Information Science and Technology Univ., China; [4]Peng Cheng Laboratory, China; [5]Peking Univ. Yangtze Delta Inst. of Optoelectronics, China.* We experimentally demonstrate PAM-4 optical transmission beyond 224 Gbps based on an ultrahigh-bandwidth slow-light silicon modulator in C-band with the combination of the artificial neural network equalizers.

AM4J.4 • 17:00
110-GHz bandwidth integrated lithium niobate modulator without direct lithium niobate etching, Yifan Qi[1], Gongcheng Yue[1], Ting Hao[2], Yang Li[1]; *[1]Tsinghua Univ., China; [2]Advanced Fiber Resources Ltd., China.* We present an integrated thin film lithium niobate (TFLN) modulator featuring a 3-dB bandwidth higher than 110 GHz without direct etching of TFLN. Our design significantly simplifies the fabrication process of integrated TFLN modulators and in turn opens up new avenues for the mass production of high-performance TFLN modulators at low cost.

AM4J.5 • 17:15
Efficient Optical Modulation: Unveiling the Potential of Si-ITO Distributed Heterojunctions Coupling in Subwavelength Gratings, Swati Rajput[1], Abhinav Singh Parihar[2], Vishal

Kaushik[3], Mukesh Kumar[4]; *[1]Department of Electrical Engineering, Indian Inst. of Technology Jodhpur, India; [2]National Sun Yat Sen Univ. Kaohsiung, Taiwan; [3]Tel Aviv Univ. Israel, Israel; [4]IIT Indore, India.* We propose an optical modulation technique using electro-optic coupling in localized multiple Si-ITO heterojunctions inside a subwavelength grating. Experimental results exhibit a 24 dB extinction coefficient, 0.34 V-mm modulation efficiency, and 36 pJ energy consumption.

AM4J.6 • 17:30

RF Crosstalk Suppression in Parallel Silicon Photonic Mach-Zehnder Modulators, Abdolkhalegh Mohammadi[1,2], Leslie Rusch[1,2], Wei Shi[1,2]; *[1]Université Laval, Canada; [2]COPL, Canada.* We use floating shield strips to suppress crosstalk in parallel traveling-wave Mach-Zehnder modulators (TW-MZM). We demonstrate an increase of nearly 50% in shoreline bandwidth density and an improved RF crosstalk lower than -25dB at 60GHz.

AM4J.7 • 17:45

A 70-GHz Lumped-EML Submodule Using Resistance-Optimized LC Resonance for Wide Temperature 112-Gbaud PAM4 Operation, Seokjun Yun[1], Youngtak Han[1], Donghun Lee[1], Hyunwoo Lee[1], Donghyu Lee[1], Janguk Shin[1], Sangho Park[1], Yongsoon Baek[1]; *[1]ETRI, Korea (the Republic of).* We report on a lumped-EML submodule with 3-dB bandwidths of > 70 GHz over wide temperature ranges of 25C ~ 70C using a resistance-optimized LC resonance effect, enabling 2-km transmission of 112-Gbaud PAM4 signals.

16:00 -- 18:00
Room: W208
FM4K • Photonic Quantum State Engineering
Presider: Matthew Grein; Massachusetts Inst of Tech Lincoln Lab, USA

FM4K.1 • 16:00

Intracavity Quantum Dynamics and Tomography in a Biased Optical Parametric Oscillator, Yannick Salamin[1], Seou Choi[2], Charles Roques-Carmes[2], Jamison Sloan[1], Michael Horodynski[1], Marin Soljačić[1]; *[1]Massachusetts Inst. of Technology, USA; [2]Stanford Univ., USA.* We present a method for reconstructing intracavity dynamics of an optical parametric oscillator and performing cavity quantum tomography. Our approach involves evaluating the sensitivity of the bistable oscillator's output to a bias field.

FM4K.2 • 16:15 (Invited)

Measuring the Impossible Using Indefinite Causal Order, Jaden McKinlay[6,1], Markus Rambach[6,1], Aaron Z. Goldberg[4,5], Khabat Heshami[4,5], Luis Sánchez-Soto[2,3], Andrew G. White[6,1]; *[1]Univ. of Queensland, Australia; [2]Universidad Complutense, Spain; [3]Max-Planck-Institut für die Physik des Lichts, Germany; [4]National Research Council of Canada, Canada; [5]Univ. of Ottawa, Canada; [6]Centre for Engineered Quantum Systems, Australia.* We demonstrate that a probe traversing a noisy channel and a measurement channel withstands arbitrarily more noise than any system with definite causal order, even if the probe is fully mixed and the noisy channel erases all information.

FM4K.3 • 16:45

Non-Gaussian States Generation Using a High-Speed Single-Pixel Superconducting Nano-Strip Photon-Number-Resolving Detector, Kazuma Takahashi[1], Mamoru Endo[1,2], Nomura Takefumi[1], Tatsuki Sonoyama[1], Takahiro Kashiwazaki[3], Asuka Inoue[3], Takeshi Umeki[3], Masahiro Yabuno[4], Fumihiro China[4], Hirotaka Terai[4], Shigehito Miki[4,5], Rajveer Nehra[6,7], Kan Takase[1,2], Warit Asavanant[1,2], Akira Furusawa[1,2]; *[1]Applied Physics, School of Engineering, The Univ. of Tokyo, Japan; [2]Optical Quantum Computing Research Team, RIKEN Center for Quantum Computing, Japan; [3]NTT Device Technology Labs, NTT Corporation, Japan; [4]Advanced ICT Research Inst., National Inst. of Information and Communications Technology, Japan; [5]Graduate School of Engineering, Kobe Univ., Japan; [6]Department of Electrical and Computer Engineering, Univ. of Massachusetts-Amherst, USA; [7]Department of Physics, Univ. of Massachusetts-Amherst, USA.* We performed the first non-Gaussian state generation through two photon subtraction with a recently developed single-pixel superconducting nano-strip photon-number-resolving detector. We observed negative values of Wigner function of W(0,1.0) = −0.0072 ± 0.006 without loss correction.

FM4K.4 • 17:00
Experimental realization of optical cat states by photon-addition, Yi-Ru Chen[1], Hsien-Yi Hsieh[1], Jingyu Ning[1], Hsun-Chung Wu[1], Hua Li Chen[1], Zi-Hao Shi[1], Popo Yang[1], Ole Steuernagel[1], Chien-Ming Wu[1], Ray-Kuang Lee[1]; *[1]National Tsing Hua Univ., Taiwan.* We added (heralded) single photons to squeezed vacuum states creating approximate optical ‘cat states’ at rates exceeding 2.3×10^5 / second; at least one order of magnitude higher than all previously reported realizations.

FM4K.5 • 17:15
Pulse Characterization by spectral correlation function measurement with a quantum pulse gate, Abhinandan Bhattacharjee[1], Laura Serino[1], Patrick Folge[1], Benjamin Brecht[1], Christine Silberhorn[1]; *[1]Paderborn Univ., Germany.* We measure the two-point spectral correlation function to completely characterize an ultrafast pulse with arbitrary level of coherence using a quantum pulse gate. Our method is readily applicable to single-photon pulses.

FM4K.6 • 17:30
Strict Verification of Multiple Indefinite Causal Orders on a Programmable Silicon-Photonic Quantum Chip, Yaohao Deng[1], Jianwei Wang[1]; *[1]Peking Univ., China.* We report strict verification of multiple types of indefinite causal orders and demonstrate distillation of indefinite causal order utilizing a programmable silicon-photonic quantum chip. This experimental implementation contributes to the development of a resource theory for indefinite causal order.

FM4K.7 • 17:45
Deterministic Quantum State Generators and Stabilizers From Nonlinear Photonic Filter Cavities, Sean Chen[1], Nicholas Rivera[2,1], Jamison Sloan[3], Marin Soljačić[1,3]; *[1]Physics, Massachusetts Inst. of Technology, USA; [2]Physics, Harvard Univ., USA; [3]Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA.* We develop new schemes that exploit specially designed Kerr nonlinear resonators with non-Markovian dissipation to deterministically generate and stabilize important non-Gaussian quantum states (e.g., Fock, cat, and photon-number-comb states) from simple inputs.

16:00 -- 18:00
Room: W209A
SM4L • High Precision Spectroscopy and Waveform Characterization
Presider: Havva Begüm Kabagöz; Caltech – LIGO Livingston, USA

SM4L.1 • 16:00 (Tutorial)
Dual-comb Interferometry: Principle and Latest Trends, Nathalie Picqué[1]; *[1]Max-Planck-Institut fur Quantenoptik, Germany.* An interferometer can be formed using two frequency combs of slightly different line spacing. Dual-comb interferometers without moving parts are fundamentally different from any other type of interferometers. They outperform state-of-the-art devices in an increasing number of fields including spectroscopy and three-dimensional imaging. This tutorial introduces dual-comb interferometry and reviews a selection of exciting recent developments.

SM4L.2 • 17:00
Femtosecond Pulse Characterization using Nanophotonic Parametric Amplification, Thomas Zacharias[1], Robert M. Gray[1], James Williams[1], Luis Ledezma[1], Alireza Marandi[1]; *[1]Caltech, USA.* We introduce and experimentally demonstrate a FROG-based ultrashort pulse characterization technique using nanophotonic parametric amplification as a crucial tool for ultrafast nanophotonic circuits, and measure sub-50-femtosecond pulses.

SM4L.3 • 17:15
Spectral Speckle Customization, Nicholas Bender[1], Henry Haig[1], Demetrios Christodoulides[2], Frank Wise[1]; *[1]Cornell Univ., USA; [2]Ming Hsieh Department of Electrical and Computer Engineering, Univ. of Southern California, USA.* We present an experimental technique for customizing the spatio-spectral speckled intensity statistics of ultra-short optical pulses at the output of a a disordered multimode fiber by controlling the spatial profile of the input light.

SM4L.4 • 17:30
TIPTOE Laser Waveform Sampling with AlGaN Photodiode for Fast Scanning Measurements, Christopher A. Lantigua[1], Tran C. Truong[1], Chelsea Kincaid[1], Dipendra S. Khatri[1], Aamir Mushtaq[1], Michael Chini[1,2]; *[1]Physics, Univ. of Central Florida, USA; [2]College of Optics and Photonics, Univ. of Central Florida, USA.* Multiphoton excitation in AlGaN provides a sub-cycle gate capable of sampling few-cycle waveforms in the near-infrared. We demonstrate near-infrared laser waveform sampling using an AlGaN photodiode in a scanning TIPTOE geometry.

SM4L.5 • 17:45
Lithium Niobate Chip-Based Ultrafast Optical Signal Processor, Clayton Cheung[1], Xinyi Ren[1], Chun-Ho Lee[1], Reshma Kopparapu[1], Yu Yue[1], Zaijun Chen[1], Mengjie Yu[1]; *[1]Univ. of Southern California, USA.* We realize an ultrafast optical processor via combining a low-loss dispersive device with an electro-optic time lens on lithium niobate-based chips. We show the ability to Fourier transform and magnify sub-picosecond temporal waveforms by > 800x.

16:00 -- 17:45
Room: W209B
SM4M • Quantum and Photonic Computing II
Presider: Blair Morrison; Xanadu, Canada

SM4M.1 • 16:00
Silicon Multi-Functional Photonic Processing Chip for Multiply-Accumulate Computation, Rou Wang[1], Liangjun Lu[1,2], Yuanbin Liu[1], Yue Wu[1], Yu Li[1,2], Jianping Chen[1,2], Linjie Zhou[1,2]; *[1]Shanghai Jiao Tong Univ., China; [2]SJTU-Pinghu Inst. of Intelligent Optoelectronics, China.* We propose a silicon multi-functional photonic processing chip for multiply-accumulate computation (MAC), which is capable for high-speed data encoding and flexible weight control. Experimental results verify a 6-bit MAC precision and image convolution operation.

SM4M.2 • 16:15
Realization of a Compact Photoelectric Platform for Optical Convolution Processing, Shupeng Ning[1], Hanqing Zhu[1], Chenghao Feng[1], Christian Uselton[1], Jiaqi Gu[1,2], Rongxing Tang[1], David Z. Pan[1], Ray T. Chen[1,3]; *[1]Department of Electrical and Computer Engineering, The Univ. of Texas at Austin, USA; [2]School of Electrical, Computer and Energy Engineering, Arizona State Univ., USA; [3]Omega Optics, Inc., USA.* We presents a hardware-efficient optical computing architecture for structured neural networks (OSNNs). The performance of our neural chip was validated on a photonic-electronic testing platform experimentally, demonstrating reduced optical component utilization and small deviation.

SM4M.3 • 16:30 (Invited)
Nonvolatile Platforms for On-chip Photonic Computing, Nathan Youngblood[1], Sadra Rahimi Kari[1], Nicholas A. Nobile[1], Vivswan Shah[1]; *[1]Univ. of Pittsburgh, USA.* This talk discusses various strategies for photonic computing using nonvolatile optical materials on an integrated silicon photonics platform. Both experimental demonstrations and methods for modeling large scale photonic neural networks will be presented.

SM4M.4 • 17:00
Prototyped and Upgraded Programmable On-chip Photonic Joint Transform Correlator-Based CNN, Hangbo Yang[1], Nicola Peserico[2,3], Shurui Li[1], Benyamin F. Motlagh[1], Jaskirat S. Virdi[1], Puneet Gupta[1], Volker Sorger[2,3], Chee Wei Wong[1]; *[1]Electrical and Computer Engineering, UCLA, USA; [2]Electrical and Computer Engineering, Univ. of Florida, USA; [3]Florida Semiconductor Inst., Univ. of Florida, USA.* We manufacture and optimize a prototyped programmable on-chip photonic joint transform correlator-based convolution neural network. We also illustrate the upgraded potential of the system.

SM4M.5 • 17:15
Ultra-compact optical neural network chip, Wencan Liu[1], Tingzhao Fu[1], Yuyao Huang[1], Run Sun[1], Sigang Yang[1], Hongwei Chen[1]; *[1]Tsinghua Univ., China.* Two diffractive optical neural network chips featuring an integration level of over 60,000 neurons/mm2 are fabricated, experimentally yielding accuracies of 90.0% and 93.3% on the Iris plants dataset, respectively.

SM4M.6 • 17:30

Integrated Coherent Photonic Crossbar Arrays for Efficient Optical Computing, Sadra Rahimi Kari[1], Allison Hastings[1], Nicholas A. Nobile[1], Dominique Pantin[1], Vivswan Shah[1], Nathan Youngblood[1]; *[1]Univ. of Pittsburgh, USA.* We present a scalable approach to optical computing using coherent crossbar arrays for processing temporally multiplexed signals. Our design enables scalable matrix-matrix operations, and correlation detection, enabling efficient on-chip optical computing for diverse AI applications.

16:00 -- 18:00
Room: W209C
SM4N • Nonlinear Integrated Photonics II
Presider: Saman Jahani; ASML Optics LLC, USA

SM4N.1 • 16:00
Sidewall poled lithium niobate ridge waveguides for efficient UV generation, Cornelis A. Franken[1,2], Soumya S. Ghosh[2,4], Caique C. Rodrigues[2,3], CJ Xin[2], Keith Powell[2], JIayu Yang[2], Shengyuan Lu[2], Neil Sinclair[2], Klaus Boller[1], Marko Loncar[2]; *[1]Univ. of Twente, Netherlands; [2]Harvard S.E.A.S., USA; [3]State Univ. of Campinas, Brazil; [4]Harvard Physics, USA.* We demonstrate a novel process enabling poling of the entire ridge in etched thin-film lithium niobate waveguides for upconversion from visible to UV. We achieve a peak on-chip UV power of 13.7 ± 3.9 µW.

SM4N.2 • 16:15
Diffusion-Doped Lithium Tantalate Waveguides for Watt-level Nonlinear Frequency Conversion in the Near UV, Sergiy Suntsov[1], Sarah Kretschmann[1], Kore Hasse[1], Detlef Kip[1]; *[1]Helmut-Schmidt-Univ., Germany.* Highly photorefractive optical damage resistant ridge waveguides for near UV and short-wavelength visible ranges have been fabricated using high-temperature diffusion doping with different metal ions and vapor transport equilibration method of commercially available congruently melting $LiTaO_3$ crystals.

SM4N.3 • 16:30
Type-II Second-order Nonlinear Processes in Silicon Carbide Nanophotonic Waveguides, Xiaodong Shi[1,2], Yaoqin Lu[2], Sihao Wang[1], Veerendra Dhyani[1], Sakthi S. Mohanraj[1], Victor Leong[1], Jingjing Zhang[3], Haiyan Ou[2], Di Zhu[4,1]; *[1]IMRE, A*STAR, Singapore; [2]Technical Univ. of Denmark, Denmark; [3]Jiangsu Univ., China; [4]National Univ. of Singapore, Singapore.* Silicon carbide (SiC) is a promising material for integrated nonlinear and quantum photonics. We experimentally demonstrate type-II phase-matched second-harmonic generation and sum-frequency generation in 4H-SiC-on-insulator (SiCOI) nanophotonic waveguides.

SM4N.4 • 16:45
61.3% Efficiency of Second Harmonic Generation in a Lithium Niobate Microresonator, Zhiyan Wang[1], Xiao Wu[2], Zhenzhong Hao[2], Qi-Tao Cao[1], Fang Bo[2], Yun-Feng Xiao[1]; *[1]State Key Laboratory for Mesoscopic Physics and Frontiers Science Center for Nano-optoelectronics, School of Physics, Peking Univ., China; [2]MOE Key Laboratory of Weak-Light Nonlinear Photonics, TEDA Inst. of Applied Physics and School of Physics, Nankai Univ., China.* We demonstrate the second harmonic generation process with a record efficiency of 61.3%, benefiting from the generalized critical coupling condition. Besides, a dichromatic pump-probe method is proposed for real-time phase-matching monitoring.

SM4N.5 • 17:00
Active nonlinear mid-infrared photonics, Dmitry Kazakov[1], Theodore P. Letsou[1], Marco Piccardo[1], Lorenzo Columbo[2], Massimo Brambilla[3], Franco Prati[4], Pawan Ratra[1], Sandro Dal Cin[5], Maximilian Beiser[5], Michael Pushkarsky[6], David Caffey[6], Timothy Day[6], Nikola Opacak[5], Luigi Lugiato[4], Benedikt Schwarz[5], Federico Capasso[1]; *[1]Harvard Univ., USA; [2]Politecnico di Torino, Italy; [3]Univ. of Bari, Italy; [4]Univ. of Insubria, Italy; [5]TU Vienna, Austria; [6]DRS Daylight Solutions, USA.* Our DC-driven semiconductor laser chip generates one picosecond solitons at 8.3 μm, using active nonlinear resonators. It integrates all components (pump, resonator, filter), enabling turnkey, background-free bright pulse generation with immediate applications in nonlinear mid-infrared photonics.

SM4N.6 • 17:30
Enhanced On-Chip Green Light Generation by Nonlinear Up-Conversion Using Fabry-Pérot Microcavities, Md Saiful Islam Sumon[1], Shrivatch Sankar[1], Imad I. Faruque[2], Sarvagya Dwivedi[3], Shamsul Arafin[1]; *[1]Ohio State Univ., USA; [2]Univ. of Bristol, UK; [3]Texas Instruments, USA.* Photonic integrated circuits for green light generation through up-conversion of on-chip near-infrared lasers are designed using SiN-LN hybrid waveguides. A Fabry-Pérot microcavity-based technique is employed to enhance the nonlinear conversion efficiency.

SM4N.7 • 17:45
Sub-Terahertz field-resolved detection using a thin-film lithium niobate platform, Alessandro Tomasino[1], Amirhassan Shams-Ansari[2], Marko Loncar[2], Ileana-Cristina Benea-Chelmus[1]; *[1]Ecole Polytechnique Federale de Lausanne, Switzerland; [2]Harvard School of Engineering and Applied Sciences, Harvard Univ., USA.* We present a new class of thin-film lithium niobate integrated detectors, featuring a millimeter-long sensitive area and capable of performing the off-focus field-resolved reconstruction of sub-terahertz transients

16:00 -- 18:00
Room: W209DE
FM4O • Application of Photonic & Plasmonic Metasurfaces
Presider: Nicolò Maccaferri; Umea Universitet, Sweden

FM4O.1 • 16:00
MEMS-based metasurfaces for a dynamic OAM-Gaussian switching fiber laser, Chuanshuo Wang[1,2], Chao Meng[2], Xianglong Mei[1], Lili Gui[1], Paul Conrad Vaagen Thrane[2,3], Fei Ding[2], Sergey I. Bozhevolnyi[2], Kun Xu[1]; *[1]Beijing Univ. of Posts and Telecomm, China; [2]Univ. of Southern Denmark, Denmark; [3]SINTEF Microsystems and Nanotechnology, Norway.* We introduce a dynamic fiber laser with an intracavity electrically-driven MEMS metasurface for efficient and rapid switching between complex vortex and simple Gaussian beam modes at 1030 nm wavelength.

FM4O.2 • 16:15
Integrated plasmonic gradient metasurfaces for directional photodetection, Jianing L. Liu[1], Roberto Paiella[1]; *[1]Boston Univ., USA.* We demonstrate the use of plasmonic gradient metasurfaces to tailor the angular response of generic planar photodetectors. The resulting

devices are promising for a wide range of computational imaging applications with enhanced miniaturization and functionality.

FM4O.3 • 16:30

Experimental observation of propagation of off-Γ BIC in 1D grating structures, Komei Hamaya[1], Yuto Moritake[1], Taiki Yoda[1], Eiichi Kuramochi[2,3], Masaaki Ono[2,3], Masaya Notomi[1,2]; *[1]Tokyo Inst. of Technology, Japan; [2]NTT Basic Research Laboratories, Japan; [3]NTT Nanophotonics center, Japan.* We directly observed propagation of off-Γ bound states in the continuum (BIC) in gratings in the near-infrared region. Millimeter-scale long propagation and unique self-collimation behavior were observed, which explained by high Q-factor of off-Γ BIC.

FM4O.4 • 16:45

Radiation Pressure Measurement on Power-Reporting Lightsail Membranes, Lior Michaeli[1], Ramon Gao[1], Michael D. Kelzenberg[1], Claudio U. Hail[1], John E. Sader[2], Harry A. Atwater[1]; *[1]Department of Applied Physics and Materials Science, California Inst. of Technology, USA; [2]Graduate Aerospace Laboratories, California Inst. of Technology, USA.* We measure radiation pressure forces exerted on a 50-nm-thick silicon nitride lightsail membrane by a collimated beam, as a function of angle. The lightsail reports the driving power by simultaneously acting as a micromechanical bolometer.

FM4O.5 • 17:00

Free-space electro-optic modulators using high quality factor silicon on lithium niobate metasurfaces, Sahil Dagli[1], Halleh Balch[1], Hamish Carr Delgado[1], Sajjad AbdollahRamezani[1], Jefferson Dixon[1], Varun Dolia[1], Jung-Hwan Song[1], Elissa Klopfer[1], Babatunde Ogunlade[1], Jennifer Dionne[1]; *[1]Stanford Univ., USA.* We present electro-optically tunable high quality factor metasurfaces using a silicon on lithium niobate platform. Using electrically biased guided mode resonant nanoantennas, our metasurface modulates the amplitude of telecom light in the >100 MHz range.

FM4O.6 • 17:30

Multiplex Immunoassays Enabled by Pixelated High-Quality Factor Metasurfaces and Acoustic Bioprinting, Sajjad AbdollahRamezani[1]; *[1]Stanford Univ., USA.* We demonstrate a compact multiplex immunoassay platform by leveraging ultra-densely-pixelated high-quality factor metasurfaces, acoustic bioprinting of surface chemistry, and hyperspectral imaging for the rapid detection of multiple proteins with high sensitivity and specificity.

FM4O.7 • 17:45

Amplifying and Reshaping Quantum Well Photo-Luminescence with Plasmonic Metasurfaces, Tamar Haimov[1], Iddo Tsur[1], Jacob Scheuer[1]; *[1]Tel Aviv Univ., Israel.* We present a theoretical framework and experimental verification of photoluminescence enhancement from QWs and spectral reshaping, by coupling to plasmonic metasurfaces. The model facilitates spectral emission design and reveals the significance of polarization effects.

16:00 -- 18:00
Room: W209F
SM4P • THz Metasurfaces
Presider: Tom Seifert; Freie Universität Berlin, Germany

SM4P.1 • 16:00 (Invited)
Controlled THz generation by plasmonic nonlinear metasurfaces, Tal Ellenbogen[1]; *[1]Department of Physical Electronics, Tel Aviv Univ., Israel.* We will present recent advancements in the ability of nano-engineered plasmonic metasurfaces to generate broadband, highly controlled THz waveforms. Mechanisms for radiation efficiency enhancement and spatiotemporal amplitude phase and polarization control will be discussed.

SM4P.2 • 16:30
Magnetically Controlled Multi-resonance Modes in Near-field Coupled Metasurfaces, Nityananda Acharyya[1], Soumyajyoti Mallick[1], Shreeya Rane[1], Mousumi Upadhyay Kahaly[2], Dibakar Roy Chowdhury[1]; *[1]Mahindra Univ., India; [2]Extreme Light Infrastructure, Hungary.* We have demonstrated active control (magnetically) over multi-resonances in near field coupled metasurfaces. Our proposed design allows the external magnetic field to impose simultaneous dynamic control over dipolar and higher order modes.

SM4P.3 • 16:45
Continuous-wave Terahertz Difference-Frequency Generation from Intersubband Polaritonic Metasurface, Jonas Heiko Krakofsky[1], Simon Stich[1], Gerhard Boehm[1], Mikhail A. Belkin[1]; *[1]Walter-Schottky Inst. (TU Munich), Germany.* Metasurface with giant nonlinear response ($\chi^{(2)} \approx 10^5$ pm/V) for terahertz difference-frequency generation is experimentally realized. Terahertz generation using commercial continuous-wave lasers is demonstrated with infrared-to-terahertz conversion efficiency exceeding that of photomixers in the 2.5-5 THz range.

SM4P.4 • 17:00
A High-Efficiency Terahertz Sensor Based on Surface Lattice Resonance Metasurface for Biochemical Detection, Hongshun Sun[1], Li Liye[1], Lijun Ma[1], Yunhao Cao[1], Yusa Chen[1], Wengang Wu[1]; *[1]Peking Univ., China.* We propose a novel terahertz sensor based on surface lattice resonance metasurface with high sensitivity (502.8GHz/RIU), and simple structure design. In addition, the resonance frequency and sensitivity can be controlled regularly by adjusting the period.

SM4P.5 • 17:15
Mitigating Saturation Effects in Heterodyne Terahertz Detection with Plasmonic Nanoantenna Arrays, Joseph J. Hwang[1], Szu-An Tsao[1], Nezih T. Yardimci[1,2], Mona Jarrahi[1]; *[1]UCLA, USA; [2]Lookin Inc., USA.* We experimentally compare the performance of a plasmonic nanoantenna array with an antenna-coupled photomixer for high sensitivity heterodyne detection and demonstrate its superiority in mitigating saturation effects.

SM4P.6 • 17:30
Large Optical Tunability of Terahertz Third Harmonic Generation in Metamaterial, Chen Wang[1], Yong Tan[1], Yongzheng Wen[1], Shiqiang Zhao[1], Kaixin Yu[1], Jingbo Sun[1], Ji Zhou[1]; *[1]Tsinghua Univ., China.* We experimentally demonstrated large optical tunability of

terahertz third harmonic generation in metamaterial comprising aluminum split ring resonators and silicon film, achieving modulation depth up to 2.1×10^4% in picosecond time.

16:00 -- 18:00
Room: W210
SM4Q • Advances in Nonlinear Pulse Compression and Characterization
Presider: Shu-Wei Huang; Univ. of Colorado at Boulder, USA

SM4Q.1 • 16:00
Generation of 1.8-mJ, 2.5-µm, Sub-3-Cycle Laser Pulses via Hollow-Core Fiber Pulse Compression, Huanyu Song[1], Mat Britton[1], Kirk Larsen[1], Brian Kaufman[1], Martin Gebhardt[2], Christian Brahms[2], John Travers[2], Marcel Neuhaus[1], Christopher A. Lantigua[3], Chelsea Kincaid[3], Yi Wu[3], Michael Chini[3], Zenghu Chang[3,4], Joseph Robinson[1], Eric Cunningham[1], Ruaridh Forbes[1]; *[1]Linac Coherent Light Source, SLAC National Accelerator Laboratory, USA; [2]School of Engineering and Physical Sciences, Heriot-Watt Univ., UK; [3]Inst. for the Frontier of Attosecond Science and Technology, Univ. of Central Florida, USA; [4]Department of Physics, Univ. of Ottawa, Canada.* We report on nonlinear compression of 2.5-µm, sub-100 fs laser pulses using a noble-gas-filled hollow core fiber. MgF_2 wedges are used to compress the pulse and perform dispersion-scan. Sub-3-cycle, 1.8-mJ pulses are obtained after compression.

SM4Q.2 • 16:15
Withdrawn

SM4Q.3 • 16:30
Quasi-continuous air waveguiding, Andrew T. Goffin[1], Andrew Tartaro[1], Howard M. Milchberg[1]; *[1]Univ. of Maryland, College Park, USA.* Using high-repetition-rate structured multi-filamentation of femtosecond laser pulses, we generate a continuously operating air waveguide. We demonstrate undisrupted guiding of a CW probe beam with significantly improved performance.

SM4Q.4 • 16:45 (Invited)
Withdrawn

SM4Q.5 • 17:15
High Efficiency Plasma Gratings Generated by Laser-Driven Avalanche Ionization, Stefan K. Waczynski[1], Anthony Zingale[1,3], Matthew Edwards[2], Pierre Michel[2], Howard M. Milchberg[1]; *[1]UMD IREAP, USA; [2]Lawrence Livermore National Laboratory, USA; [3]Los Alamos National Laboratory, USA.* We demonstrate high-efficiency diffraction of intense l=3.9 um laser pulses from plasma gratings generated by avalanche ionization of atomic clusters driven by a pair of intersecting 1.064 nm pulses.

SM4Q.6 • 17:30
Pulse energy scaling of post-compression using folded multi-pass cells, Arthur Schönberg[1], Supriya Rajhans[1,2], Nikita Khodakovskiy[1], Esmerando Escoto[1], Victor Hariton[1], Wim P. Leemans[1], Ingmar Hartl[1], Christoph M. Heyl[1,2]; *[1]Deutsches Elektronen-Synchrotron DESY, Germany; [2]Helmholtz-Inst. Jena, Germany.* We present a concept for pulse energy scaling of post-compression using a folded multi-pass cell geometry. We experimentally show

efficient spectral broadening of 8 mJ pulses and demonstrate compression from 1 ps to 51 fs in a compact setup.

SM4Q.7 • 17:45
146 W, 7 fs, 11 µJ Thin-Disk Oscillator Compressed with Multipass Cells, Semyon Goncharov[1], Kilian Fritsch[2], Oleg Pronin[1]; *[1]Helmut-Schmidt Univ., Germany; [2]n2-Photonics, Germany.* We report nonlinear broadening and pulse compression in two consecutive multipass cells based on dielectric mirrors. The 120 fs pulses at 14 MHz containing 12.8 µJ were compressed to 7.2 fs with 146 W average power.

16:00 -- 18:00
Room: W211
FM4R • Quantum Estimation and Characterization
Presider: Animesh Datta; Univ. of Warwick, UK

FM4R.1 • 16:00
Optimal Quantum Multi-Parameter Estimation with Few-Photon States, Hugo Ferretti[1], Caitlin P. Dobney[1], Y. Batuhan Yilmaz[1], Kent Bonsma-Fisher[2], Aaron Z. Goldberg[2], Noah Lupu-Gladstein[1], Arthur O. T. Pang[1], Aephraim M. Steinberg[1,3]; *[1]Univ. of Toronto, Canada; [2]National Research Council of Canada, Canada; [3]CIFAR, Canada.* We report on the experimental demonstration and characterisation of the “tetrahedron state”, the optimal four-photon state for simultaneous estimation of all parameters describing a rotation. We propose a follow-up experiment to create the optimal two-photon state for this task.

FM4R.2 • 16:15
Tomography of a Frequency-Bin Qubit, Richard Oliver[1], Sidarth Raghunathan[1], Hoi Chun Chiu[1], Ali Binai motlagh[1], Alexander L. Gaeta[1]; *[1]Columbia Univ., USA.* Using Bragg-scattering four-wave mixing, we prepare frequency-bin qubits and measure a purity of 0.92 through a lossy channel, suggesting viability for quantum networks using existing telecommunications infrastructure. Such a frequency-bin qubit obviates the polarization-compensation requirement of polarization qubits.

FM4R.3 • 16:30
Threshold Quantum State Tomography, Daniele Binosi[1], Diego Maragnano[2], Giovanni Garberoglio[1], Maurizio Dapor[1], Marco Liscidini[2]; *[1]European Centre for Theoretical Studies in Nuclear Physics and Related Areas, Italy; [2]Department of Physics, Univ. of Pavia, Italy.* We introduce a new approach to quantum state tomography (QST) in which the number of measurements can be dramatically smaller than in traditional QST without compromising fidelity. We show experimental results up to 7 qubits.

FM4R.4 • 16:45
Single Photon Entangled State Tomography in a Single Measurement Setup, Ron Ziv[1], Roey Shafran[1], Mordechai Segev[1]; *[1]Technion, Israel.* We propose a method for reconstructing density matrices of single-photon OAM-polarization entangled states using a single intensity measurement, facilitated by coupling the state to higher-order OAM modes.

FM4R.5 • 17:00 (Invited)

Variational Quantum Algorithm for Multiparameter Estimation, Valeria Cimini[1]; *[1]Univ degli Studi di Roma La Sapienza, Italy.* Variational techniques offer a powerful tool for optimizing the operation of quantum sensors, excelling in multiparameter problems. We demonstrate their efficacy by implementing these methods on a programmable optical chip operating in noisy conditions.

FM4R.6 • 17:30

Measuring Bell Inequalities via Diffraction, Gilad Pollack[1], Ofer Kfir[1]; *[1]Tel-Aviv Univ., Israel.* We present a approach for measuring Bell inequalities using only diffraction, utilizing post-selection for discretizing the continuous data, completely analogous to the traditional measurements that employ beam-splitters and polarizers.

FM4R.7 • 17:45

Programmable high-dimensional mode-sorting of time-frequency states of single photons, Laura Serino[1], Abhinandan Bhattacharjee[1], Michael Stefszky[1], Christof Eigner[1], Benjamin Brecht[1], Christine Silberhorn[1]; *[1]Universität Paderborn, Germany.* We demonstrate a high-dimensional mode-sorter for single photons based on a multi-output quantum pulse gate, which can programmatically switch encoding between temporal modes, frequency bins and time bins, reaching a fidelity of 0.967 ± 0.031 at the single-photon level.

Tuesday, 7 May

08:00 -- 10:00
CLEO Hub
Joint Plenary Session I

Quantum Science and Atomic Clocks, Jun Ye[1]; *[1]Univ. of Colorado, USA.* Scaling up the size of coherent quantum systems advances the frontier of precision measurement, and quantum entanglement is poised to make major impact in the near term. Quantum science is thus revolutionizing today's atomic clocks and metrology, providing opportunities to probe fundamental physics and explore emerging quantum phenomena.

How Can Optical Imaging Help Reduce Global Inequities in Cancer?, Rebecca Richards-Kortum[1]; *[1]Rice Univ., USA.* Cancer is the first and second leading cause of premature death in 134 of 183 countries and it is estimated that global incidence of cancer will increase by 50% from 2018 to 2040. The number of cases is projected to double in countries with low Human Development Index; these countries have the least resources and infrastructure to adequately care for cancer patients. This talk will describe development and deployment of affordable, accurate technologies that integrate imaging and biomarkers for use in low-resource settings. Examples will include systems for early detection of precancerous leisons and for histopathologic cancer diagnosis.

Near- and Mid-IR Integrated Photonics for Sensing, Interconnects and Computing, Ray T. Chen[1]; *[1]The Univ. of Texas Austin, USA.* The advancement of sensing, interconnects and computing in the last one hundred years is mainly from the R&D works on electrons and photons, which carry drastically different characteristics defining different technology roadmaps. Due to the saturation of the Moore's law, the advantages of photon-based devices provide solutions with the unprecedented performance. In this talk, we will present the integrated photonic devices covering near and mid-IR wavelengths for spectroscopy, biosensing and SERS. Mid-IR Lidar Chip centered at 4.6 micron will also presented. Silicon photonics for both digital and analog computing will be introduced with low latency, high bandwidth and multi-wavelength operations.

11:30 -- 13:00
CLEO Hub
JTu2A • Joint Poster Session I

JTu2A.1
AI-Driven Laser Parameter Optimization for Enhanced Pseudocapacitor Electrodes, Kavian Khosravinia[1], Amirkianoosh Kiani[1]; *[1]Silicon Hall, Ontario Tech Univ., Canada.* We present an optimization approach for fabricating pseudocapacitor electrodes via picosecond laser pulses, incorporating artificial neural networks and simulated annealing. The optimized samples exhibit superior capacitive performance, with enhanced current density and charge depletion time.

JTu2A.2

Unlocking Potential of Ultra-Short Laser Pulses for Development of Thin Film CuO for Electrode Fabrication, Mayuresh Khot[1], Amirkianoosh Kiani[1]; *[1]Silicon Hall, Ontario Tech Univ., Canada.* A single-step fabrication technique was utilized for the fabrication of in-situ CuO thin film via picosecond laser pulses. This approach opens new avenues to explore for the fabrication of electrode for energy storage devices.

JTu2A.3

Photocarrier Dynamics in Highly Scattering Nanocatalyst Clusters, Sunil Gyawali[1], Ravi Teja Addanki Tirumala[2], Harrison A. Loh[3], Marimuthu Andiappan[2], Alan Bristow[1]; *[1]Department of Physics and Astronomy, West Virginia Univ., USA; [2]School of Chemical Engineering, Oklahoma State Univ., USA; [3]Department of Mechanical and Aerospace Engineering, West Virginia Univ., USA.* Including pump scattering in the rate equation analysis allows for precise estimation of photoexcited population dynamics in highly scattering samples. Additionally, pump scattering profiles may be utilized to investigate the size distribution of nanocatalyst clusters.

JTu2A.4

Plasmon near-field coupling in a shifted-core coaxial nano-cavity pair, Abbas Ghaffari[1], Xi Li[1], Farhat Abbas[2], Qing Gu[1,3]; *[1]Electrical and Computer Engineering, North Carolina State Univ., USA; [2]The Univ. of Texas at Dallas, USA; [3]Physics, North Carolina state Univ., USA.* We explore the near-field coupling of surface plasmons in a pair of shifted-core coaxial cavities. By shifting the cores, the electromagnetic field becomes localized in nanoscale regions, leading to significant nanofocusing and splitting of modes.

JTu2A.5

First Principles Calculation of Impact Ionization in Solids, Sheikh Z. Ahmed[1,2], Shafat Shahnewaz[1], Samiran Ganguly[3], Avik W. Ghosh[1]; *[1]Univ. of Virginia, USA; [2]Intel Corporation, USA; [3]Virginia Commonwealth Univ., USA.* A theoretical calculation of impact ionization using quantum transport is presented here. An atomistic matrix Hamiltonian in real space, capable of capturing complex mass tensors in heterostructures, is combined with Non-equilibrium Green's functions using a self-consistent Born approximation for Coulomb interactions between electrons and holes.

JTu2A.6

Temporal Speckle-learned Orbital Angular Momentum Classification, Purnesh S. Badavath[1], Vijay Kumar[1]; *[1]NIT Warangal, India.* The orbital angular momentum beams subjected to spatially-varying random phases result in spatial-temporal speckle patterns. The machine learning model trained on temporal speckle signals acquired using a photodiode classifies the OAM beams with 94% accuracy.

JTu2A.7

Improving Electrical Conductivity of Polymer Composites via Photothermal Heating, Erin Crites[1], Nora Hicks[1], Jason Bochinski[1], Laura Clarke[1]; *[1]North Carolina State Univ., USA.* We increase the conductivity of polymer composites via photothermal heating of carbon nanotubes. We find a relative increase in conductivity for composites related to the intensity of the laser used during photothermally treatment.

JTu2A.8

Examining thermal waves at liquid-vapor interface far from equilibrium with dark hollow beams, Mahdi Eshaghi[1], Cristian Acevedo[1], Aristide Dogariu[1]; *[1]Univ. of Central Florida, CREOL, USA.* Remotely measuring the liquid-vapor interfaces far from thermal equilibrium is a daunting task. We demonstrate that scattering of dark hollow beams enhances considerably the sensitivity to temperature changes and permits detecting subtle interface fluctuations.

JTu2A.9

Effective Temperature of an Optically-induced Collective Non-steady State, Sohila M. Abdelhafiz[1], Amir M. Jazayeri[1], Aristide Dogariu[1]; *[1]Univ. of Central Florida, USA.* We demonstrate that the notion of motional effective temperature is relevant even in non-steady state. We show experimentally that the effective temperature increase is a collective effect due to optically-induced interaction between colloidal particles.

JTu2A.10

Spatial Correlation of Whispering Gallery Modes in an Active Micro-Bottle Resonator, Subhajit Dutta[1], Somnath Pandit[1], Shivakiran Bhaktha B.N.[1]; *[1]IIT Kharagpur, India.* The spatio-spectral imaging of active micro-bottle resonator (MBR) is performed and the spatial correlation of the whispering gallery modes (WGMs) are investigated in a dye-doped poly (methyl methacrylate) (PMMA) coated silica micro-bottle resonator.

JTu2A.11

Limits of Thermal Emission from Vertically Aligned Carbon Nanotubes Stimulated by Nanosecond Pulsed Laser, Emmanuel Sarpong[1], Arpit Dave[1], Kenan Darden[1], Glenn D. Boreman[1], Joshua Lentz[2], Tsing-Hua Her[1]; *[1]UNC Charlotte, USA; [2]AFRL, USA.* We show repetitive heating of carbon nanotubes at high laser fluence degrades the material due to oxidation. We also demonstrate laser heating of nanotubes in an oxygen-free atmosphere increases the degradation threshold fluence by 50%

JTu2A.12

Luminescent Waveguides with Synaptic Properties for Photonic Artificial Neural Networks, Lilia Dias[1,2], Lianshe Fu[2], Elias Towe[3], Maria R. Ferreira[2], Paulo S. Andre[1]; *[1]Instituto De Telecomunicacoes, Portugal; [2]CICECO—Aveiro Inst. of Materials, Portugal; [3]CMU, USA.* We replicate biological neurons and synapses, transmitting 0.2 Hz impulses through luminescent waveguides with adjustable features. This breakthrough has significant implications for neuromorphic engineering, providing valuable insights into neural networks technological applications and signal transmission.

JTu2A.13

A Single-Shot Electro-Optic Pulse Shape Acquisition System for OMEGA Laser Applications, Yihan Liu[1,2], William Donaldson[1,2], Matt Heimbuegger[2], Brain Kruschwitz[1,2]; *[1]Univ. of Rochester, USA; [2]Laboratory for Laser Energetics, USA.* A single-shot, electro-optic data-acquisition system to measure the temporal pulse shape on the OMEGA laser is demonstrated. With multiple, optical-wavelength multiplexing and an electro-optic modulator, this prototype is demonstrated to give constant results, with a high dynamic range and low signal-to-noise ratio.

JTu2A.14

Direct measurement of coherent light proportion from a laser source without spectral filtering, Xi Jie Yeo[1], Eva Ernst[1], Alvin Leow[2], Lijiong Shen[1], Jaesuk Hwang[1], Christian Kurtsiefer[1,2], Peng Kian Tan[1]; *[1]Center for Quantum Technologies, Singapore; [2]Department of Physics, National Univ. of Singapore, Singapore.* We present a technique to estimate the proportion of coherent emission in the light emitted by a semiconductor laser, by measuring photon correlations between the output ports of an asymmetric Mach-Zehnder interferometer.

JTu2A.15

In-situ Metrology Interferometric Set-up For the Diagnosis and Analysis of Coherent Beam Combining Lasers, Thomas Rousseaux[1], Jérôme Primot[1], Bastien Rouzé[1], Jean-Christophe Chanteloup[2], Cindy Bellanger[1]; *[1]ONERA, France; [2]LULI, CNRS, Ecole Polytechnique, France.* We present a new compact Pistil interferometer, specifically designed for easy integration on all CBC lasers. This demonstrator enables self-referenced and accurate measurements of the near-field phase, whatever the set-point applied.

JTu2A.16

Probing Spectral Transition of Soliton Molecules in MIR Mode-locked Fiber Laser, Guyue Hu[1], Minghui Shi[1], Xin Dong[1], Yi Zhou[1], Kenneth Kin-Yip Wong[1]; *[1]The Univ. of Hong Kong, Hong Kong.* Dissipative soliton generation in a novel MIR mode-locked laser is presented. The laser emits at 2.8 um with ~30 nm bandwidth, and the spectral transitions of soliton molecules between different states are observed.

JTu2A.17

Diodes-pumped femtosecond Ti:sapphire lasers for two-photon microscopy, Dong Hoon Song[2,1], Hyung Woo Kim[2], Hong-Seok Seo[2,1]; *[1]Electronics and Telecom Research Inst, Korea (the Republic of); [2]Blue Tile Lab., Korea (the Republic of).* We report compact and low-cost two femtosecond self-starting mode-locked Ti:sapphire lasers operating at different repetition rates of 76 MHz and 250 MHz, respectively, based on spectrally combined diodes-pumped sources.

JTu2A.18

High-power Middle-infrared Laser Using W-shape Cavity and Cr^{2+}:ZnS Crystal, Jiqiang Kang[1], Jinge Wei[1], Guyue Hu[1], Yi Zhou[1], Kenneth Kin-Yip Wong[1]; *[1]Department of Electrical and Electronic Engineering, the Univ. of Hong Kong, Hong Kong.* A multiple longitudinal mode operation laser in a W-shape cavity using a Cr^{2+}:ZnS crystal as the gain media is demonstrated. The emission has a ~100 nm spectrum centered at ~2280 nm and 400 mW power.

JTu2A.19

Bismuth-doped Fiber Laser at 1.3 µm Mode-locked by Nonlinear Polarization Rotation, Xiaoxiao Wen[1], Tian Qiao[1], Xin Dong[1], Meng Zhou[1], Kenneth Kin-Yip Wong[1,2]; *[1]Department of Electrical and Electronic Engineering, The Univ. of Hong Kong, China; [2]Advanced Biomedical Instrumentation Centre, Hong Kong Science Park, China.* We propose a 1320 nm laser using homemade Bismuth-doped fiber, mode-locked by nonlinear polarization rotation with 20-nm bandwidth and 5-MHz repetition rate. This laser is of significant potential for biological imaging.

JTu2A.20

Transient gas pinhole based on saturated absorption for high energy ultraviolet lasers, Ke Ou[1], Victor M. Perez-Ramirez[1], Jin Lee[1], Matthew Edwards[1]; *[1]Stanford Univ., USA.* We propose a novel pinhole design with much higher damage thresholds than traditional pinholes by leveraging the saturated absorption of ultraviolet light in ozone. Compact and robust soft-edge spatial filtering was demonstrated experimentally.

JTu2A.21

Characterization of the Pound-Drever-Hall Feedback Loop in an Ultra-Stable Laser System, Ji Wenchao[3,2], Bowei Wang[1,2], Yi Hu[1,2], Xing-Yang Cui[1,2], Ping Xu[1,2], Xiao Jiang[1,2], Han-Ning Dai[1,2], Yu-Ao Chen[1,2]; *[1]Shanghai Research Center for Quantum Sciences and CAS Center for Excellence in Quantum Information and Quantum Physics, Univ. of Science and Technology of China, China; [2]Hefei National Laboratory, Univ. of Science and Technology of China, China; [3]Hefei National Research Center for Physical Sciences at the Microscale and School of Physical Sciences, Univ. of Science and Technology of China, China.* In this paper, the transfer function of the Pound-Drever-Hall feedback loop in an ultra-stable laser system is comprehensively measured and verified, and then a noise analysis is performed.

JTu2A.22

Sub-nanosecond MW microchip oscillator for Laser Tattoo Removal MOPA System, Marcus V. Catarina[1], Allan Bereczki[1], Niklaus Wetter[1]; *[1]IPEN, Brazil.* We investigate a Q-switched Nd:YAG laser aimed to work as an oscillator in a MOPA system for laser tattoo removal. Pulses of 4.8 MW peak power with 680 ps pulses were obtained.

JTu2A.23

Performance Investigation of Dual Stage Nested Loop Configuration for Scalable Coherent Beam Combination, Sooraj M S[1], Satyajit Maji[1], Viswanathan Sankar[1], Linslal C L[1], Deepa Venkitesh[1], Balaji Srinivasan[1]; *[1]IIT Madras, India.* We investigate the performance of a dual-stage modular array with tip-tilt optimization for coherent beam combination by studying the dependence of efficiency and Strehl's ration on the fill and tilt factors in the outer module.

JTu2A.24

An efficient mid-infrared erbium-doped ZBLAN amplifier using a double-pass configuration, Yihuan Shi[1,4], Qi Kang[2], Qiao Wen[2], Dongmei Huang[1,4], P. K. A. Wai[3,4]; *[1]Hong Kong Polytechnic Univ., Hong Kong; [2]Shenzhen Univ., China; [3]Hong Kong Baptist Univ., Hong Kong; [4]The Hong Kong Polytechnic Univ. Shenzhen Research Inst., China.* The double-pass configuration of the erbium-doped ZBLAN fiber amplifier is achieved for the first time. The amplification efficiency is ~40% higher than that of the single-pass amplifier, which is significant for compact mid-infrared fiber amplifiers.

JTu2A.25

Withdrawn

JTu2A.26

Laser Beam Induced Current for Defect Concentration and Aging Analysis of Broad Area Laser Diodes, Elaine McVay[1], Robert J. Deri[1], Daniel Mittelberger[1], William E. Fenwick[1], Salmaan Baxamusa[1], Matthew Boisselle[1], Jiang Li[1], Joel Varley[1], Rebecca Swertfeger[1], Laina Gilmore[1], Mark Crowley[2], Prabhuram Thiagarajan[2], Jiyon Song[2], Gerald Thaler[2]; *[1]Lawrence*

Livermore National Laboratory, USA; [2]Leonardo Electronics US Inc., USA. Laser Beam Induced Current Spectroscopy (LBIC) is used to identify failure locations during aging of ~800 nm broad area laser diodes. The magnitude of the spatially integrated LBIC signal is correlated with the threshold current.

JTu2A.27
High-speed 940 nm Ge-VCSEL with an Over 15 GHz Modulation Bandwidth at 85 ºC, Yun-Cheng Yang[1,3], Zeyu Wan[2], Chih-Chuan Chiu[4], Wei-Hsin Chen[5], Markus Feifel[6], David Lackner[6], Guangrui (Maggie) Xia[2], Chao-Hsin wu[1,5]; *[1]Graduate Inst. of Electronics Engineering, National Taiwan Univ., Taiwan; [2]Department of Materials Engineering, Univ. of British Columbia, Canada; [3]Center for Quantum Science and Engineering, National Taiwan Univ., Taiwan; [4]Graduate School of Advanced Technology, National Taiwan Univ., Taiwan; [5]Graduate Inst. of Photonics and Optoelectronics, National Taiwan Univ., Taiwan; [6]Fraunhofer Inst. for Solar Energy Systems (ISE), Germany.* This achievement marks a major milestone, establishing a dedicated pathway for epitaxy and fabrication of high-speed Ge-VCSELs. This technology offers extensive insights into epitaxial processes, advancing the field of VCSEL development.

JTu2A.28
Withdrawn

JTu2A.29
Quantification of Pulse Train Instabilities in Mode-Locked Quantum-Dot Laser Diodes, Tiago d. Gomes[1,2], Benjamín Alonso[3,4], Helder Crespo[2,5], Maria Ana Cataluna[1]; *[1]Inst. of Photonics and Quantum Sciences, Heriot-Watt Univ., UK; [2]IFIMUP and Departamento de Física e Astronomia, Faculdade de Ciências, Universidade do Porto, Portugal; [3]Grupo de Aplicaciones del Láser y Fotónica (ALF), Departamento de Física Aplicada, Universidad de Salamanca, Spain; [4]Unidad de Excelencia en Luz y Materia Estructuradas (LUMES), Universidad de Salamanca, Spain; [5]Blackett Laboratory, Imperial College, UK.* We have quantified pulse train instabilities in mode-locked laser diodes, using a highly-sensitive dispersion-scan setup with the self-calibrating retrieval algorithm. We investigated the influence of operating bias conditions on pulse instabilities from quantum-dot lasers.

JTu2A.30
On scalability of static 940 nm VCSEL arrays, Stefano Gretter[1], Andre Maaßdorf[1], Markus Weyers[1]; *[1]Ferdinand-Braun-Institut, Germany.* Static light-current-voltage (LIV) curves, spectrum, and far-field of oxide-confined 7, 19, 100, and 312 vertical-cavity surface-emitting laser (VCSEL) arrays centered at 940 nm were collected to quantify scalability limits set by thermal coupling.

JTu2A.31
10 GHz Low Divergence Angle Mode-Locked Lasers with Ultralow Timing Jitter through Injection-Locking Techniques, Mohanad Al-Rubaiee[1,2], Shengwei Ye[1], Bocheng Yuan[1], Yizhe FAN[1], John Marsh[1], Lianping Hou[1]; *[1]James Watt School of Engineering, Univ. of Glasgow, UK; [2]EPSRC Centre for Doctoral Training in Applied Photonics, UK.* A 1.55 μm 10 GHz low divergence passively mode-locked laser was stabilized by injection locking, achieving a sub-hertz RF linewidth and a 63 fs timing jitter, establishing it as a highly stable optical clock source.

JTu2A.32

Narrow Linewidth DBR Laser Diodes Based on Twin-Waveguide Epitaxial Structure, Qianru Lu[1], Yuanhao Zhang[1], Can Liu[2], Guojiong Li[1], Juan Xia[1], Qiaoyin Lu[1], Weihua Guo[1]; [1]*Huazhong Univ. of Science and Technology, China;* [2]*Ori-chip Opoelectronics Technology Ltd., China.* Narrow linewidth DBR lasers based on the twin-waveguide epitaxial structure are demonstrated. The fabricated 8µm-wide ridge waveguide DBR laser exhibited the stable single mode operation with the linewidth narrower than 50kHz and SMSR over 55dB.

JTu2A.33
A Three-Active-Section Directly Modulated Laser with Enhanced Modulation Bandwidth, Hefei Qi[1], Shaobo Li[1], Jiantao He[1], Wenqi Yu[1], Yuedi Ding[1], Xiang Ma[1]; [1]*The 54th Research Inst. of CETC, China.* We demonstrate a three-active-section directly modulated laser to expand the modulation bandwidth. The modulation bandwidth reaches 48 GHz through the photon-photon resonance (PPR) effect generated by active optical feedback and the detuned loading effect.

JTu2A.34
Modeling and Optimization of Interband Cascade Laser AM Frequency Combs, Michael Povolotskyi[1], Igor Vurgaftman[2]; [1]*Jacobs Engineering, USA;* [2]*Naval Research Laboratory, USA.* The effect of group velocity dispersion, intraband relaxation, and nonradiative recombination on AM frequency combs produced by mid-IR interband cascade lasers with optimized two-section (gain and saturable absorber) cavities is analyzed using a detailed numerical model.

JTu2A.35
Accurate Laser Model for Electrically Injected Monolithic GaAs on Silicon Nano-ridge Laser Diodes, Andualem A. Yimam[1], Geert Morthier[1], Dries Van Thourhout[1]; [1]*Ghent Univ., Belgium.* We present a semi-analytical model that explains the working principle behind electrically injected $In_{0.2}Ga_{0.8}As$/GaAs-on-silicon monolithic nano-ridge laser diodes. We show how the model can be used to study the spectral behavior and the threshold gain.

JTu2A.36
Characterization of Quantum Cascade Laser Facets via Steady-State Thermoreflectance, Andrew Jones[1], Brian M. Foley[1], Jeremy D. Kirch[2], Shuqi Zhang[2], Luke J. Mawst[2], Dan Botez[2]; [1]*Laser Thermal, Inc., USA;* [2]*Univ. of Wisconsin-Madison, USA.* We investigate the use of steady-state thermoreflectance as a hitherto unexplored method of QCL evaluation via material characterization of the material thermal conductivity. We demonstrate the effectiveness of this approach for quantitative thermal characterization of post-fabrication QCL epitaxy at the sub-micron scale.

JTu2A.37
Reciprocity Principle and Structure-Induced Asymmetry between Counterpropagating Modes in Whistle-Geometry Ring Lasers, Hosuk Lee[1], Gennady A. Smolyakov[1], Marek A. Osinski[1]; [1]*Univ. of New Mexico, USA.* The asymmetry between the counterpropagating modes in whistle-geometry semiconductor ring lasers might be misconstrued as a violation of the Helmholtz reciprocity principle. We confirm the unidirectionality of the whistle-geometry configuration through rigorous 3D FDTD simulation.

JTu2A.38

Coherent High-power Pulsing in a Gain-switched Array of Laser Diodes with Filtered Feedback, Luis E. Maldonado-Castillo[1], Olivier Spitz[1], Suyesh Koyu[1], Mark Berrill[2], Yehuda Braiman[1]; *[1]Univ. of Central Florida, USA; [2]Oak Ridge National Laboratory, USA.* Optimal roundtrip cavity time in a gain-switched laser diode array with filtered optical feedback and global coupling is numerically investigated. We exhibit configurations where coherent high-power picosecond pulses are generated.

JTu2A.39
Fabry–Pérot Laser Diode for WDM-PON with Temperature-insensitive Laser Spectral Envelope, Ruigang Zhang[1,2], Yu Han[1,2], Qi Tian[1,2], Qingyun Xian[1,2], Deming Liu[1,2], Shuang Zheng[1,2], Minming Zhang[1,3]; *[1]School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China; [2]National Engineering Research Center for Next Generation Internet Access System, China; [3]Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, China.* We propose a novel Fabry–Pérot laser diode with temperature-insensitive laser spectral envelope. By introducing a temperature-insensitive optical filter structure into the laser diode resonator, the laser spectral envelope shows substantially reduced temperature sensitivity.

JTu2A.40
Experimental characterization and modeling of sub-nanosecond Fe:ZnSe mid-IR gain-switched laser operating at room temperature, Saugat Ghimire[1], Dmitry V. Martyshkin[1], Vladimir V. Fedorov[1], Sergey B. Mirov[1]; *[1]Department of Physics, Univ. of Alabama at Birmingham, USA.* We report on the experimental characterization and modeling of sub-nanosecond Fe:ZnSe mid-IR gain-switched laser operating at room temperature. A single-spike oscillation with an output energy of 0.33 mJ was achieved under 4.67 mJ pump energy.

JTu2A.41
Optically Pumped Quantum Dot Photonic Crystal Surface Emitting Lasers (QD-PCSELs) based on Epitaxial Regrowth, Subhashree Seth[1], Kevin J. Reilly[1], Fatih F. Ince[1], Akhil Kalapala[2], Chhabindra Gautam[2], Thomas Rotter[1], Zhonghe Liu[2], Sadhvikas Addamane[3], Weidong Zhou[2], Ganesh Balakrishnan[1]; *[1]Center For High Technology Materials, Univ. of New Mexico, USA; [2]Department of Electrical Engineering, The Univ. of Texas at Arlington, USA; [3]Center for Integrated Nanotechnologies, Sandia National Laboratories, USA.* Epitaxial regrowth is used to fabricate QD-PCSELs. Three layers of InAs dots-in-well are used as the active region. Device results from an optically pumped QD-PCSEL with an emission wavelength of 1200 nm is presented.

JTu2A.42
A Faraday laser based on corner-cube retroreflector, Zhiyang Wang[1], Zijie Liu[1], Hangbo Shi[1], Xiaomin Qin[1], Xiaolei Guan[1], Tiantian Shi[1], Jingbiao Chen[1]; *[1]Peking Univ., China.* We present a single-mode Faraday laser based on the corner-cube retroreflector, whose wavelength can correspond to the atomic transition line. The linewidth can be narrowed below 10 kHz, and the maximum wavelength change is 3.3 pm within 46 hours.

JTu2A.43
Diffusive Loss Engineering of Quantum Cascade Laser Frequency Combs, Mithun Roy[1,2], Zhenyang Xiao[1,2], Sadhvikas Addamane[3], David Burghoff[1,2]; *[1]Univ. of Texas at Austin, USA; [2]EE, Univ. of Notre Dame, USA; [3]Sandia National Laboratories, USA.* We demonstrate that adding carefully engineered resonant loss to a quantum cascade laser cavity can

counteract the diffusive effect of the gain medium, allowing broader bandwidth combs to form. An improvement of 30% in comb bandwidth is reported.

JTu2A.44
Gain-Switched-Laser Frequency Comb Self-Injection-Locked to a Microresonator, Wenle Weng[1], Ankit Sharma[2], Aleksandra Kaszubowska-Anandarajah[3], Prince Anandarajah[2], Andre Luiten[1]; *[1]Univ. of Adelaide, Australia; [2]Dublin City Univ., Ireland; [3]Trinity College Dublin, Ireland.* A gain-switched-laser frequency comb is self-injection-locked to an electrooptic microresonator. The comb exhibits narrowed linewidth, suppressed frequency instability, and agile frequency control ability.

JTu2A.45
Bayesian Estimation of Frequency Noise in Narrow-Linewidth Lasers, Lutz Mertenskötter[1], Markus Kantner[1]; *[1]WIAS-Berlin, Germany.* We present a statistical inference approach to estimate the frequency noise power spectral density of narrow-linewidth lasers from delayed self-heterodyne beat note experiments in the presence of considerable measurement noise.

JTu2A.46
C-band 12-Channel DFB Laser Array with High Output Power and Narrow Linewidth, Yuanhao Zhang[1], Qianru Lu[1], Can Liu[1], Minwen Xiang[1], Guojiong Li[1], Juan Xia[1], Qiaoyin Lu[1], Weihua Guo[1]; *[1]HuazhongUniv. of Science&Technology, China.* We demonstrated a high power 12-channel DFB laser array with 200-GHz-spacing, realizing output power over 85mW, SMSR over 50dB and Lorentzian linewidth below 350 kHz for each channel.

JTu2A.47
Quantum Cascade Lasers Powered by a Pulsed 6.78 MHz Wireless Power Transfer System, Richard Brun Jr[1], Shukai Wang[1], Minjie Chen[1], Xiaojun Wang[2], Claire Gmachl[1]; *[1]Princeton Univ., USA; [2]Adtech Optics Inc., USA.* We demonstrate a high-frequency, pulsed, inductive, wireless power transfer system with a full-bridge diode receiver for quantum cascade lasers. It operates at 6.78MHz to create a pulsed 2μs 10V/1.2A output, for room-temperature pulsed laser operation.

JTu2A.48
Electrically injected GeSn laser operating up to 135 K, Sudip Acharya[3,2], YiYin Zhou[2], Sylvester Amoah[2], Rajesh Kumar[4], Wei Du[2,4], Baohua Li[1], Shui-Qing (Fisher) Yu[2,4]; *[1]Arktonics, LLC, USA; [2]Department of Electrical Engineering and Computer Science, Univ. of Arkansas, USA; [3]Material Science and Engineering, Univ. of Arkansas, USA; [4]Inst. for Nanoscience and Engineering, Univ. of Arkansas, USA.* We demonstrated electrically injected GeSn laser with the threshold of 800 A/cm^2 at 77 K. The decreased threshold compared to previous results was achieved by reducing optical loss and improving the optical confinement. The peak power was measured as 1.25 mW/facet at 77 K. At 135 K, the emission peak is at 2656 nm.

JTu2A.49
1390nm Dilute Nitride VCSELs on 150mm GaAs, Ijeoma O. Obuseli[1], Craig Allford[1], Sara Gillgrass[1], Peter Smowton[1], Andrew Clark[2], K. Nunna[2], Iwan Davies[3]; *[1]Cardiff Univ., UK; [2]IQE - North Carolina, USA; [3]IQE plc, UK.* The first growth and characterization of 150mm GaAs based dilute nitride VCSELs emitting in the 1390nm range is reported. Threshold currents

(1.78±0.24)mA and emission spectra (1392.53±2.02)nm have been measured for 5µm oxide aperture devices.

JTu2A.50

980 nm micro-cavity lasers with sub-milliampere threshold, Qi LIN[1], Ying Xue[1], Jie Huang[1], Wen Gu[1], Kei May Lau[1]; *[1]HKUST, Hong Kong.* We report electrically-pumped InGaAs/GaAs/GaAsP quantum well micro-cavity lasers on GaAs with low thresholds down to the sub-milliamp level and a maximum operating temperature of 95°C. Micro-lasers with various cavity designs were characterized and compared.

JTu2A.51

Large Tolerance of Lasing Properties to Impurity Defects in GaAs(Sb)-AlGaAs Core-Shell Nanowire Lasers, Tobias Schreitmüller[1], Hyowon W. Jeong[1], Hamidreza Esmaielpour[1], Christopher Mead[2], Manfred Ramsteiner[3], Paul Schmiedeke[1], Andreas Thurn[1], Akhil Ajay[1], Markus Döblinger[4], Lincoln Lauhon[2], Jonathan Finley[1], Gregor Koblmüller[1]; *[1]Technische Universität Munchen, Germany; [2]Northwestern Univ., USA; [3]Paul-Drude Institut Berlin, Germany; [4]LMU Munich, Germany.* Performance limiting factors for GaAs(Sb)-AlGaAs nanowire lasers are unveiled by exploring the impact of impurity-induced point defects. Lasing properties show large tolerance to these defects which, however, limit radiative efficiency and lasing threshold beyond critical densities.

JTu2A.52

500 GHz Terahertz Wave-Optic Modulators in Thin Film Lithium Niobate, Yiwen Zhang[1,2], Zhaoxi C. Chen[1,2], Jingwei Yang[1,2], Hanke Feng[1,2], Sha Zhu[3,2], Cheng Wang[1,2]; *[1]Electrical Engineering, City Univ. of Hong Kong, Hong Kong; [2]State Key Laboratory of Terahertz and Millimeter Waves, City Univ. of Hong Kong, Hong Kong; [3]Beijing Univ. of Technology, China.* We report a terahertz wave lithium niobite modulator enabling efficient modulation up to 500 GHz with low RF half-wave voltage (V_π) of 6 V at 300 GHz and 8 V at 500 GHz.

JTu2A.53

Terahertz spectroscopy and imaging of MOVPE grown AlGaN films, Christoph Margenfeld[2], Giovanni B. Netto[1], Flavio C. Cruz[1], Andreas Waag[2], Jonathas D. Siqueira[1]; *[1]State Univ. of Campinas, Brazil; [2]Inst. of Semiconductor Technology, Technische Universitat Braunschweig, Germany.* We investigate MOVPE-grown $Al_{0.67}Ga_{0.33}N$ alloys with varying silicon n-type doping using Terahertz Time-Domain Spectroscopy and Imaging. We observe a compensation regime and spatially inhomogeneous conductivity.

JTu2A.54

Electrical Conduction of Liquid-Exfoliated Nanographite Flakes as Components for Functional Inks, Harrison A. Loh[1], Konstantinos Sierros[1], Alan Bristow[1]; *[1]West Virginia Univ., USA.* THz-TDS is used to measure AC conductivity of nanographite flakes to relate carrier concentration and scattering time from Drude-Smith with the flake size. The carrier concentration and scattering were observed to change with flake size.

JTu2A.55

Inverse Design of All-dielectric THz Metasurface for Long Depth of Focus with Uniform Intensity, Yujin Nam[1], DongYoung Lee[1], Jisoo Kyoung[1]; *[1]Dankook Univ., Korea (the Republic of).* Large depth of focus for THz beams is crucial for 6G communications. An inverse design method was employed to create all-dielectric THz metasurfaces with a DOF in the millimeter range, while maintaining uniform intensity distribution.

JTu2A.56
A Self-Aligned Assembling Terahertz Metasurface Microfluidic Sensor with High Sensing Performance, Yunhao Cao[1], Hongshun Sun[1], Yusa Chen[1], Li Liye[1], Lijun Ma[1], Wengang Wu[1]; [1]*Peking Univ., China.* We propose a self-aligned assembling terahertz metasurface microfluidic sensor. Compared with some related work, the sensitivity is increased by 40%, the *Q*-factor is increased by 3~5 times, and the *FOM* is increased by 5 times

JTu2A.57
A Set of Non-sinusoidal Terahertz Pulses, George A. Hine[1]; [1]*Spallation Neutron Source, Oak Ridge National Laboratory, USA.* An analytical expression for a set of few-cycle pulses is derived and compared to experimental measurements of sub-cycle terahertz pulses. A set of pulses with orthogonal spectra are derived for more general ultrabroadband pulses.

JTu2A.58
Mechanical Tuning of the Diffraction Efficiency of THz Slanted Wire Gratings, Nuren Z. Shuchi[1], V. Paige Stinson[1], Uma Subash[1], Menelaos K. Poutous[1], Tino Hofmann[1]; [1]*Univ. of North Carolina at Charlotte, USA.* The diffraction efficiency of a slanted wire diffraction grating is experimentally investigated at 0.11 THz while mechanically changing the slant angle from 25° to 45°. The diffraction efficiency is found to vary by more than 50%

JTu2A.59
Broadband and Tailorable THz Emission from Spintronic Photonic Crystals, Abbas Ghaffari[1], Puja Thapa[1], Ramón Collazo[1], Kenan Gundogdu[1], Dali Sun[1], Qing Gu[1]; [1]*North Carolina State Univ., USA.* We explore THz generation from structured ferromagnet/ultrawide bandgap semiconductor heterostructures. The emission spectrum can span the entire THz gap, be enhanced, and tuned by changing size and periodicity of the subwavelength pillars in photonic crystal.

JTu2A.60
Injection-Seeded 60-GHz Bandwidth Tunable High-Frequency Backward Terahertz-Wave Parametric Oscillator, Joselito Muldera[1], Kouji Nawata[2], Yuma Takida[1], Deepika Yadav[1], Hiroaki Minamide[1]; [1]*Tera-Photonics Research Team, RIKEN, Japan;* [2]*Department of Information and Communication Engineering, Tohoku Inst. of Technology, Japan.* We report an injection-seeded high-frequency (~0.87 THz) backward terahertz-wave parametric oscillator with a slant-stripe-type periodically-poled lithium niobate. Substantial reduction in oscillation threshold and enhanced pump energy conversion efficiency were observed against the unseeded case.

JTu2A.61
Multiplexed All-Optical Permutation Operations Using Diffractive Networks with Layer Rotations, Guangdong Ma[2,1], Xilin Yang[2], Bijie Bai[2], Jingxi Li[2], Yuhang Li[2], Tianyi Gan[2], Yijie Zhang[2], Yuzhu Li[2], Mona Jarrahi[2], Aydogan Ozcan[2]; [1]*School of Physics, Xi'an Jiaotong Univ., China;* [2]*Electrical and Computer Engineering Department, Univ. of California, Los Angeles, USA.* We demonstrate an all-optical design to perform a large set of permutation operations

using diffractive networks with diffractive layer rotations. Experimental validation of this rotatable design was demonstrated at the terahertz part of the spectrum.

JTu2A.62
Self-sustained "Active" Metasurfaces Under Intense-Terahertz Fields, Soumyajyoti Mallick[1], Nityananda Acharyya[1], Vineet Gupta[2], Shreeya Rane[1], Monika Devi Koijam[3], Ashutosh Sharma[2], József Fülöp[2], Dibakar Roy Chowdhury[1]; *[1]Mahindra Univ., India; [2]ELI-ALPS Research Inst., Szeged, Hungary, Hungary; [3]IEMN-CNRS, Univ. of Lille, France, France.* This work demonstrates self-induced dynamically-tunable metasurface on a metal-on-insulator framework. The meta-geometry operates by harnessing the intense terahertz-driven nonlinearity of substrate dispersive properties mediated by "impact-ionization."

JTu2A.63
Production of Extremely Strong Accelerating Electric Field by Focusing THz Pulses with a Paraboloid Ring, László Pálfalvi[1,2], Zerihun T. Godana[1,3], György Tóth[1], János Hebling[1,3]; *[1]Inst. of Physics, Univ. of Pécs, Ifjúság ú. 6, Pécs 7624 Hungary, Hungary; [2]HUN-REN−PTE High-Field Terahertz Research Group, Ifjúság ú. 6, Pécs 7624, Hungary, Hungary; [3]Szentágothai Research Centre, Univ. of Pécs, Ifjúság ú. 20, Pécs, 7624, Hungary, Hungary.* Our numerical simulations of focusing radially polarized THz pulses having only 3 mJ energy with a paraboloid ring predict peak electric field approaching 100 MV/cm. Such electric fields are well appropriate for sub-relativistic electron acceleration.

JTu2A.64
Electromechanically Tunable Metasurface for Guided Spoof Surface Plasmon Polaritons, Lars Franke[1], Steffen Klingel[1], Marco Rahm[1]; *[1]RPTU Kaiserslautern-Landau, Germany.* We report an electromechanically tunable metasurface for active manipulation of spoof surface plasmon polaritons (SSPPs). We designed a dynamic SSPP low pass filter that can be actively controlled by application of an electric bias field.

JTu2A.65
Terahertz wave generation by dual-wavelength laser lights injection-locked to a soliton microcomb in mode spacing of 560 GHz for wireless communication with advanced modulation format, Yu Tokizane[1], Takumi Kikuhara[1,2], Yoshihiro Makimoto[3], Hiroki Kishikawa[1], Yasuhiro Okamura[6], Kenji Nishimoto[2], Atsushi Kanno[4], Shintaro Hisatake[5], Naoya Kuse[1], Takeshi Yasui[1]; *[1]pLED, Tokushima Univ., Japan; [2]Tokushima Univ., Japan; [3]Tokushima Prefectural Industrial Technology Center, Jamaica; [4]Nagoya Inst. of technology, Japan; [5]Gifu Univ., Japan; [6]Univ. of Yamanashi, Japan.* We demonstrate the THz-wave generation using dual wavelength lasers injection-locked to a soliton microcomb and photomixing. We also apply the generated wave to THz wireless communication in 560 GHz band using advanced modulation format.

JTu2A.66
Development of CO_2 Laser Pumped Terahertz Sources, Gergo Illés[1], János Hebling[1,2], György Tóth[1,2]; *[1]Univ. of Pécs, Hungary; [2]Szentagothai Research Center, Hungary.* Thorough investigation using advanced simulations showed that high energy single-cycle terahertz pulses can be generated with currently available CO_2 laser technology. Computations predict efficiencies up to 4% and electric fields above 3 MV/cm.

JTu2A.67

Controlled Radially Polarized Terahertz Radiation Generation for Medical Application, Manendra[1,2], Anil k. Malik[1], Arun K. Singh[2]; *[1]CCS Univ. MEERUT, India; [2]Electronics and Communication Engineering, Punjab Engineering College, India.* We propose a scheme for controlling radially polarised terahertz radiation by non-linear mixing two hollow Gaussian lasers. Radially polarised light can penetrate the skin more deeply while offering a lower risk of collateral damage.

JTu2A.68

Photonic-assisted THz Wideband Frequency Hopping and Secure Communication Based on Optical Injection Locking, Zhencan Yang[1], Fan Yang[1], Jian Zhang[1]; *[1]UESTC, China.* We propose a photonic frequency-hopping terahertz communication system based on optical injection-locking. Secure THz transmission is demonstrated with a 25 GHz hopping bandwidth and 2.5 Gbps data rate in 115-140 GHz band.

JTu2A.69

Probabilistic High Dynamic Range Preprocessing for Ptychography, Shantanu P. Kodgirwar[1], Lars Loetgering[2], Chang Liu[1,3], Leona Licht[1], Aleena Joseph[1], Daniel Santiago Penagos[1,3], Wilhelm Eschen[1,3], Jan Rothhardt[1,3], Michael Habeck[1,4]; *[1]Friedrich Schiller Univ. Jena, Germany; [2]Carl Zeiss AG, Germany; [3]Helmholtz Inst. Jena, Germany; [4]Max Plank Inst. for Multidisciplinary Sciences, Germany.* Fusing acquisitions by varying exposures, from under to overexposed, yields a high dynamic range image. To enhance resolution, this is often used as a preprocessing step in ptychography. Our proposed probabilistic approach models overexposure while taking into account readout noise, resulting in improved inverse modeling.

JTu2A.70

Femtosecond laser written and selectively etched structures for micro-optofluidics in a monolithic lithium niobate chip, Daniel T. Nwatu[1], Sergiy Suntsov[1], Detlef Kip[1], Kore Hasse[1]; *[1]Faculty of Electrical Engineering, Helmut Schmidt Univ., Germany.* Femtosecond laser written and selectively etched 3D-micro-optofluidic devices have been fabricated with high selectivity (~2900) and low roughness (~23 nm), combining a waveguide with a microchannel in the volume of a monolithic lithium niobate chip.

JTu2A.71

Thermally Robust Silicon-on-Insulator Ring Resonator for Biosensing in the Near-Infrared, Christian Schweikert[1], Wolfgang Vogel[1], Manfred Berroth[1], Georg Rademacher[1]; *[1]Univ. of Stuttgart, Germany.* We present a ring resonator designed in the 220 nm silicon-on-insulator technology that serves as a thermally robust biosensor. Utilizing the negative thermo-optic coefficient of aqueous analytes, the suppression of undesired temperature drifts is demonstrated.

JTu2A.72

Quantifying the Effects of Chemotherapy-Induced Toxicity and Knockout of the Transcription Factor C-Myc on Mice Kidney Metabolism Using Optical Imaging, Mehrnoosh Neghabi[1], Parisa Nategh[1], Busenur Ceyhan[1], Shalaka Konjalwar[1], Aline G. Santana[2], Jaqueline F. Machi[2], Claudia O. Rodrigues[2], Mahsa Ranji[1]; *[1]Department of Electrical Engineering and Computer Science, Florida Atlantic Univ., USA; [2]Department of Biomedical Science, Florida Atlantic Univ., USA.* The study explores knockout of c-Myc and doxorubicin toxicity influence on mouse kidney's metabolism. Cryo-imaging unveils knockout is significantly more oxidized compared to control group while this was not observed between doxorubicin and saline group.

JTu2A.73

Biomimetic Transparent Nanoplasmonic Meshes for Bio-interfaced Spatiotemporal Multimodal SERS Bioanalysis, Aditya Garg[1], Wei Zhou[1]; [1]*Virginia Tech, USA.* This study introduces biomimetic transparent nanoplasmonic microporous mesh (BTNMM) devices fabricated via reverse nanoimprint lithography. These devices offer spatiotemporal multimodal SERS measurements for bio-interfaced applications, enabling targeted pH sensing and molecular profiling of microbial biofilms.

JTu2A.74

Quantitative Phase Imaging in Tissue with Gradient Retardance Optical Microscopy, Jinming Zhang[1], Mirsaeid Sarollahi[1], Andreas Vasdekis[1]; [1]*Department of Physics, Univ. of Idhao, USA.* We report a cost-effective quantitative-phase imaging configuration that yields no losses in parallel imaging modalities, such as fluorescence. We validate our approach by imaging a variety of targets, including optically thick plant root tissue.

JTu2A.75

Fast Optical Diffraction Tomography Microscopy with Large Field of View and Lossless Pupil Beam Combination, Wanxue Wei[1], Dashan Dong[1], Kebin Shi[1]; [1]*State Key Laboratory for Mesoscopic Physics, Department of Physics, Peking Univ., China.* Optical diffractive tomograph is a label-free 3D imaging technology.The traditional ODT microscopy has a small FOV of about 80um.In the paper, an large FOV-ODT microscopy is proposed.The results show that the large FOV-ODT microscopy has better imaging performance, higher signal-to-noise ratio on the sub-millimeter samples without splicing.

JTu2A.76

Femtosecond Laser-Triggered Dynamic Vapor Nanobubble Generation from Nanopillar Plasmonic Nanotransducer Arrays, Meitong Nie[1], Junyeob Song[2], Seied Ali Safiabadi Tali[1], Wei Zhou[1]; [1]*Virginia Tech, USA;* [2]*National Inst. of Standards and Technology, USA.* Vapor nanobubble is generated on nanopillar plasmonic nanotransducer arrays using femtosecond laser. Its spatial-temporal dynamics is extracted and analyzed, facilitating the development of highly precise and efficient nanoscale cell manipulation techniques.

JTu2A.77

Multi-color Structured Illumination Microscopy based on Ghost Imaging via Sparsity Constraints, Li Chen[1,2], Pengwei Wang[1], Zhentao Liu[1], Jianrong Wu[1], ShenSheng Han[1]; [1]*Key Laboratory of Quantum Optics, Shanghai Inst. of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai 201800, China, China;* [2]*Univ. of Chinese Academy of Sciences, Beijing 100049, China, China.* We proposed a multi-color structured illumination microscopy based on ghost imaging via sparsity constraints, which can improve the spatial resolution of multi-color imaging with a fast imaging speed.

JTu2A.78

Dual-wavelength Raman laser enables photoacoustic identification of water and lipid, Hanjie Wang[1], Lin Zhao[1], Huiyue You[1], Xin Dong[2], Hongsen He[1], Jun Dong[1]; [1]*Xiamen*

Univ., China; [2]The Univ. of Hong Kong, Hong Kong. We demonstrate a compact Raman nanosecond passively Q-switched solid-sate laser with dual wavelengths (1064 and 1176 nm) for efficient identification of water and lipid in photoacoustic microscopy.

JTu2A.79
Multi-stage Optical Sampling for Photonics-assisted Wideband Signal Analog-to-Digital conversion, Younus N. Mandalawi[1], Janosch Meier[1], Karanveer Singh[1], Mohamed I. Hosni[1], Thomas Schneider[1], Deepanshu Yadav[1]; *[1]Technische Universität Braunschweig, Germany.* We introduce a multi-stage photonics-assisted analog-to-digital conversion of wideband signals. In a proof-of-concept, we show the processing of signals with nine times the bandwidth of the incorporated electronics with an ENOB improvement of around 3.

JTu2A.80
Seamlessly Converged Optical-Wireless Access Networks Using Free-Running Laser-enabled mmWave Signal Generation and RF Envelope Detection, Luis Vallejo[1], Wei Jin[1], Jianming Tang[1]; *[1]Digital Signal Processing Centre of Excellence, UK.* Low-cost component-based converged optical-wireless networks without DSP at intermediate RRHs are proposed and experimentally demonstrated, supporting 1.67 Gbit/s/ch dynamic and continuous BBU-UE data flows over 50 km SSMF and 3 m 38 GHz wireless links.

JTu2A.81
Weight Clustering for Low-Complexity Time Domain-based Chromatic Dispersion Compensation in Optical Fiber Links, Geraldo Gomes[1], Pedro J. Freire[1], Jaroslaw E. Prilepsky[1], Sergei K. Turitsyn[1]; *[1]Aston Univ., UK.* We use weight clustering to reduce chromatic dispersion compensation complexity in a 16-QAM transmission across 1280 km of SSMF at 32Gbd. As non-linearity increases, we observe that fewer clusters are needed to equalize.

JTu2A.82
FPGA Verification of Generalized LDPC Convolutional Codes with Hamming Code, Yinlong Shi[1]; *[1]ZTE, China.* Employing FPGA emulations, we investigate the performance of the hybrid check generalized LDPC convolutional code, and reveal that a small proportion of generalized check nodes can not effectively decrease the error floor down to 10^{-15}.

JTu2A.83
Complexity reduction of CMA for polarization demultiplexing according to the autocorrelation function of SOP, Yan Zhang[1], Nan Cui[1], Xiaoguang Zhang[1]; *[1]Beijing Univ. of Posts and Telecommunications, China.* We found the symbol update interval in CMA can be lengthened according to the ACF of SOP in fibers. For a 32GBaud PDM system with 300krad/s SOP, 50% reduction in CMA complexity can be achieved.

JTu2A.84
High Speed SOP Tracking Added by an Optical Domain Polarization Demultiplexing Prototype in Short Range Coherent Optical Communication System, Wanxin Zhao[1], Linan Shan[1], Yihan Jia[1], Chong Wang[1], Shuning Sun[1], Xiaoguang Zhang[1], Lixia Xi[1]; *[1]BUPT, China.* We demonstrated a SOP tracking in a 10km coherent optical communication system, added by an optical-domain polarization demultiplexing prototype. The updating time interval of CMA taps is greatly lengthened about 25 times with 600krad/s SOP.

JTu2A.85

10 Mbit/s UV Solar-Blind OWC at 30 Photons per Bit, Feng Liu[1], James Farmer[1], Grahame Faulkner[1], Zhaoming Wang[1], Jianming Wang[1], Dominic O'Brien[1], Enyuan Xie[2], Jordan Hill[2], Johannes Herrnsdorf[2], Jonathan J.D. McKendry[2], Martin D. Dawson[2]; *[1]Univ. of Oxford, UK; [2]Univ. of Strathclyde, UK.* We report an ultra-sensitive UV solar-blind receiver with DCR below 10 kHz. Paired with a UV-C micro-LED, a 10 Mbit/s link with a BER of $3\times10^{(-3)}$ at ~30 photons per bit is established.

JTu2A.86

High-Precision and Large-Range Deflection of Light Beam with Fast Steering Mirrors, Jin T. Mei[1], Ke Huang[1], Haoran Fang[1], Zixiao Zhang[2], Chen Liu[1]; *[1]Huazhong Univ. of Science and Techn, China; [2]QLMN (Quantum, Light, Materials, and Nano Sciences) Master program, Physics Graduate School, Paris-Saclay Univ., France.* We proposed a combined kinematic model and mechanical decoupling method to extend FSM's operation range. Experimental result demonstrates pointing error is smaller than 0.05° in the range of -30° to 36° horizontally and ±24° vertically.

JTu2A.87

Design Aspects of Frequency-Domain Learned MIMO Volterra Equalisers, Nelson Castro[1], Sonia Boscolo[1], Andrew Ellis[1], Stylianos Sygletos[1]; *[1]Aston Univ., UK.* We numerically demonstrate a frequency-domain learned multiple-input multiple-output Volterra nonlinear equaliser and reveal the impact of practical implementation parameters on the per-channel performance.

JTu2A.88

A Large-scale Visible Light Communications Receiver based on Luminescent Solar Concentrator, Gonçalo R. Figueiredo[1,2], Lianshe Fu[2], Vitor Sencadas[2], Paulo S. Andre[1,2], Maria R. Ferreira[2]; *[1]Instituto De Telecomunicacoes, Portugal; [2]CICECO—Aveiro Inst. of Materials, Portugal.* We proposed a large dimension visible light communications receiver, achieving rates up to kps, through the utilization of luminescent solar concentrators. This solution addresses the challenges associated with directivity in uplink communications within indoor environments.

JTu2A.89

Experimental demonstration of optical waveform transmission with multiple-eigenvalue 16-APSK modulation, Tao Huang[1], Li Jianping[1], Yuwen Qin[1], Xinkuo Yu[1], Jianqing He[1], Gai Zhou[1], Songnian Fu[1]; *[1]Guangdong Univ. of Technology, China.* We experimentally demonstrate the optical waveform transmission with multiple eigenvalues and parameter optimization, and the transmission of 30-eigenvalue 8-ns soliton pulses with 16-APSK over 200km NZ-DSF has achieved with BER of 5.9E-3.

JTu2A.90

Optical domain SOP monitoring up to 5Mrad/s in long-haul WDM transmission systems, Linan Shan[1], Xiaoguang Zhang[1], Wanxin Zhao[1], Guanghao Yao[1], Yihan Jia[1], Shuning Sun[1], Chong Wang[1], Lixia Xi[1], Xiaosheng Xiao[1], Nan Cui[1]; *[1]Beijing Univ of Posts & Telecom, China.* We propose a simple structure for monitoring SOP in optical-domain, which can monitor SOP of 500rad/s~5Mrad/s within 4% error, with tolerance of more than 25840 ps/nm CD and 4ps PMD in 1520km long-haul WDM systems.

JTu2A.91

Neural network-based wavefront prediction for atmospheric channels, Chen Yan[1], Shanyong Cai[1], Zhiguo Zhang[1]; *[1]Beijing Univ. of Posts and Telecommunications, China.* A wavefront prediction method based on intensity images with neural network is proposed. Result shows that using the predicted wavefront for phase retrieval is more effective than the wavefront correction method without prediction.

JTu2A.92

In-Service OTDR Based on Native Transmitter for TDM PON, Yang Zou[1], Xiaoxiao Dai[1,2], Mengfan Cheng[1,2], Lei Deng[1,2], Liang Wang[1,2], Qi Yang[1,2], Deming Liu[1,2]; *[1]Wuhan National Lab for Optoelectronics (WNLO) & National Engineering Laboratory for Next Generation Internet Access System, School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China; [2]Optics Valley Laboratory, China.* We proposed an in-service OTDR based on native transmitters, which achieves rate matching without adding hardware complexity by introducing DSM. It achieves a dynamic range of >10 dB and a spatial resolution of 10 m.

JTu2A.93

Constellations to Combat non-Gaussian PAM4 Noise for SiP Modulators, Erwan Weckenmann[1], Amir Omidi[1], Benoît Paquin[1], Zibo Zheng[1], Alireza Geravand[1], Ming Zeng[1], Wei Shi[1], Leslie Rusch[1]; *[1]ECE, COPL - Université Laval, Canada.* The use of amplification with silicon photonics modulators increases the achievable baud rate, but leads to non-Gaussian noise at detection. We use neural networks to optimize the constellations for the asymmetric histograms in detected symbols.

JTu2A.94

A Fast Fiber Channel Modelling Based on Koopman Neural Operator for PDM Signal Transmission, Jianxiong Fei[1], Anlin Yi[1], Junling Huang[1], Lianshan Yan[1], Xingchen He[1], Lin Jiang[1], Bin Luo[1], Wei Pan[1]; *[1]Southwest Jiaotong Univ., China.* A 1600km PDM optical fiber channel modeling using Koopman Neural Operator is proposed. It provides relatively high efficiency comparable to 160-StPs-SSFM, while especially reducing its time consumption (Running time decreased from 34s to only 0.01s).

JTu2A.95

Nonlinear Interference Mitigation in Coupled Core Multi-Core Fiber using Subcarrier Multiplexing, Hossam Selmy[1], Andrea Carena[1]; *[1]Dipartimento di Elettronica e Telecomunicazioni, Politecnico di Torino, Italy.* Nonlinear interference (NLI) is a performance limiting factor for long-haul transmission in coupled-core multi-core fiber (CC-MCF). We propose to use subcarrier multiplexing (SCM) technique to reduce the amount of generated NLI increasing the maximum reachable distance.

JTu2A.96

Enhancing the Performance of BOCDA Sensor using Deconvolution Algorithm, Shuyan Chen[1], Zhiyong Zhao[1], Huan He[1], Weilun Wei[1], Xuan Zou[1], Ming Tang[1]; *[1]Huazhong Univ. of Science and Tech, China.* We have achieved a fourfold-improved spatial resolution and a much wider dynamic range without extra system hardware complexity by using deconvolution algorithm to post-process the data of traditional BOCDA sensor

JTu2A.97

Prior-free and inverse-free single photon single pixel imaging through thick scattering medium, Long Pan[1], Xiaohua Feng[1]; [1]*Zhejiang Lab, China.* By time gating and one-way light scattering characteristic of single pixel imaging, we demonstrate a prior-free and inverse diffusion equation-free single photon single pixel imaging through 60 mm thick scattering medium.

JTu2A.98
Accuracy Enhancement in Sweep-Free BOTDA Enabled by Simultaneous Full-Field Brillouin Spectrums Measurement, Huan He[1], Zhiyong Zhao[1], Ming Tang[1], Yucheng Yao[1]; [1]*Huazhong Univ. of Science and Tech., China.* Utilizing frequency-agility double-sideband digital optical frequency comb, a fast BOTDA based on full-field Brillouin spectrums is demonstrated with a record 4-m spatial resolution and less than 1.4-MHz frequency uncertainty over 10 km fiber.

JTu2A.99
A Self-powered Optical Strain Sensor Integrated with a Circuit Board, Qinchuan Jiang[1], Yang Zou[1], Xin Zeng[1], Xingen Guo[1], Yongzheng Liang[1], Kemin Li[1], Qingming Chen[1]; [1]*Sun Yat-Sen Univ., China.* A self-powered mechanoluminescent optical fiber is attached to the circuit board to form a strain sensor system. Both the strain strength up to 50% and stretching speed of 200-500 mm/min have been detected.

JTu2A.100
Ultra-Linear Wideband FMCW Laser Based on Frequency-Shifted Self-Injection Locking, Jichen Zhang[1], Shangyuan Li[1], Xiaoping Zheng[1], Xiaoxiao Xue[1]; [1]*Tsinghua Univ., China.* A self-injection locked diode laser is demonstrated for frequency-modulated continuous-wave light generation. The residual nonlinearity is reduced by 26 folds compared to the free-running state, reaching 5.8×10^{-7} when the modulation bandwidth is 100 GHz.

JTu2A.101
Ultra-Sensitive Fiber Bragg Grating Sensor Based on Optoelectronic Oscillator with Optically Injected DFB-LD, Hao Chen[2,1], Jiahui Lin[2], Chen Zhu[1]; [1]*Zhejiang Laboratory, China;* [2]*Hangzhou Inst. of Advanced Studies, Zhejiang Normal Univ., China.* A fiber Bragg grating (FBG) sensor based on an optoelectronic oscillator (OEO) with an optically injected distributed feedback laser diode is proposed and experimentally demonstrated, showing a linear and high temperature sensitivity of -0.973 GHz/°C.

JTu2A.102
Surface-Enhanced Infrared Absorption with Photonic Crystal Guided Resonances, Jin-Yen Lin[1], Chi Ting Weng[1], Tzu-Hsun Huang[1], Wei-Chang Huang[1], Jia-Wun Liaw[1], Tsung-Bo Chen[1], Jui-Nung Liu[1,2]; [1]*Department of Electrical Engineering and Inst. of Microelectronics, National Cheng Kung Univ., Taiwan;* [2]*NCKU Academy of Innovative Semiconductor and Sustainable Manufacturing, Taiwan.* We numerically demonstrate EIA-like mid-infrared absorption enhancement of a deep-subwavelength-thick molecular layer by more than an order of magnitude with a high-Q photonic crystal guided resonance (PCGR).

JTu2A.103
Synthesis of rapid and highly-linear frequency-stepping optical carriers over 100 GHz bandwidth, Jiarong Zhang[1], Yihan Li[1], Li Yi[2]; [1]*Beihang Univ., China;* [2]*Osaka Univ., Japan.* We

demonstrate the generation of frequency-modulated optical signals with up to >100 GHz tuning range and >1 GHz/µs stepping rate based on a recirculating frequency shifting fiber loop.

JTu2A.104

Scene Plane Recognition via Depth-Infrared Intensity Fusion Using ToF Camera, Dongzhao Yang[1], Dong An[2], Qiang Wang[3], Zhongqi Pan[4], Yang Yue[1]; *[1]School of Information and Communications Engineering, Xi'an Jiaotong Univ., China; [2]Inst. of Modern Optics, Nankai Univ., China; [3]Angle AI (Tianjin) Technology Co., Ltd., China; [4]Department of Electrical & Computer Engineering, Univ. of Louisiana at Lafayette, USA.* A scene plane information recognition method is demonstrated based on data fusion using a single ToF camera. This approach effectively tackles general LiDAR's deficiencies in identifying planar content, achieving an impressive recognition accuracy of 98.3%.

JTu2A.105

Machine Learning-Enhanced Sapphire Fiber Bragg Grating for Fast, Resilient and High-Accuracy Temperature Sensing, Xiao Liu[1], Bo Liu[1,2], Chen Zhu[1]; *[1]Zhejiang lab, China; [2]Zhejiang Univ., China.* This study introduces a robust and fast temperature sensing approach using a machine learning-assisted sapphire fiber Bragg grating configuration, achieving high accuracy (0.23 celcius) at 5 kHz acquisition rate and robust resilience to environmental vibrations.

JTu2A.106

Characterizing the Bending Response of Forward Stimulated Brillouin Scattering in Photonic Crystal Fiber, Xuan Zou[1], Weilun Wei[1], Shuyan Chen[1], Zhiyong Zhao[1], Chen Yang[2], Ming Tang[1], Yucheng Yao[1]; *[1]Huazhong Univ. Of Science and Tech, China; [2]Yangtze Optical Fibre and Cable Joint Stock Limited Company, China.* We characterize the bending response of forward stimulated Brillouin scattering (FSBS) in photonic crystal fiber (PCF). Thanks to the unique air-core geometry, high curvature sensitivity (-1.7790 MHz/cm) and high stability (≤ 87.8 KHz) are obtained.

JTu2A.107

Stable Frequency Transmission over a 68-km Installed Telecom Fiber Network, Hao Gao[1], Jiahui Cheng[1], Jie Zhang[1], Baodong Zhao[1], Yapeng Liu[1], Chenxia Liu[2], Ziyang Chen[3], Bin Luo[1], Song Yu[1], Hong Guo[3]; *[1]Beijing Univ of Posts & Telecomm, China; [2]North China Electric Power Univ., China; [3]Peking Univ., China.* We demonstrate a stable frequency transmission over a 68 km installed telecom fiber and compare the effect of occasional vibrations within a city on the frequency instability of the system.

JTu2A.108

Super-resolution interferometric phase measurement with directionally-unbiased linear-optical devices, Christopher Schwarze[1], David S. Simon[1,2], Abdoulaye Ndao[3], Alexander V. Sergienko[1]; *[1]Boston Univ., USA; [2]Physics, Stonehill College, USA; [3]ECE, Univ. of California, San Diego, USA.* A beam-splitter forbids input light from exiting the input port. We introduce a four-port linear scatterer without this restriction, establishing an alternate approach to cavity interferometry. The Michelson configuration enables super-resolution phase measurements without post-selection.

JTu2A.109

Breaking the trade-off between spatial resolution and sensing resolution in optical frequency domain reflectometry-based distributed sensing, Zhaopeng Zhang[1], Wei Peng[1], Lingmei Ma[1], Chen Zhu[1]; [1]*Zhejiang Lab, China.* Empowered by a data and physics-driven neural network, an OFDR-based high-performance distributed sensor is experimentally validated with sub-millimeter spatial resolution and sub-με sensing resolution over a long sensing range of 140 m.

JTu2A.110
High-sensitivity, high-speed underwater ultrasonic detection based on time-stretched self-coherent detection, Yujia Li[1], King Shing Lo[1], Dongmei Huang[1], Chao Lu[1], P. K. A. Wai[1]; [1]*The Hong Kong Polytechnic Univ, Hong Kong.* A MHz-level underwater ultrasonic wave with the kPa-level pressure is detected by the time-stretched self-coherence system with a high speed and highly coherent swept laser, which is significant for ultrasound detection.

JTu2A.111
High-Stable RF Transmission over 64.4 km Metropolitan Area Network, Zhuoze Zhao[1], Zhengkang Wang[1], Hao Gao[1], Jiahui Cheng[1], Jie Zhang[1], Baodong Zhao[1], Yunlan Luo[1], Bin Luo[1], Song Yu[1]; [1]*BJ Univ. of Posts and Telecommunuca, China.* The paper describes a high-stable RF transmission in a metropolitan area network over a distance of 64.4 km and demonstrates the experimental verification of the impact of link dispersion configuration on transmission instability.
JTu2A.112
Withdrawn

JTu2A.113
Reduction of Additive Phase Noise of Electrical Amplifiers for Electronic-Photonic Low Noise Signal Generation, Pedram Shirmohammadi[1], Steven Bowers[1]; [1]*Univ. of Virginia, USA.* A low-phase noise amplifier featuring 17.2 dB peak gain and -152 dBc/Hz additive phase noise at 10 GHz is presented. The study explores strategies for reducing phase noise by trading-off amplitude and phase noise.

JTu2A.114
Subspace Analysis of Noise Trade-off in the Design of Resonant Electro-Optic Combs, Holger Heebøll[1], Jasper Riebesehl[1], Aleksandr Razumov[1], Pooja Sekhar[2], Scott A. Diddams[2,3], Francesco Da Ros[1], Michael Galili[1], Darko Zibar[1]; [1]*Technical Univ. of Denmark, Denmark;* [2]*Department of Physics, Univ. of Colorado Boulder, USA;* [3]*Department of Electrical, Computer and Energy Engineering, Univ. of Colorado Boulder, USA.* We identify an additional phase noise component in resonant electro-optic combs. To minimize its contribution, our results suggest a trade-off between modulation index, cavity finesse and free spectral range.

JTu2A.115
Quantifying Uncertainty for a Bayesian Laser Phase Noise Measurement Method, Jasper Riebesehl[1], Holger Heebøll[1], Aleksandr Razumov[1], Michael Galili[1], Darko Zibar[1]; [1]*DTU Electro, Technical Univ. of Denmark, Denmark.* We quantify the uncertainty of a Bayesian filtering method to measure phase noise below the measurement noise floor. With 95% certainty phase noise is estimated to be ∼7.6 dB below the noise floor.

JTu2A.116

When does interferometric imaging achieve superresolution?, Michael R. Grace[1]; [1]*Physical Sciences and Systems, Raytheon BBN, USA.* Multi-aperture imaging is often said to enable equivalent spatial resolution to a single aperture spanning the interferometric baseline. We quantitatively evaluate this statement and identify conditions when interferometry achieves functional superresolution compared to monolithic imaging.

JTu2A.117

Phase Noise Characterization of Cr:ZnS Frequency Comb using Subspace Tracking, Aleksandr Razumov[1], Sergey Vasilyev[2], Jasper Riebesehl[1], Holger Heebøll[1], Francesco Da Ros[1], Darko Zibar[1]; [1]*DTU, Denmark;* [2]*IPG Photonics Corporation, USA.* Phase noise characterization of the frequency comb based on Cr:ZnS modelocked laser is demonstrated using subspace tracking, allowing decomposition of phase noise sources. We measure the corresponding phase noise power spectral densities and scaling with comb-line number.

JTu2A.118

Withdrawn

JTu2A.119

High-Speed Optical Sampling via Repetition Rate Switching of an Optically-Injected Mode-Locked Laser Diode, Ana Filipa Ribeiro[1], Tiago d. Gomes[1,2], Maria Ana Cataluna[1]; [1]*Heriot-Watt Univ., UK;* [2]*Universidade do Porto, Portugal.* We demonstrate high-speed parallel heterodyne interferometry via repetition rate exchange through direct square-wave modulation of the repetition rate of an optically-injected mode-locked quantum-dot laser, showing potential for less demanding RF specifications and significant cost reduction.

JTu2A.120

Withdrawn

JTu2A.121

Withdrawn

JTu2A.122

Secondary-electron Multiplication during the Extreme Ultraviolet Photoemission from Nanostructures and its Ultrafast Interaction with Electron Pulses, Pengzuo Jiang[1], Wei Zheng[1], Xiaofang Li[1], Yu Liu[1], Yang Wang[1], Yaoling Li[1], Chengyin Wu[1]; [1]*Peking Univ., China.* Ultrafast extreme ultraviolet (EUV) radiation was built and connected with the photoemission electron microscope. Secondary electron multiplication was observed in spatial and energy when the EUV pulse illuminated gold nanostructures. These secondary electrons formed a transient electric field which would manipulate an electron pulse.

JTu2A.123

Energy Transfer Between Alq_3 Molecules and Si Revealed by Pump-Probe Spectroscopy, Yu-Chan Tai[1], Wen-Yen Tzeng[1,5], Jhen-Dong Lin[1], Yi-Hou Kuo[1], Fu-Xiang Rikudo Chen[1], Ruei-Jhe Tu[1], Ming-Yang Huang[1], Shyh-Shii Pai[2], Nick Weihan Chang[2], Sheng-Yang Tseng[2], Chi Chen[3], Chun-Liang Lin[1], Atsushi Yabushita[1], Shun-Jen Cheng[1], Chih-Wei Luo[1,4]; [1]*Department of Electrophysics, National Yang Ming Chiao Tung Univ., Taiwan;* [2]*FAB 12B, Taiwan Semiconductor Manufacturing Company, Ltd., Taiwan;* [3]*Research Center for*

Applied Sciences, Academia Sinica, Taiwan; [4]Taiwan Consortium of Emergent Crystalline Materials (TCECM), National Science and Technology Council, Taiwan; [5]Department of Electronic Engineering, National Formosa Univ., Taiwan. We employ ultrafast optical pump-probe spectroscopy to reveal the energy transfer (ET) mechanism between organic Alq_3 molecules and Si. Inserting ultrathin SiO_2 layers between Alq_3 and Si exposes SiO_2-thickness-dependent relaxation dynamics of photoexcited carriers and discloses ET from Alq_3 to Si, comparable with a dipole-dipole interaction model.

JTu2A.124

Strain-Modulated Exciton Recombination Probability in Semiconductor Nanocrystals, Daniel Hensel[1], Daniel Schmidt[3], Mallika Khosla[1], Mariana Brede[1], Fariba Hatami[2], Peter Gaal[1,3]; *[1]Leibniz-Institut für Kristallzüchtung, Germany; [2]Humboldt Universität zu Berlin, Germany; [3]TXproducts UG (haftungsbeschränkt), Germany.* Photoacoustic strain modifies the recombination probability of excitons in semiconductor nanocrystals via deformation potential coupling. Optical and X-Ray pump-probe schemes were used to characterize their mechanical response. The modulation of photoluminescence efficiency will be monitored by time-correlated single photon counting.

JTu2A.125

Withdrawn

JTu2A.126

Carrier Transfer From C-Plane to Semipolar-Plane Regions in a Red-Emitting InGaN/GaN Heterostructure, Yakshita Malhotra[1], Yifan Shen[1], Yuanpeng Wu[1], Josey Hanish[1], Yifu Guo[1], Yixin Xiao[1], Kai Sun[1], Theodore Norris[1], Zetian Mi[1]; *[1]Univ. of Michigan, USA.* Temperature and power dependent time-resolved photoluminescence measurements are performed on a novel ultra-stable red-emitting InGaN/GaN heterostructure. PL dynamics at two distinct wavelengths indicate a lateral carrier transfer from c-plane to semipolar-plane InGaN in the structure.

JTu2A.127

Ultrafast Coherent Raman Study of Lattice Vibration Dynamics in Wide-bandgap Semiconductors, Helani Achintha Singhapura Singhapurage[1], Dinusha M. Senarathna[1], Jeremy Sylvester[1], Chandra P. Neupane[1], Feruz Ganikhanov[1]; *[1]Department of Physics, Univ. of Rhode Island, USA.* Optical phonon dynamics, including decay of symmetry forbidden modes, have been studied in technologically important wide-bandgap semiconductors. Phonon decay times for LO- and TO- phonon modes have been found to be within 0.82-1.56 ps and are explained in terms of parametric phonon interactions.

JTu2A.128

Nonlinear spectroscopy with classical and quantum light to probe exciton quantum dynamics, Ajay Ram Srimath Kandada[1], Esteban Rojas-Gatjens[2], Katherine A Koch[1], Evan Kumar[1], Ravyn Malatesta[2], Lorenzo Uboldi[3,1], David O Tiede[4,1], Eric R Bittner[5], Giulio Cerullo[3], Carlos Silva[6]; *[1]Wake Forest Univ., USA; [2]Georgia Inst. of Technology, USA; [3]Politecnico di Milano, Italy; [4]Instituto de Ciencias de Materiales de Sevilla, Spain; [5]Univ. of Houston, USA; [6]Univ. of Montreal, Canada.* Coherent nonlinear optical response of materials provides mechanistic insights into exciton many-body interactions, although several ambiguities persist due to high excitation densities. We introduce an alternative experimental methodology based on spectrally entangled biphoton states as a probe of many-body physics of excitonic materials.

JTu2A.129

Polarization-Dependent Spectral Phase of Exciton-Polaritons in a Semiconductor Microcavity, Hunter L. Louscher[1], Jagennath Paul[2], Giuseppe Fumero[2], Jared K. Wahlstrand[2], Alan Bristow[1,2]; *[1]West Virginia Univ., USA; [2]Nanoscale Device Characterization, National Inst. of Standards and Technology, USA.* Peak amplitude, phase, linewidth, and energy are recorded for exciton-polaritons measured with rephasing two-dimensional coherent spectroscopy as a function of detuning and polarization. The relative phases with respect to co-circular polarization are detuning dependent.

JTu2A.130

The Terrace Structures Induced by Femtosecond Laser on Reduced Lithium Niobate under High Temperature, Xinda Jiang[1], Yaoyao Liu[1], Xitan Xu[1], Jianghong Yao[1], Qiang Wu[1], Jingjun Xu[1]; *[1]Nankai Univ., China.* Different from typical femtosecond laser induced material removal, novel terrace structures are induced on the surface of reduced lithium niobate at high temperature by using multi-pulses femtosecond laser.

JTu2A.131

Optical Stark effects of attractive and repulsive Fermi polarons in charge-tunable monolayer WSe_2 devices, Hyojin Choi[1], Jinjae Kim[1], Jiwon Park[1], Lee Yewon[2], Jekwan Lee[1], Kenji Watanabe[3], Takashi Taniguchi[3], Moon-ho Jo[2], Hyunyong Choi[1]; *[1]Seoul National Univ., Korea (the Republic of); [2]Inst. for Basic science, Korea (the Republic of); [3]National Inst. for materials science, Japan.* We have investigated the ultrafast optical Stark effect of attractive and repulsive polarons. Surprisingly, doping-dependent results show that the shift of attractive polarons increases with increasing the carrier density, while that of repulsive polarons decreases.

JTu2A.132

Spatially and Spectrally Selective Excitation of Magnetic Dipole Transitions in Eu^{3+} Doped Yttrium Oxide, Elizaveta Gangrskaia[1], Rokas Jutas[1], Alessandra Bellissimo[1], Valentina Shumakova[1], Sarah Pulikottil Alex[1], Ignác Bugár[1], Lorenz Grünewald[2,3], Sebastian Mai[2], Thomas Schachinger[4], Dariusz Pysz[5], Ryszard Buczynski[5], Andrius Baltuška[1,6], Audrius Pugzlys[1,6]; *[1]Photonics Inst., Technische Universität Wien, Austria; [2]Inst. of Theoretical Chemistry, Faculty of Chemistry, Univ. of Vienna, Austria; [3]Vienna Doctoral School in Chemistry (DoSChem), Univ. of Vienna, Austria; [4]Univ. Service Centre for Transmission Electron Microscopy (USTEM), Technische Universität Wien, Austria; [5]Lukasiewicz Research Network - Inst. of Microelectronics and Photonics, Poland; [6]Center for Physical Sciences & Technology, Lithuania.* Combining Stimulated Raman Scattering and spectral focusing, we generate narrowband tunable pulses for selective excitation of electric or magnetic dipole transitions in FIB-fabricated $Eu^{3+}Y_2O_3$ nanostructures. Spatial electivity is enhanced by implementing azimuthally polarized beams.

JTu2A.133

Role of Band Alignment on the Two-Photon Absorption of Nanocrystal Heterostructures, Arthur Alo[1], Luana A. Reis[1], Leonardo W. Barros[1], Gabriel Nagamine[1], Jonathan C. Lemus[1], Josep Planelles[2], José L. Movilla[3], Juan I. Climente[2], Hak June Lee[4,5], Wan Ki Bae[5], Lazaro Padilha[1]; *[1]Instituto de Física Gleb Wataghin, Brazil; [2]Dept. de Química Física i Analítica, Universitat Jaume I, Spain; [3]Dept. d'Educació i Didàctiques Específiques,* *Universitat Jaume I, Spain; [4]School of Chemical and Biological Engineering, Seoul National Univ., Korea (the Republic of); [5]SKKU Advanced Inst. of Nanotechnology (SAINT), Sungkyunkwan Univ. (SKKU), Korea (the Republic of).* The influence from different band alignment of nanocrystal heterostructures on their two-photon absorption (2PA) is discussed, showing the possibility to increase the 2PA cross-section by one order of magnitude without significantly changing the emission spectra.

JTu2A.134

Does Quantum Interference Control of injected Photocurrents Produce a Current or Voltage?, Yiming Gong[1], Steven T. Cundiff[1]; [1]*Univ. of Michigan, USA.* We address the question “Quantum Interference Control (QuIC) of injected Photocurrents Produces a Current or Voltage?” by studying the dependence on external resistance for Schottky- and Ohmic-contact devices, resolving a long-standing puzzle about QuIC.

JTu2A.135

Quantum Enhanced Nonlinear Spectroscopy of Photonic Microcavities, Evan J. Kumar[1], Lorenzo Uboldi[2,1], Ravyn Malatesta[3], Esteban Rojas-Gatjens[3], Andy Cruz[4], Vinod Menon[4], Giulio Cerullo[2], Luca Moretti[2], Ajay Ram Srimath Kandada[1]; [1]*Wake Forest Univ., USA; [2]Dipartemento di Fisica, Politecnico di Milano, Italy; [3]School of Chemistry and Biochemistry, Georgia Inst. of Technology, USA; [4]Department of Physics, City College of New York, City Univ. of New York, USA.* Quantum entangled photons are suggested as an optical probe to isolate specific many-body interactions in molecular materials and improve upon measurement sensitivity in conventional nonlinear spectroscopy experiments.

JTu2A.136

Third-Order Harmonic Generation in Bulk Al_2O_3, Fe_2O_3, and Bi_2Se_3 Crystals, Isabelle Tigges-Green[1], Matthew Mason[1], Nicholas M. Fasano[2], Andreas Giakas[2], Vedin Dewan[2], Michelle M. Wang[3], Ava N. Hejazi[1], Somnath Biswas[6], Timothy Bennett[2], Matthew Edwards[4], Nicholas Karpowicz[5], Gregory D. Scholes[1], Julia M. Mikhailova[2]; [1]*Princeton Department of Chemistry, USA; [2]Mechanical and Aerospace Engineering, Princeton Univ., USA; [3]Electrical and Computer Engineering, Princeton Univ., USA; [4]Mechanical Engineering, Stanford Univ., USA; [5]Quantum Optics, Max Planck Inst. of Quantum Optics, Germany; [6]Chemistry, Univ. of Washington, USA.* We present the analysis of the third-order harmonic generation in bulk crystals driven by a near-IR laser in the reflection geometry. We compare the energies of the third-order harmonic generated by these crystals.

JTu2A.137

Excitonic Single- and Two-Photon Photoluminescence Excitations in Bilayer GaN/AlN Nanowires, Liangqing Cui[1], You Wu[1], Yuanpeng Wu[1], Zetian Mi[1], Mackillo Kira[1], Theodore Norris[1]; [1]*Univ. of Michigan, USA.* The energy difference between the 1s and 2p exciton states of bilayer GaN/AlN is measured and computed by comparing excitonic resonances in photoluminescence excitation spectra following single- versus two-photon absorption.

JTu2A.138

The Polarization Dependence of QuIC Injected Photocurrents Reveals Current Injection Tensors, Yiming Gong[1], Steven T. Cundiff[1]; [1]*Univ. of Michigan, USA.* We study current injection tensors of Quantum interference control (QuIC) processes by measuring their dependences on single-polarization rotation. We discover that the polarization of odd-order optical absorptions determines the direction of QuIC photocurrents.

JTu2A.139

Coherent trion formation reveals ultrafast evolution of free-carrier statistics in MoS_2, Manobina Karmakar[1,2], Prasanta Datta[1]; *[1]Indian Inst. of Technology Kharagpur, India; [2]NanoScience Technology Center, Univ. of Central Florida, USA.* We reveal the ultrafast dynamics of photo-doping in MoS_2 as we monitor the coherent trion formation by a broadband probe (1.5 eV - 2 eV) while photo-exciting with an intense pump pulse (2.48 eV).

JTu2A.140

Intervalley charge-carrier dynamics in type-II InAs/AlAs1-xSbx multiple quantum wells, Juan Del Castillo[1,2], Sunil Gyawali[1], Vincent R. Whiteside[3], Tetsuya D. Mishima[3], Michael B. santos[3], Ian R. Sellers[4,3], Alan D. Bristow[1]; *[1]West Virginia Univ., USA; [2]Fisica, Universidad de Sonora, Mexico; [3]Physics, Univ. of Oklahoma, USA; [4]Electrical Engineering, Univ. of Buffalo - SUNY, USA.* Photocarrier dynamics are measured in type-II MQW heterostructures for excitation that allows for relaxation through the L-valley. Both characteristic timescales of relaxation and the decay mechanisms are modified from those without intervalley scattering.

JTu2A.141

Temperature-Dependent Terahertz Spectroscopy of Saline Water and Ice, Seth M. Woodwyk[1], Sunil Gyawali[1], Harrison A. Loh[1], Gregory T. Forcherio[2], Alan D. Bristow[1]; *[1]West Virginia Univ., USA; [2]Naval Surface Warfare Center, USA.* The complex dispersion for saline, based on a sea-water mix, is measured at terahertz frequencies from liquid at room temperature down through the identifiable freezing point transition to the lowest report temperature on Earth.

JTu2A.142

Understanding the Influence of Capping Layer on Spin Wave Modes: An In-Depth Investigation with a Custom Time-Resolved Magneto-Optical Kerr Effect (TR-MOKE) Setup, Debkanta Ghosh[1], Chitra Dolai[1], Shailab Singh Bodra[1]; *[1]Indian Inst. of Technology Kharagpur, India.* Here we investigated ultrafast magnetization dynamics of Ni thin film with and without HfO2 capping layer using TR-MOKE microscopy. The outcomes provide insights into the recovery and potential improvement of spin mobility in Ni films.

JTu2A.143

Spectral and Spatial Self-Transformations of Terawatt Laser Beams in Low-Pressure Gases, Andreas Giakas[1], Matthew Edwards[2], Nicholas M. Fasano[1], Isabelle Tigges-Green[1], Timothy Bennett[1], Julia M. Mikhailova[1]; *[1]Princeton Univ., USA; [2]Stanford Univ., USA.* Spectral broadening of 25-fs multi-terawatt laser pulses has been achieved in low-pressure atmospheric gases without significant loss of spatial coherence in the laser beam by femtosecond laser filamentation.

JTu2A.144

Demonstration of Lorentz boosts of space-time wave packets, Murat Yessenov[1], Miguel Romer[1], Naoki Ichiji[2], Ayman F. Abouraddy[1]; *[1]Univ. of Central Florida, CREOL, USA; [2]Inst. of Industrial Science, The Univ. of Tokyo, Japan.* We demonstrate Lorentz transformation of space-time wave packets (STWPs) - propagation-invariant optical pulse - transforming into another STWP, confirming the change in its pulse-width, invariance of the spatial profile, and the change in group velocity.

JTu2A.145

Plasma Density Effects on the Diffraction Efficiency of Ionization Gratings, Victor M. Perez-Ramirez[1], Nicholas M. Fasano[2], Michelle M. Wang[2], Ke Ou[1], Sida Cao[1], Andreas Giakas[2], Pierre Michel[3], Julia M. Mikhailova[2], Matthew Edwards[1]; *[1]Stanford Univ., USA; [2]Princeton Univ., USA; [3]Lawrence Livermore National Laboratory, USA.* We present an experimental characterization of how the diffraction efficiency of an ionization plasma grating increases with plasma density. Grating performance follows trends predicted by optical theory, suggesting a path to ultra-high-damage-threshold optics.

JTu2A.146

A Time-Reversal-Symmetric Laser in the Polarization Space, Marie-Céline Gauthier Danve[1], Daniel Rojas[1], Shawn Lapointe[1], Jean-Francois Bisson[1]; *[1]Universite de Moncton, Canada.* The concept of parity-time reflection symmetry can be generalized to any antiunitary operator. Using anisotropic thin films made by glancing angle deposition, we designed and characterized a *time-reversal symmetric* solid-state laser in the polarization space.

JTu2A.147

Large Saturation Absorption of Resonant Aluminum Metasurfaces, Hailun Xie[1], Lili Gui[1], Kun Xu[1]; *[1]BUPT, China.* We experimentally demonstrate that an aluminum metasurface is prospective saturable absorber with significant modulation depth (9.56%) under a low incident fluence of 25 μJ/cm^2, due to local-field enhancement by surface lattice resonance in the near-infrared.

JTu2A.148

Inverse Design of Dual-Band Metasurfaces for Vortex Fiber Laser, Shulei Bi[1], Lili Gui[1], Chuanshuo Wang[1], Xianglai Liao[1], Kun Xu[1]; *[1]Beijing Univ. of Posts and Telecomm, China.* We present a deep learning and genetic algorithm-driven inverse design strategy for dual-band metasurfaces, which can be applied to vortex fiber lasers around the wavelengths of 1030 nm and 1550 nm.

JTu2A.149

Adjustable polymer dispersed liquid crystal grating, Hsuan-Han Huang[1], Yu-Jen Li[1], Chiu-Chang Huang[1], Chieh-Hsiung Kuan[1]; *[1]National Taiwan Univ., Taiwan.* The double-period grating structure is integrated in a polymer dispersed liquid crystal (PDLC) device and guides the arrangement of PDLC droplets. The grating period is changed by electronic control.

JTu2A.150

A polarization-sensitive visible broadband absorber based on a phase-modulation metasurface, Liye Li[1], Wengang Wu[1]; *[1]Peking Univ., China.* We propose a polarization-sensitive visible broadband absorber based on a phase-modulation metasurface. The measured average absorptivity of the y-polarized beam reaches 76.8%, and the x-polarized reflectivity is 56.4%, with angle robustness and working band tunability.

JTu2A.151

Study on Thermal Effect of Metasurface for Temperature-Insensitive Hybrid Optical System, DongYoung Lee[1], Yujin Nam[1], Dongjae Seo[1], Taesik Ryu[1], Sungchan Park[1], Jisoo Kyoung[1]; *[1]Dankook Univ., Korea (the Republic of).* We analyzed the thermal effects of metasurfaces to design temperature-insensitive hybrid optical systems. We found that the deformation of meta-atom (nano-structure) or the change of the index is negligible but the substrate expansion is important.

JTu2A.152
Multimodal surface lattice resonances based on angle and polarization multiplexing in an all-metal metasurface, Liye Li[1], Wengang Wu[1]; *[1]Peking Univ., China.* Bi- and tri-mode surface lattice resonances can be generated regularly based on the angle and polarization multiplexing in an all-metal metasurface, and corresponding resonance wavelengths can be described by a set of formulas precisely.

JTu2A.153
Effect of Configuration Statistics on the Spectral Properties of Random Arrays of Particles, Romil Audhkhasi[1], Maksym Zhelyeznyakov[1], Steven Brunton[1], Arka Majumdar[1]; *[1]Univ. of Washington, USA.* We investigate correlations between the spectral responses of one- and two-dimensional random arrays of particles and their configuration statistics. We exploit these correlations for spectral prediction of such complex systems in the visible wavelength range.

JTu2A.154
Resonance Nesting and Degeneracy of Bilayer Spherical Dielectric Cavities within Zero-index Materials, Nuo Wang[1], Yun Ma[1], Qi Liu[1], Yu Tian[1], Yuye Wang[2], Qihuang Gong[1], Ying Gu[1]; *[1]Peking Univ., China; [2]Tianjin Univ., China.* We investigate the mode characteristic of bilayer spherical dielectric cavities embedded in ZIMs and find the resonance and mode degeneracy effect. Superior to monolayer cavities, the electric field distribution and mode degeneracy of bilayer cavities can be manipulated by changing the geometrical sizes.

JTu2A.155
Multimode Fibre Imaging Resilience to Deformation in the Near-field and Far-field, Robert J. Kilpatrick[1], Chaitanya K. Mididoddi[1], Shuhui Li[2], David B. Phillips[1]; *[1]Physics and Astronomy, Univ. of Exeter, UK; [2]Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, China.* Multimode fibres exhibit degraded imaging performance when the fibre bends. We contrast the spatial variation of the imaging performance due to bending between imaging in the near and far-field of the output facet.

JTu2A.156
Complexity Imbalance of Nanostructured Antireflective Surfaces, Subhasree Srenevas[1], Menelaos Poutous[1]; *[1]Univ. of North Carolina, Charlotte, USA.* Effective-medium computations fail to predict scatter from random antireflective surface structures. We used granulometry and surface structural disorder calculations to establish a relation between surface complexity and the on-set of spectral scatter.

JTu2A.157
Withdrawn

JTu2A.158
A Prototypical Metasurface Dual-Band Radar Antenna Design, Dustin T. Louisos[1], Kristy Hecht[2], Erick Matilde[1], Jimmy Touma[3], Tino Hofmann[1], Mario Mencagli[1], Andrew Willis[1]; *[1]UNCC, USA; [2]JPL, USA; [3]AFRL, USA.* A multi-disciplinary design of a modulated

metasurface antenna is proposed that incorporates realistic material properties and fabrication constraints for radar applications at two common use frequencies: 10~GHz and 100~GHz.

JTu2A.159

Topologically Protected Asymmetric Mode Conversion in a Fiber with a Chiral Index and Gain Modulation, Huanyu Zhou[1], Mingshu Chen[1], Kestutis Staliunas[2,3], Almantas Galvanauskas[1]; *[1]Gerard Mourou Center for Ultrafast Optical Science, Univ. of Michigan, USA; [2]Dep. De Fisica, Universitat Politecnica Catalunya, Spain; [3]ICREA, Spain.* We show that asymmetric mode-coupling can be achieved in a fiber with a helical index-gain modulation, with conversion efficiency controlled by varying the separation between the unidirectional and the exceptional points in fiber parameter space.

JTu2A.160

Spaceplates based on photonic crystal slabs supporting orthogonal resonances, Francisco J. Díaz-Fernández[1,2], Luis M. Máñez-Espina[1], Ana Díaz-Rubio[1], Viktar S. Asadchy[2]; *[1]Nanophotonics Technology Center, Universitat Politècnica de València, Spain; [2]Department of Electronics and Nanoengineering, Aalto Univ., Finland.* Recently, spaceplates were proposed to replace free-space gaps in optical systems. Through overlapping of two resonances with opposite symmetries in a photonic crystal slab, we show enhanced space compression with improved bandwidth and other characteristics.

JTu2A.161

Orthogonality between Thermal Noise and Transmitted Signals: A Novel Aspect in CPA Networks, Douglas Oña[1], Ángel Ortega[1], Osmery Hernández[1], Iñigo Liberal[1]; *[1]Department of Electrical, Electronic and Communications Engineering, Public Univ. of Navarra, Spain.* We demonstrate a novel CPA's feature: the intrinsic orthogonality between CPA thermal noise and transmitted signals. This effect may have a relevant technological impact, such as the intra-network heat transfer processes.

JTu2A.162

Optical Power-Handling Capabilities of Active Phase-Change Metasurfaces, George J. Braid[1], Carlota Ruiz De Galarreta[1,2], Joe Pady[1], Andrew Comley[3], Jacopo Bertolotti[1], C. David Wright[1]; *[1]Univ. of Exeter, UK; [2]Instituto de Optica, Spain; [3]Atomic Weapons Establishment, UK.* Phase-change materials can deliver active metasurfaces, but it is not well-studied how these devices perform in high-power applications. We develop a model for optical performance changes induced by high-power lasers, applying it to two metasurface designs.

JTu2A.163

A Secondary Grating Metasurface based on Guided-Mode Resonance for Highly Sensitive Biochemical Sensing, Lijun Ma[1], Liye Li[1], Hongshun Sun[1], Yunhao Cao[1], Yusa Chen[1], Wengang Wu[1]; *[1]Peking Univ., China.* We present a secondary grating metasurface based on guided-mode resonance (GMR) which significantly enhances refractive index (RI) sensitivity compared to the traditional dielectric metasurface by up to 5.8 times.

JTu2A.164

Implementing the Geometric Phase for Designing the Axially Asymmetric Metasurface Element, Hosna Sultana[1], Binbin Weng[1]; *[1]Univ. of Oklahoma, USA.* Designing a metasurface with appropriate phase correlation between light's linear and circular polarization states is challenging. The focus here is obtaining the geometric phases from different geometric shapes for optimum dielectric metasurface design.

JTu2A.165
Scaling of the Mesoscopic Conductance, Krishna C. Joshi[1], Israel Kurtz[1], Azriel Genack[1]; [1]*Physics, Queens College and the Graduate Center of the City Univ. of New York, USA.* Dips are observed in the microwave transmittance due to the vanishing of transmission in the lowest transmission eigenchannel, which pulls down transmission in all other eigenchannels. Ohm's law is approached as sample dimensions increase.

JTu2A.166
Statistics of Singularities in the Complex Plane, Israel Kurtz[1], Krishna C. Joshi[1], Azriel Genack[1]; [1]*Queens College CUNY, USA.* We explore densities of the poles and transmission zeros in the complex plane in the crossover to new channels introduced by widening the sample or increasing the frequency of the incident wave.

JTu2A.167
Voltage Tunable Nonlinear Response from Semi-Parabolic Quantum Wells Coupled to Metasurfaces, Jaeyeon Yu[1], Jongwon Lee[1], Sadhvikas Addamane[2], Hyunseung Jung[2], Igal Brener[2], Raktim Sarma[2]; [1]*Department of Electrical Engineering, Ulsan national Inst. of science and technologyNIST, Korea (the Republic of);* [2]*Center for integrated nanotechnologies, Sandia national laboratories, USA.* We present a new nonlinear polaritonic system comprised of quantum-engineered intersubband transitions in symmetry-broken semi-parabolic quantum wells coupled to metasurfaces. These metasurfaces has potential for applications ranging from voltage-tunable high-harmonic generation to ultrafast beam steering.

JTu2A.168
All-Dielectric Metasurface with a Locally Flat Photonic Band in All Directions, Christopher Munley[1], Minho Choi[1], Arnab Manna[1], Johannes E. Fröch[1], Arka Majumdar[1]; [1]*Univ. of Washington, USA.* Here we demonstrate a photonic band in a Lieb lattice metasurface that is locally flat in all directions around normal incidence up to a numerical aperture of ~.1.

JTu2A.169
Complex Photonic Media and their Interfaces: Space Time Speckle Correlations, Shubham Dawda[1], Aristide Dogariu[1]; [1]*Univ. of Central Florida, USA.* We demonstrate the existence of novel space-time speckle correlations in multiply scattering media and use them to assess the evolution of randomness from the optical interface to far away into the bulk of scattering media.

JTu2A.170
Losses and the Limits of Hyperbolic Materials, Eric Jackson[1], Joseph G. Tischler[2], Daniel C. Ratchford[1], Chase T. Ellis[1]; [1]*Naval Research Laboratory, USA;* [2]*Univ. of Oklahoma, USA.* We derive an analytic formula for the dispersion relation of uniaxial, hyperbolic materials. The dispersion is always closed. The scaling of the maximum wavevector with loss and of the propagation length versus wavelength are determined.

JTu2A.171

Asymmetric Loss-Driven Terahertz Metasurface Encircling Exceptional Point, Indu Krishna[1], Dibakar Roy Chowdhury[1]; *[1]Mahindra Univ., India.* Exceptional point is a singular point in a non-Hermitian system where eigenstates and eigenvectors simultaneously coalesce. We demonstrate that the introduction of controlled asymmetric losses in near-field coupled metasurface leads to EP in polarization space.

JTu2A.172

Numerical Investigation of Absorption Mechanisms in Black Aluminum Films, Taavi Repän[1], Joris More-Chevalier[2], Jiri Martan[3], Petr Hruska[4], Michal Novotný[2], Petra Honnerová[3], Jan Kejzlar[5], Morgane Poupon[2], Dejan Prokop[4], Premysl Fitl[5], Ján Lančok[2], Raivo Jaaniso[1]; *[1]Inst. of Physics, Univ. of Tartu, Estonia; [2]Inst. of Physics, Czech Academy of Sciences, Czechia; [3]New Technologies Research Centre, Univ. of West Bohemia, Czechia; [4]Faculty of Mathematics and Physics, Charles Univ., Czechia; [5]Department of Physics and Measurements, Univ. of Chemistry and Technology, Czechia.* Using magnetron sputtering, we produced black aluminum samples with varying surface morphology. Here, we developed a finite-element model to reproduce and gain additional insight into experimentally measured optical properties.

JTu2A.173

Strong Coupling and Resonance Splitting in Thickness-Dependent Epsilon-Near-Zero Metasurface with Au Nanodisk, Chen Xingyu Huang[1], H. Y. Fu[1], Qian Li[2]; *[1]Tsinghua Shenzhen International Graduate School, Tsinghua Univ., China; [2]School of Electronic and Computer Engineering, Peking Univ., China.* The hybrid epsilon-near-zero/gold metasurface is investigated numerically. It is observed that the resonances induced by gold nanodisk and indium tin oxide film are strongly coupled, highly dependent on the thickness of epsilon-near-zero film.

JTu2A.174

Stokes singularity lattice formation using phase ramps, Kapil K. Gangwar[1], Sarvesh Bansal[1], P Senthilkumaran[1]; *[1]Indian Inst. of Technology Delhi, India.* An approach for generating Stokes singularity lattices utilizing a phase ramp structure within a polarization interferometer is presented here. Simulated results are presented to elucidate and illustrate the proposed concept.

JTu2A.175

Index measurement of a structured beam carrying polarization singularity using astigmatic lens, Sarvesh Bansal[1], P Senthilkumaran[1]; *[1]Indian Inst. of Technology Delhi, India.* We demonstrate the method for polarization singularity index measurement using an astigmatic lens. This method is effective in the determination of orbital angular momentum carried by orthogonal spin states in the superposition.

JTu2A.176

A kernel-based framework for the estimation of the laser ablation area, Yu-Chan Tai[1], Yin-Huan Gao[1], Li-Yang Jiang[1], Chun-Liang Lin[1], Chih Wei Luo[1]; *[1]National Yang Ming Chiao Tung Univ., Taiwan.* The proposed technique employs clustering analysis and Depth-First Search (DFS) algorithms to identify and quantify the ablation area, which offers a more efficient and accurate automated ablation area recognition solution by leveraging computer-vision capabilities.

JTu2A.177

Ultrafast Laser Functionalization and Route to Industrial Applications of Large Freeform Surfaces: A Laser Head as Structured Light System for Positioning and Texturing, Antoine Bouchut[4], Jorge Leconte[4,2], Julien Granier[3], Xxx Sedao[1], Jean-Marie Becker[1], Thierry Fournel[1]; *[1]UMR CNRS 5516 Laboratoire Hubert Curien, Saint-Etienne Univ., France; [2]VisioShape, France; [3]Manutech USD, France; [4]Institut d'Optique Graduate School, France.* A structured light system using the same laser for both positioning and texturing was developed. The head is positioned in one step by measuring distortions with respect to the concentric circles of the optimal pose.

JTu2A.178

Broadband Filters Based on Tilted Waveguide Bragg Gratings Written in Bulk Glass by Femtosecond Laser, JiaMing Wu[1], Xuewen Shu[1]; *[1]Huazhong Univ of Science and Technology, China.* We demonstrate the first tilted waveguide Bragg grating inscribed in bulk glass by femtosecond laser, which can be used to achieve broadband filtering, and the bandwidth can be adjusted from 10 nm to 350 nm.

JTu2A.179

Passive Waveguide Fabrication through Femtosecond Laser irradiation in Ag-doped GeO_2–PbO glasses for photonic applications, Thiago V. Fernandes[1], Camila D. Bordon[1], Niklaus Wetter[2], Wagner de Rossi[2], Luciana Kassab[3]; *[1]Departamento de Engenharia de Sistemas Eletrônicos, Escola Politécnica da Universidade de São Paulo, Brazil; [2]Instituto de Pesquisas Energéticas e Nucleares, IPEN-CNEN, Brazil; [3]Faculdade de Tecnologia de São Paulo, Brazil.* We present the fabrication of dual waveguides in Ge_2O-PbO glasses doped with silver nanoparticles using direct femtosecond laser inscription. The study involves results of beam quality, propagation loss, and polarization of the dual waveguides.

JTu2A.180

Light-Assisted Drying (LAD) for Biologics Stability at Room Temperature, Anteneh A. Tsegaye[1], Daniel Furr[1], Gunnar Olson[1], Susan R. Trammell[1]; *[1]Physics and Optical Science, Univ. of North Carolina at Charlotte, USA.* Light-assisted drying (LAD) is a new technique that uses near-infrared (1064 nm) laser light to selectively heat water, quickly dehydrating samples and forming an amorphous trehalose preservation matrix that can be stored at supra-zero temperatures.

JTu2A.181

Withdrawn

JTu2A.182

Tailoring the Diffraction Characteristics of Reflective Metagratings Employing One-Step Residue-Free UV Laser Interference Patterning, Carlota Ruiz De Galarreta[1,2], Joe Shields[2], Miguel Alvarez-Alegria[1], C. David Wright[2], Rosalia Serna[1], Jan Siegel[1]; *[1]Consejo Sup Investigaciones Cientificas, Spain; [2]Engineering, Univ. of Exeter, UK.* We demonstrate a single step, cost efficient, and residue free UV-interferometric technique for the instantaneous fabrication of high performance, near infrared metagratings with tailored diffraction properties both in terms of dispersion and efficiency.

JTu2A.183
Ghost Imaging of a Biological Object with X-ray-based Speckle Illumination, Sanjit Karmakar[1], Justin C. Goodrich[2], Andrei Fluerasu[2], Kwangmin Yu[2], Cinzia DaVia[1], Andrei Nomerotski[1], Elisha Siddiqui Matekole[2], Lonny Berman[2], Timothy Paape[2], Sean McSweeney[2]; *[1]SUNY Stony Brook, USA; [2]Brookhaven National Laboratory, USA.* This article reports an experimental demonstration of ghost imaging of a biological object using X-ray-based speckle illumination. This experimental result shows the direction to observe the internal structure of biological objects with reduced dose.

JTu2A.184
SU-8 coated etched fiber Bragg grating sensors: A versatile platform for detection of any biomarker using antibody-antigen chemistry, Srivatzen S[1], Kavitha BS[1], Asokan Sundarrajan[1]; *[1]Indian Inst. of Science, India.* Novel eFBG sensors using SU-8 coating detect biomarkers via antibody-antigen chemistry, offering enhanced sensitivity and stability.The reflected Bragg wavelength (l_B) of the eFBG sensor is modulated by the added antigen concentration. Demonstrated, they detect antigen concentrations from 8 pg/ml to 80 ng/ml with 32.3 pm 10-1 g-1 ml sensitivity.

JTu2A.185
Self-synchronized Two-color Fiber Laser System for Coherent Anti-Stokes Raman Scattering Microscopy in Cell-silent Regime, Meng Zhou[3], Xiaoxiao Wen[3], Cihang Kong[1], Hongsen He[2], Tian Qiao[3], Qiao Ran[4], Chaogu Zheng[4], Kenneth Kin-Yip Wong[3]; *[1]Inst. for Translational Brain Research, MOE Fron-tiers Center for Brain Science, Fudan Univ., China; [2]Department of Electronic Engineering, Xiamen Univ., China; [3]Department of Electrical and Electronic Engineering, Univ. of Hong Kong, Hong Kong; [4]School of Biological Sciences, Univ. of Hong Kong, Hong Kong.* We present a self-synchronized two-color fiber laser system, generating Stokes beam at 1057 nm and pump beam at 860 nm. The system can realize coherent anti-Stokes Raman scattering microscopy in cell-silent regime around 2100 cm^{-1}.

JTu2A.186
Two-photon Polymerization Assisted Fabrication of Polymeric Zone Plates, Gaurav P. Singh[1], Arun Jaiswal[2], Sweta Rani[3], Ajinkya Palwe[1], Himanshu Soni[1], Twinkle Soni[3], Sumit Saxena[1,3], Shobha Shukla[1,3]; *[1]Indian Inst. of Technology Bombay, India; [2]School of Biomedical Engineering, Univ. of Sydney, Australia; [3]IITB-Monash Research Academy, Indian Inst. of Technology Bombay, India.* We demonstrate the implementation of two-photon lithography to fabricate zone plates in a polymer matrix. This technique facilitates creation of geometries with tailored responses by controlling the dimension and refractive index of the polymerized features.

JTu2A.187
Extended OCT depth range and phase stability using ultrasonically-sculpted optical waveguides, Hang Yang[1], Junze Liu[1], Lloyd Lobo[2], Maysamreza R. Chamanzar[2], B. H. Park[1]; *[1]Bioengineering, UC Riverside, USA; [2]Electrical and Computational Engineering, Carnegie Mellon Univ., USA.* An ultrasonically-sculpted virtual optical waveguide in the sample arm of an optical coherence tomography system can provide an extended depth of field with sufficient phase stability to quantify flow.

JTu2A.188

DermaPlex: A Metasurface-based Hyperspectral Skin Cancer Detection System, Arturo Burguete Lopez[1], Maxim O. Makarenko[1], Qizhou Wang[1], Andrea Fratalocchi[1]; *[1]KAUST, Saudi Arabia.* We introduce DermaPlex, a metasurface-based hyperspectral skin cancer detection system. DermaPlex can capture high-resolution hyperspectral images in real-time and is a scalable technology manufactured at a fraction of the cost of conventional hyperspectral systems.

JTu2A.189

Fabrication of Fluorescent Biopolymeric Micro/Nanostructures Using Femtosecond Laser Lithography, Tejas Suryawanshi[1], Aman Singhal[1], Sumit Saxena[1], Abhijit Majumder[1], Shobha Shukla[1]; *[1]Indian Inst. of Technology, Bombay, India.* Biopolymeric micro/nanostructures are of key importance in biomedical field. Here we demonstrate, femtosecond laser assisted fabrication of fluorescent biopolymeric micro/nanostructures on gelatin. These structures were morphologically characterized and showed features as small as 550-700nm.

JTu2A.190

Classification of pre-cancerous human oral tissue using FTIR spectroscopy aided by machine learning, Pranab J. Talukdar[4], Kartikeya Bharti[4], Sautami Basu[2], Moushumi Pal[3], Ranjan R. Paul[3], Pooja Lahiri[1], Basudev Lahiri[4]; *[1]Advanced Technology Development Centre, IIT Kharagpur, India; [2]Thapar Inst. of Engineering and Technology, India; [3]Oral and Maxillofacial, Guru Nanak Inst. of Dental Sciences and Research, India; [4]Electrical and Electronics Communication Engineering, IIT Kharagpur, India.* We presented FTIR spectroscopy to analyze vibrational assessments of oral pre-cancerous tissue of various grades. Classification model based on spectra of protein sections (amide I and amide III band) yields 83.33% sensitivity and 84% accuracy.

JTu2A.191

Fourier Series Expansion with Correction Terms: An Innovative Algorithm for ECG Signal Analysis, Hsin-Jung Lee[1], Cheng-Che Lee[1], Yi-Min Yang[1], Wei-Yu Lee[1], Chieh-Hsiung Kuan[1]; *[1]National Taiwan Univ., Taiwan.* This study presents an advancement in signal processing for ECG signal analysis. By choosing the correct frequency and boundary conditions, the modified Fourier series expansion with correction terms can enhance the accuracy and reliability of signal reconstruction, enhancing signal accuracy for better medical diagnoses and treatment.

JTu2A.192

Realtime Laser Beam Steering and Calibration Method for Coherent Biomedical Distance and Motion Sensing, Marius Schmidt[1], Misha Sadeghi[2], Farnaz Rahimi[2], Björn Eskofier[2], Arda Buglagil[1], Bernhard Schmauss[1], Christian Carlowitz[1]; *[1]Instiute of Microwave and Photonics, FAU Erlangen-Nürnberg, Germany; [2]Machine Learning and Data Analytics, FAU Erlangen Nürnberg, Germany.* This paper presents a depth camera based 3D position tracking and calibration method for realtime millimeter-accuracy galvanometer laser beam steering that enables high sensitivity coherent optical distance and movement sensing for biomedical applications.

JTu2A.193

Optical biosensor for non-invasive detection of medical biomarkers, Magdalena A. Zadura[1], Anna Szerling[1], Weronika Glowadzka[1,2], Tomasz Czyszanowski[1,2], Marek Ekielski[1], Karolina Bogdanowicz[1,2], Piotr Polak[1], Krzysztof Piskorski[1], Joanna Jankowska-Sliwinska[1], Kamil Kosiel[1]; *[1]Lukasiewicz IMIF, Poland; [2]Inst. of Physics, Univ. of Technology, Poland.* A novel optical biosensor specifically designed to identify glucose or oncoproteins is presented. It is subwavelength quasi-periodic structure, made of polymer and coated with inorganic layers with properly designed thickness to reveal Fano resonance peak.

JTu2A.194
Deep Learning Enhanced Ghost Holography: Optimizing CNNs for Robust Image Recognition in Noisy Environments, Shima Tabakhi[1], Mohammad Mohammadzadeh[1], Dina Famouri[1], Mohammad Sayeh[1]; *[1]school of Electrical, Computer and Biomedical Engineering, Southern Illinois Univ., USA.* In this study, we present a deep learning-based ghost holography approach to recover occlusion-obscured image details, using a neural network trained on varied datasets, markedly enhancing image reconstruction in complex imaging scenarios.

JTu2A.195
Fabrication of sapphire single crystal fiber with high length-to-diameter ratio via the LHPG method, Xibao Gao[1], Xiao Liu[1], Kaidi Cai[1], Yingying Chen[1], Bo Liu[1,2]; *[1]Zhejiang Lab, China; [2]Zhejiang Univ., China.* We report a continuous growth of single-crystal sapphire fiber over 15hours without any interruption. The obtained sapphire fiber is 1.5 meters long with a diameter variation mostly around ±5μm.

JTu2A.196
Tight focusing of radially-azimuthally polarized higher-order Poincare sphere beams, Sushanta K. Pal[1], Leslie Rusch[1]; *[1]Université Laval, Canada.* We examine tight focusing of radially-azimuthally (RPAP) polarized higher-order Poincare sphere (HOPS) beams. These optical fields can be used to achieve equal strengths of longitudinal and transverse components, with good power at the focal plane.

JTu2A.197
Withdrawn

JTu2A.198
Design and Development of a Portable Raman Spectrometer for Early Diagnosis of Parkinson's Disease, Umesh C. Garnaik[1], Shilpi Agarwal[1]; *[1]Jawaharlal Nehru Univ., India.* Raman spectroscopy offers specific, highly sensitive, deliberate, and multiplex disease diagnosis. A portable Raman spectrometer is developed and optimized for the characterization and classification of Parkinson's Disease by salivary Raman fingerprint of individuals.

JTu2A.199
Altering Level Shifts and Spontaneous Decay Rates of Distant Atoms Using Partially Transparent Asymmetric Mirror Interfaces, Nicholas Furtak-Wells[2,1], Benjamin Dawson[2,1]; *[1]NIQS Tech (Leeds) Ltd., UK; [2]Univ. of Leeds, UK.* Dipole-dipole interactions, affecting atomic shifts and decay rates, are usually limited by light's wavelength. This paper demonstrates extending these interactions' range using asymmetric mirrors, enabling stronger interactions between distant atoms, enhancing quantum technology applications.

JTu2A.200

A Stochastic optimization approach to laser speckle contrast imaging for a better estimation of blood flow, Murali Krishnamoorthy[1], Soumyajit Sarkar[1], Susweta Das[1], Hari M. Varma[1]; *[1]Indian Inst. of Technology, Bombay, India.* We recently proposed to use stochastic differential equations to simulate speckle intensity for imaging tissue blood flow. Here, we extend the above-mentioned model to compute better estimates of blood flow using a stochastic optimization approach and validate the method using simulations, tissue-mimicking phantoms, and in-vivo human experiments.

JTu2A.201

Transverse stress sensor based on FMF and silicon photonic integrated circuits, Mingyuan Zhang[1], Wu Zhou[1], Yeyu Tong[1]; *[1]Hong Kong Univ of Sci & Tech (Guangzhou), China.* We proposed a low-cost solution for transverse stress sensing based on few-mode fiber (FMF) and silicon photonic integrated circuits (PICs). The inter-mode crosstalk caused by the transverse stress can be effectively quantified.

JTu2A.202

OFDR-based high-temperature-resolution sensing by using TC-HNA sensing fiber and deep-learning denoising, Zhaopeng Zhang[1], Wei Peng[1], Lingmei Ma[1], Chen Zhu[1]; *[1]Zhejiang Lab, China.* Combining TC-HNA sensing fiber and a deep-learning denoising technique, a temperature resolution of 0.29 °C on a 50-m fiber with a spatial resolution of 1 mm based on an OFDR system is experimentally achieved.

JTu2A.203

A Giant interferometric fiber optic gyroscope with Low Self-Noise for Geophysical Rotation Sensing, Huimin Huang[1], Yujia Cao[2], LanXin Zhu[1], Yanjun Chen[1], Wenbo Wang[1], Fangshuo Shi[1], Zhengbin Li[1]; *[1]Peking Univ., China; [2]China Earthquake Administration, China.* A low Self-noise giant interferometric fiber optic gyroscope system has been built for geophysical rotation sensing. The gyroscope 24-hour stability test shows that sensitivity can reach 1.65×10^{-9} rad/s/√Hz

JTu2A.204

High-performance Raman-based Distributed Temperature Sensing Empowered by Data-Driven Dual-Stage 1D-CNN, Wei Peng[1], Ruimin Jie[1], Bo Liu[1], Lingmei Ma[1], Chen Zhu[1]; *[1]Zhejiang Lab, China.* With the assistance of a data-driven dual-stage convolutional neural network model, we have experimentally demonstrated a high-performance Raman-based distributed temperature sensing system with an update rate of 0.02 s and a temperature uncertainty of 0.09°C.

JTu2A.205

Marine Surface Layer Optical Turbulence Measurements over a Vertical Path, Peter Lee[1], Svetlana Avramov-Zamurovic[1], John Solie[1], Winston Maa[1], Miranda van Iersel[2]; *[1]US Naval Academy, USA; [2]Univ. of Dayton, USA.* **A Gaussian beam is propagated along a 30 m vertical downlink in a maritime environment. The scintillation index is measured at three levels along the propagation path to characterize the optical turbulence.**

JTu2A.206

Detection bandwidth reduction of the dual-comb parallel FMCW LiDAR based on frequency matching, Long Wang[1], Yaxin Shang[1], Xiaoen Chen[1], Liang Hu[1], Jianping Chen[1], Wenhai Jiao[2], Guiling Wu[1]; *[1]Shanghai Jiao Tong Univ., China; [2]Beijing Inst. of Tracking and Telecommunication Technology, China.* A frequency matching algorithm is proposed to reduce the detection bandwidth of the dual-comb parallel FMCW LiDAR system. The detection bandwidth can be reduced by one order of magnitude, significantly saving the system cost.

JTu2A.207
Convolution Network for Phase Unwrapping of Interferometric Fiber Sensing Signals, Junyi Duan[1], Jiageng Chen[1], Hanzhao Li[1], Zuyuan He[1]; *[1]Shanghai Jiaotong Univ., China.* A convolution neural network is proposed to reconstruct the true value from phase-wrapped interferometric sensing signals. The MAE and RMSE in a real phase dataset sampled by DAS are 0.069π and 0.352π respectively.

JTu2A.208
Two-Stage Deep Learning Pipeline for Automated Mineral Classification in Planetary Raman Spectra, B Ramanan[1], S Bhuvaneswari[1], Prashanth C. Upadhya[1], R Venkateswaran[1], K V. Sriram[1]; *[1]Laboratory For Electro Optics Systems, Indian Space Research Organisation, India.* A novel approach is employed to improve mineral classification in planetary Raman spectra using a two-stage deep learning pipeline utilizing convolutional denoising autoencoders for pre-processing and convolution neural networks to classify minerals.

JTu2A.209
Quantum enhanced dynamic range of an atomic memory magnetometer, Shubham Jaiswal[1], Goutam Manna[1], Pratik Adhikary[1], Saikat Ghosh[1]; *[1]IIT KANPUR, India.* Quantum memory based on electromagnetically induced transparency (EIT) is a well-established field. This article discusses their use in magnetometry for two different configurations in a four level system, viz., lin and pi-probe and the advantage of one over the other in terms of dynamic range.

JTu2A.210
Novel annular small-period long-period fiber gratings for dual parameter sensing, Yulei Liu[1], Jintao Cai[1], Hanyuan Liu[1], Xuewen Shu[1]; *[1]Huazhong Univ of Science and Technology, China.* A new type of small-period long-period fiber grating consisting of a series of annuli inscribed by a femtosecond laser in a single-mode fiber is demonstrated, which is very practical for simultaneous sensing of refractive index and temperature.

JTu2A.211
Increased Efficiency Within Time of Flight LiDAR Systems Through the Inclusion of Mid-IR Components, Patrick T. Camp[1], Jason Midkiff[1], Po-Yu Hsiao[1], Ray T. Chen[1]; *[1]The Univ. of Texas at Austin, USA.* **NIR ToF LiDAR systems suffer from atmospheric attenuation and noise caused by background solar irradiance. By incorporating Mid-IR components, we propose a direct ToF LiDAR system with increased efficiency when compared to conventional NIR systems.**

JTu2A.212
A Hybrid FMCW LiDAR with Nonlinearity-Corrected VCSEL for 3D Imaging Beyond Coherence Length, Yi Hao[1], Qingyang Zhu[1], Yaqi Han[1], Lican Wu[1], Ziming Ye[1], Annan Xia[1],

Connie J. Chang-Hasnain[1], H. Y. Fu[1]; [1]*Tsinghua Univ., China.* A novel hybrid FMCW LiDAR system for breaking laser coherence length limit is presented. The linearized frequency sweep of VCSEL and superior 3D imaging performance within and beyond coherence length are experimentally validated.

JTu2A.213
Two-photon Lithography assisted Fluorescence sensor for sensitive detection of lead ions in water, Archana Thachanamoorthy[1]; [1]*IIT Bombay, India.* We report the fabrication of a miniaturized sensor by femtosecond laser-assisted two-photon lithography for the sensitive detection of Lead in water. Fluorescence turn-off or quenching was achieved at ppb levels.

JTu2A.214
Spectroscopic Investigation of Nanosecond and Femtosecond Laser-Induced Plasma Emission for Remote Sensing Applications, Antaryami Mohanta[1], Reem Al Ameri[1], Guillaume Matras[1], Chaouki Kasmi[1]; [1]*Directed Energy Research Center, Technology Innovation Inst., United Arab Emirates.* A comprehensive spectroscopic investigation of laser-induced plasma emission from aluminum, copper, steel, acrylic, white and black ABS is conducted, with a specific focus on both nanosecond and femtosecond laser pulses for remote sensing applications.

JTu2A.215
Refractometry Using Plasmonic Mode Interference in Degenerate n-doped Si Waveguide, Saurabh M. Tripathi[2,1], Neha Ahlawat[2]; [1]*Indian Inst. of Technology Kanpur, India;* [2]*Optics and Photonics Centre, Indian Inst. of Technology Delhi, India.* Using 1D asymmetric, degenerate n-doped Si waveguide, we show that the symmetric-SPP mode has stronger field localization in analyte region compared to the anti-symmetric SPP mode, making the former a better choice for sensing applications.

JTu2A.216
Modular Raman Microscopy for *in-vivo* Phenotyping of Nutrient Uptake in Plant Roots, Alma Fernandez[1], Dipankar Sen[1], Ze Fang[1], Brian Henrich[1], Alexei Sokolov[1], Marlan Scully[1], Sakiko Okumoto[1], Aart Verhoef[1]; [1]*Texas A&M Univ., USA.* We investigate plant nitrate uptake with a custom-built modular Raman microscope. This platform enables non-invasive tissue-specific nitrate concentration measurements in Arabidopsis roots, with a spatial resolution and dynamic range beyond the capabilities of alternative methods.

JTu2A.217
Utilizing a State of Polarization Change Detector and Machine Learning for Enhanced Security in Fiber-Optic Networks, Adrian Tomasov[1], Petr Dejdar[1], Petr Munster[1], Tomas Horvath[1]; [1]*Department of Telecommunications, Brno Univ. of Technology, Czechia.* The paper presents a novel method for securing fiber-optic infrastructures using a state of polarization analyzer combined with machine learning algorithms. The proposed system detects vibrations indicative of security breaches, achieving an F1-score above 95.65 %.

JTu2A.218
Excitation of Whispering Gallery Modes In A Microbottle Resonator Using An Optical Beam Carrying Orbital Angular Momentum, Suresh Chejarla[1,2]; [1]*IIT Madras, India;* [2]*Optoelectronics Research Center, Univ. of Southampton, UK.* We investigate the

excitation of WGM in a microbottle resonator with parabolic resonator profile using an optical beam carrying orbital angular momentum beam through FDTD-based simulations and by evaluating the overlap integral.

JTu2A.219
Advances in Highly Sensitive D-shaped Optical Filter Using Soft Film Bragg Grating Techniques, Hsin-Jung Lee[1], Yu-Wen Luo[1], Yu-Cheng Ye[1], Li-ling Chu[1], Wei-Ching Chuang[1], Wei-Yu Lee[1]; *[1]National Formosa Univ., Taiwan.* This work achieved a highly sensitive D-shaped fiber optical filter by soft film Bragg grating techniques and Polydimethylsiloxane master mold. The D-shaped fiber covered by a polymer Bragg grating plate with a refractive index of 1.512 demonstrated a reflection wavelength of 1547.6 nm and an optical power of 8.3 dB.

JTu2A.220
Analytical Study on Slow-Light Orbital Angular Momentum Beams in Vertical Photonic Crystal Waveguides for Gas Detection, May Hlaing[1,2]; *[1]Electrical and Computer Engineering, Univ. of Texas at Austin, USA; [2]Omega Optics, Inc., USA.* We introduce 2D hexagonal air-hole lattice vertical photonic crystal waveguides (VPCWs) to generate orbital angular momentum beams carrying the slow-light effect for on-chip gas sensing through photonic absorption spectroscopy.

JTu2A.221
Wide bandwidth TM tunable vernier rings for heterogeneously integrated lasers, Nathan Henry[1]; *[1]Sandia National Laboratories, USA.* We present a novel design of a III-V-on-silicon heterogeneously integrated tunable ring laser, achieving >80 nanometers of tuning bandwidth, the widest conceived using only two rings, fostering many applications such as spectroscopy and beam steering.

JTu2A.222
Waveguide Integrated Germanium Photocells in Silicon, Tracy A. Sjaardema[1], Christina M. Dallo[1], Andrew Starbuck[1], Andrew S. Pomerene[1], Douglas C. Trotter[1], Mike Gehl[1], Ashok Kodigala[1]; *[1]Sandia National Labs, USA.* We demonstrate for the first time waveguide integrated cascaded germanium photodetector arrays operated as photocells. We characterize several different array designs, and discuss their effects on voltage and photocurrent performance parameters.

JTu2A.223
Arrayed vector mode emitters, Vighnesh N[1], Hamim M. Rivy[1], Karan K. Mehta[1]; *[1]Cornell Univ., USA.* We present a robust passive high-purity circular polarization emitter leveraging asymmetric perturbations to vectorial waveguide modes. 3D FDTD simulations for a hafnia-based device at lambda=405nm indicate ability to radiate >99% purity over the radiated beam.

JTu2A.224
Multiphoton Multidimensional Entanglement Based on Graph Theory, Jueming Bao[1], Zhaorong Fu[1], Tanumoy Pramanik[1], Jun Mao[1], Yulin Chi[1], Yingkang Cao[1], Chonghao Zhai[1], Yifei Mao[1], Tianxiang Dai[1], Xiaojiong Chen[1], Xinyu Jia[1], Leshi Zhao[1], Yun Zheng[1], Bo Tang[2], Zhihua Li[2], Jun Luo[2], Wenwu Wang[2], Yan Yang[2], Yingying Peng[3], Dajian Liu[3], Daoxin Dai[3], Qiongyi He[1], Alif L. Muthali[4], Leif K. Oxenløwe[4], Caterina Vigliar[4], Stefano Paesani[5], Huili Hou[6], Raffaele Santagati[7], Joshua W. Silverstone[6], Anthony Laing[6], Mark G. Thompson[6], Jeremy L.

O'Brien[6], Yunhong Ding[4], Qihuang Gong[1], Jianwei Wang[1]; *[1]Peking Univ., China; [2]Chinese Academy of Sciences, China; [3]Zhejiang Univ., China; [4]Technical Univ. of Denmark, Denmark; [5]Univ. of Copenhagen, Denmark; [6]The Univ. of Western Australia, Australia; [7]Boehringer Ingelheim, Germany.* We demonstrate the capability of graph theory scheme to realize complex multiphoton multidimensional state. We show the generation of quantum states based on graph theory was realized by the reconfigurable integrated quantum chip. The 4-photon 3-dimensional GHZ state was generated and verified and manipulated for the first time.

JTu2A.225
Ultra-High-Resolution Pixel Density Formed Directly with Photolithography for Micro-LED Displays, Shan-Yu Chen[1], Chen-Hsun Wu[1], Chi-Shiang Chen[1], Chih-Yuan Tsai[1], Ching-Fuh Lin[1]; *[1]National Taiwan Univ., Taiwan.* Red and green pixel density achieves 5080 PPI with a 4x4-µm pixel size, employing etching-free photolithography. Doping nanoparticles into transparent photoresist boosts quantum efficiency to 70.6% (red) and 70.0% (green), enhancing color conversion layer vividness.

13:00 -- 15:00
Room: W201AB
ATu3A • Guided Photons at Work for Environmental Sensing
Presider: Peter Dragic; Univ of Illinois at Urbana-Champaign, USA

ATu3A.1 • 13:00
High-precision Brillouin Curvature Sensors Based on Deep Neural Networks, Donghe Sheng[1], Zhe Han[1], Huiping Tian[1]; *[1]Beijing Univ of Posts & Telecom, China.* We report a high-precision Brillouin curvature sensor assisted by deep neural networks (DNNs). The results show that over an order of magnitude improvement in the sensing accuracy using DNN compared with conventional methods.

ATu3A.2 • 13:15
Temperature Sensing with Reduced dn/dT Helical Fibers, Jennifer Campbell[1], Alexander Pietros[1], Peter D. Dragic[1]; *[1]UIUC, USA.* Temperature sensing based on low *dn/dT* helical glass core fiber is described. These fibers possess intrinsic bend loss with attenuation that is a strong function of temperature. A proof of concept over 25-80°C is presented.

ATu3A.3 • 13:30
Φ-OTDR model for arbitrary laser linewidth and pulse duration based on fiber frozen-in stress, Pedro Tovar[1], Jean Pierre von der Weid[2]; *[1]Univ. of Ottawa, Canada; [2]Electrical Engineering, Pontifical Catholic Univ. of Rio de Janeiro, Brazil.* We propose a new theoretical model for Φ-OTDR, accurately representing traces for arbitrary pulse widths and laser linewidths. Local refractive index fluctuations are modeled from frozen-in stress in fibers, causing random variations of 10^{-7}.

ATu3A.4 • 13:45
High Temperature Measurements and Predictions Using Fiber Bragg Gratings and Neural Networks, Jieru Zhao[1], Qirui Wang[1], Yuqi Li[1], Kehao Zhao[1], Kevin Chen[1]; *[1]Univ. of Pittsburgh, USA.* Neural networks are utilized with FBGs in this paper to improve temperature prediction

accuracy and speed. A minimum mean absolute error of 0.56°C is achieved in two rounds of 810°C furnace tests.

ATu3A.5 • 14:00 (Invited)
Silicon Photonics Across the Infrared for Ultra Compact Sensors, Alexander Spott[1]; *[1]Mirios, Inc., USA.* We discuss advancements in mid-infrared silicon photonic integration for miniaturized sensor technologies.

ATu3A.6 • 14:30
Photothermal gas detection on an integrated photonic waveguide, Yue Yan[1], Kun Duan[1], Hanke Feng[2], Cheng Wang[2], Wei Ren[1]; *[1]The Chinese Univ. of Hong Kong, Hong Kong; [2]City Univ. of Hong Kong, Hong Kong.* We report on-chip photothermal gas sensing on a nanophotonic lithium niobate waveguide with meandering length of 9 cm. This approach achieves a carbon dioxide detection limit of 900 ppm at wavelength of 2 μm.

ATu3A.7 • 14:45
Room Temperature Detection of Dimethyl methylphosphonate (DMMP) with Interband Cascade Laser by Photonic Integrated Circuit Agent Sensing Sorbent (PICASSo), Chul Soo Kim[1], William Bewley[1], Viet Nguyen[1], Mijin Kim[2], Chadwick Canedy[1], Jerry Meyer[1], Christopher Kendziora[1], Andrew McGill[1], Igor Vurgaftman[1]; *[1]US Naval Research Laboratory, USA; [2]Jacobs Corporation, USA.* A nerve agent simulant is successfully detected by a Photonic Integrated Circuit Agent Sensing Sorbent (PICASSo) device using the threshold shift of an interband cascaded laser (ICL) evanescently coupled to an oapBPAF sorbent film.

13:00 -- 15:00
Room: W201CD
ATu3B • Optical Biosensors
Presider: Mahsa Ranji; Florida Atlantic Univ., USA

ATu3B.1 • 13:00 (Invited)
Ultra-sensitive Plasmonic Biosensors Based on Two-dimensional Nanomaterials-enhanced Phase Singularity, Shuwen Zeng[1]; *[1]French National Centre for Scientific Re, France.* In this talk, I will present the use of hybrid 2D nanomaterials-based metasurface nanostructure as an enhanced sensing substrate. Here, both a sharp phase signal change and phase-related Goos-Hänchen signal shift were achieved due to the strong resonance at the surface of the sensing film. This hybrid 2D nanomaterial-based metasurfaces would provide a good opportunity for developing portable theranostic devices in clinical applications.

ATu3B.2 • 13:30
Ultra-high Q values for microtoroid resonators with free space coupling, Sartanee Suebka[1], Euan McLeod[1], Judith Su[1]; *[1]Univ of Arizona, Coll of Opt Sciences, USA.* We demonstrate free-space coupling into microtoroid optical resonators while maintaining Q-values more than 10^8. Our results set the foundation for these sensors to be translated out of the lab in a compact and portable system

ATu3B.3 • 13:45

Photonic Crystal Enhanced Fluorescence Emission for Ultrasensitive Biosensing in Liquid Biopsies, Yanyu Xiong[1], Priyash Barya[1], Lifeng Zhou[1], Skye Shepherd[1], Shengyan Liu[1], Lucas D. Akin[1], Opeyemi Arogundade[1], Taylor D. Canady[1], Congnyu Che[1], Laura Cooper[2], Abhisek Dwivedy[1], Rohit Gupta[3], Qinglan Huang[1], Anh Igarashi[1], Hankeun Lee[1], Caitlin M. Race[1], Tingjie Song[1], Joseph Tibbs[1], Xiaojing Wang[1], Tong Wang[5], Lijun Rong[2], Manish Kohli[4], Andrew M. Smith[1], Srikanth Singamaneni[3], Xing Wang[1], Brian T. Cunningham[1]; *[1]Univ. of Illinois at Urbana−Champaign, USA; [2]Univ. of Illinois at Chicago, USA; [3]Washington Univ. in St. Louis, St. Louis, USA; [4]Huntsman Cancer Inst., USA; [5]City Univ. of New York, USA.* We present advanced biosensing methods with photonics crystal enhanced fluorescence emission from Quantum Dots, Plasmonic Fluorophores, and DNA Nano-grippers for nucleic acid, protein, and pathogen detection in liquid biopsies.

ATu3B.4 • 14:00
Nanopore Integrated Optofluidic Platform for Quantitative Viral RNA Analysis from Clinical Primate Biofluids, Mohammad Julker Neyen Sampad[1], S. M. Saiduzzaman[1], Zach J. Walker[2], Jesse X. Wayment[2], Ephraim M. Ong[2], Stephanie D. Mdaki[3], Manasi Tamhankar[3], Jean L. Patterson[3], Aaron R. Hawkins[2], Holger Schmidt[1]; *[1]School of Engineering, Univ. of California Santa Cruz, USA; [2]ECEn Department, Brigham Young Univ., USA; [3]Texas Biomedical Research Inst., USA.* Optical trapping of nucleic acid enriched microbeads enables high-throughput nanopore sensing of molecular biomarkers on optofluidic devices. Amplification-free and label-free quantitative viral RNA analysis, with performances comparable with PCR from clinical animal biofluids, is reported.

ATu3B.5 • 14:15
From Head to Toe: Non-contact Laser Heart Rate and Respiration Rate Detection under Obstructive Conditions, ChenChia Wang[1], Feng Jin[1], Sudhir Trivedi[1], Mark Goncharovsky[1], Irwin Wang[1], Gary P. Zientara[2], Jacob Khurgin[3], Fow-sen Choa[4]; *[1]Brimrose Corporation, USA; [2]US Army Research Inst. of Environmental Medicine, USA; [3]Department of Electrical and Computer Engineering, The Johns Hopkins Univ., USA; [4]Computer Science and Electrical Engineering, Univ. of Maryland Baltimore County, USA.* We demonstrate experimentally laser-based wireless, non-contact sensing of vital physiological signatures including heartbeat and respiration rates, from human subjects without skin access by the laser beam, with nearly arbitrary interrogation locations, from cranium to phalanges.

ATu3B.6 • 14:30
Antigen-independent single-cell detection of circulating tumor cells using biolaser, Weishu WU[1], Yu Zhang[1], Xiaotian Tan[2], Sunitha Nagrath[1], Xudong Fan[1]; *[1]Univ. of Michigan, USA; [2]Shenzhen Inst. of Advanced Technology, China.* We developed a deep learning-powered biolaser platform that can differentiate cell types on a single-cell basis without immuno-staining. This method can achieve around 95% accuracy differentiating circulating tumor cells from white blood cells.

ATu3B.7 • 14:45
Efficient Single-Cell Analysis through a Cost-Effective Droplet Microfluidic System, Yuanyuan Wei[1], Wu Yuan[1], Ho-Pui Ho[1]; *[1]The Chinese Univ. of Hong Kong, Hong Kong.* In this study, we introduce a cost-effective and high-throughput microfluidic system capable of generating uniform droplet reactors and conducting real-time analysis of single-cell

morphology and apoptosis. This system holds great promise in the fields of biological research and personalized disease treatment.

13:00 -- 15:00
Room: W204AB
STu3C • Vertical Cavity Surface Emitting Lasers
Presider: Yasutomo Ota; Keio Univ., Japan

STu3C.1 • 13:00 (Tutorial)
Commercializing High Contrast Grating VCSELs, Connie J. Chang-Hasnain[1]; *[1]Berxel Photonics, USA.* Abstract not available.

STu3C.2 • 14:00
A Metasurface-integrated Vertical Cavity Surface-emitting Laser Based on Dammam Grating, Xiaorui Zhao[1], Yiyang Xie[1], Pan Fu[1], Bo Wu[1]; *[1]Beijing Univ. of Technology, China.* We integrates the function of Damman gratings into the VCSEL by utilizing the metasurface as the mediue. It enables a 5×5 lattice at a field of view angle of 22° with contrast ratios of 0.315.

STu3C.3 • 14:15
Over 39 GHz-Bandwidth of Directly Modulated 1060 nm Single-Mode VCSEL with Intra-cavity Metal-aperture, Babu Dayal Padullaparthi[1], Xiaodong Gu[1,3], Satoshi Shinada[2], Fumio Koyama[1]; *[1]Inst. of Innovative Research, FIRST, Tokyo Inst. of Technology, Japan; [2]NICT, Japan; [3]Tokyo Tech Yokohama Venture Plaza, Ambition Photonics Inc., Japan.* We demonstrate a 1060nm single-mode metal-aperture VCSEL with 8x InGaAs/GaAsP quantum wells having single-mode operation of SMSR>50dB and record high >39GHz bandwidth, enabling 100Gbps PAM-4 BTB and 50Gbps NRZ 2km SMF transmissions.

STu3C.4 • 14:30
Current injection laser oscillation of 1.55 µm InAs quantum dot vertical-cavity surface-emitting lasers, Michinori Shiomi[1], Haruki Kishimoto[1], Tomomasa Watanabe[1], Masayuki Tanaka[1], Daiji Kasahara[1], Hiroshi Nakajima[1], Ryoji Arai[1], Yuta Inaba[1], Yudai Yamaguchi[1], Yuya Kanitani[1], Yoshihiro Kudo[1], Noriyuki Futagawa[1], Mikihiro Yokozeki[1], Kouichi Akahane[2], Naokatsu Yamamoto[2]; *[1]Sony Semiconductor Solutions Corporation, Japan; [2]National Inst. of Information and Communications Technology, Japan.* We have successfully demonstrated, for the first time, current injection laser oscillation in a 1.55 µm VCSEL using InAs quantum dot active layers grown on an InP(311)B substrate.

STu3C.5 • 14:45
SWIR VCSELs Enabled by Homoepitaxial Nanoporous-InP DBRs, Bingjun Li[1], Chenziyi Mi[1], Jin-Ho Kang[1], Rami T. Elafandy[1], Jung Han[1]; *[1]Yale Univ., USA.* High-index-contrast InP DBRs were realized through a conductivity-selective electrochemical porosification process. Furthermore, continuous-wave (CW) operation of NP-InP VCSELs were demonstrated at both 1,380 and 1,550 nm from two separate structures with milli-watt output power.

13:00 -- 15:00
Room: W205AB
STu3D • Fiber Amplifiers
Presider: Ori Henderson-Sapir; Univ. of Adelaide, Australia

STu3D.1 • 13:00
> 1 MW Peak Power at 1300 nm through Efficient Fiber Parametric Chirp-Matched Amplification, Sarat C. Tirumala[1], Zhenhua Guo[1], William H. Renninger[1]; *[1]Inst. of Optics, Univ. of Rochester, USA.* Efficient fiber parametric amplification of ultrashort pulses is achieved at 1300 nm by tailoring the relative chirp between passively synchronized pump and seed sources. 180-fs pulses with >1-MW peak power are observed, in agreement with numerical predictions.

STu3D.2 • 13:15
High-energy Mid-IR Fiber CPA system at ~2.78µm using single-mode operation of a coiled 46µm core low-NA Er:ZBLAN fiber, Yu Bai[1], Bohan Zhou[1], Weizhi Du[1], Yifan Cui[1], Almantas Galvanauskas[1]; *[1]Univ. of Michigan, USA.* We report development of the first large-core fiber CPA system operating in Mid-IR. Up to ~100µJ were obtained with ~500ps stretched femtosecond pulses after single-mode amplification in a coiled 46µm and ~0.07NA core Er:ZBLAN fiber.

STu3D.3 • 13:30
Investigation of Stability in 2µm Optical Fiber Amplifiers for Narrow-Linewidth Laser Sources, Andrea Pertoldi[1,2], Jakob M. Hauge[1], Poul Varming[1], Patrick Montague[1]; *[1]NKT Photonics A/S, Denmark; [2]Niels Bohr Inst., Univ. of Copenhagen, Denmark.* Coherent backscatter causes noise and instability in fiber amplifiers when the wavelength of the laser is modulated. We investigate the effect of laser frequency, tuning speed, pumping scheme, dopant type, fiber length and amplifier gain.

STu3D.4 • 13:45
Effects of Seeding and Wave-Breaking in Gain-Managed Nonlinear Amplification for Compact High Energy Systems, Jonathan Musgrave[1], Neeraj Prakash[1], Shu-Wei Huang[1]; *[1]Univ. of Colorado Boulder, USA.* We conduct a systematic study of gain-managed nonlinear fiber amplifiers. The importance of the initial seed characteristics is discussed. An experimental, numerical, and theoretical framework is developed for the engineering of high-peak-power compact fiber systems.

STu3D.5 • 14:00
Characterization of O-band Bismuth-doped Fiber Amplifier Using Swept Wavelength Interferometer, Yetian Huang[1,2], Haoshuo Chen[2], Hanzi Huang[1,2], Weiqi Wang[1], Nicolas Fontaine[2], Pat Iannone[2], Cheng Guo[2], Mikael Mazur[2], Roland Ryf[2], Yingxiong Song[1], Jianxiang Wen[1], Tingyun Wang[1]; *[1]Shanghai Univ., China; [2]Nokia Bell Labs, USA.* We first characterize the spatially and spectrally resolved gain profiles of an O-band BDFA via Rayleigh backscattering measured by a coherent swept wavelength interferometer, with a small signal gain reaching 35 dB at 1320 nm.

STu3D.6 • 14:15
Radiation-resistant Bismuth-doped Germanosilicate Fiber Amplifier in the E+S Band, Ziwei Zhai[1], Arindam Halder[1], Daniel Negut[2], Jayanta Sahu[1]; *[1]Univ. of Southampton,*

UK; [2]Horia Hulubei National Inst. for R&D in Physics and Nuclear Engineering, Romania. We report a radiation-resistant Bi-doped germanosilicate fiber amplifier with a 35dB gain at 1440nm after 2.5kGy γ-irradiation, for a -23dBm input signal. The NF, in-band OSNR, and gain coefficient are 6dB, 26dB, and 0.075dB/mW, respectively.

STu3D.7 • 14:30
Spectroscopic Properties of Thulium-doped High-power Integrated LMA Amplifiers, Jan Lorenzen[1,2], Kai Wang[3], Muharrem Kilinc[1], Henry Francis[4], Jose Carreira[4], Michael Geiselmann[4], Umit Demirbas[1], Milan Sinobad[1], Mikhail Pergament[1], Sonia Garcia-Blanco[3], Franz Kärtner[1,5], Neetesh Singh[1]; *[1]Center for Free-Electron Laser Science CFEL, Deutsches Elektronen-Synchrotron DESY, Germany; [2]Inst. of Experimental and Applied Physics, Univ. of Kiel, Germany; [3]Integrated Optical Systems, MESA+ Inst. for Nanotechnology, Univ. of Twente, Netherlands; [4]LIGENTEC SA, Switzerland; [5]Department of Physics and The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Germany.* We measured spectroscopic properties of Tm-doped alumina-based integrated highpower LMA amplifiers. Pump power dependent lifetime data is presented and the effect of energy transfer upconversion is highlighted. High-power amplification over one Watt is demonstrated.

13:00 -- 15:00
Room: W205CD
STu3E • Nonlinear Photonics Materials and Devices
Presider: Gianlorenzo Masini, USA

STu3E.1 • 13:00
Long-lived photorefractive and pyroelectric effects in thin film lithium niobate microresonantors, Xinyi Ren[1], Chun-Ho Lee[1], Kaiwen Xue[1], Shaoyuan Ou[1], Yue Yu[1], Zaijun Chen[1], Mengjie Yu[1]; *[1]Univ. of Southern California, USA.* We demonstrated the long-lived (over hours) photorefractive and pyroelectric effects on a thin-film lithium niobate platform, and deterministic tuning of the optical properties of high-*Q*-factor microresonators via light excitation and temperature variation over time.

STu3E.2 • 13:15
Towards wavelength-accurate quasi-phasematched frequency conversion in thin-film lithium niobate, CJ Xin[1], Shengyuan Lu[1], JIayu Yang[1], Amirhassan Shams-Ansari[1], Nicholas Achuthan[1], Neil Sinclair[1], Marko Loncar[1]; *[1]Harvard Univ., USA.* We report progress on a process flow for fabricating wavelength-accurate quasi-phasematched frequency conversion devices in thin-film lithium niobate. Of 156 sampled devices, ~48% are phasematched within ±5 nm of a target second-harmonic generation process.

STu3E.3 • 13:30 (Invited)
Integrated Photonics with Thin-film Lithium Niobate, Mian Zhang[1]; *[1]HyperLight Corporation, USA.* Thin-film lithium niobate (TFLN) is a rapid developing material platform for high-speed integrated photonics applications, driven by the demand of faster communications and AI infrastructure. This talk will review current progress of platform development and applications.

STu3E.4 • 14:00

Perovskite nickelate thin film devices as adaptive weights for photonic computing networks, Tae Joon Park[1], Mohamad Hossein Idjadi[2], Farshid Ashtiani[2], Chenghao Wan[3,5], Mikhail A. Kats[3,5], Shriram Ramanathan[1,4]; *[1]School of Materials Engineering, Purdue Univ., USA; [2]Nokia Bell Labs, USA; [3]Department of Electrical and Computer Engineering, Univ. of Wisconsin-Madison, USA; [4]Department of Electrical and Computer Engineering, Rutgers, The State Univ. of New Jersey, USA; [5]Department of Materials Science and Engineering, Univ. of Wisconsin-Madison, USA.* Atomic layer deposition (ALD) and sputtering of strongly correlated perovskite nickelate thin films are emerging fields for wafer-scale demonstration of quantum technologies. Functional properties of such oxide quantum materials for proof-of-principle non-Von Neumann photonic computing networks are reported.

STu3E.5 • 14:15

Symmetry breaking of the $\chi^{(2)}$ polarization in poled thin film lithium niobate waveguides enabling phase matching, Olivia Hefti[1,2], Jean-Etienne Tremblay[1], Andrea Volpini[1], Homa Zarebidaki[1], Ivan Prieto[1], Olivier Dubochet[1], Michel Despont[1], Steve Lecomte[1], Camille Brès[2], Hamed Sattari[1], Davide Grassani[1]; *[1]CSEM, Switzerland; [2]EPFL, Switzerland.* Poling the bottom of etched LNOI waveguides enables modal phase matching with an anti-symmetric mode and a measured second harmonic generation efficiency of 1980 %W-1cm-2. The simple design allows for reproducible on-chip frequency conversion.

STu3E.6 • 14:30

Periodic poling of single crystal thin film barium titanate-on-insulator, Pragati Aashna[1], Hong-Lin Lin[1], YU CAO[1], Gao Yuan[1], Sakthi S. Mohanraj[2], Di Zhu[3], Aaron Danner[1]; *[1]Electrical and computer engineering, National Univ. of Singapore, Singapore; [2]3Inst. of Materials Research and Engineering, Agency for Science, Technology and Research, Singapore; [3]Department of Material Science and Engineering, National Univ. of Singapore, Singapore.* We report, for the first time, electric field periodic poling of single-crystal thin film barium titanate grown using pulsed-laser-deposition on dysprosium scandate substrate. Uniform domains with periods 5-7 µm are obtained and imaged using piezo-response-force-microscopy.

STu3E.7 • 14:45

Integration of scandium aluminum nitride with silicon nitride for enhanced nonlinear optics, Jiangnan Liu[1], Shuai Liu[1], Ding Wang[1], Zheshen Zhang[1], Zetian Mi[1]; *[1]Univ. of Michigan, USA.* We report on the integration of the second-order nonlinear media ScAlN with the low-loss Si_3N_4 in a microring resonator platform for enhanced nonlinear optics interaction.

13:00 -- 15:00
Room: W206A
FTu3F • Entangled Fiber Optic Networks
Presider: Kristina Meier; Los Alamos National Laboratory, USA

FTu3F.1 • 13:00

Entanglement Distribution in Packet-Switched Quantum Wrapper Network, Mehmet Berkay On[1], Roberto Proietti[2], Gamze Gul[3], Gregory Kanter[3], Sandeep Kumar Singh[4], Prem Kumar[3], S. J. Ben Yoo[1]; *[1]Univ. of California, Davis, USA; [2]Department of Electronics and Telecommunications Engineering, Politecnico di Torino, Italy; [3]Department of Electrical and*

Computer Engineering, Northwestern Univ., USA; [4]Department of Electronics and Communication Engineering, Indian Inst. of Technology, India. We experimentally demonstrate entanglement distribution between a source and two distinct destination nodes in a packet-switched quantum network with >86% fidelity, where the packets consist of classical bits as labels and entangled photons as payloads.

FTu3F.2 • 13:15
Entanglement Distribution for Metropolitan-scale Quantum Networks with Classical Coexistence, Anouar Rahmouni[1,2], Paulina S. Kuo[1], Yicheng Shi[1], Jabir M. V.[1], Nijil Lal[1], Ivan A. Burenkov[1], Ya-Shian Li-Baboud[1], Mheni Merzouki[1], Abdella Battou[1], Sergey Polyakov[1], Oliver Slattery[1], Thomas Gerrits[1]; *[1]NIST, USA; [2]Univ. of Maryland, USA.* We achieved successful polarization entanglement distribution in metropolitan-scale quantum networks, coexisting with classical systems. We utilized deployed fiber infrastructure across the NIST campus and extended the distance to over 100 km using fiber spools.

FTu3F.3 • 13:30
Procrustean Entanglement Concentration for Quantum-Classical Coexistence, Hsuan-Hao Lu[1], Muneer Alshowkan[1], Jude Alnas[2], Joseph M. Lukens[3,1], Nicholas A. Peters[1]; *[1]Oak Ridge National Laboratory, USA; [2]Duke Univ., USA; [3]Arizona State Univ., USA.* We present a theoretical framework for Procrustean entanglement concentration tailored for polarization-entangled states infiltrated by polarized classical crosstalk, and experimentally validate its efficacy in a deployed quantum local area network.

FTu3F.4 • 13:45
Scalable Photonic Quantum Network, Hyeongrak Choi[1], Marc G. Davis[1], Álvaro Iñesta[2], Dirk Englund[1]; *[1]Massachusetts Inst. of Technology, USA; [2]QuTech, TU Delft, Netherlands.* We present efficient multi-flow entanglement routing in Quantum Tree Network (QTN) with sublinear overhead, congestion-free operations, and error correction, outperforming conventional mesh networks.

FTu3F.5 • 14:00
Enabling phase-stable quantum protocols over optical fiber networks, Nicholas Nardelli[1,2], Lynden Shalm[1], Michael Mazurek[1,2], Tara Fortier[1]; *[1]National Inst. of Standards and Technology, USA; [2]Univ. of Colorado Boulder, USA.* We present a path length stabilization protocol using interleaved photonic classical and quantum channels through a 200 m fiber link and demonstrate a phase drift < lambda/50 over 10 minutes.

FTu3F.6 • 14:15
Phase stabilization with single photon detection for quantum networks, Jabir M. V.[1], N. Fajar R. Annafianto,[1], Ivan A. Burenkov[1,2], Abdella Battou[1], Sergey Polyakov[1,2]; *[1]NIST, USA; [2]Univ. of Maryland, USA.* We demonstrate phase stabilization of a 3.2 km quantum network link with faint light. Our stabilization signal can empower phase-reliant quantum communication protocols and supports coexistent multiplexing of classical/quantum channels in a scaleable quantum network.

FTu3F.7 • 14:30
Teleportation of entanglement at the Fermilab Quantum Network, Samantha I. Davis[1], Raju Valivarthi[1], Rahaf Youssef[1], Chang Li[3], Lautaro Narvaez[1], Cristian Pena[2], Si Xie[2], Panagiotis

Spentzouris[2], Maria Spiropulu[1]; *[1]California Inst. of Technology, USA; [2]Fermi National Accelerator Laboratory, USA; [3]Univ. of Chicago, USA.* We demonstrate an entanglement swapping protocol for time-bin qubits in a fiber-based quantum network at Fermilab. We report state-of-the-art entanglement swapping visibilities of up to 92.3 +/- 3.8%.

FTu3F.8 • 14:45
Quantum and Classical Communications in Shared Optical Fibers: Teleportation and Beyond, Jordan M. Thomas[1], Fei Yeh[2], Jim Chen[2], Joe Mambretti[2], Scott Kohlert[3], Gregory Kanter[4], Prem Kumar[1]; *[1]Northwestern Univ., USA; [2]International Center for Advanced Internet Research, USA; [3]Ciena Corporation, USA; [4]NuCrypt, LLC, USA.* We discuss recent experimental progress in quantum teleportation systems operating in the same fibers as high-rate classical communications. We evaluate methods for optimizing teleportation fidelity in the presence of spontaneous Raman scattering noise.

13:00 -- 15:00
Room: W206B
FTu3G • Applications of Metamaterials and Complex Media I
Presider: Sui Yang; Arizona State Univ., USA

FTu3G.1 • 13:00
Large-Scale Self-Assembled Nanophotonic Scintillators for X-Ray Imaging, Louis Martin-Monier[1], Charles Roques-Carmes[2,3], Simo Pajovic[4], Juejun Hu[1], Marin Soljačić[2,4]; *[1]Department of Materials Science and Engineering, MIT, USA; [2]Research Laboratory of Electronics, MIT, USA; [3]E. L. Ginzton Laboratory, Stanford, USA; [4]Department of Mechanical Engineering, MIT, USA.* We develop a scalable fabrication method for nanophotonic scintillators embedded with self-assembled nanophotonic structures. We demonstrate a 2.6-fold scintillation enhancement in a conventional scintillator over 4×4cm, showing the potential of our technique for X-ray imaging.

FTu3G.2 • 13:15
Image denoising using diffractive optical processors, Cagatay Isil[1], Tianyi Gan[1], Onuralp Ardic[1], Koray Mentesoglu[1], Jagrit Digani[1], Huseyin Karaca[1], Hanlong Chen[1], Jingxi Li[1], Deniz Mengu[1], Mona Jarrahi[1], Kaan Aksit[2], Aydogan Ozcan[1]; *[1]Univ. of California, Los Angeles, USA; [2]Department of Computer Science, Univ. College London, UK.* We report an image denoising analog processor composed of passive diffractive layers engineered through deep learning to filter out various types of noise from input images, instantly projecting denoised images at the output field-of-view.

FTu3G.3 • 13:30
Class-specific image encryption using a diffractive optical processor, Bijie Bai[1], Heming Wei[2], Xilin Yang[1], Tianyi Gan[1], Deniz Mengu[1], Mona Jarrahi[1], Aydogan Ozcan[1]; *[1]Univ. of California Los Angeles, USA; [2]Shanghai Univ., China.* We present a framework for all-optical image encryption that is class-specific, performing a distinct image transformation function for each data class. Experimental validation of this method was conducted using both terahertz and near-infrared wavelengths.

FTu3G.4 • 13:45 (Invited)

"Thermal" Radiation from Emitters Not Quite in Equilibrium, Mikhail A. Kats[1]; [1]*Univ. of Wisconsin-Madison, USA.* I will discuss examples of 'heat-powered radiation' in situations where the emitter is not in equilibrium. Heat-powered radiation in nonequilibrium cases can be hard to distinguish from thermal radiation, but is a broader class of phenomena, which can include super-Planckian emission.

FTu3G.5 • 14:15
Local and Non-Local Phase-Change Metasurfaces for Reconfigurable Optical Edge-Detection, Stuart Kendall[1], Carlota Ruiz de Galarreta[1], Joe Shields[1], Guoce Yang[2], Mengyun Wang[2], June Sang Lee[2], Nikolaos Farmakidis[2], Andy Moskalenko[2], Kairan Huang[2], Mario Mencagli[3], Lou Deguzman[3], Andrea Alù[4], Jacopo Bertolotti[1], Harish Bhaskaran[2], C. David Wright[1]; [1]*Univ. of Exeter, UK;* [2]*Univ. of Oxford, UK;* [3]*Univ. of North Carolina, USA;* [4]*City College of New York, USA.* Local and non-local phase-change metasurfaces for dual-function edge-detection/bright-field imaging are designed and simulated. Reconfigurability is via switching phase-change material between crystal and amorphous states. Applications include fast pre-processing for image analysis, optical microscopy and more.

FTu3G.6 • 14:30
General image compression using random-PSF metasurfaces and computational back-end, Yubo Zhang[1], Rui Chen[1], Minho Choi[1], Johannes E. Fröch[1], Arka Majumdar[1]; [1]*Univ. of Washington, USA.* Compressive imaging that reduces the pixel numbers can lower the cost and power consumption. Here, we use a random-PSF metasurface and computational back-end to achieve a compression rate of 50% for general scenes.

FTu3G.7 • 14:45
Non-Hermitian quasicrystal lattices, Ananya Ghatak[2], Ioannis Komis[2], Ziad H. Musslimani[3], Konstantinos Makris[2,1]; [1]*Univ. of Crete, Greece;* [2]*Inst. of Electronic Structure and Laser, FORTH, Greece;* [3]*Department of Mathematics, Florida State Univ., USA.* We study the wavepacket diffraction in non-Hermitian two-dimensional quasicrystals. The effect of spatial symmetries and the localization degree of the associated non-orthogonal eigenstates on the wave propagation are examined in detail.

13:00 -- 15:00
Room: W207A
ATu3H • A&T Topical Review on Silicon Photonics for Optical I/O, Artificial Intelligence and High-Performance Computing I
Presider: Chaoran Huang; Chinese Univ. of Hong Kong, Hong Kong

ATu3H.1 • 13:00 (Invited)
300-mm Monolithic CMOS Silicon Photonics Foundry Technology, Yusheng Bian[1]; [1]*GLOBALFOUNDRIES, USA.* This paper reviews recent advancements in GlobalFoundries Fotonix™ technology: a 300-mm monolithic CMOS silicon photonics foundry platform. The discussion encompasses photonic and CMOS device library, advanced packaging, PDK compact models, reliability and in-house test capabilities.

ATu3H.2 • 13:30 (Invited)

Ultra-high Density Optical I/O based on Novel Silicon Optical modulator, Xi Xiao[1,2], Daigao Chen[1], Hongguang Zhang[1], Lei Wang[1], Shaohua Yu[2,1]; *[1]NOIEC, China; [2]Peng Cheng Laboratory, China.* We present several feasible solutions for high density and high speed optical I/O based on novel silicon optical modulators, which demonstrating the highest speed up to 300 Gb/s per lane and ultra-compactness of ~20 μm.

ATu3H.3 • 14:00 (Invited)
Silicon Photonics and 3-D Technologies for Next-generation AI/HPC Systems, Joris Van Campenhout[1]; *[1]InterUniv. Microelectronics Center, Belgium.* We will outline our vision for bringing optical interconnects to the package, interposer, and wafer level, leveraging scaled Silicon Photonics and 3D technologies, and share some recent results from our ongoing research and development efforts.

ATu3H.4 • 14:30 (Invited)
Title to be Announced, Sergey Shumarayev[1]; *[1]Altera part of Intel, USA.* Abstract not available.

13:00 -- 15:00
Room: W206BC
FTu3I • Nanophotonic Coupling to Solid State Spins
Presider: Amit Agrawal; US Army Research Laboratory

FTu3I.1 • 13:00
Purcell Enhancement of a Single T Center Coupled to a Silicon Nanophotonic Cavity, Ulises Félix Rendón[1], Adam Johnston[1], Yu En Wong[1], Songtao Chen[1]; *[1]Rice Univ., USA.* We demonstrate Purcell enhancement of a single T center integrated in a silicon photonic crystal cavity, increasing the fluorescence decay rate by a factor of 6.89 and achieving a photon outcoupling rate of 73.3 kHz

FTu3I.2 • 13:30
Integrated Platform for Spin-Photon Interfaces in Silicon, Hanbin Song[1,2], Xueyue Zhang[3,4], Yiyang Zhi[3], Lukasz Komza[4,2], Alp Sipahigil[3,2]; *[1]Department of Materials Science and Engineering, Univ. of California, Berkeley, USA; [2]Materials Science Division, Lawrence Berkeley National Laboratory, USA; [3]Department of Electrical Engineering and Computer Sciences, Univ. of California, Berkeley, USA; [4]Department of Physics, Univ. of California, Berkeley, USA.* We demonstrate optical initialization and readout of electron spins of a single T center in a silicon nanophotonic waveguide. We present progress for coherent control of the waveguide single spin for silicon spin-photon interfaces development.

FTu3I.3 • 13:45
Frequency multiplexed emission from cavity-enhanced T centers, Lukasz Komza[1,2], Xueyue Zhang[3,1], Yu-Lung Tang[1,2], Hanbin Song[4,2], Alp Sipahigil[3,2]; *[1]Physics, Univ. of California, Berkeley, USA; [2]Materials Sciences Division, Lawrence Berkeley National Laboratory, USA; [3]Electrical Engineering and Computer Sciences, Univ. of California, Berkeley, USA; [4]Materials Science and Engineering, Univ. of California, Berkeley, USA.* To enable efficient spin-photon interfaces with T centers, cavity-enhanced emission is essential. We build an integrated photonics platform demonstrating cavity-enhanced emission from multiple T centers across distinct cavities, featuring a minimum lifetime of 126 nanoseconds.

FTu3I.4 • 14:00

Enhanced Light-Matter Interactions for a Single T Center in a Silicon Nanocavity, Yu En Wong[2,1], Adam Johnston[2,1], Ulises Felix-Rendon[2,1], Songtao Chen[2,3]; *[1]Applied Physics, Rice Univ., USA; [2]Electrical and Computer Engineering, Rice Univ., USA; [3]Smalley-Curl Inst., Rice Univ., USA.* We investigate light-matter interactions for a single T center coupled to a silicon photonic crystal cavity. By solving Lindblad master equation, we extract the cavity-QED parameters for the coupled system.

FTu3I.5 • 14:15

Photo-physics of Silicon X-center Ensembles with Above Bandgap Excitations, Cody S. Fan[1], Murat Can Sarihan[1], Jiahui Huang[1], Jin Ho Kang[1], Baolai Liang[1], Chee Wei Wong[1]; *[1]UCLA, USA.* We study the carrier dynamics of X-center ensembles in silicon, which were obtained via ion implantation and annealing on a bulk silicon substrate.

FTu3I.6 • 14:30

Temperature-Resolved Photoionization Spectroscopy of the Nitrogen–Vacancy ^{1}E Singlet State, Sean M. Blakley[1,2], Thuc Mai[2], Angela Hight Walker[2], Robert McMichael[2]; *[1]Quantum Science & Technology Branch, DEVCOM Army Research Laboratory, USA; [2]Physical Measurement Laboratory, National Inst. of Standards and Technology, USA.* By applying wavelength-tuned spin-selective photoionization, the energies of the ^{1}E and $^1A_1$ nitrogen–vacancy (NV) singlet states relative to the diamond band-gap edges are determined as a function of temperature.

FTu3I.7 • 14:45

Investigating atomic-scale solid-state properties with an SnV electrometer in diamond, Tim Schroder[1,2]; *[1]Humboldt Universität zu Berlin, Germany; [2]Ferdinand-Braun-Institut, Germany.* We present an electrometer based on an optically-active spin defect in diamond with a non-linear Stark response. Using this sensor, we successfully localize charge traps, quantify their impact on transport dynamics and noise generation, analyze relevant material properties, and develop strategies for material optimization.

13:00 -- 15:00
Room: W207D
ATu3J • Integrated Photonic Subsystems
Presider: Rakesh Krishna; Georgia Tech, USA

ATu3J.1 • 13:00 (Invited)

Applications of Tensor Decomposition in Optical Computing, Xian Xiao[1], Wolfger Peelaers[1], Yequan Zhao[2], Yuan Yuan[1], Thomas V. Vaerenbergh[1], Geza Kurczveil[1], Marco Fiorentino[1], Zheng Zhang[2], Raymond G. Beausoleil[1]; *[1]Hewlett Packard Enterprise, USA; [2]Univ. of California, Santa Barbara, USA.* We introduce our recent work in applying tensor compression techniques in optical computing and highlight two applications: the tensorized integrated coherent Ising machine and the tensorized optical multimodal fusion network.

ATu3J.2 • 13:30

Acoustoelectric RF Mechanical Oscillator with Optomechanical Readout, Johnathan Mack[2], Matthew J. Storey[1], Nils T. Otterstrom[1], Ryan O. Behunin[3], Andrew Starbuck[1], Andrew Leenheer[1], Katherine Musick[1], Douglas C. Trotter[1], Peter Rakich[4], Matt Eichenfield[2,1]; *[1]Sandia National Labs, USA; [2]Wyant College of Optical Sciences, Univ. of Arizona, USA; [3]Department of Applied Physics and Materials Science, Northern Arizona Univ., USA; [4]Department of Applied Physics, Yale Univ., USA.* We present a CMOS-integrable optomechanical microdisk resonator with acoustoelectric gain for a ~1 GHz mechanical mode. Gain is applied via a DC bias, and we observe a 9.5 dB increase in the optically-detected RF power.

ATu3J.3 • 13:45
A 3D Image Sensor Based on Intentionally Shifted Focal Plane Switch Array with Detection Range above 200 m, Daisuke Inoue[1], Tadashi Ichikawa[1], Tetsuya Shimogaki[1], Hiroyuki Matsubara[1], Akari Kawasaki[1], Tatsuya Yamashita[1]; *[1]Toyota Central R&D Labs Inc., Japan.* We proposed and demonstrated a novel three-dimensional (3D) scanning image sensor consisting of a lens and chip with a detection range of 204 m and 3D imaging of a building located 45 m away.

ATu3J.4 • 14:00
A Silicon-Based Integrated Photonic-Assisted Emitter for High Date-Rate Microwave Wireless Communication, Zhujun Wei[1], Qiang Zhang[2], Zhilei Fu[1], Nannan Ning[1], Qikai Huang[1], Jianyi Yang[1], Hui Yu[2]; *[1]Zhejiang Univ., China; [2]Zhejiang Lab, China.* We propose and demonstrate a silicon-based integrated photonic-assisted emitter. It consists of an aperiodically distributed traveling wave photodetector, a compact Yagi antenna and a bias circuitry network. The measured radiated power is above -20 dBm from 31 GHz to 38 GHz. Furthermore, a wireless data transmission at 3/5/8 Gbps is demonstrated.

ATu3J.5 • 14:15
Recovering optical chaos through turbulence with silicon photonic processor, Heming Huang[1], Andres I. Martinez[2], Sara Zaminga[1], Seyedmohammad Seyedinnavadeh[2], Andrea Melloni[2], Francesco Morichetti[2], Frédéric Grillot[1,3]; *[1]Télécom Paris, France; [2]Politecnico di Milano, Italy; [3]Univ. of New Mexico, USA.* This work demonstrates the ability of a silicon photonic mesh in recovering spectral information from chaotic light propagating through turbulent media. Results showcase the potential of the mesh in future LiDAR and communication applications.

ATu3J.6 • 14:30
Refractive Index Sensing using the optical heterodyne method and Photonic crystal hybrid laser, Liam O'Faolain[1], Taynara Oliveria[1], Artem Vorobev[1], Maria Kotlyar[1], Simone Iadanza[2]; *[1]CAPPA, Munster Technological Univ., Ireland; [2]Paul Scherer Inst., Switzerland.* We have demonstrated a new approach to refractive index sensing based on the optical heterodyne method and a refractive index sensitive hybrid laser. We achieved over an order of magnitude improvement in the detection limit relative to the RI measurement based on a passive optical resonator.

ATu3J.7 • 14:45
Frequency Modulation Based Long Wave Infared Detection, Tianyi Guo[1], Sayan Chandra[1], Debashis Chanda[1]; *[1]Univ. of Central Florida, USA.* The frequency modulation based long-wave infrared detection approach demonstrates extraordinary performance in room temperature with

low noise equivalent power, fast response time, and high detectivity, which holds potential for next generation of LWIR detection.

13:00 -- 15:00
Room: W208
JTu3K • Symp: Dissipative Temporal Solitons and Frequency Combs via Quadratic Nonlinearities I

Presider: Nicolas Englebert; California Inst. of Technology, Belgium

JTu3K.1 • 13:00 (Invited)
Origin and Stability of Dissipative Structures in Quadratic Nonlinear Cavities: A General Pattern Formation Perspective, Pedro Parra-Rivas[1]; *[1]Univ degli Studi di Roma La Sapienza, Italy.* A general overview on the formation and stability of dissipative localized structures in quadratic nonlinear cavities is presented. To do so I will follow a pattern forming perspective by applying principles of dynamical systems theory.

JTu3K.2 • 13:15 (Invited)
Title to be Announced, Mingming Nie[1]; *[1]Univ. of Colorado, USA.* Abstract not available.

JTu3K.3 • 13:30 (Invited)
Microresonator Frequency Combs Involving Both $\chi^{(2)}$ and $\chi^{(3)}$ Nonlinearities, Xiaoxiao Xue[1], Kaiyi WU[2]; *[1]Tsinghua Univ., China; [2]School of Electrical and Computer Engineering, Purdue Univ., USA.* Many microresonator platforms for frequency comb generation have both chi(2) and chi(3) nonlinearities. Here we discuss several comb formation behaviors in this scenario, including second-harmonic assisted four-wave mixing, Kerr soliton regulation and single-cavity comb self-referencing.

JTu3K.4 • 14:00 (Invited)
Beyond Self-phase Modulation: Solitons and Supercontinua in Quasi-phasematched Nonlinear Nanowaveguides, Marc Jankowski[1,2]; *[1]Physics and Informatics Laboratory, NTT Research Inc., USA; [2]Edward L. Ginzton Laboratory, Stanford Univ., USA.* Waveguides with second-order nonlinearities can combine dispersive effects with multi-wave interactions to realize an incredible variety ultrafast behaviors. In this talk we discuss supercontinuum generation by saturated frequency conversion and parametric downconversion by gain-trapped solitons.

JTu3K.5 • 14:30 (Invited)
Electro-optic Frequency Combs - Towards Visible Results, Harald G. Schwefel[1,2]; *[1]Physics, Univ. of Otago, New Zealand; [2]Dodd-Walls Centre for Photonic and Quantum Technologies, New Zealand.* Electro-optic frequency combs based on the quadratic nonlinearity in high-quality crystalline whispering-gallery-mode-resonators allow single and ultra-stable dual frequency combs centred around the optical pump laser. New results in the visible are presented.

13:00 -- 15:00
Room: W209A
FTu3L • Atomic Quantum Metrology
Presider: Jeremy Glick; DEVCOM Army Research Laboratory, USA

FTu3L.1 • 13:00
Spectrum-To-Position Conversion Via Programmable Spatial Dispersion, Marcin Jastrzebski[1,2], Stanislaw Kurzyna[1,2], Bartosz Niewelt[1,2], Mateusz Mazelanik[1], Wojciech Wasilewski[1,2], Michal Parniak[1]; *[1]QOT Warsaw, Poland; [2]Faculty of Physics, Univ. of Warsaw, Poland.* We present a protocol for spectrum-to-position conversion using spatial spin wave modulation technique in gradient echo quantum memory. We present the characterization of our interface as well as the uncertainty discussion.

FTu3L.2 • 13:15
Bright Highly Polarization-Squeezed Light Beam for Quantum Metrology, Samir Bali[1], Thad Walker[2]; *[1]Physics, Miami Univ., USA; [2]Physics, Univ. of Wisconsin, USA.* We propose to create a bright polarization-squeezed light beam, with unprecedented squeezing at near-dc frequencies, by exploiting off-resonant Faraday rotation in dense atomic vapor. This may have profound implications for quantum-enhanced spin-exchange-relaxation-free (SERF) optical magnetometry.

FTu3L.3 • 13:30
Measurement of an ion's motional state via qubit spectroscopy in an ion trap with integrated photonics, Alfredo Ricci Vasquez[1], Carmelo Mordini[1], Daniel Kienzler[1], Jonathan Home[1]; *[1]ETH Zürich, Switzerland.* We present a method to generate spin-motion coupling in trapped ions by using state-dependent optical potentials from a phase-stable standing wave generated using integrated photonics in a surface-electrode trap. We employ this method to directly observe the motional state of an ion using qubit spectroscopy

FTu3L.4 • 14:00 (Invited)
Neutral Atom Quantum Computing with Ytterbium Erasure Qubits, Jeff Thompson[1]; *[1]Princeton Univ., USA.* I will present recent results from our group on implementing high-fidelity gates on nuclear spins encoded in metastable 171Yb atoms, including mid-circuit detection of gate errors using erasure conversion.

FTu3L.5 • 14:30
How Much Time Does a Photon Spend as an Atomic Excitation Before Being Transmitted?, Kyle Thompson[1], Kehui Li[1], Daniela Angulo[1], Vida M. Nixon[1], Josiah SInclair[3], Amal V. Sivakumar[2], Howard M. Wiseman[4], Aephraim Steinberg[1,5]; *[1]Department of Physics, and Centre for Quantum Information and Quantum Control, Univ. of Toronto, Canada; [2]Department of Physical Sciences, Indian Inst. of Science Education and Research Kolkata, India; [3]Department of Physics, MIT-Harvard Center for Ultracold Atoms and Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA; [4]Centre for Quantum Computation and Communication Technology (Australian Research Council), Centre for Quantum Dynamics, Griffith Univ., Australia; [5]Canadian Inst. For Advanced Research, Canada.* We show that if a photon is transmitted through an atom cloud, the time it spent as an atomic excitation along the way--as measured by weakly probing the atoms--is equal to the group delay, which can be negative.

FTu3L.6 • 14:45

Fluorescence by nonclassical light: Getting it right, Christian Drago[1], Alan McLean[2], Ralph Jimenez[2], John Sipe[1]; *[1]Univ. of Toronto, Canada; [2]JILA, USA.* We calculate the fluorescence of cold cesium atoms excited by low intensity, non-degenerate squeezed light, which enhances the fluorescence rate compared to classical light. The signal is predicted to be in an experimentally detectable regime.

13:00 -- 15:00
Room: W209B
JTu3M • Symp: Laser-driven Nuclear Fusion: A 60-year Success Story
Presider: Tammy Ma; Lawrence Livermore National Laboratory, USA

JTu3M.1 • 13:00 (Invited)

The National Ignition Facility: The Beginning, Edward M. Campbell[1]; *[1]MCM Consultants, USA.* We will describe the national security needs and efforts that led to the Department of Energy's decision to construct the National Ignition Facility, supported by extensive research on the NOVA laser that preceded NIF.

JTu3M.2 • 13:30 (Invited)

The NIF Journey: A Revolutionary Facility for High Energy Density Science (HEDS) and Fusion Ignition, Mary L. Spaeth[1], Edward Moses[1]; *[1]Lawrence Livermore National Laboratory, USA.* The National Ignition Facility has transformed HEDS, including the demonstration of fusion ignition. We will review the combination of technology breakthroughs with supply-chain development, strong systems engineering and disciplined operations that made NIF possible.

JTu3M.3 • 14:15 (Invited)

The NIF Laser System: Groundbreaking Capabilities in Support of Stockpile Stewardship, Discovery Science, and National Security, Jean-Michel G. Di Nicola[1]; *[1]Lawrence Livermore National Laboratory, USA.* Since NIF's 2009 commissioning, taking advantage of its architecture and operations strategy, we have continuously improved NIF's performance for its missions, surpassing all design goals. We will review these advances and plans for future developments.

JTu3M.4 • 14:45 (Invited)

Beyond NIF: Getting to Inertial Fusion Energy, Tammy Ma[1]; *[1]Lawrence Livermore National Laboratory, USA.* The achievement of ignition on the NIF now lays the groundwork to explore laser inertial fusion as a path toward clean, abundant, safe energy for climate and energy security. We will discuss the U.S. roadmap.

13:00 -- 15:00
Room: W209C
JTu3N • Structured Light and Beam Shaping (Joint SI1+FS5)

Presider: Shima Gholam Mirzaeimoghadar; National Research Council Canada, Canada

JTu3N.1 • 13:00

Spatiotemporal Torquing of Light, Scott W. Hancock[1], Sina Zahedpour[1], Andrew T. Goffin[1], Howard M. Milchberg[1]; *[1]Univ. of Maryland at College Park, USA.* We show transverse orbital angular momentum can be imparted to light pulses in the spatiotemporal domain for sufficiently fast and spatiotemporally overlapped transient perturbations and/or the removal of energy from a pulse having spatiotemporal phase.

JTu3N.2 • 13:15

Rotatum of Light, Ahmed Dorrah[1], Alfonso Palmieri[1], Lisa Li[1], Federico Capasso[1]; *[1]Harvard John A. Paulson School of Engineering and Applied Sciences, Harvard Univ., USA.* We introduce optical rotatum where a vortex beam experiences a quadratic chirp in its orbital angular momentum along the optical path. We discuss the physical dynamics of this topological deformation as well as potential use in metrology and sensing.

JTu3N.3 • 13:30

Realization of vortex ladder via pseudospin pumping in photonic graphene, Sihong Lei[1], Shiqi Xia[1], Daohong Song[1], Hrvoje Buljan[1,2], Zhigang Chen[1]; *[1]Teda College of Nankai Univ., China; [2]Univ. of Zagreb, Croatia.* We demonstrate an approach for ladder-type vortex generation in photonic graphene. This is achieved by exciting the ring spectrum of the Dirac cone, enabling pseudospin mode pumping and periodic singularity mapping to high-order topological charges.

JTu3N.4 • 13:45

Topologically protected vortex discrimination and transport, Zhichan Hu[1], Domenico Bongiovanni[2,1], Ziteng Wang[1], Xiangdong Wang[1], Daohong Song[1], Jingjun Xu[1], Roberto Morandotti[2], Hrvoje Buljan[1,3], Zhigang Chen[1]; *[1]School of Physics, Nankai Univ., China; [2]EMT, INRS Univ., Canada; [3]Department of Physics, Univ. of Zagreb, Croatia.* We demonstrate a universal principle for the realization of robust topological vortex guidance, showing clearly the advantage of using topological disclination for OAM-mode discrimination and transport as compared to a single waveguide.

JTu3N.5 • 14:00

Inverted pin beams for robust propagation through atmospheric turbulence, Sotiris Droulias[2], Michalis Loulakis[3], Dimitris Papazoglou[3,4], Stelios Tzortzakis[3,4], Zhigang Chen[5,6], Nikolaos K. Efremidis[1,2]; *[1]Univ. of Crete, Greece; [2]Inst. of Applied and Computational Mathematics, Foundation for Research and Technology - Hellas, Greece; [3]Inst. of Electronic Structure and Laser, Foundation for Research and Technology - Hellas, Greece; [4]Department of Materials Science and Technology, Univ. of Crete, Greece; [5]MOE Key Laboratory of Weak-Light Nonlinear Photonics, TEDA Applied Physics Inst. and School of Physics, Nankai Univ., China; [6]Collaborative Innovation Center of Extreme Optics, Shanxi Univ., China.* We introduce a new class of beams the "inverted pin beams". We show that in atmospheric turbulence inverted pin beams outperform (have reduced scintillations) other classes of beams in moderate to strong fluctuation regimes.

JTu3N.6 • 14:15
Observation of Boyer-Wolf Gaussian Modes, David Guacaneme[1], Konrad Tschernig[1], Oussama Mhibik[1], Ivan Divliansky[1], Miguel A. Bandres[1]; *[1]CREOL, Univ. of Central Florida, CREOL, USA.* We experimentally observe a new family of fundamental laser modes of stable resonators: the Boyer-Wolf Gaussian modes. The lasing Boyer-Wolf Gaussian modes exhibit an inherent parabolic structure and show remarkable agreement with our theoretical predictions.

JTu3N.7 • 14:30
Machine Learning assisted Structured Light Demultiplexing using Nanostructures, Purnesh S. Badavath[1], Chayanika Sharma[1], Supraja P[1], Rakesh Kumar R[1], Vijay Kumar[1]; *[1]NIT Warangal, India.* Interaction of high-dimensional structured light beams with randomly grown ZnO-nanosheets of uniform distribution results in information carrying speckle patterns. Supervised deep learning model, trained on the speckle patterns classifies structured light beams with >96% accuracy.

JTu3N.8 • 14:45
Laser Ablation by the Enhanced Longitudinal Electric Field of a Tightly Focused Radially Polarized Beam, Yukine Tsuru[1,2], Yuichi Kozawa[1], Yuuki Uesugi[1], Shunichi Sato[1]; *[1]Inst. of Multidisciplinary Research for Advanced Materials, Tohoku Univ., Japan; [2]Department of Materials Science, Graduate School of Engineering, Tohoku Univ., Japan.* Single-shot laser ablation by the longitudinal electric field of a radially polarized beam is demonstrated. The longitudinal field can be significantly enhanced at the rear surface of a transparent material by total reflection.

13:00 -- 15:00
Room: W209DE
FTu3O • New Methods for Single and Entangled Photon Generation
Presider: Galan Moody; Univ. of California Santa Barbara, USA

FTu3O.1 • 13:00
Photonic-wire bonded pump reject and tunable wavelength demultiplexer circuit using contra-directional couplers for a silicon micro-ring resonator photon-pair source, Abdelrahman Afifi[1], Malcolm Haynes[1], Sudip Shekhar[1], Lukas Chrostowski[1,2], Jeff Young[1,2]; *[1]Univ. of British Columbia, Canada; [2]Stewart Blusson Quantum Matter Inst., Canada.* A wavelength demultiplexer and pump-reject circuit using three contra-directional couplers is integrated with a silicon micro-ring resonator and connected using photonic wire bonds that achieve a pair-generation rate of 13~kHz and CAR of 320.

FTu3O.2 • 13:15
Photon-pair Generation via Raman-active N_2 Defects in Silicon Nitride Waveguides, Kathleen Oolman[1,2], Kai Shinbrough[1,2], Virginia O. Lorenz[1,2]; *[1]Department of Physics, Univ. of Illinois Urbana-Champaign, USA; [2]IQUIST, Univ. of Illinois Urbana-Champaign, USA.* We show preliminary photon-pair generation data from Raman-active interstitial N_2 defects in silicon nitride waveguides. Using calculated phase-mismatch of the propagating photons, we propose an experimental scheme for deterministic single-photon generation using non-degenerate pumping wavelengths.

FTu3O.3 • 13:30

Quantum Calculation of Photon Pair Generation in Quasi-phase Matched AlGaAs Microrings, Samuel E. Fontaine[1], Colin Vendromin[1], Trevor J. Steiner[2], Galan Moody[3], John Bowers[2,3], Amirali Atrli[1], Marco Liscidini[4], John Sipe[1]; *[1]Physics, Univ. of Toronto, Canada; [2]Materials, Univ. of California, USA; [3]Electrical and Computer Engineering, Univ. of California, USA; [4]Fisica, Universita di Pavia, Italy.* We calculate the rate of spontaneous parametric down-conversion, and generated biphoton wavefunction, in an AlGaAs microring resonator designed to take full advantage of the quasi-phase matching occurring as the light propagates around the ring.

FTu3O.4 • 13:45

Creating Entanglement Through a Joint Decay Channel, Offek Tziperman[1], Ron Ruimy[1], Alexey Gorlach[1], Ido Kaminer[1]; *[1]Solid state Inst., Technion, Israel Inst. of Technology, Israel.* We propose a protocol to create entanglement between emitters in cavity- or waveguide-QED through their decay to a common channel. Heralding on emitters' states creates desired quantum light states such as cat and GKP.

FTu3O.5 • 14:00

Programmable formation of telecom band quantum emitters in silicon, Kaushalya Jhuria[1], Vsevolod Ivanov[1], Debanjan Polley[2], Wei Liu[1], Arun Persaud[1], Yertay Zhiyenbayev[2], Walid Redjem[2], Wayesh Qarony[2], Prabin Parajuli[1], Qing Ji[1], Anthony Gonsalves[1], Jeffery Bokor[2], Liang Tan[1], Boubacar Kante[2], Thomas Schenkel[1]; *[1]Lawrence Berkeley National Lab, USA; [2]Univ. of California, USA.* Here, we demonstrate local writing and erasing of selected light-emitting defects using fs laser pulses in combination with hydrogen-based defect activation and passivation which also lead to rediscovering a potential Spin-photon qubit.

FTu3O.6 • 14:15

Efficient Heralding of Pure Single-Photons at Telecom Wavelength from Pulsed Cavity-Enhanced SPDC, Xavier Barcons Planas[1,2], Helen M. Chrzanowski[2], Leon Messner[1], Janik Wolters[2,3]; *[1]Institut für Physik, Humboldt-Universität zu Berlin, Germany; [2]Inst. of Optical Sensor Systems, German Aerospace Center (DLR), Germany; [3]Institut für Optik und Atomare Physik, Technische Universität Berlin, Germany.* Highly efficient sources of pure single photons are essential for photonic quantum technologies. We present a source of pure single-photons with 85% heralding efficiency based on pulsed spontaneous parametric down-conversion in a monolithic cavity.

FTu3O.7 • 14:30

Optically Active InGaAs Axial Nanowire Heterostructures for Quantum Integrated Photonic Circuits, Hyowon W. Jeong[1], Akhil Ajay[1], Nitin Mukhundhan[1], Markus Döblinger[2], Sebastian Sturm[2], Mikel Gomez-Ruiz[3], Richard Zell[2], Tobias Schreitmüller[1], Jonas Lähnemann[3], Knut Müller-Caspary[2], Jonathan Finley[1], Gregor Koblmüller[1]; *[1]Technische Universität Munchen, Germany; [2]LMU Munich, Germany; [3]Paul-Drude Institut Berlin, Germany.* We propose a nanowire (NW) quantum light source coupled to a silicon quantum photonic integrated circuit. Starting from modelling the coupling dependencies of key dimensional parameters of NW/Si-waveguide, we further show experimental progress towards such a quantum light source using InGaAs emitters in a GaAs(Sb) NW cavity.

FTu3O.8 • 14:45

Room-Temperature Silicon Nitride Quantum Emitters for Advancing Quantum Key Distribution, Alexander Senichev[1], Zachariah O. Martin[1], Samuel Peana[1], Artem Kryvobok[1], Alexei S. Lagoutchev[1], Alexandra Boltasseva[1], Vladimir M. Shalaev[1]; [1]*Purdue Univ., USA.* Newly discovered silicon nitride quantum emitters hold great promise for industrial-scale quantum photonic applications. We assess the performance of intrinsic room-temperature SiN single-photon emitters for quantum key distribution, showcasing their exceptional brightness and single-photon purity.

13:00 -- 15:00
Room: W209F
STu3P • Optical Computing and Signal Processing

Presider: Mikko Huttunen; Tampere Univ., Finland

STu3P.1 • 13:00

Experimental Demonstration of Directly Detecting the Output of a Tunable 2-Symbol 10-GBaud QPSK Optical Correlator Using Optical Biasing and Nonlinear Wave Mixing, Abdulrahman Alhaddad[1,2], Amir Minoofar[1], Wing Ko[1], Huibin Zhou[1], Narek Karapetyan[1], Muralekrishnan Ramakrishnan[1], Yuxiang Duan[1], Zile Jiang[1], Xinzhou Su[1], Yingning Wang[1], Ruoyu Zeng[1], Hao Song[1], Ahmed Almaiman[3], Jonathan Habif[1,4], Moshe Tur[5], Alan Willner[1,6]; [1]*Univ. of Southern California, USA;* [2]*Fouad Alghanim & Sons Group of Companies, Kuwait;* [3]*King Saud Univ., Saudi Arabia;* [4]*Information Sciences Inst., Univ. of Southern California, USA;* [5]*School of Electrical Engineering, Tel Aviv Univ., Israel;* [6]*Dornsife Department of Physics & Astronomy, Univ. of Southern California, USA.* We experimentally demonstrate direct detection of a 2-symbol 5/10-Gbaud QPSK optical correlator output using nonlinear wave mixing and optical biasing. We capture the output using a photodiode and apply power thresholding to find multiple patterns.

STu3P.2 • 13:15

Demonstration of Tunable Optical Matrix Convolution of a 10-Gbaud QPSK 2-D Image with a Kernel Using Wave Mixing, Amir Minoofar[1], Abdulrahman Alhaddad[1], Wing Ko[1], Huibin Zhou[1], Narek Karapetyan[1], Zile Jiang[1], Ahmed Almaiman[2], Muralekrishnan Ramakrishnan[1], Murali Annavaram[1], Jonathan Habif[1], Moshe Tur[3], Alan Willner[1]; [1]*Univ. of Southern California, USA;* [2]*King Saud Univ., Saudi Arabia;* [3]*School of Electrical Engineering, Tel Aviv Univ., Israel.* We experimentally demonstrate reconfigurable matrix convolution of a QPSK-encoded input image at 3/5/10-Gbaud rates. The kernel values are applied by adjusting the relative phase and amplitude of pumps, which coherently mix with the signals using nonlinear wave mixing.

STu3P.3 • 13:30 (Invited)

Optical Neural Networks Implemented using Linear and Nonlinear Optics, Peter L. McMahon[1]; [1]*Cornell Univ., USA.* In this talk I will review some of the motivations for building optical neural networks and discuss various recent implementations from both my own group and others', highlighting some of the research challenges and opportunities.

STu3P.4 • 14:00

Matrix-Matrix Multiplication Through Hyperspectral Compute-in-Memory, Byoung Jun Park[2,1], Mostafa Honari Latifpour[2,3], Yoshihisa Yamamoto[2], Myoung-Gyun Suh[2]; *[1]Korea Univ., Korea (the Republic of); [2]Physics & Informatics Laboratories, NTT Research, USA; [3]City Univ. of New York, USA.* We propose a hyperspectral compute-in-memory architecture using optical frequency combs and programmable optical memories. By fully utilizing frequency, space, and time dimensions, this approach demonstrates energy-efficient and highly-scalable op- tical Matrix-Matrix Multiplication, potentially exceeding PetaOPS-level performance.

STu3P.5 • 14:15
Brained-inspired optical computing unit based on transient nonlinear dynamics of single-mode fibers, Nicolas Perron[1], Bennet Fischer[2], Mario Chemnitz[2], Yi Zhu[1], Piotr Roztocki[3], Benjamin MacLellan[1], Luigi Di Lauro[1], Aadhi Rahim[1], Cristina Rimoldi[4], Tiago H. Falk[1], Roberto Morandotti[1]; *[1]Institut National de la Recherche Sci., Canada; [2]Leibniz Inst. of Photonic Technology, Germany; [3]Ki3 Photonics Technologies, Canada; [4]Dipartimento di Elettronica e Telecomunicazioni Politecnico di Torino, Italy.* We developed and studied a hardware-based neuromorphic wave computer using optical nonlinearities. Here, we showcase the low-power consumption, robustness, and scalable complexity of soliton-based spectral broadening as a novel neuromorphic approach.

STu3P.6 • 14:30
All-Optical Recurrent Neural Network Using Ultrafast Nonlinear Optics, Gordon H. Li[1], Christian R. Leefmans[1], James Williams[2], Nicolas Englebert[2], Midya Parto[2,3], Alireza Marandi[1,2]; *[1]Applied Physics, California Inst. of Technology, USA; [2]Electrical Engineering, California Inst. of Technology, USA; [3]Physics and Informatics Laboratories, NTT Research, Inc., USA.* We experimentally demonstrate an end-to-end all-optical recurrent neural network utilizing short laser pulses and ultrafast $\chi^{(2)}$ nonlinear optics to unlock unprecedented computational clock rates and massively parallel information processing for time-series classification and prediction tasks.

STu3P.7 • 14:45
An Optical Neural Network Based on Nanophotonic Optical Parametric Oscillators, Midya Parto[1,2], Gordon H. Li[3], Ryoto Sekine[1], Robert M. Gray[1], Luis Ledezma[1], James Williams[1], Alireza Marandi[1,3]; *[1]Electrical Engineering, California Inst. of Technology, USA; [2]NTT Research, USA; [3]Applied Physics, California Inst. of Technology, USA.* We experimentally demonstrate a recurrent optical neural network based on a nanophotonic optical parametric oscillator fabricated on thin-film lithium niobate. Our demonstration paves the way for realizing optical neural networks exhibiting ultra-low latencies.

13:00 -- 15:00
Room: W210
STu3Q • Micro and Nanocavities I
Presider: Chaitali Joshi; Google LLC, USA

STu3Q.1 • 13:00
Recent advances in photonic crystal rings: loss spectrum, bandgap behavior, and nonlinear application, Xiyuan Lu[1,2], Yi Sun[1,2], Roy T. Zektzer[1,2], Kartik Srinivasan[1,2]; *[1]National Inst of Standards & Technology, USA; [2]Univ. of Maryland College Park, USA.* We report recent

findings in photonic crystal rings including improved understanding of its full loss spectrum, a simplified approach to multi-mode frequency engineering for nonlinear optics, and a non-intuitive bandgap closing behavior.

STu3Q.2 • 13:15
Cavity Continuum, Fan Cheng[1], Vladimir Shuvayev[2], Mark Douvidzon[3], Lev Deych[4], Tal Carmon[1]; *[1]School of Electrical Engineering, Tel Aviv Univ., Israel; [2]Physics Department, Queens College of CUNY, USA; [3]Solid State Inst., Technion-Israel Inst. of Technology, Israel; [4]The Graduate Center of CUNY, USA.* We demonstrate large arrays of coupled whispering gallery resonators formed by droplets. Employing fluorescent mapping, we measure the spatial and spectral distribution of light intensity across the modes within this cavity ensemble.

STu3Q.3 • 13:30 (Invited)
High-Q Asymmetrical Microcavity Optics, Yun-Feng Xiao[1], Hao-Jing Chen[1]; *[1]Peking Univ., China.* In this talk, I will introduce some new advances in asymmetrical microcavity optics, including the chaos-assisted momentum transformation for broadband optical coupling, phase-space tailor for controlled emission pattern, and chaos-enhanced chirality of light field.

STu3Q.4 • 14:00
Vicinity of exceptinal point-induced mode-locking in coupled microresonators, Riku Imamura[1], Shun Fujii[2], Ayata Nakashima[1], Takasumi Tanabe[1]; *[1]Department of Electronics and Electrical Engineering, Keio Univ., Japan; [2]Department of Physics, Keio Univ., Japan.* A Coupled-cavity system with gain and loss enables mode-locking without natural saturable absorbers. Our theoretical and numerical findings demonstrate significant modulation in system Q near the exceptional point, even with minimal Kerr effect involvement.

STu3Q.5 • 14:15
Ultra-high-Q Integrated Flame Hydrolysis Deposited Germano-silica Resonators on Silicon, Hao-Jing Chen[1], Kellan Colburn[1], Jin-Yu Liu[1], Lue wu[1], Bruno Moog[2], Christopher Holmes[2], James C. Gates[2], Henry Blauvelt[1], Kerry Vahala[1]; *[1]California Inst. of Technology, USA; [2]Univ. of Southampton, UK.* Flame hydrolysis deposition is used to create integrated optical resonators with Q factors greater than 100 million. Absorption-limited Q factors up to 440 million are measured.

STu3Q.6 • 14:30
Widely separated tunable optical parametric oscillation in GaN microresonators, ZhaoQin He[1], Changzheng Sun[1], Bing Xiong[1], Jian Wang[1], Zhibiao Hao[1], Lai Wang[1], Yanjun Han[1], Hongtao Li[1], Lin Gan[1], Yi Luo[1]; *[1]Department of Electronic Engineering, Tsinghua Univ., China.* Widely separated tunable optical parametric oscillation (OPO) is demonstrated in GaN microresonators with specially designed waveguide for phase-matching. OPO frequency separation up to 96.6 THz with a tuning range of 20 THz is recorded.

STu3Q.7 • 14:45
Inverse Designed Silicon Nitride Photonic Linear Microresonators, Toby Bi[1,2], Shuangyou Zhang[1], Alekhya Ghosh[1,2], Yaojing Zhang[1], Olga Lohse[1], Irina Harder[1], Ki Youl Yang[3], Pascal Del'Haye[1,2]; *[1]Max Planck Inst. for the Science of Light, Germany; [2]Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany; [3]John A. Paulson School of Engineering and Applied Sciences, Harvard Univ., USA.* We fabricate and characterize silicon

nitride microresonators formed between pairs of inverse-designed integrated photonic mirrors. These type of Fabry-Pérot cavities can be used for nonlinear optics and Kerr soliton generation in dispersion engineered resonators.

13:00 -- 15:00
Room: W211
FTu3R • Optical Thermodynamics
Presider: Demetrios Christodoulides

FTu3R.1 • 13:00
Statistical mechanics and pressure of composite optical systems, Nikolaos K. Efremidis[1,2], Demetrios Christodoulides[3]; *[1]Univ. of Crete, Greece; [2]Inst. of Applied and Computational Mathematics, Foundation for Research and Technology - Hellas, Greece; [3]Ming Hsieh Department of Electrical and Computer Engineering, Univ. of Southern California, USA.* We develop a thermodynamic theory that takes into account the synergistic action of multiple components. We compute the optomechanical pressure and find that the type of the nonlinearity involved can lead to different thermal equilibria.

FTu3R.2 • 13:15
Comparing optical thermalization dynamics in different lattices via Kullback-Leibler divergence, Guowen Yang[1], Domenico Bongiovanni[2], Daohong Song[1], Roberto Morandotti[2], Zhigang Chen[1], Nikos Efremidis[1,3]; *[1]School of Physics, Nankai Univ., China; [2]EMT, INRS Univ., Canada; [3]Department of Applied Mathematics, Univ. of Crete, Greece.* We study optical thermalization dynamics in different optical lattices by evaluating mode occupation and entropy maximization under different nonlinear conditions. Via the Kullback-Leibler divergence, we unveil the difference in thermalization speed towards reaching the Rayleigh-Jeans distribution.

FTu3R.3 • 13:30
Optical condensation of light via Joule-Thomson expansion, Georgios G. Pyrialakos[1,2], Marco S. Kirsch[3], Richard Altenkirch[3], Julius Beck[3], Huizhong Ren[2], Mahmoud A. Selim[2], Pawel Jung[1], Mercedeh Khajavikhan[2], Alexander Szameit[3], Matthias Heinrich[3], Demetrios Christodoulides[2]; *[1]Univ. of Central Florida, CREOL, USA; [2]Ming Hsieh Department of Electrical and Computer Engineering, Univ. of Southern California, USA; [3]Institut für Physik, Universität Rostock, Germany.* We establish a thermodynamic framework for an all-optical Joule-Thomson expansion process in multimoded nonlinear systems. We experimentally demonstrate that power from single-site inputs can universally condense into the fundamental mode of a waveguide lattice.

FTu3R.4 • 14:00
Stochastic approach in Thermodynamics of nonlinear multimode lattices, Konstantinos Makris[1,2], Georgios Pyrialakos[3], Fan O. Wu[3], Demetrios Christodoulides[4]; *[1]Univ. of Crete, Greece; [2]IESL, FORTH, Greece; [3]CREOL, USA; [4]Ming Hsieh Department of Electrical and Computer Engineering, Univ. of Southern California, USA.* We develop a stochastic Langevin type of approach for thermodynamics of weakly nonlinear multimode optical systems. Our analytical theory captures the complex system-bath dynamics, based on the mixing that caused by optical nonlinearity.

FTu3R.5 • 14:15

Nonlinear mode stabilization of full-Poincare beams in atmospheric turbulence, Long D. Nguyen[2], Saumya Choudhary[1], Dhanush Bhatt[2], Robert W. Boyd[1,2]; [1]*Inst. of Optics, Univ. of Rochester, USA;* [2]*Department of Physics and Astronomy, Univ. of Rochester, USA.* We discuss a regime of stable nonlinear propagation of a high-powered laser beam with a Full-Poincare polarization structure through atmospheric turbulence enabling higher-power transfer to localized distant areas.

FTu3R.6 • 14:30

Amplified Cooling of Light via Emergent Onsager Irreversible Thermodynamics, Zhongfei Xiong[2], Fan O. Wu[1], Yang Liu[3], Jian-Hua Jiang[3,4], Demetrios Christodoulides[5], Yuntian Chen[2,6]; [1]*Cornell Univ., USA;* [2]*School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China;* [3]*Soochow Univ., China;* [4]*Suzhou Inst. for Advanced Research, Univ. of Science and Technology of China, China;* [5]*Department of Electrical Engineering, Univ. of Southern California, China;* [6]*Wuhan National Laboratory of Optoelectronics, Huazhong Univ. of Science and Technology, China.* While conventional cooling schemes solely depend on temperature differences, here we demonstrate that in photonics configurations, amplified cooling can be achieved by judiciously manipulating Onsager coefficients through engineering the density of states of the structure.

16:00 -- 18:00
Room: W201AB
ATu4A • From Land to Sea-Novel Sensing Techniques for Aqueous to Terrestrial Environments

Presider: Anthony Yu; NASA Goddard Space Flight Center, USA

ATu4A.1 • 16:00

Coherent Laser Interferometry Over the Deployed Pptical Fiber Network for Seismic Monitoring, Filippo Levi[1], Simone Donadello[1], Cecilia Clivati[1], Aladino Govoni[2], Lucia Margheriti[2], Maurizio Vassallo[2], Daniele Brenda[3], Marianna Hovsepyan[3], Elio Bertacco[1], Roberto Concas[1], Alberto Mura[1], Andre Herrero[2], Francesco Carpenteri[3], Davide Calonico[1]; [1]*INRIM, Italy;* [2]*INGV, Italy;* [3]*Open Fiber, Italy.* Integrating sensing capabilities into optical fiber networks offers opportunities in geophysical and environmental monitoring. We present an earthquake observatory based on coherent interferometry with ultrastable lasers, reporting numerous seismic events for a scalable sensing network

ATu4A.2 • 16:15 (Invited)

Low Cost and Realtime Detection of Bacterial Content in Drinking Water: How to Improve Specificity?, Rijan Maharjan[1], Anusa Thapa[1], Prajwal Rajbhandari[5], Daniele Faccio[2], Emiliano Martins[3], Thomas Krauss[4], Ashim Dhakal[1]; [1]*Phutung Research Inst., Nepal;* [2]*Univ. of Glasgow, UK;* [3]*Univ. of Sao Paolo, Brazil;* [4]*Univ. of York, UK;* [5]*RIBB, Nepal.* Reagentless optics-based techniques, such as fluorimetry, outperform all current methods in all key requirement categories for microbial risk assessment of potable water in resource-limited settings, provided that their specificity for viable bacteria is improved.

ATu4A.3 • 16:45

Phase and Intensity Characteristics of Laser Light Propagating through a Controllable Underwater Stochastic Process, Owen O'Malley[3], Thomas Kelly[1], Nathan Faust[1], Svetlana Avramov-Zamurovic[1], Nathaniel Ferlic[2], Linda Mullen[2], Matthew Kalensky[3], Peter Judd[5], Carlos Pirela[4], Jaime Anguita[4]; *[1]US Naval Academy, USA; [2]Naval Air Warfare Center Aircraft Division, USA; [3]Naval Surface Warfare Center Dahlgren, USA; [4]Millennium Inst. for Research in Optics, Chile; [5]USA Naval Research Laboratory, USA.* A Gaussian beam is propagated through a controllable underwater stochastic system governed by Rayleigh-Bénard convection. Characterization of the system is done through measurement of the optical wavefront and intensity

ATu4A.4 • 17:00 (Invited)
Optical Fibers for Underwater Sensing, Gilberto Brambilla[1]; *[1]ORC, Southampton Univ., UK.* Abstract not available.

ATu4A.5 • 17:30
Detection of Dissolved Methane in Harsh Environments Using Robust Microfiber Coupler, Kalen Barnfather[2], Tim Lee[2], Zimo Wang[2], Sebastian steigenberger[1], Efstathios Papadimitriou[1], Martynas Beresna[2], Matt Mowlem[1], Gilberto Brambilla[2], Rand Ismaeel[1,2]; *[1]National Oceanography Centre, UK; [2]ORC, Univ. Of Southampton, UK.* A novel hydrocarbon sensor for harsh environments is presented, packaged to withstand pressures between 1 to 600 bar. In this proof-of-concept work, we demonstrate the suitability of microfiber devices for ocean-sensing applications.

ATu4A.6 • 17:45
Development of a surface plasmon resonance sensor for Marine dissolved methane, Rand Ismaeel[1,2], Sam McQuillian[2], Tim Lee[2], Zimo Wang[2], Efstathios Papadimitriou[1], Sebastian steigenberger[1], Thierry Brotin[3], Matt Mowlem[1]; *[1]National Oceanography Centre, UK; [2]ORC, Univ. Of Southampton, UK; [3]Univ. de lyon, France.* A miniaturized system based on the surface plasmon resonance (SPR) for refractive index sensing has been developed to demonstrate its feasibility as miniaturized Dissolved methane marine sensor. A massive dynamic range has been achieved using ZnSe as the dielectric material for the prism guiding the light.

16:00 -- 18:00
Room: W201CD
ATu4B • Novel Microscopic and Graphene Based Biophotonics
Presider: Euan McLeod; Univ. of Arizona, USA

ATu4B.1 • 16:00
High resolution Multi-Modal Microscopy using Microlens Substrates, Somaiyeh Khoubafarin Doust[1], Peuli Nath[1], Hannah Popofski[1,2], Aniruddha Ray[1]; *[1]Univ. of Toledo, USA; [2]Eastern Michigan Univ., USA.* The resolution of optical microscopes is limited by the numerical aperture of objective lens. We introduced a cost-effective microlens substrate for multimodal optical microscopy, that enables imaging beyond the diffraction limit, which was used to image mammalian cells and tissues.

ATu4B.2 • 16:15 (Invited)

Single-objective Light-sheet Microscopy Techniques to Boost Spatiotemporal Resolution, Bingying Chen[1], Bo-jui Chang[1], Reto Fiolka[1]; *[1]Lyda Hill Department of Bioinformatics, Univ. of Texas Southwestern, USA.* Oblique Plane Microscopy inherits the advantages of standard Light-sheet microscopy but greatly frees up space for sample mounting. It also opens new design spaces for optical engineering, which we exploit to increase its spatiotemporal resolution.

ATu4B.3 • 16:45
A Photonic Resonator Interferometric Scattering Microscope for Label-free Imaging of Bio-nanoparticles in Point-of-use Environments, Leyang Liu[1], Joseph Tibbs[1], Nantao Li[1], Amanda Bacon[1], Skye Shepherd[1], Hankeun Lee[1], Neha Chauhan[1], Utkan Demirci[2], Xing Wang[1], Brian T. Cunningham[1]; *[1]Univ. of Illinois at Urbana-Champaign, USA; [2]Stanford Univeristy, USA.* We report a compact Photonic Resonator Interferometric Scattering Microscope for digital detection of gold nanoparticles, viruses, extracellular vesicles, and protein molecules for point-of-use environments in diagnostics and life science research applications.

ATu4B.4 • 17:00 (Invited)
Autonomous Light-Sheet Microscopy, Zach Marin[1]; *[1]UT Southwestern Medical Center at Dallas, USA.* Abstract not available.

ATu4B.5 • 17:30
Graphene Photogating Devices for Retinal Implants, Shadi Nashashibi[1], Stefan M. Koepfli[1], Raphael Schwanninger[1], Josua Graf[1], Wadood Haq[2], Yuriy Fedoryshyn[1], Eberhart Zrenner[2], Juerg Leuthold[1]; *[1]Inst. of Electromagnetic Fields (IEF), ETH Zurich, Switzerland; [2]Inst. for Ophthalmic Research, Univ. of Tuebingen, Germany.* We demonstrate a graphene-based phototransistor array with a dynamic range of six orders of magnitude starting from 7 lux. These devices feature a biomimetic logarithmic power dependence and are thus of interest for retinal implants.

ATu4B.6 • 17:45
Ultra-high Sensitivity Electro-optic Sensor for Optically Multiplexed Neural Recording, Zabir Ahmed[1], Xiang Li[1], Kanika Sarna[1], Harshvardhan Gupta[1], Vishal Jain[1], Maysamreza Chamanzar[1]; *[1]Carnegie Mellon Univ., USA.* A novel graphene integrated electro-optic nanophotonic sensor capable of encoding sub-mV neural signal into optical domain is demonstrated. Wavelength division multiplexing of such highly sensitive sensors can enable massive parallelization of neural recording.

16:00 -- 18:00
Room: W204AB
STu4C • High Power Semiconductor Lasers
Presider: Sebastian Klembt; Julius-Maximilians-Universität Würzburg, USA

STu4C.1 • 16:00
Generation of watt-class FM signals with suppressed AM from PCSELs for coherent free-space optical communications, Takuya Inoue[1], Ryohei Morita[1], Shuei Nakano[1], Shota Ishimura[2], Kosuke Nishimura[2], Hidenori Takahashi[2], Takehiko Tsuritani[2], Menaka D. Zoysa[1], Kenji Ishizaki[1], Masatoshi Suzuki[2], Susumu Noda[1]; *[1]Kyoto Univ., Japan; [2]KDDI Research Inc.,*

Japan. We demonstrate frequency modulation (FM) of watt-class photonic-crystal surface-emitting lasers (PCSELs) toward long-distance coherent free-space optical communications. We also demonstrate two-section PCSELs that can further enhance FM signals while suppressing amplitude modulation (AM).

STu4C.2 • 16:15
Withdrawn

STu4C.3 • 16:30
Kilowatt-class high-peak-power pulsed operation of large-area photonic-crystal surface-emitting lasers, Masahiro Yoshida[1], Shumpei Katsuno[1], Menaka D. Zoysa[1], Takuya Inoue[1], Susumu Noda[1]; [1]*Kyoto Univ., Japan.* We demonstrate kilowatt-class high-peak-power operation of a 3-mm-diameter PCSEL. Both a 1-kW peak power and a 1-GWcm^{-2}sr^{-1} brightness are realized. Laser color marking of metal is demonstrated by using such high-peak-power, high-brightness pulsed PCSELs.

STu4C.4 • 17:00
Dynamic Characteristics of Low Threshold 1.55-um-band Quantum Dot DFB-LD, Atsushi Matsumoto[1], Ryota Yabuki[2], Shinya Nakajima[1], Toshimasa Umezawa[1], Siim Heinsalu[2], Yuichi Matsushima[2], Kouichi Akahane[1], Naokatsu Yamamoto[1], Katsuyuki Utaka[2]; [1]*National Inst. of Information & Comm Tech, Japan;* [2]*Waseda Univ., Japan.* We demonstrated the low-threshold p-doped QD-DFB-LD, and clear eye pattern could be obtained even under the direct modulation of NRZ signal in 14 Gb/s despite the long cavity length of 1000 um

STu4C.5 • 17:15
Superharmonic Injection Locking in Bragg-Reflection Waveguide Lasers, Phillip S. Blakey[1], Bilal Janjua[1], Amr S. Helmy[1]; [1]*The Edward S. Rogers Sr. Department of Electrical and Computer Engineering, Univ. of Toronto, Canada.* The intra-cavity second order nonlinearity of a Bragg-reflection waveguide laser (BRW laser) was used to generate a second harmonic signal that serves as seed for injection locking the BRW laser.

STu4C.6 • 17:30
Investigation of Intensity Noise in an Interband Cascade Laser Epitaxially Grown on Silicon and Designed for High-speed Applications, Hyunah Kim[1], Pierre Didier[1,5], Sara Zaminga[1], Heming Huang[1], Daniel Andres Diaz Thomas[2], Alexei Baranov[2], Jean Baptiste Rodriguez[2], Eric Tournié[2], Hedwig Knoetig[3], Benedikt Schwarz[3], Laurent Cerutti[2], Olivier Spitz[4], Frédéric Grillot[1,6]; [1]*Télécom Paris, France;* [2]*Université de Montpellier, France;* [3]*Technische Universität Wien, Austria;* [4]*Univ. of Central Florida, USA;* [5]*mirSense, France;* [6]*Univ. of New Mexico, USA.* The high-speed parameters of an interband cascade laser grown on silicon are analyzed through the prism of relative intensity noise. The evolution of the relaxation frequency allows deriving a modulation bandwidth in the GHz range.

STu4C.7 • 17:45
High-peak-power short-pulse operation of modulated PCSELs emitting structured light, Ryoichi Sakata[1], Kenji Ishizaki[1], Takuya Inoue[1], Ryohei Morita[2], Souki Tanaka[2], Yuta Yagi[2], Menaka D. Zoysa[1], Susumu Noda[2,1]; [1]*Photonics and Electronics Science and Engineering Center, Kyoto Univ., Japan;* [2]*Department of Electronic Science and Engineering, Kyoto Univ., Japan.* We propose modulated PCSELs (M-PCSELs) with a double lattice and a Q-

switching mechanism for emitting structured light. A 28-dot pattern with a peak power of >5W is successfully generated at a current injection of ~1A, where the pulse width is <100ps and each dot has a narrow divergence angle of <0.5°.

16:00 -- 18:00
Room: W205AB
STu4D • Fiber Lasers and Amplifiers
Presider: Igor Kudelin; Univ. of Colorado at Boulder, USA

STu4D.1 • 16:00
Active beam shaping in a 1.5 µm pulsed single-frequency multimode fibre amplifier, Ori Henderson-Sapir[1,3], Shuen Wei[1], Caleb Holme[1], Darcy Smith[1,3], Stephen C. Warren-Smith[2,4], Linh V. Nguyen[2,4], Heike Ebendorff-Heidepriem[1], David J. Ottaway[1,3]; *[1]Inst. for Photonics and Advanced Sensing, School of Physics, Chemistry and Earth Sciences, Univ. of Adelaide, Australia; [2]Future Industries Inst., Univ. of South Australia, Australia; [3]OzGrav - Adelaide, Australian Research Council Centre of Excellence for Gravitational Wave Discovery, Australia; [4]Laser Physics and Photonics Devices Laboratories, Univ. of South Australia, Australia.* We demonstrate single-frequency 1550 nm pulsed amplification using Er/Yb co-doped multimode fiber, achieving 1.5 kW peak power and 11 dB gain at 10 kHz. Adjusting the seed wavefront, we obtained good output beams while maintaining gain and linewidth.

STu4D.2 • 16:15
High Power Parabolic Pulse Amplification of Femtosecond Optical Vortex Beams from a Few-mode Fiber Amplifier, Shan Wang[1], Ziheng Zhuang[1], Weijia Luo[1], Di Lin[1,2], Cong Zhang[1], Meng Xiang[1,2], Li Jianping[1,2], Songnian Fu[1,2], Yuwen Qin[1,2]; *[1]Inst. of Advanced Photonics Technology, School of Information Engineering, Guangdong Univ. of Technology, China; [2]Key Laboratory of Photonic Technology for Integrated Sensing and Communication, Ministry of Education of China, Guangdong Univ. of Technology, China.* We demonstrate the amplification of optical vortex pulses from an Yb-doped fiber amplifier, achieving 33W average output power with 1.4µJ pulse energy that can be compressed to 245fs with a peak power of 5MW.

STu4D.3 • 16:30
Erbium-Doped Fiber Amplification of 28 OAM Modes, Aaron G. Peterson-Greenberg[1], Poul Kristensen[2], Miranda Mitrovic[2], Siddharth Ramachandran[1]; *[1]Boston Univ., USA; [2]OFS-Fitel, Denmark.* Exploiting the regime of topological confinement that has enabled scaling mode counts in passive fibers, we demonstrate the first active version of such fibers yielding an EDFA with a record high uncoupled mode count (28).

STu4D.4 • 17:00
Multimode Fiber Amplifier Modelling for Wavefront Shaping Applications, Darcy Smith[1,2], Ori Henderson-Sapir[1,2], Linh V. Nguyen[3], Stephen C. Warren-Smith[3], David J. Ottaway[1,2]; *[1]Inst. for Photonics and Advanced Sensing and The School of Physics, Chemistry and Earth Sciences, The Univ. of Adelaide, Australia; [2]Australian Research Council Centre of Excellence for Gravitational Wave Discovery (OzGrav), Australia; [3]Future Industries Inst., Univ. of South Australia, Australia.* Nonlinear effects in multimode fiber amplifiers can be suppressed using

seed wavefront shaping. We present a fiber amplifier model for investigating the effects of multimode propagation and transverse spatial hole burning on fiber amplifier operation.

STu4D.5 • 17:15
Improving Frequency Noise of DFB Fiber Lasers by Acoustic Wave Suppression, Andrea Pertoldi[1,2], Rasmus D. Engelsholm[1], Ivan Galinskiy[2], Poul Varming[1], Patrick Montague[1]; *[1]NKT Photonics A/S, Denmark; [2]Niels Bohr Inst., Univ. of Copenhagen, Denmark.* The frequency noise of narrow linewidth fiber laser can be improved by addressing resonant longitudinal acoustic waves in the optical cavity. Comprehensive measurements and simulations of phonon modes aid in understanding and mitigating this phenomenon.

STu4D.6 • 17:30
Sub-kHz-linewidth self-injection locked distributed feedback fiber laser using a weak fiber Bragg grating, Meng Zou[1,2], Yuze Dai[1], Xiangpeng Xiao[1], Weiliang Zhao[1], Kai Shen[2], Qizhen Sun[1,2], Luming Zhao[1], Zhijun Yan[1,2]; *[1]Huazhong Univ. of Science and Technology, China; [2]Wuxi Research Inst., Huazhong Univ. of Science and Technology, China.* We present a compact sub-kHz-linewidth fiber laser with a weak FBG injection, which the laser has around 300 Hz linewidth. And the phase noise is suppressed by 20 dB and the relative intensity noise is reduced to -120 dB/Hz.

16:00 -- 18:00
Room: W205CD
STu4E • Integrated Photonics with New Platforms
Presider: Drew Weninger; Massachusetts Inst. of Technology, USA

STu4E.1 • 16:00 (Tutorial)
Silicon Photonics Coming of Age, Gianlorenzo Masini[1]; *[1]Cisco, USA.* Silicon Photonics, as the art of leveraging Silicon technologies with the purpose of processing light signals, has seen conspiquous developments in recent years. Several Companies have used it to bring successful products on the market. This tutorial will introduce to the subject and present an overview of how existing and new technologies have been adapted and invented to cope with the needs of light processing.

STu4E.2 • 17:00
Low Loss ScAlN-on-Insulator Photonic Integrated Circuits, Guangcanlan Yang[1], Yu Guo[1], Hong Tang[1]; *[1]Electrical Engineering, Yale Univ., USA.* ScAlN has recently emerged as a promising CMOS-compatible material for nonlinear photonics applications, but its exploitation has been limited by its growth on suitable substrates to allow efficient waveguiding. Here, we report a low loss ScAlN-on-insulator photonic circuit enabled by flip-chip bonding.

STu4E.3 • 17:15
Low-Loss Aluminum Nitride Waveguides in a 300 mm CMOS Foundry Process, Anthony Rizzo[1], Eric Thornton[2], Tuan Vo[3], Lewis G. Carpenter[3], Soumen Kar[3], Gerald Leake[3], Amos M. Smith[1], Christopher Tison[1], Daniel Coleman[3], Stefan Preble[2], Michael Fanto[1]; *[1]Information Directorate, US Air Force Research Laboratory, USA; [2]Electrical and Microelectronic Engineering, Rochester Inst. of Technology, USA; [3]College of Nanoscale Science and Engineering, Univ. at Albany, USA.* We demonstrate low-loss aluminum nitride waveguides

fabricated using a standard silicon photonics process flow in a CMOS foundry. The material's wide transparency and $\chi^{(2)}$ nonlinearity can extend silicon photonics to novel visible wavelength applications.

STu4E.4 • 17:30
Wafer-Scale Processing of Ultra-Low-Loss Gallium Phosphide Integrated Photonics, Alberto Nardi[1,2], Javier Naya Hernandez[1,3], David Indolese[1], Charles Möhl[1,2], Daniele Caimi[1], Maryline Sousa[1], Nikolai Kuznetsov[2,4], Tobias J. Kippenberg[2,4], Paul Seidler[1]; *[1]IBM Research Europe, Zurich, Switzerland; [2]Inst. of Physics, Swiss Federal Inst. of Technology Lausanne (EPFL), Switzerland; [3]Department of Physics, Swiss Federal Inst. of Technology Zurich (ETHZ), Switzerland; [4]Center of Quantum Science and Engineering (EPFL), Switzerland.* We demonstrate wafer-scale processing of integrated photonic circuits made of gallium phosphide, with propagation losses in waveguides as low as 0.40 dB/cm, and establish new record-high quality factors with resonators on this material platform.

16:00 -- 18:00
Room: W206A
FTu4F • Entanglement in Time and Frequency
Presider: Navin Lingaraju; JHU Applied Physics Laboratory, USA

FTu4F.1 • 16:00
Frequency Comb of Spectrally Pure Biphotons Using Time-Varying Cavities, Jordan Gaines[1], Karthik V. Myilswamy[1], Joseph M. Lukens[2,3], Andrew M. Weiner[1]; *[1]School of Electrical and Computer Engineering and Purdue Quantum Science and Engineering Inst., Purdue Univ., USA; [2]Research Technology Office and Quantum Collaborative, Arizona State Univ., USA; [3]Quantum Information Science Section, Oak Ridge National Laboratory, USA.* We propose and analyze the use of linear, time-variant cavities to spectrally compress broadband frequency-correlated photon pairs into combs of spectrally pure biphotons. Our approach relies on rapid switching of input coupling to the cavity.

FTu4F.2 • 16:15
Dual quantum comb generation via cascaded cavities, Xiang Cheng[1], Kai-Chi Chang[1], Yujie Chen[1], Murat C. Sarihan[1], Chee Wei Wong[1]; *[1]Univ. of California Los Angeles, USA.* We demonstrated the dual quantum comb generation via a cascaded cavities scheme. The dual quantum comb state is examined via temporally-resolved correlation measurements, verifying the quantum coherence of the constituent quantum comb states.

FTu4F.3 • 16:30
Measuring Frequency-Bin Entanglement From a Quasi-Phase-Matched Lithium Niobate Microring, Suparna Seshadri[1], Karthik V. Myilswamy[1], Zhao-Hui Ma[2], Yuping Huang[2], Andrew M. Weiner[1]; *[1]School of Electrical and Computer Engineering and Purdue Quantum Science and Engineering Inst., Purdue Univ., USA; [2]Department of Physics and Center for Quantum Science and Engineering, Stevens Inst. of Technology, USA.* We employ phase modulation to measure the phase coherence between 31.75 GHz-spaced frequency bins in a biphoton frequency comb generated from an integrated quasi-phase-matched thin-film lithium niobate microresonator.

FTu4F.4 • 16:45

Shaping of Time-Resolved Biphoton Correlations with a Microresonator-Based Spectral Shaper, Lucas M. Cohen[1], Kaiyi WU[1], Karthik V. Myilswamy[1], Hsuan-Hao Lu[2], Navin B. Lingaraju[3], Joseph M. Lukens[4,2], Andrew M. Weiner[1]; *[1]Purdue Univ., USA; [2]Oak Ridge National Laboratory, USA; [3]Johns Hopkins Univ. Applied Physics Laboratory, USA; [4]Arizona State Univ., USA.* We report on the manipulation of the time-resolved biphoton correlation function using a sub-GHz resolution silicon nitride microresonator-based spectral shaper capable of programmable amplitude and phase modulation.

FTu4F.5 • 17:00

Spatial quantum beating in a cavity-filtered biphoton frequency comb, Yujie Chen[1], Xiang Cheng[1], Kai-Chi Chang[1], Murat C. Sarihan[1], Sophi Chen Song[1], Hsiao-Hsuan Chin[1], Chee Wei Wong[1]; *[1]ECE department, Univ. of California, Los Angeles, USA.* We examine frequency entanglement via spatial quantum beating in a biphoton frequency comb, for both doubly and singly-filtered cases. The observed HOM revival is the incoherent superposition of SQB from different frequency pairs.

FTu4F.6 • 17:15

On-chip Generation and Processing of Ultrafast Time-Entangled Photonic Qudits for Quantum Communications, Stefania Sciara[1], Hao Yu[1,2], Mario Chemnitz[1,3], Nicola Montaut[1], Bennet Fischer[1,3], Robin Helsten[1], Benjamin Crockett[1], Benjamin Wetzel[4], Thorsten A. Goebel[5], Ria Kraemer[5], Brent Little[8], Sai CHU[9], Stefan Nolte[5,6], William J. Munro[7], David Moss[10], José Azaña[1], Zhiming Wang[2], Roberto Morandotti[1]; *[1]INRS-EMT, Canada; [2]Univ. of Science and Technology of China, China; [3]Leibniz Inst. of Photonic Technology, Germany; [4]XLIM Research Inst., France; [5]Friedrich Schiller Univ. Jena, Germany; [6]Fraunhofer Inst. for Applied Optics and Precision Engineering IOF, Germany; [7]Okinawa Inst. of Science and Technology Graduate Univ., Japan; [8]QXP Technology Inc., China; [9]City Univ. of Hong Kong, Hong Kong; [10]Swinburne Univ. of Technology, Australia.* We present a photonic platform for the generation and processing of picosecond-spaced time entangled qudits, based on on-chip interferometers and a spiral waveguide. We utilize these qudits to implement quantum communications over standard optical fibers.

FTu4F.7 • 17:30

Frequency Bin Encoding and Graphs, Milica Banic[1,2], John Sipe[1], Marco Liscidini[3]; *[1]Univ. of Toronto, Canada; [2]National Research Council, Canada; [3]Univ. of Pavia, Italy.* We present a strategy for designing passive sources of multipartite frequency-bin-encoded states, based on the target state's graph representation. As examples we present integrated sources of three- and four-photon GHZ states, and four-photon L_{a4} states.

FTu4F.8 • 17:45

Comb-Like Time-Frequency Entanglement via Two-Photon Interference and Distribution, Sheng-Hung Wang[1], Yen-Hung Chen[1], Pin-Ju Tsai[1]; *[1]National Central Univ., Taiwan.* We demonstrate comb-like time-frequency entangled (TFE) photon pair generation, distribution, and verification in a single interferometer. The comb-TFE photon source showcases its high entanglement nature and robust adaptability in a 2.64-km fiber network.

16:00 -- 18:00
Room: W206B
FTu4G • Applications of Metamaterials and Complex Media II
Presider: Cesare Soci; Nanyang Technological Univ., Singapore

FTu4G.1 • 16:00
A Long-wavelength Infrared Wide-field Broadband Camera Based on Extra-large Metalens Doublet, Linhan Li[1], Yan Chen[1], Mingming Hou[1], Sitan Liu[1], Fei Yi[1,2]; *[1]Huazhong Univ. of Science and Technology, China; [2]Optics Valley Laboratory, China.* We designed and fabricated an extra-large metalens doublet(EMD). Leveraging on the EMD, we developed a camera for broadband large field of view imaging in the long-wavelength infrared spectrum, and evaluated the performances of the meta-camera.

FTu4G.2 • 16:15
$Ge_2Sb_2Se_4Te$-based reconfigurable on-chip metasurface NIR filter, Cosmin-Constantin Popescu[1], Kiumars Aryana[2], Parth Garud[2], Khoi Phuong Dao[1], Steven Vitale[3], Christopher Roberts[3], Vladimir Liberman[3], Hyung Bin Bae[6], Tae Woo Lee[6], Myungkoo Kang[4], Kathleen Richardson[4], Carlos A. Rios Ocampo[5], Yifei Zhang[1], Tian Gu[1], Juejun Hu[1], Hyun Jung Kim[2]; *[1]Massachusetts Inst. of Technology, USA; [2]Langley Research Center, NASA, USA; [3]MIT Lincoln Laboratory, USA; [4]CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA; [5]Department of Materials Science and Engineering, Univ. of Maryland, USA; [6]KAIST Analysis Center, Korea Advanced Intitute of Science and Technology, Korea (the Republic of).* A tunable level, phase change material-based metasurface near IR optical filter on a transmissive doped silicon-on-insulator platform is demonstrated. This type of filter is non-volatile, non-mechanical, with switching being enabled by Joule heating via current pulses.

FTu4G.3 • 16:30
Disordered Metasurface Doublets for Asymmetric Visibility and Synergistic Imaging in the Mid-infrared, Romil Audhkhasi[1], Maksym Zhelyeznyakov[1], Anna Wirth-Singh[1], Arka Majumdar[1]; *[1]Univ. of Washington, USA.* We propose an all-silicon metasurface doublet that performs imaging in the mid-infrared only along a predefined light propagation direction. As a second application, we optimize two metasurfaces to perform imaging only when used in conjunction with each other.

FTu4G.4 • 16:45
Simultaneous Camouflage in Both 3-5um and 8-14um Windows, Roy Maman[1], Noa Mazurski[1], Uriel Levy[1]; *[1]The Hebrew Univ. of Jerusalem, Israel.* We experimentally demonstrate a plasmonic metasurface for modulating thermal emission in both MWIR (3-5um) and LWIR (8-14um) regimes simultaneously. The use of this technology in thermal camouflage is demonstrated by encoding infrared information into a chip.

FTu4G.5 • 17:00
All-Dielectric Metasurface With Over 500 nm of Tuning in the Midwave Infrared, Jesse A. Frantz[1], Cobey L. McGinnis[1], Anthony Clabeau[2], Robel Y. Bekele[1], Jason D. Myers[1], Austin F. Moore[3], Vinh Q. Nguyen[1], Jasbinder Sanghera[1]; *[1]US Naval Research Laboratory, USA; [2]Univ. Research Foundation, USA; [3]Jacobs, USA.* An all-dielectric metasurface filter, based on an As_2S_3 metasurface paired with an As_2S_3 shifter, with over 500 nm of tuning in the midwave infrared is presented. Theoretical results are compared to experimental data.

FTu4G.6 • 17:15

Broadband Dispersion Engineered Volumetric Metamaterial for Polarization Beam Splitting at Large Deflection Angles, Neuton Li[1,2], Ian Foo[2], Dragomir Neshev[1], Andrey Sukhorukov[1], Andrei Faraon[2]; *[1]Australian National Univ., Australia; [2]California Inst. of Technology, USA.* We propose miniaturizing polarizing beam splitters (PBS) with metamaterials. We use an inverse design approach that can optimize for the entire device compatible with 3D lithography. The devices operate with broadband beam deflection up to 45° and minimal dispersion in the mid wave infrared range of 4.3 μm to 4.5 μm.

FTu4G.7 • 17:30

High-Q Wavefront Shaping with Higher-order Mie-resonant Metasurfaces, Claudio U. Hail[1], Morgan Foley[1], Ruzan Sokhoyan[1], Lior Michaeli[1], Harry A. Atwater[1]; *[1]Caltech, USA.* We report on a higher-order Mie-resonant optical metasurface for manipulating light in two dimensions with high quality factor as exemplified by beam deflection and radial lensing with up to Q = 1472.

FTu4G.8 • 17:45

Optical memory in non-diffractive speckle fields, Kang-Min Lee[1], Cristian Hernando Acevedo[1], Shubham Dawda[1], Aristide Dogariu[1]; *[1]CREOL, USA.* We numerically and experimentally demonstrate an optical memory effect that occurs when a perfect vortex beam interacts with inhomogeneous media. Our results suggest a new way to effectively characterize randomly inhomogeneous media.

16:00 -- 18:00

Room: W207A

ATu4H • ATTR: Silicon Photonics for Optical I/O, Artificial Intelligence and High-Performance Computing II

Presider: Mahdi Nikdast; Colorado State Univ., USA

ATu4H.1 • 16:00 (Invited)

Deep Photonic Neural Networks for Image Classification, Firooz Aflatouni[1]; *[1]Univ. of Pennsylvania, USA.* An integrated highly-scalable architecture for photonic deep neural networks is presented. The implemented system utilizes optical interconnects and performs computation by propagation resulting in significantly reduced classification time and energy compared to conventional digital systems.

ATu4H.2 • 16:30 (Invited)

Scalable Interconnects for AI/ML Workloads, M. Ashkan Seyedi[1]; *[1]NVIDIA Corporation, USA.* This talk will provide an overview on our efforts to build AI/ML systems with CPO silicon photonics to enable unprecedented bandwidth escape density to balance memory and network bandwidth, resulting in faster convergence for model training and overall system performance.

ATu4H.3 • 17:00 (Invited)

Breaking the Beachfront Limitations with Silicon Photonics, Angelina Totovic[1], Abhijit Abhyankar[1], Ankur Aggarwal[1], Nikos Bamiedakis[1], Zoltan Bekker[1], Mohamed Benromdhane[1], Nadav Bergstein[1], Ties Bos[1], Christopher Davies[1], Andrew Gimlett[1], Xiaoping Han[1], Kavya Mahadevaiah[1], Hakki Ozguc[1], Kevin Park[1], Sujit Ramachandra[1], Jason Redgrave[1], Subal Sahni[1], Ajmer Singh[1], Matteo Staffaroni[1], Saurabh Vats[1], Phil Winterbottom[1], Darren

Woodhouse[1], Waleed Younis[1], Shifeng Yu[1], David Lazovsky[1]; [1]*Celestial AI, USA.* We present a 2.5D integrated photonics platform for optical connectivity to the point-of-compute in high-power ASICs. Relying on electro-absorption modulators, the platform features exceptional temperature stability, low latency, and high bandwidth density.

ATu4H.4 • 17:30 (Invited)
Petascale Photonic Connectivity for Energy Efficient Scaling of AI Computing, Keren Bergman[1]; [1]*Columbia Univ., USA.* High-performance systems are increasingly bottlenecked by the energy and communications costs of interconnecting numerous compute and memory resources. Integrated silicon photonics and new architectural constructs enable seamless system-wide high-bandwidth connectivity for energy-efficient performance scaling.

16:00 -- 18:00
Room: W206BC
STu4I • Single Photon Detectors & Integrated Devices
Presider: Frederik Thiele; Universität Paderborn, Germany

STu4I.1 • 16:00 (Invited)
New Techniques and Integrated Technologies for Trapped-ion Quantum Information Processing, John Chiaverini[1,2]; [1]*Massachusetts Inst of Technology Lincoln Laboratory, USA;* [2]*Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA.* Trapped ions held in chip-based electrode structures and manipulated using optical fields are a promising candidate system for quantum computing, sensing, and networking. Novel methodologies of control integration provide improved prospects for practical systems.

STu4I.2 • 16:30
Waveguide Integrated Avalanche Photodiodes for Quantum Application, Tracy A. Sjaardema[1], Matthew S. Boady[1], Andrew Starbuck[1], Andrew S. Pomerene[1], Douglas C. Trotter[1], Nils T. Otterstrom[1], Mike Gehl[1]; [1]*Sandia National Labs, USA.* We demonstrate evanescently coupled waveguide integrated silicon photonic avalanche photodiodes designed for single photon detection for quantum applications. Simulation, high responsivity, and record low dark currents for evanescently coupled devices are presented.

STu4I.3 • 16:45
Low noise microwave generation for quantum information systems via cryogenic extended-InGaAs photodiodes, Takuma Nakamura[1,2], Dahyeon Lee[1,2], Jason Horng[1], John Teufel[3], Franklyn Quinlan[1,4]; [1]*Time and Frequency division, NIST, USA;* [2]*Department of Physics, Univ. of Colorado Boulder, USA;* [3]*Applied Physics Division, National Inst. of Standards and Technology, USA;* [4]*Electrical, Computer and Energy Engineering, Univ. of Colorado, USA.* We demonstrate low-noise photonic microwave generation derived from 1550 nm fspulses via cryogenic extended-InGaAs photodiode. The phase noise is 18 dB below the shot-noise limited amplitude noise, and >20 dB below that of modulated-CW illumination.

STu4I.4 • 17:00
Performing Balanced Homodyne Detection with Superconducting Nanowire-Single Photon Detectors, Maximilian Protte[1], Timon Schapeler[1], Jan Sperling[1], Tim J. Bartley[1]; [1]*Inst. for Photonic Quantum Systems, Paderborn Univ., Germany.* We present a continuous-wave

homodyne experiment with SNSPDs. Utilizing the low noise of SNSPDs, we achieve a SNC of 46 dB. From the joint-click statistics, we characterize a weak coherent state in terms of its continuous variables.

STu4I.5 • 17:15
Maximizing photon-number resolution from an SNSPD, Niklas Lamberty[1], Timon Schapeler[1], Thomas Hummel[1], Fabian Schlue[1], Michael Stefszky[1], Benjamin Brecht[1], Christine Silberhorn[1], Tim J. Bartley[1]; *[1]Inst. for Photonic Quantum Systems, Paderborn Univ., Germany.* We present a principal component analysis of the electrical output of a commercial SNSPD, finding a photon-number resolution up to four photons. Further we identify features of interest when determining photon number.

STu4I.6 • 17:30
Superconducting Nanowire Single-Photon Detector Arrays for Mid-Infrared Applications, Benedikt Hampel[1,2], Richard P. Mirin[1], Sae Woo Nam[1], Varun B. Verma[1]; *[1]National Inst. of Standards and Technology (NIST), USA; [2]Department of Physics, Univ. of Colorado Boulder, USA.* We present current progress towards single-photon imagers based on superconducting nanowire single-photon detectors (SNSPDs) optimized for mid-infrared photons up to a wavelength of 10 µm for applications in astronomy and chemistry.

STu4I.7 • 17:45
Site-Selective Enhancement of Superconducting Nanowire Single-Photon Detectors via Local Helium Ion Irradiation, Stefan Strohauer[1], Fabian Wietschorke[1], Lucio Zugliani[1], Rasmus Flaschmann[1], Christian Schmid[1], Stefanie Grotowski[1], Manuel Müller[2], Björn Jonas[1], Matthias Althammer[2], Rudolf Gross[2], Jonathan Finley[1], Kai Müller[1]; *[1]TU Munich, Germany; [2]Walther-Meißner-Institut, Germany.* We investigate the influence of helium ion irradiation on the properties of NbTiN superconducting single-photon detectors and observe enhanced detector performance. Tailoring the detector design and irradiation enables detectors that outperform optimized unirradiated detectors.

16:00 -- 18:00
Room: W207D
ATu4J • Advances in LEDs
Presider: William Whelan-Curtin; Univ. College Cork, Ireland

ATu4J.1 • 16:00
Achieving Bipolar Photoresponse in III-Nitride Nanowires for Encrypted Optical Communication, Wei Chen[1], Danhao Wang[2], Yang Kang[1], Xin Liu[1], Shi Fang[1], Yuanmin Luo[1], Haiding Sun[1]; *[1]Univ of Science and Technology of China, China; [2]Univ. of Michigan, USA.* We construct a spectral-distinctive photodetector based on p-AlGaN/n-Si nanowires modified with carbon layer, where the carbon layer effectively regulates the surface band bending of the nanowires, further successfully applying to the encrypted optical communication system.

ATu4J.2 • 16:15
Record Efficiency of Infrared 2D Materials Light-Emitting Diode Based on a Type-I $MoTe_2/WSe_2$ Heterostructure, Yutong Zhong[1,2], Yongzhuo Li[1], Jiabin Feng[1], Chen Li[1,2], Jialu Xu[1,2], Chenxin Yu[1,2], Cun-zheng Ning[1,2]; *[1]Department of Electronic Engineering, Tsinghua Univ.,*

China; [2]College of Integrated Circuits and Optoelectronic Chips, Shenzhen Technology Univ., China. We demonstrate an efficient infrared light-emitting diode based on a type-I $MoTe_2/WSe_2$ heterostructure with a record EQE of 1% at room temperature, where multilayer WSe_2 boosts carrier transport while monolayer $MoTe_2$ enhances radiative recombination.

ATu4J.3 • 16:30

Investigation of Micron-scale Indium Gallium Nitride Light Emitting Diode with Atomic-Layer-Deposited Passivation, Hao-Jen Chang[1], Ke-Hsi Chiang[1], Yu-Ming Jao[1], Yuan-Chao Wang[1], Jian-Jang Huang[1], Hao-Chung Kuo[2], Chien-Chung Lin[1]; *[1]Graduate Inst. of Photonics and Optoelectronics, National Taiwan Univ., Taipei City, 106, Taiwan, National Taiwan Univ., Taiwan; [2]Department of Photonics, Inst. of Electro-Optical Engineering, National Yang Ming Chiao Tung Univ., National Yang Ming Chiao Tung Univ., Taiwan.* We fabricated and demonstrated 2-micron InGaN micro LEDs. The devices can work with ALD passivation and exhibit high quantum efficiencies. As high as 7.36% of quantum efficiency can be obtained in 100-micron devices.

ATu4J.4 • 16:45

Dual-function DUV micro-diodes for on-chip communication systems, Huabin Yu[1], Shudan Xiao[1], Muhammad Hunain Memon[1], Wei Chen[1], Haiding Sun[1]; *[1]Univ of Science and Technology of China, China.* We showcased highly efficient and high-speed triangular micro-size light-emitting/detecting diodes excelling in light output power density (75 W/cm^2), modulation bandwidth (566 MHz), photo-responsivity (160 mA/W), and response time (3.1 ns), outperforming traditional circular micro-diodes.

ATu4J.5 • 17:00

Towards scalable on-chip excitation of micro- and nano-photonic emitters, Zhongyi Xia[1], Dimitars Jevtics[1], Benoit Guilhabert[1], Jonathan J.D. McKendry[1], Hark H. Tan[2], Chennupati Jagadish[2], Martin D. Dawson[1], Michael J. Strain[1]; *[1]Department of Physics, Univ. of Strathclyde, UK; [2]Department of Electronic Materials Engineering, The Australian National Univ., Australia.* Individually addressable micro-LED-on-CMOS arrays are promising candidates for scalable on-chip excitation of micro- and nano-photonic emitters. Using this technology platform, frequency modulated excitation of waveguide-embedded nanowire devices was demonstrated at MHz rates.

ATu4J.6 • 17:30

Recombination Rate Analysis of High-Speed Blue InGaN/GaN micro-LEDs at Elevated Temperatures, Daniel Rogers[1], Haotian Xue[1], Fred Kish[1], Bardia Pezeshki[2], Alex Tselikov[2], Jonathan Wierer[1]; *[1]North Carolina State Univ., USA; [2]AvicenaTech Corp, USA.* InGaN/GaN micro-light-emitting diodes with high bandwidths (2.6 GHz) at high temperatures (250°C) are demonstrated. Recombination rate analysis is performed to understand the effects of radiative and non-radiative rates on modulation response at varying temperatures.

ATu4J.7 • 17:45

Unlocking MicroLED Potential: Damage-free Anisotropic Etching for Enhanced Pixel Densit, Clarence Chan[2], Henry C. Roberts[1], Yixin Xiao[3], Zetian Mi[3], Xiuling Li[1]; *[1]Univ. of Texas at Austin, USA; [2]Univ. of Illinois at Urbana-Champaign, USA; [3]Univ. of Michigan, USA.* One of the biggest hurdles in microLED-technology is the efficiency degradation with shrinking pixel-size, due to etching damage. We present the scaling of µLED from 45 to 5 µm by MacEtch, with near size-independent EQE.

16:00 -- 18:00
Room: W208
JTu4K • Symp: Dissipative Temporal Solitons and Frequency Combs via Quadratic Nonlinearities II
Presider: François Leo; Universite Libre de Bruxelles, Belgium

JTu4K.1 • 16:00 (Invited)
Quadratic Optical Frequency Combs, Salvatore Castrignano[2], Iolanda Ricciardi[2], Tobias Hansson[3], Stefan Wabnitz[1,2]; *[1]DIET, Sapienza Univ. of Rome, Italy; [2]CNR-INO, Italy; [3]Linköping Univ., Sweden.* We overview theoretical approaches and experimental advances on temporal soliton and optical frequency comb generation in coherently driven, quadratic nonlinear optical cavities

JTu4K.2 • 16:30 (Invited)
Title to be Announced, Marko Loncar[1]; *[1]Harvard Univ., USA.* Abstract not available.

JTu4K.3 • 17:00 (Invited)
Ultrafast Quadratic Nonlinear Nanophotonics: From Superior Components to Advanced Circuits, Alireza Marandi[1]; *[1]California Inst. of Technology, USA.* I will overview ultrafast nonlinear nanophotonics in lithium niobate including intense parametric amplification, all-optical switching, vacuum squeezing, mode-locked lasers, ultrabroadband sources, and formation of different solitons, and discuss ongoing efforts toward advanced ultrafast nanophotonic circuits.

JTu4K.4 • 17:30 (Invited)
Broadband Frequency Comb Generation Based on X(2) cw Optical Parametric Oscillators, Majid Ebrahim-Zadeh[1]; *[1]ICFO -Institut de Ciencies Fotoniques, Spain.* We present a novel approach for coherent broadband frequency comb generation based on bulk degenerate (2) OPOs with intracavity dispersion control and driven by continuous-wave lasers, with a temporal output corresponding to transform-limited femtosecond pulses.

16:00 -- 18:00
Room: W209A
FTu4L • Rydberg Quantum Devices
Presider: Paul Kunz; Army Research Labs, USA

FTu4L.1 • 16:00 (Tutorial)
How to hot atom – from quantum optics to quantum sensors, Robert Loew[1]; *[1]5th Inst. of Physics, Univ. of Stuttgart, Germany.* The spectroscopy of hot atomic vapors carries great potential, ranging from fundamental research to applications in the context of quantum technologies. I will review the fundamentals of vapor cell spectroscopy, photonic technologies and potential application.

FTu4L.2 • 17:00

Upconverting microwave and terahertz radiation using Rydberg atoms, Sebastian Borówka[1], Wiktor Krokosz[1], Wojciech Wasilewski[1], Mateusz Mazelanik[1], Michal Parniak[1]; *[1]Univ. of Warsaw, Poland.* Upconversion of electromagnetic waves to the optical domain gives unique perspectives for novel detection systems. We present a quantum-limited, Rydberg-atom enabled system capable of detecting microwaves from photonic or electronic sources across a broad range of frequencies.

FTu4L.3 • 17:15

High Density Rydberg Gas Produced by Ultrashort Pulse Excitation and Spontaneous Ionization Induced by Rydberg-Rydberg Interactions, Takuya Matsubara[1], Seiji Sugawa[1,2], Vikas S. Chauhan[1], Vineet Bharti[1], Arnab Maity[1], Tirumalasetty P. Mahesh[1], Takafumi Tomita[1], Sylvain De Leseleuc[1], Kenji Ohmori[1]; *[1]Inst. for Molecular Science, Japan; [2]Department of Basic Science, The Univ. of Tokyo, Japan.* We realized ~10^{11} cm^{-3} high density Rydberg gas of ultracold ^{87}Rb atoms by ultrafast excitation using improved picosecond pulse laser system, and observed the spontaneous ionization induced by Rydberg-Rydberg interactions.

FTu4L.4 • 17:30

RydIQule: Graph-based Modeling of Atomic Systems, David H. Meyer[1], Benjamin Miller[2], Teemu Virtanen[2], Christopher O'Brien[2], Kevin C. Cox[1]; *[1]US Army Research Laboratory, USA; [2]Naval Air Warfare Center, USA.* We present a powerful, open-source tool for semi-classical modeling of atomic systems. We demonstrate its use in modeling novel Rydberg electrometer configurations and spectroscopy readout schemes.

16:00 -- 18:00
Room: W209B
ATu4M • Lithium Niobate Integrated Photonics
Presider: Tianren Fan; Amazon Web Services, USA

ATu4M.1 • 16:00

High-Efficiency and Polarization-Insensitive Grating Couplers on Thin-Film Lithium Niobate Waveguides, Haoyang Tan[1], Zhaoyang Chen[2,3], Yanjing Zhao[4], Bin Chen[1], Shiming Gao[1], Xiaowei Guan[3]; *[1]Centre for Optical and Electromagnetic Research, State Key Laboratory of Modern Optical Instrumentation, International Research Center for Advanced Photonics, Zhejiang Univ., China; [2]Inst. of Optoelectronic Technology, China Jiliang Univ., China; [3]Jiaxing Key Laboratory of Photonic Sensing & Intelligent Imaging, Intelligent Optics and Photonics Research Center, Jiaxing Research Inst., Zhejiang Univ., China; [4]DTU Electro, Department of Electrical and Photonics Engineering, Technical Univ. of Denmark, Denmark.* We demonstrate polarization-insensitive grating couplers on thin-film lithium niobate waveguides. Inverse optimization method is used and the fabricated couplers exhibit efficiencies of −6 dB for the TE mode and −6.5 dB for the TM mode.

ATu4M.2 • 16:15

Photonic Crystal Microring Resonator on a Hybrid Silicon nitride-on-lithium niobate Platform, Zhongdi Peng[1], Rakesh M. Krishna[1], Xi Wu[1], Amir Hosseinnia[1], Tianren Fan[1], Ali Adibi[1]; *[1]Georgia Inst. of Technology, USA.* We demonstrate a photonic crystal resonator on hybrid silicon nitride-on-lithium niobate (SiN-on-LN) platform, designed for microwave-assisted optical-frequency conversion applications. We measure a large intrinsic quality factor (Q_{int}) of 1.47×10^5 with mode-splitting bandwidth of 14.6 GHz.

ATu4M.3 • 16:30
Erbium-doped Lithium Niobate on Insulator Waveguide Amplifier with Ultra-high Internal Net Gain of 38 dB, Yimeng Wang[1], Bo Wang[1], Bitao Shen[1], Sijie Yang[1], Ruixuan Chen[1], Haowen Shu[1], Xingjun Wang[1,2]; *[1]Peking Univ., China; [2]Peng Cheng Laboratory, China.* We demonstrate an erbium-doped lithium niobate on insulator waveguide amplifier which achieved the highest internal net gain of 38 dB with a 9.16 cm waveguide at 1531.7 nm.

ATu4M.4 • 17:00
Widely and fast tunable vernier micro-ring filter based on an LNOI platform, Zhenzheng Wang[1], Zhaoxi C. Chen[1], Cheng Wang[1]; *[1]City Univ. of Hong Kong, Hong Kong.* We report an LNOI vernier cascaded micro-ring filter integrated with both thermo-optic and electro-optic tuning electrodes, featuring a 41-nm thermo-optic tuning range, 6-ns electro-optic response time, and a high sidelobe suppression ratio of 19.2 dB.

ATu4M.5 • 17:15
Low Loss Asymmetric Bragg Grating Mode Couplers on Thin Film Lithium Niobate for Efficient Extraction of Reflected Light, Lars Emil Gutt[1], Thach Nguyen[2], Peter Girouard[1], Guanghui Ren[2], Leif K. Oxenløwe[1], Bill Corcoran[3], Arnan Mitchell[2], Pengyu Guan[4]; *[1]Danmarks Tekniske Universitet, Denmark; [2]Integrated Photonics and Applications Centre, RMIT, Australia; [3]Monash Univ., Australia; [4]School of Cyberspace Science and Technology, Beijing Inst. of Technology, China.* Bragg gratings are important components in integrated photonics, however, efficiently accessing the reflected waves remains challenging. Here, we demonstrate an asymmetric Bragg grating mode coupler in thin-film lithium niobate with 1 dB insertion loss.

ATu4M.6 • 17:30
Multiband electro-optic modulator employing a lithium niobate racetrack resonator integrated with two pulley couplers, Hyeon Hwang[1], Mohamad Reza Nurrahman[1], Hyungjun Heo[2], Kiyoung Ko[1], Kiwon Moon[3], Jung J. Ju[3], Sang-Wook Han[2], Hojoong Jung[2], Hansuek Lee[1], Min-Kyo Seo[1]; *[1]KAIST, Korea (the Republic of); [2]Korea Inst. of Science and Technology (KIST), Korea (the Republic of); [3]Electronics and Telecommunication Research Inst. (ETRI), Korea (the Republic of).* We present a multiband electro-optic modulator based on a lithium niobate racetrack micro-resonator. Integration with two pulley couplers allows high-extinction modulation over multiple spectral bands of 775, 980, and 1550 nm in a single device.

ATu4M.7 • 17:45
A Hybrid 3C-silicon carbide-lithium niobate Photonic Platform for Active and Nonlinear devices, Rakesh M. Krishna[1], Tianren Fan[1], Amir Hosseinnia[1], Xi Wu[1], Zhongdi Peng[1], Sajjad Abdollahramezani[1], Ali Adibi[1]; *[1]Georgia Tech, USA.* We present a novel hybrid silicon carbide (SiC)-lithium niobate (LN) photonic platform enabled through wafer bonding of cubic 3C-SiC and LN-on-insulator (LN). On this platform, we demonstrate ring-resonators with loaded quality factors ≈ 43,096

16:00 -- 18:00
Room: W209C
STu4N • Next Generation Lidar
Presider: Gar-Wing Truong; Thorlabs Inc., USA

STu4N.1 • 16:00
High-Resolution Arrayed-Waveguide-Grating-Assisted Passive Integrated Optical Phased Array for 2-D Beam Steering, Yuan Liu[1], Chongxin Zhang[1], Daniel DeSantis[2], Diya Hu[1], Thomas Meissner[1], Andres Garcia Coleto[2], Benjamin Mazur[2], Jelena Notaros[2], Jonathan Klamkin[1]; *[1]Univ. of California Santa Barbara, USA; [2]Massachusetts Inst. of Technology, USA.* We demonstrate a 64-channel arrayed-waveguide-grating-assisted silicon-nitrite integrated optical phase array (OPA) for 2-D beam steering. A field of view of 5°×25° with 0.3° vertical resolution are achieved over a wavelength range of 100 nm through a single input. Higher vertical resolution can be attained by utilizing all the inputs of the OPA.

STu4N.2 • 16:30
Full-Stokes polarimetric imaging LiDAR using multi-mode-fiber-coupled fractal SNSPDs, Yun Meng[1], Kai Zou[1], Yifan Feng[1], Zifan Hao[1], Jing Li[1], Yuxi Xiao[1], Thomas Descamps[2], Adrian Iovan[2], Val Zwiller[2], Xiaolong Hu[1]; *[1]Tianjin Univ., China; [2]Royal Inst. of Technology (KTH), Sweden.* We demonstrate full-Stokes polarimetric imaging LiDAR using four multi-mode-fiber-coupled fractal SNSPDs. An outdoor target 384 m away is successfully recognized with pixel dwell time of 1 ms.

STu4N.3 • 16:45
Breaking Speed Barriers for Scanning LiDAR Through High-Order Dispersion, Zihan Zang[1], Yi Hao[1], Yaqi Han[1], Qingyang Zhu[1], H. Y. Fu[1]; *[1]Tsinghua Shenzhen International Graduate School, Tsinghua Univ., China.* This paper presents a novel method using high-order dispersive devices for faster scanning LiDAR, achieving up to 2000 fps and 1.8 MHz scanning rates, significantly improving speed and resolution.

STu4N.4 • 17:00 (Tutorial)
Design and Optimization of Avalanche Photodiodes, Madison Woodson[1,2]; *[1]Freedom Photonics, USA; [2]Luminar Semiconductor Inc., USA.* This tutorial delves into critical parameters of avalanche photodiode design, highlighting effective strategies for modeling device performance. Special attention will be given to SWIR wavelength devices on InP substrates, including both linear- and Geiger-mode APDs.

16:00 -- 18:00
Room: W209DE
FTu4O • Quantum Effects in Nanophotonics
Presider: Yohannes Abate, USA

FTu4O.1 • 16:00 (Invited)
Title to be Announced, Maiken Mikkelsen[1]; *[1]Duke Univ., USA.* Abstract not available.

FTu4O.2 • 16:30

Triplet-Triplet Annihilation Upconversion Enhancement in Plasmonic Nano-Gap Cavities, Rachel Bangle[1], Hengming Li[1], Maiken Mikkelsen[1]; *[1]Duke Univ., USA.* Integration of molecular pairs known to perform upconversion via triplet-triplet annihilation into plasmonic nano-gap cavities resulted in up to 45-fold emission brightness enhancement. Cavity resonance tuning revealed absorption enhancement to be the primary operative mechanism.

FTu4O.3 • 16:45

Withdrawn

FTu4O.4 • 17:00

Withdrawn

FTu4O.5 • 17:15

Nanoplasmonics for Purcell-enhanced Spontaneous Emission in Diamond Silicon Vacancy Centers, Hengming Li[1], Deniz Acil[1], Andrew Boyce[1], Nathan Wilson[1], Qixin Shen[1], Maiken Mikkelsen[1]; *[1]Duke Univ., USA.* Slow spontaneous emission limits photonic-based quantum information applications. Here, we discuss our recent progress in realizing ultrafast emission in silicon vacancy centers through integrating diamond membranes with sub-diffraction limited plasmonic cavities through Purcell enhancement.

FTu4O.6 • 17:30

Electronically Controlled Quantum Confinement for Tunable Plasmonic Metasurfaces, Vishal Kaushik[1,2], Swati Rajput[4,3], Prem Babu[2], Suresh Pandey[2], Rahul Mishra[2], Haoron Ren[5], Stefan A. Maier[6,5], Volker Sorger[7], Hamed Dalir[7], Jacob Scheuer[1], Mukesh Kumar[2]; *[1]Electrical Engineering, Tel Aviv Univ., Israel; [2]IIT Indore, India; [3]IIT Jodhpur, India; [4]Univ. of Toronto, Canada; [5]Monash Univ., Australia; [6]Imperial College of London, UK; [7]George Washington Univ., USA.* Here we demonstrate a novel approach for high-speed voltage-controlled Localized Surface Plasmon Resonance (LSPR) in semiconductor-nanostructures at the telecommunication window. The novel platform can have exciting applications in tunable metasurfaces, spasers, modulators, and many more.

FTu4O.7 • 17:45

Laser-induced Electron Coherence in Quantum Materials Based on Spatial Self-phase Modulation, Jimin Zhao[1,2]; *[1]Inst. of Physics, Chin. Acad. Of Sci., China; [2]School of Physical Sciences, Univ. of Chinese Academy of Sciences, China.* Spatial self-phase modulation is a third-order nonlinear optical response. We found its mechanism is laser-induced nonlocal electron coherence in quantum materials. I address its cutting-edge progress, emphasizing the physics mechanism and application in all-optical switching.

16:00 -- 17:30
Room: W209F
STu4P • Fundamental Component for Optical Computing
Presider: Keisuke Kondo; Utsunomiya Univ., Japan

STu4P.1 • 16:00
Cavity-enhanced Narrowband Spectral Filters in Rare-earth Ion-doped Thin-film Lithium Niobate, Yuqi Zhao[1,2], Dylan Renaud[3], Demitry Farfurnik[4], Marko Loncar[3], Neil Sinclair[3], Edo Waks[1,2]; *[1]Inst. for Research in Electronics and Applied Physics (IREAP), Univ. of Maryland, USA; [2]Department of Electrical and Computer Engineering, Univ. of Maryland, USA; [3]John A. Paulson School of Engineering and Applied Sciences, Harvard Univ., USA; [4]Department of Electrical and Computer Engineering, North Carolina State Univ., USA.* We demonstrate cavity-enhanced narrow bandpass filtering based on rare-earth-ion-doped thin-film lithium niobate by spectral hole burning in a critically-coupled resonance mode. Furthermore, we show that bandstop filtering can also be realized utilizing an under-couped cavity.

STu4P.2 • 16:30
Integrated Preparation of Photonic Spin-Orbit Qudits, Hao-Qi Zhao[1], Yichi Zhang[1], Zihe Gao[1], Jieun Yim[1], Shuang Wu[1], Natalia M. Litchinitser[2], Li Ge[3], Liang Feng[1]; *[1]Univ. of Pennsylvania, USA; [2]Duke Univ., USA; [3]The City Univ. of New York, USA.* Here, using an integrated approach, we explore the synergy from two degrees of freedom of light, spatial mode and polarization, to generate, encode, and manipulate flying photon qudits in a four-dimensional Hilbert space with high quantum fidelity, intrinsically enabling enhanced noise resilience and higher quantum data rates.

STu4P.3 • 16:45
Surface acoustic wave Brillouin scattering in thin-film lithium niobate waveguides, Kaixuan Ye[1], Hanke Feng[2], Yvan Klaver[1], Akshay Keloth[1], Akhileshwar Mishra[1], Cheng Wang[2], David Marpaung[1]; *[1]Univ. of Twente, Netherlands; [2]City Univ. of Hong Kong, Hong Kong.* We observed the first-ever Brillouin scattering in thin-film lithium niobate (TFLN) waveguides. The z-cut TFLN waveguide, at 20° rotation angle, achieves a remarkable 84.9 $m^{-1}W^{-1}$ Brillouin gain coefficient, facilitated by 8.06 GHz surface acoustic waves.

STu4P.4 • 17:00
A Brillouin Microwave Photonic Notch Filter in Thin Film Lithium Niobate Platform, Akhileshwar Mishra[1], Kaixuan Ye[1], Hanke Feng[2], Yvan Klaver[1], Akshay Keloth[1], Cheng Wang[2], David Marpaung[1]; *[1]Univ. of twente, Netherlands; [2]City Univ., China.* We report first demonstration of microwave photonic notch filter based on Stimulated Brillouin scattering in a thin-film lithium niobate waveguide. We achieve a rejection of 15 dB with a filter bandwidth of 16 MHz and utilizing only 0.45 dB on-chip SBS gain.

STu4P.5 • 17:15
Wafer-Scale Fabrication of InGaP-on-Insulator for Nonlinear Quantum Photonics Applications, Lillian Thiel[1], Joshua E. Castro[1], Trevor J. Steiner[1], Nicholas Lewis[1], John Bowers[1], Galan Moody[1]; *[1]UC Santa Barbara, USA.* We present 100-mm wafer fabrication of InGaP-on-insulator---a promising integrated quantum photonic platform with strong $X^{(2)}$ and $X^{(3)}$. We achieve 3.25 dB/cm waveguide loss and microresonators with Q>160,000 for entangled-pair generation.

16:00 -- 18:00
Room: W210
STu4Q • Micro and Nanocavities II
Presider: Chao Xiang

STu4Q.1 • 16:00
Continuous Tuning From Bright to Dark States in Coupled Photonic Resonators, Graydon J. Flatt[1], Karl J. McNulty[1], Oliver L. Wang[1], Michal Lipson[1]; *[1]Columbia Univ., USA.* We show continuous tuning into an all-optical dark state by modifying coherent interference between coupled photonic resonators. The quality factor is tuned from 50,000 in the bright state to 1.4 million in the dark state.

STu4Q.2 • 16:15
Selective linewidth control in a micro-resonator with a resonant interferometric coupler, Paula L. Pagano[2,1], Massimo Borghi[1], Federica Moroni[1], Alice Viola[1], Parimal Edke[3], Matteo Menotti[3], Marco Liscidini[1], Matteo Galli[1], Daniele Bajoni[1]; *[1]Univ. of Pavia, Italy; [2]Centro de Investigaciones Opticas, Argentina; [3]Xanadu Quantum Technologies, Canada.* We present a silicon nitride micro-resonator in which we can selectively control the linewidth of a single resonance using a resonant interferometric coupler.

STu4Q.3 • 16:30
Thermometric Control of the Resonance Frequency of a High-*Q* Si_3N_4 Microresonator, Sai Kanth Dacha[1], Yun Zhao[1], Karl J. McNulty[2], Michal Lipson[2,1], Alexander L. Gaeta[1,2]; *[1]Department of Applied Physics and Applied Mathematics, Columbia Univ., USA; [2]Department of Electrical Engineering, Columbia Univ., USA.* We demonstrate a new method to stabilize the absolute resonance frequency of a high-*Q* Si_3N_4 microcavity against long term drift using an on-chip temperature sensing and control scheme.

STu4Q.4 • 16:45
Imaging of standing-wave patterns from a bi-directionally pumped microresonator, Haochen Yan[1,2], Alekhya Ghosh[1,2], Arghadeep Pal[1,2], Hao Zhang[1], Toby Bi[1,2], George Ghalanos[1], Shuangyou Zhang[1], Lewis J. Hill[1], Yaojing Zhang[1], Yongyong Zhuang[1,3], Jolly Xavier[1,4], Pascal Del'Haye[1,2]; *[1]Max-Planck Inst., Germany; [2]Physics, Friedrich Alexander Univ. Erlangen-Nuremberg, Germany; [3]Electronic and Information Engineering, Xi'an Jiaotong Univ., China; [4]Indian Inst. of Technology, India.* We perform real-time imaging of standing waves in bi-directionally pumped microresonators. This is achieved by collecting scattered light with a short-wave infrared camera. The measurements enable subwavelength distance measurements of scattering sources with nanometer-level accuracy

STu4Q.5 • 17:00
Self-assembled silicon photonic cavities with atomic-scale confinement, Ali N. Babar[1,2], Thor A. Weis[1], Konstantinos Tsoukalas[1], Shima Kadkhodazadeh[3,2], Guillermo Arregui[1], Babak Vosoughi Lahijani[1,2], Soren Stobbe[1,2]; *[1]DTU Electro, Technical Univ. of Denmark, Denmark; [2]NanoPhoton – Center for Nanophotonics, Technical Univ. of Denmark, Denmark; [3]DTU Nanolab, Technical Univ. of Denmark, Denmark.* We realize nanocavities that confine light in silicon with atomic-scale gaps and aspect ratios exceeding 100. The cavities are

self-assembled and self-aligned to a photonic circuit, enabled by merging conventional semiconductor technology with bottom-up nanotechnology.

STu4Q.6 • 17:15
Plasma Microcavities, Baheej Bathish[2], Raanan Gad[1], Fan Cheng[1], Kristoffer Karlsson[3], Ramgopal Madugani[3], Mark Douvidzon[4], Síle Nic Chormaic[3], Tal Carmon[1]; *[1]School of Electrical Engineering, Tel Aviv Univ., Israel; [2]Faculty of Mechanical Engineering, Technion-Israel Inst. of Technology, Israel; [3]Okinawa Inst. of Science and Technology Graduate Univ., Japan; [4]Solid State Inst., Technion-Israel Inst. of Technology, Israel.* We demonstrate, for the first time, an optical microresonator with plasma inside. This plasma cavity might impact new types of plasma-based optical interconnects and electrically pumped ultracoherent-microlasers.

STu4Q.7 • 17:30
High Efficiency and Optically Transparent 2D-MoS_2 Heaters for Silicon Photonics, Dor Oz[1], Nathan Sulymanov[2], Boris Minkovich[2], Vladislav Kostianovskii[2], Liron Gantz[3], Dmitry Polyushkin[4], Thomas Mueller[4], Ilya Goykhman[1]; *[1]Inst. of Applied Physics, The Hebrew Univ., Israel; [2]Electrical and Computer Engineering, Technion, Israel; [3]NVIDIA Israel Ltd., Israel; [4]Inst. of Photonics, Vienna Univ. of Technology, Austria.* We experimentally demonstrate the first 1L-MoS2 microheater integrated with a silicon MRR, showing the best-reported power efficiency of ~7.5 mW/π with no significant penalty on insertion loss when placed close to the resonator (~30 nm).

STu4Q.8 • 17:45
Fabry-Perot Bragg Grating Cavity Based Singly-Resonant Four-Wave Mixing in the AlGaAs-on-Insulator Platform, Chaochao Ye[1], Yang Liu[1], Xinda Lu[1], Kresten Yvind[1], Minhao Pu[1]; *[1]Technical Univ. of Denmark, Denmark.* We demonstrate a singly-resonant four-wave mixing process using an AlGaAs-oninsulator Fabry-Perot Bragg grating cavity and achieve up to 16.3 dB conversion efficiency enhancement compared to a waveguide configuration with the same device length.

16:00 -- 18:00
Room: W211
Ftu4R • Ultrafast Optics, Time Varying Media and Time Crystals
Presider: Marco Piccardo; Técnico Lisboa, Portugal

FTu4R.1 • 16:00
Temporal Mode Conversion in a Waveguide by Fast Motion of its Plates, Diego Martinez Solis[1], Shixiong Yin[2], Emanuele Galiffi[2], Andrea Alù[2,3], Nader Engheta[4]; *[1]Univ. of Extremadura, Spain; [2]City Univ. of New York, Photonics Initiative, Advanced Science Research Center, USA; [3]City Univ. of New York, Physics Program, Graduate Center, USA; [4]Department of Electrical and Systems Engineering, Univ. of Pennsylvania, USA.* We show, semi-analytically and numerically, how the relativistic accelerated motion of a waveguide's parallel plates induces fast mode conversion including reflection, similar to the temporal interface by sudden variation of 171trathclyde distance through conductivity switching.

FTu4R.2 • 16:15

Four-Waves Mixing in Photonic Time-Crystals, Moshe-Ishay Cohen[1], Noa Konforty[1], Mordechai Segev[1]; *[1]Technion Israel Inst. of Technology, Israel.* We study the process of four wave mixing in photonic time-crystals. We find that the phase matching condition is altered by the momentum band-structure of the time-crystal, enabling the enhancement of any chosen frequency.

FTu4R.3 • 16:30

Enhancing the Size of Momentum Bandgaps Using Resonant Spatiotemporal Metasurfaces, Puneet Garg[1], Xuchen Wang[1], Aristeidis Lamprianidis[1], Mohammad S. Mirmoosa[2], Viktar S. Asadchy[3], Carsten Rockstuhl[1]; *[1]Karlsruher Institut für Technologie, Germany; [2]Univ. of Eastern Finland, Finland; [3]Aalto Univ., Finland.* Photonic time crystals often require high modulation depths of material properties to exhibit large momentum bandgaps. We show that such a requirement can be dramatically relaxed by exploiting the structural resonances of a spatiotemporal metasurface.

FTu4R.4 • 16:45

Inhomogeneous Broadening in Time Domain Solvers: Gauss-Lorentz, Gauss-Drude, and Gauss-Debye Models, Ludmila J. Prokopeva[1], Colton Fruhling[1], Chen Qian[2], Bo Zhen[2], Alexander Kildishev[1]; *[1]Purdue Univ., USA; [2]Univ. of Pennsylvania, USA.* We develop a systematic approach to introduce inhomogeneous broadening in Lorentz/Drude/Debye models. Implementation in time/frequency domains uses minimax semi-analytical approximation, and Faddeeva functions. Applications include simulations of the systems with plasma and multilevel carrier kinetics.

FTu4R.5 • 17:00

Mapping the temporal evolution of the refractive index in few-femtosecond time-varying media, Ohad Segal[1], Mark Lyubarov[1], Colton Fruhling[2], Alexandra Boltasseva[2], Vladimir M. Shalaev[2], Mordechai Segev[1]; *[1]Technion Inst. of technology 172trath, Israel; [2]Elmore Family School of Electrical and Computer Engineering, Birck Nanotechnology Center and Purdue Quantum Science and Engineering Inst., Purdue Univ., USA.* We present the temporal evolution of the refractive index of a homogenous time-varying medium, reconstructed from experimental time-gated measurements of optical time-refraction in the single-cycle regime.

FTu4R.6 • 17:30

Ultrafast Optical Modulation by Virtual Interband Transitions, Evgenii E. Narimanov[1]; *[1]Purdue Univ., USA.* We present an approach to non-perturbative optical modulation based on virtual interband transition excitation. It can induce a large change of the refractive index, that is inherently ultra-fast and dissipation-free.

FTu4R.7 • 17:45

Time Domain Phase Engineering of Metasurfaces Enables Passive Ultrafast Photonic Streaking, Nicholas Karl[1,2], Prasad Iyer[1,2]; *[1]Sandia National Laboratories, USA; [2]Center for Integrated Nanotechnologies, USA.* We describe a time-domain nano-photonic design principle for controlling electromagnetic waves at femtosecond timescales and illustrate a metasurface design that numerically demonstrates streaking of ultrafast pulses passively using arrays of resonance-based dielectric metasurfaces.

Wednesday, 8 May

08:30 – 10:00
CLEO Hub
Joint Plenary Session II

08:30 (Plenary)
Science Diplomacy in the Middle East: Slogan or Reality?, Gihan Kamel[1]; *[1]Helwan Univ., Egypt.* Despite the national standards those are pillars to create a state of harmony within any society, one still needs to speak a language that must be unbiased in order to be accepted at least as a midpoint. To some degree, this is the case with science. To some degree, this is the particular case of the Middle East. Transforming repulsion into trust by using science as a new solo player is undoubtedly a huge success. SESAME Members are Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, Palestine and Türkiye. It seeks excellency of science, besides functioning as a bridge of understanding for a community that will be able to deal with scientific challenges, political conflicts, and beyond.

09:15 (Plenary)
A Revolution in High-Q Integrated Photonics, Kerry Vahala[1]; *[1]California Inst. of Technology, USA.* High-Q microresonators provide access to nonlinear optical phenomena at milli-Watt power levels. And the resulting device functions, now in miniature form, are paving the way to integrated optical systems for sensing, metrology, spectroscopy, microwave generation, time keeping and data transmission. Once discrete and reliant upon specialized processing techniques for optical loss reduction, high-Q microresonators are today planar, capable of integration and in some cases fabricated on CMOS foundry lines. After a brief overview of their history and early nonlinear optical demonstrations, Vahala will focus on recent system demonstrations and conclude by considering the future performance limits of high-Q systems.

11:30 – 13:00
CLEO Hub
JW2A • Joint Poster Session II

JW2A.1
Optical Nonlinear Dynamics of High-Speed Silicon Microring Modulators, Farshid Shateri[1], Alireza Geravand[1], Wei Shi[1], Erwan Weckenmann[1]; *[1]Laval Univ., Canada.* We present a comprehensive dynamic model for microring modulators, encompassing optical nonlinear and self-heating effects. Our simulation aligns with experiments with different input optical powers, predicting significant bandwidth enhancement for operations exceeding 50 GHz.

JW2A.2
Brillouin Amplifier Autonomously Generating Pump Light with Optimum Frequency Offset, Satoshi Suda[1], Takayuki Kurosu[1], Takeru Amano[1]; *[1]Natl Inst of Adv Industrial Sci & Tech, Japan.* We propose a simple scheme to precisely generate pump light for Brillouin amplification in an all-optical manner exploiting Brillouin laser and four-wave mixing. Gain over 28dB is achieved with thorough noise suppression in entire C-band.

JW2A.3 • 11:30

Degenerate Optical Parametric Oscillation Stability in a SiN Microring With Anomalous Group Velocity Dispersion, Eduardo S. Gonçalves[1,3], Nathalia Tomazio[2,3], Laís Fujii[4,3], Luca Trinchao[1,3], Paulo Jarschel[1,3], Felipe Santos[1,3], Thiago Alegre[1,2], Gustavo S. Wiederhecker[1,3]; *[1]Gleb Wataghin Physics Inst., Universidade Estadual de Campinas (UNICAMP), Brazil; [2]Inst. of Physics, Univ. of Sao Paulo, Brazil; [3]Photonics Research Center, Universidade Estadual de Campinas (UNICAMP), Brazil; [4]School of Electrical Engineering and Computer Science, Univ. of Ottawa, Canada.* This study explores experimentally the stability parameter space of degenerate optical parametric oscillation in a silicon nitride microring in the anomalous dispersion regime. The results highlight a narrow region of the parameter space where the system achieves sustained oscillation.

JW2A.4

Active Mode Conversion based on Cascaded Intra- and Inter-modal Four-wave Mixing Effects, Huang Xiaoshan[1], Gai Zhou[1], Cong Zhang[1], Meng Xiang[1], Di Lin[1], Songnian Fu[1], Yuwen Qin[1]; *[1]Inst. of Advanced Photonics Technology, School of Information Engineering, Guangdong Univ. of Technology, China.* We present an active mode conversion without parasitic wavelength conversion, by the use of cascaded intra- and inter-modal four-wave mixing (FWM) effects. The crosstalk between LP_{01} and LP_{11} mode conversion is below -7.0 dB.

JW2A.5

Noise Like Pulse Generation from Mode-locked Er-doped Fiber Laser using Multimode Interference in Graded-index Multimode Fiber, Yu Chen[1,2], Sin Jin Tan[3], Zian Cheak Tiu[4], Kaharudin Dimyati[1], Sulaiman Wadi Harun[1]; *[1]Department of Electrical Engineering, Univ. of Malaya, Malaysia; [2]Chongqing Vocational Inst. of Engineering, China; [3]School of Engineering, UOW Malaysia KDU Univ. College, Malaysia; [4]Faculty of Engineering & Quantity Surveying, INTI International Univ., Malaysia.* Noise-like-pulse was generated using multimode-interference with graded-index-multimode-fiber as mode-locker in a normal-dispersion Er-doped-fiber-laser. We observed 36^{th} harmonic NLP operating at 1575 nm with a repetition rate of 30.63 MHz and pulse width of 290 fs.

JW2A.6

Enhancing Supercontinuum Generation via Shortcut to Adiabaticity Coupling for High Order Modes in Ta_2O_5 Waveguides, Guan Hong Li[1], Zi-De Xie[1], Min-Hsiung Shih[3], Hao-Chung Kuo[3], Chi-Hung Wu[2], Shuo-Yen Tseng[2], Yi-Jen Chiu[1], Chao Kuei Lee[1]; *[1]National Sun Yan-Sen Univ., Taiwan; [2]National Cheng Kung Univ., Taiwan; [3]National Yang Ming Chiao Tung Univ., Taiwan.* In this work, by using adiabatic shortcut directional coupling approach, coupling efficiency over 80% from TE_{00} to TE_{10} mode within Ta_2O_5 nonlinear waveguide was realized. In addition, octave-spanning supercontinuum generation (650nm to 1300nm) has been demonstrated and discussed.

JW2A.7

Wavelength-Selectable Inter- and Intra-modal Four Wave Mixing in Elliptical Core Fibers, Muhammad I. Abdul Khudus[2,1], Kunhao Ji[2], Lin Xu[2], Massimiliano Guasoni[2]; *[1]Universiti Malaya, Malaysia; [2]Optoelectronics Research Centre, Univ. of Southampton, UK.* We experimentally demonstrate wavelength selectable inter- and intra-modal four-wave mixing in elliptical core fibers. Three pairs of idler-signal pairs can be independently selected by controlling the pump polarization modes (LP11a and LP11b)

JW2A.8

3x3 nonlinear optical lossy loop mirror for self-starting mode-locking in all-PM-fiber lasers, Mateusz G. Pielach[1], Agnieszka Jamrozik[1], Katarzyna Krupa[1], Yuriy Stepanenko[1]; [1]*Inst. of Physical Chemistry PAS, Poland.* 3x3 fiber couplers introduce a 2π/3 phase shift, which helps initiate the mode-locking operation. Here, we provide more in-depth insight into the performance of the 3x3 nonlinear loop mirror with an asymmetrically placed lossy splice.

JW2A.9

Nonresonant Nonlinear Optics of Semiconductors Pumped with Ultrafast Long-wave Infrared Laser Pulses, Daniel A. Matteo[1], Sergei Tochitsky[1], Chan Joshi[1]; [1]*Department of Electrical Engineering, Univ. of California Los Angeles, USA.* The nonlinear refractive index and nonlinear absorption are measured in GaAs, n-Ge, ZnSe, and Te at 10μm with intensities up to $10GW/cm^2$ using various methods. Mid-IR femtosecond semiconductor switching is also studied in these materials.

JW2A.10

Nanostructured silica glass for mode locked fiber laser, Wang Yutian[1], Mariusz Klimczak[2], Katarzyna Krupa[3], Yuriy Stepanenko[3], Songnian Fu[4], Luming Zhao[1], Ming Tang[1], Ryszard Buczynski[2]; [1]*HUST, China;* [2]*Faculty of Physics, Univ. of Warsaw, Poland;* [3]*Inst. of Physical Chemistry, Polish Academy of Sciences, Poland;* [4]*School of Information Engineering, Guangdong Univ. of Technology, China.* Mode-locking operation is demonstrated in all-fiber laser incorporating a nanostructured Yb+Er co-doped silica SMF. The femtosecond pulses with 6nm bandwidth, 850fs pulse-width and high RF spectral purity of 80dB extinction ratio have been obtained.

JW2A.11

Enhanced Parallel Optoelectronic Reservoir Computation with Multi-Time-Delay Feedbacks for Chaotic Time-Series Prediction and Optical Performance Monitoring, Xin Yuan[2], Lin Jiang[2,1]; [1]*Peng Cheng Laboratory, China;* [2]*Southwest Jiaotong Univ., China.* We successfully verified a multi-time-delay parallel optoelectronic reservoir for chaotic time-series prediction and optical performance monitoring. Results showed that both prediction accuracy and monitoring performance could be enhanced even in two time-delay feedbacks.

JW2A.12

Simultaneous Spectral Broadening and Frequency Doubling in an Aperiodically-Poled Lithium-Niobate Crystal, Robert Herda[1], Axel Friedenauer[1]; [1]*TOPTICA Photonics AG, Germany.* We demonstrate a novel method to generate spectral bandwidth during the frequency-doubling process in a non-periodically poled quasi-phase matched crystal. We can compress and frequency double the pulses of a 177 fs laser at 1560 nm down to 71 fs with an efficiency of 40%.

JW2A.13

Nonlinear Telescope for Spatially Uniform Spectral Broadening, James P. Drake[1,2], Issa Tamer[1], Leily Kiani[1]; [1]*Lawrence Livermore National Laboratory, USA;* [2]*CREOL, Univ. of Central Florida, USA.* We report the development of a nonlinear telescope to generate uniform spectral broadening across a Gaussian beam. We introduce “broadening-in-the-bucket” as an alternative metric to the compression factor for evaluating broadening efficiency.

JW2A.14

Bandstructure Engineered Nonlinear Activation Unit for Photonic Neural Networks, Zheheng Xu[1], David Burghoff[1], Sadhvikas Addamane[2]; *[1]The Univ. of Texas at Austin, USA; [2]Sandia National Laboratories, USA.* Using intersubband nanostructures, we introduce the smallest possible opto-electronic approach for nonlinear processing in photonic neural networks, demonstrating 3.5 μW threshold and 10 ps optical response within a device that is only 4 μm long.

JW2A.15

Wideband Output of Phase Sensitive Amplification Enables High-resolution Phase Retrieval from Amplitudes, Guyue Hu[1], Xin Dong[1], Jiqiang Kang[1], Yiqing Xu[2], Kenneth Kin-Yip Wong[1]; *[1]The Univ. of Hong Kong, Hong Kong; [2]Department of Physics, Univ. of Auckland, New Zealand.* A novel phase sensitive amplification (PSA) with a wideband output is presented. The phase retrieval capability of the PSA scheme is experimentally demonstrated, with the reading range extended to 2π through a phase unwrapping algorithm.

JW2A.16

Phase-sensitive pump-probe reflectivity measurements for nonlinear optics metrology, Jared K. Wahlstrand[1], Chad Cruz[1]; *[1]NIST, USA.* We show that pump-probe supercontinuum spectral interferometry in reflection is sensitive to the nonlinear refractive index and multiphoton absorption. The technique is demonstrated in silicon at photon energies above its indirect band gap.

JW2A.17

Tuning of Carrier Envelope Offset Frequency in Octave-Spanning Si_3N_4 Microcomb, Hsiao-Hsuan Chin[2], Tristan Melton[2], Alwaleed Aldhafeeri[2], Lala Rukh[1], Gabriel M. Colacion[1], Yujie Chen[2], Xiang Cheng[2], Kai-Chi Chang[2], Tara E. Drake[1], Chee Wei Wong[2]; *[1]Univ. of New Mexico, USA; [2]Univ. of California Los Angeles, USA.* We demonstrate the tuning of carrier envelope offset frequency in chip-scale micro-resonator and the effects on the spectrum, providing a pathway to f-2f stabilization.

JW2A.18

Withdrawn

JW2A.19

Sustaining Induced Optical Nonlinearity in Sodium-Doped Amorphous Niobium Oxide Waveguides, Sirawit Boonsit[1], Vasileios Mourgelas[1], Lara Karam[2], Milos Nedeljkovic[1], Marc Dussauze[2], Senthil G. Murugan[1]; *[1]Univ. of Southampton, UK; [2]Univ. of Bordeaux, France.* Utilizing poled sodium-doped Nb2O5, this study explores a promising alternative to LiNbO3, offering strong $\chi^{(2)}$ and fabrication friendliness. Successful waveguide fabrication on the poled films qualitatively demonstrates persistence of induced $\chi^{(2)}$.

JW2A.20

Withdrawn

JW2A.21

Backward Wave Optical Parametric Oscillation in a Waveguide, Patrick Mutter[1], Fredrik Laurell[1], Valdas Pasiskevicius[1], Andrius Zukauskas[1]; *[1]Kungliga Tekniska Hogskolan,* *Sweden.* We present backward wave optical parametric oscillator waveguides implemented in periodically poled Rb-doped KTP. The waveguides demonstrated low loss (0.16 dB/cm) and exhibited an oscillation threshold 19 times lower than the corresponding bulk device.

JW2A.22

High-Intensity Excitation Simulation of Two-Dimensional Coherent Spectroscopy: Coherent Control Application, Rishabh Tripathi[1], Krishna K. Maurya[1], Rohan Singh[1]; [1]*Physics, Indian Inst. of Science Education and Research, Bhopal, India.* Two-dimensional coherent spectroscopy simulations using high-intensity excitation pulses for a V-level system are performed. We demonstrate coherent control through the manipulation of amplitudes and phase of peaks in 2D spectra.

JW2A.23

Amplifier Enhanced Gain-Through-Filtering Instability in a Hybrid Kerr Cavity, Minji Shi[1], Stefano Negrini[2], Nicolas Englebert[3], François Leo[4], Matteo Conforti[2], Arnaud Mussot[2], Auro M. Perego[1]; [1]*Aston Univ., UK;* [2]*Univ. of Lille, France;* [3]*California Inst. of Technology, USA;* [4]*Université libre de Bruxelles, Belgium.* We present theoretical and experimental results about a substantial efficiency enhancement of the gain-through-filtering process for sidebands and frequency combs generation in driven normal dispersion fiber cavities through a slow-gain amplifier.

JW2A.24

Study on Chaos Synchronization of Cascaded Microresonator Optical Frequency Combs, Deniz Lemcke[2,1], David Moreno[2,5], Ayata Nakashima[2], Shun Fujii[3], Atsushi Uchida[4], Takasumi Tanabe[2]; [1]*RWTH Aachen, Germany;* [2]*Department of Electronics and Electrical Engineering, Keio Univ., Japan;* [3]*Department of Physics, Keio Univ., Japan;* [4]*Department of Information and Computer Sciences, Saitama Univ., Japan;* [5]*Nanophotonics Technology Center, Universitat Politècnica de València, Spain.* By numerically investigating the synchronization of cascaded microresonator frequency combs, we find the optimal transmittance parameters and discover that partial injection from the leader is sufficient. We also present preliminary experimental results.

JW2A.25

Concatenation of Kerr Solitary Waves for Self-Referenced Coherent Raman Imaging, Nicholas Bagley[1], Sahar Wehbi[2,7], Lucie Chretien[3], Tigran Mansuryan[2], Remy Boulesteix[3], Yago Arosa Lobato[4], Mario Ferraro[5], Mario Zitelli[5], Fabio Mangini[5], Yifan SUN[5], Katarzyna Krupa[6], Benjamin Wetzel[2], Vincent Couderc[2], Stefan Wabnitz[5], Alejandro Aceves[1], Alessandro Tonello[2]; [1]*Southern Methodist Univ., USA;* [2]*XLIM, Universite de Limoges, France;* [3]*IRCER, Universite de Limoges, France;* [4]*Univ. of Santiago de Compostela, Spain;* [5]*DIET, Sapienza Univ. of Rome, Italy;* [6]*Inst. of Physical Chemistry, Polish Academy of Sciences, Poland;* [7]*ALPhANOV, Optics and Lasers Technology Center, Institut d’optique d'Aquitaine, France.* A coherent concatenation of multiple Townes solitons may lead to a stable infrared and visible broadband filament in ceramic YAG polycrystal. This self-trapped soliton train helps implement self-referenced multiplex coherent anti-Stokes Raman scattering imaging.

JW2A.26

Optical Darboux Transformer: Solitonic Eigenvalue Filtering and Multiplexing, Auro M. Perego[1]; *[1]Aston Univ., UK.* We propose a universal method to optically filter and multiplex an arbitrary number of discrete eigenvalues (solitons) to the nonlinear spectrum of a signal.

JW2A.27

Dual-Wavelength Intracavity Diamond Raman Laser with High Peak Power, Hui Chen[1,2], Xiaowei Li[1,2], Yufan Cui[1,2], Yulei Wang[1,2], Zhiwei Lu[1,2], Zhenxu Bai[1,2]; *[1]Center For Advanced Laser Technology, Hebei Univ. of Technology, China; [2]Hebei Key Laboratory of Advanced Laser Technology and Equipment, China.* A dual-wavelength Q-switched intracavity diamond Raman laser was demonstrated for the first time. The laser features a unique energy ratio between the cascaded Stokes with peak powers up to 174 kW at 1.2 μm and 220 kW at 1.5 μm, respectively.

JW2A.28

Wavelength-multiplexed Delayed Inputs for Memory Enhancement of Microring-based Reservoir Computing, Bernard J. Giron Castro[1], Christophe Peucheret[2], Francesco Da Ros[1]; *[1]Technical Univ. of Denmark, Denmark; [2]Univ Rennes, France.* We numerically demonstrate a silicon add-drop microring-based reservoir computing scheme that combines parallel delayed inputs and wavelength division multiplexing. The scheme solves memory-demanding tasks like time-series prediction with good performance without requiring external optical feedback.

JW2A.29

Cascaded Raman Lasing in Lithium Tetraborate (LB4) Whispering Gallery Mode Resonator, Chengcai Tian[1,2], Florian Sedlmeir[1,2], Petra Becker[3], Ladislav Bohatý[3], Richard Blaikie[1,2], Harald G. Schwefel[1,2]; *[1]The Dodd-Walls Centre for Photonic and Quantum Technologies, New Zealand; [2]Department of Physics, Univ. of Otago, New Zealand; [3]Inst. of Geology and Mineralogy, Sect. Crystallography, Univ. of Cologne, Germany.* We investigate the relatively uncommon, but promising LB4 as host material for whispering-gallery mode resonators since it has a high transparency in the visible and UV regime, strong Raman gain and second order nonlinearities.

JW2A.30

Total Internal Reflection of Polychromatic Filaments in YAG, Nicholas Bagley[1], Sahar Wehbi[2,3], Lucie Chretien[4], Tigran Mansuryan[2], Remy Boulesteix[4], Yago Arosa Lobato[5], Mario Ferraro[6], Mario Zitelli[6], Fabio Mangini[6], Yifan SUN[6], Katarzyna Krupa[7], Arnaud Poisson[2], Cassia Corso[7], Benjamin Wetzel[2], Vincent Couderc[2], Stefan Wabnitz[6], Alejandro Aceves[1], Alessandro Tonello[2]; *[1]Department of Mathematics, Southern Methodist Univ., USA; [2]XLIM, Universite de Limoges, France; [3]ALPhANOV, Optics and Lasers Technology Center, Institut d'optique d'Aquitaine, France; [4]IRCER, Universite de Limoges, France; [5]Univ. of Santiago de Compostela, Spain; [6]DIET, Sapienza Univ. of Rome, Italy; [7]Inst. of Physical Chemistry, Polish Academy of Sciences, Poland.* We present experimental evidence (supported by numerical simulations) of the Goos-Hanchen effect and a nonlinear reflection process, after filament onset in Yttrium Aluminium Garnet. We then examine the dependence of these phenomena on input power.

JW2A.31

Independent Engineering of QPM Structures and Waveguides in KTP via Ion-Exchange, Cherrie S. Lee[1], Laura Barrett[1]; *[1]Kungliga Tekniska Hogskolan, Sweden.* We demonstrate a new method to fabricate waveguides in KTP. It allows for independently fabrication of the periodically poled grating via coercive field engineering and post-poling waveguide inscription via ion exchange.

JW2A.32
LBO-based broadband visible NOPA pumped by Yb:KGW amplifier system, Ahmed R. Ibrahim[1], Takayuki Kurihara[1], Teruto Kanai[1], Jiro Itatani[1]; *[1]The Univ. Of Tokyo, Japan.* LiB_3O_5-based NOPA pumped by the third harmonic of a Yb:KGW laser system is constructed. The CEP stable output that covers from 570 to 830 nm with a pulse energy of 10 µJ is achieved.

JW2A.33
Route to High Repetition Rate All-fiber Ring Mamyshev Oscillator, Corentin Delangle[2,1], Florent Scol[1], Clemens Hoenninger[2], Géraud Bouwmans[3], Olivier Vanvincq[3], Emmanuel Hugonnot[1]; *[1]CEA CESTA, France; [2]Amplitude, France; [3]Laboratoire de Physique des Lasers, Atomes et Molécules (PhLAM), France.* We report numerical simulations demonstrating the possible operation of Mamyshev oscillator at a repetition rate above 300 MHz in fundamental regime. A first experimental cavity is being built and we present preliminary results

JW2A.34
10.2-µm Seed Generation in a BGGSe Nonlinear Crystal for Nonlinear Seeding of Terawatt CO_2 Amplifiers, Ya-Po Yang[2,1], Jheng-Yu Lee[2,1], Jyhpyng Wang[2,1]; *[1]Department of Physics, National Central Univ., Taiwan; [2]Inst. of Atomic and Molecular Sciences, Academia Sinica, Taiwan.* A 3-ps, 60-µJ, 10.2-µm pulse is generated by mixing subnanosecond 1338-nm and chirped 1540-nm pulses in BGGSe nonlinear crystal. The feasibility of its application in nonlinear seeding of CO_2 laser amplifiers is proven numerically.

JW2A.35
Angular Deflection and Frequency Translation Near the Critical Angle in Finite Time-Varying Media, Colton Fruhling[1], Mustafa G. Ozlu[1], Alexandra Boltasseva[1], Vladimir M. Shalaev[1]; *[1]Purdue Univ., USA.* We study time refraction and angular deflection in finite dynamic media. We find the effect is maximized at the critical angle. Its ultrafast nature suggests an attosecond streak camera as an application.

JW2A.36
Broadband Optical Vortices with Minimized Topological Charge Dispersion from OPCPAs, Federico J. Furch[1], Gunnar Arisholm[2]; *[1]Max Born Inst., Germany; [2]Norwegian Defence Research Establishment (FFI), Norway.* By means of numerical simulations we study the generation of broadband optical vortices with clean topological charge during optical parametric chirped pulse amplification.

JW2A.37
Raman suppression and all-optical switching in media with a zero-nonlinearity wavelength, Alexis Sparapani[1,2], Lucas Gutierrez[1,2], Santiago Hernandez[1,2], Pablo Fierens[2,3], Diego Grosz[1,2], Govind P. Agrawal[4]; *[1]Instituto Balseiro, Argentina; [2]Consejo Nacional de Investigaciones Científicas y Técnicas, Argentina; [3]Instituto Tecnológico de Buenos Aires, Argentina; [4]Inst. of Optics, Univ. of Rochester, USA.* We study the interaction of an optical

soliton with a weak dispersive pulse in media with a zero-nonlinearity wavelength (ZNW). The soliton Raman shift can be controlled, with direct applications to all-optical switching.

JW2A.38
Pre-chirp managed thulium fiber amplifier for 1.8 µm ultrashort pulse generation, Ibrahim Abughazaleh[1], Ibrahim Abu[1], Panuwat Srisamran[1], Matthew Gerard[1], Duanyang Xu[1], Yongmin Jung[1], David J. Richardson[1], Lin Xu[1]; *[1]southampton Univ., UK.* We present a compact ultrafast fiber laser system designed for nonlinear microscopy at 1.8 µm, employing pre-chirp managed thulium fiber amplification. Seeded by a mode-locked laser, our system generates 180 fs pulses with a pulse energy of 40 nJ

JW2A.39
Dynamic Instantaneous Scan Rate in Optical Sampling by Cavity Tuning (OSCAT): Numerical, Analytical and Experimental Results, Kirill Kabelev[1], Ana Filipa Ribeiro[1], Tiago d. Gomes[1,2], Maria Ana Cataluna[1]; *[1]Heriot-Watt Univ., UK; [2]Departamento de Física e Astronomia, Universidade do Porto, Portugal.* We show that the instantaneous scan rate in sine-driven optical sampling by cavity tuning (OSCAT) can vary by orders of magnitude within a single scan, using numerical and analytical models, in agreement with experimental results.

JW2A.40
A novel in-fiber waveguide-based saturable absorber for mode-locked fiber laser, Qianying Li[1], Rong Zhao[1], Ming Shen[1], Xuewen Shu[1]; *[1]Huazhong Univ. of Science and Techn, China.* We demonstrate an innovative in-fiber waveguide-based saturable absorber inscribed by a femtosecond laser, directly integrating a few-mode fiber section within a single-mode fiber. This work highlights unique advantages and potential of the novel saturable absorber.

JW2A.41
Generation of 1.2 GHz, 40 fs pulses directly from a mode locked Yb:fiber Laser, Ya Wang[1,2], Ruoao Yang[2], Zhendong Chen[2], Duo Pan[2], Bin Luo[1], Zhigang Zhang[2], Jingbiao Chen[2]; *[1]Beijing Univ. of Posts and Telecommunications, China; [2]Peking Univ., China.* We demonstrated generation of 40 fs pulses from a 1.2 GHz repetition rate Yb:fiber laser at an average power up to 1.3 W.

JW2A.42
Broadband Mamyshev Oscillator at 1.7 µm, Xiaoxiao Wen[1], Meng Zhou[1], Tian Qiao[1], Jixiang Chen[1], Xin Dong[1], Jinge Wei[1], Zhichao Luo[3], Kenneth Kin-Yip Wong[1,2]; *[1]Department of Electrical and Electronic Engineering, The Univ. of Hong Kong, China; [2]Advanced Biomedical Instrumentation Centre, Hong Kong Science Park, China; [3]Guangdong Provincial Key Laboratory of Nanophotonic Functional Materials and Devices & Guangzhou Key Laboratory for Special Fiber Photonic Devices and Applications, South China Normal Univ., China.* We demonstrate a single-pulse Mamyshev oscillator at 1.7 µm using Tm-doped fiber. The results of 5.4-MHz repetition rate and 95-nm optical spectrum bandwidth at 10 dB highlight its potential application for nonlinear microscopy.

JW2A.43
MHz Hollow-Core Fiber Pulse Compression with 84% Efficiency, Étienne Doiron[1], Marco Scaglia[1], Maksym Ivanov[1,2], Pedram Abdolghader[1], Gabriel Tempea[1], Bruno E. Schmidt[1]; *[1]few-*

cycle, Canada; [2]INRS, Canada. We demonstrate spectral broadening and pulse compression of 71µJ, 338fs at 1MHz (71W) using a high transmission hollow-core fiber with 400µm ID. With 5bars of xenon, 48fs pulses were measured with 84% fiber transmission.

JW2A.44

Pulse Measurement of Second-Harmonic Generation from Random Quasi-Phase-Matching in ZnS, Noah Glick[1], Tianyou Li[1], Sergey Vasilyev[2], William Putnam[1]; *[1]Univ. of California Davis, USA; [2]IPG Photonics Corporation, USA.* We use 2.4-micron laser pulses to produce second-harmonic generation via random quasi-phase-matching in ZnS. Using a frequency-resolved optical gating system, we reconstruct the complex temporal profile of the second-harmonic pulses.

JW2A.45

NIR-vSHG: A new nonlinear vibrational spectroscopy of interfaces, Somaiyeh Dadashi[1], Ziyad Thekkayil[1], Hao Li[1], Bijoya Mandal[1], Eric Borguet[1]; *[1]Chemistry, Temple Univ., USA.* NIR-vSHG, a new nonlinear vibrational spectroscopy, was used to investigate the overtones of the free OH of mica in air and the CH stretch mode of chloroform and acetonitrile at Al_2O_3 (0001), revealing the anharmonicity and bond dissociation energies

JW2A.46

Sub-100-fs SESAM mode-locked Yb:$Ysr_3(PO_4)_3$ laser, Zhiqiang Li[2], Huangjun Zeng[2], Ge Zhang[2], Guangda Wu[3], Fapeng Yu[3], Xian Zhao[3], Pavel Loiko[4], Xavier Mateos[5], Hsing-Chih Liang[6], Valentin Petrov[1], Weidong Chen[2,1]; *[1]Max Born Inst., Germany; [2]Fujian Inst. of Research on the Structure of Matter, Chinese Academy of Sciences, China; [3]Shandong Univ., China; [4]Université de Caen, France; [5]Universitat Rovira I Virgili, Spain; [6]National Yang Ming Chiao Tung Univ., Taiwan.* We report on a diode-pumped SESAM mode-locked Yb:$ySr_3(PO_4)_3$ laser generating soliton pulses as short as 61 fs at 1062.7 nm with an average power of 38 mW at ~66.7 MHz.

JW2A.47

Multi-band Chirped Mirror Design for Highly Dispersive Optical Systems, Shih-Hsuan Chia[1], Yan-Cheng Li[1], Chi-Kuang Sun[2,3], Franz Kärtner[4,5]; *[1]Inst. of Biophotonics, National Yang Ming Chiao Tung Univ., Taiwan; [2]Graduate Inst. of Photonics and Optoelectronics and Department of Electrical Engineering, National Taiwan Univ., Taiwan; [3]Molecular Imaging Center and Graduate Inst. of Biomedical Electronics and Bioinformatics, National Taiwan Univ., Taiwan; [4]Deutsches Elektronen-Synchrotron (DESY), Center for Free Electron Laser Science (CFEL), Germany; [5]Physics, Univ. of Hamburg, Germany.* We present multi-band chirped mirror pairs, adept at managing group delay variations within and across bands. These designs outperform ultra-broadband mirrors, offering enhanced dispersion control and facilitating precision in nonlinear microscopy applications.

JW2A.48

10 GHz, 583 fs Regeneratively Mode-Locked Erbium-Doped Fiber Laser Combining Nonlinear Polarization Evolution, Xiangxiang Zhou[1], yue Zhou[1], Wang Weijin[1], Tian Zhang[1], Kun Xu[1]; *[1]Beijing Univ. of Posts and Telecommunications, China.* We report a regeneratively mode-locked Er fiber laser generating 583 fs optical pulses at 10 GHz with supermode suppression over 80 dB, achieved by combining an appropriate biased nonlinear polarization evolution (NPE).

JW2A.49

Optimization of Femtosecond Pulses by AI-assisted Spectral Phase Modulation: Influence of Spectral Resolution, Alicja K. Kwasny[1], Mikolaj Krakowski[1], Grzegorz J. Sobon[1]; [1]*Politechnika Wroclawska, Poland.* We investigate the possibility of optimization of ultrashort laser pulses by spectral phase modulation using machine learning algorithms. The Grey Wolf Algorithm is applied and efficiency of various spectral resolution patterns is examined.

JW2A.50

Femtosecond pulse amplification assisted with spectral phase modulation, Mikolaj H. Krakowski[1], Alicja K. Kwasny[1], Grzegorz J. Sobon[1]; [1]*Wroclaw Univ. of Science and Techno, Poland.* This experiment aimed to improve the pulse shape and the pulse duration, with phase modulation of the seed laser pulse with spatial light modulator before amplifier stage and the employment of Artificial Intelligence algorithms.

JW2A.51

Multi-watt SESAM Mode-locking and Broad CW Tuning (996-1073 nm) in Diode-Pumped Yb:LLF Laser, Serdar Okuyucu[1,2], Umit Demirbas[1,2], Jelto Thesinga[2], Mikhail Pergament[2], Franz Kaertner[2]; [1]*Antalya Bilim Univ., Turkey;* [2]*UFOX, Deutsches Elektronen-Synchrotron (DESY), Germany.* We report broadest continuous-wave tuning in 996-1073 nm range and SESAM mode-locking with highest power 1.6-2.8 W (352-570 mW) and 181 fs (110 fs) long pulses from diode-pumped Yb:LLF laser systems.

JW2A.52

Measurement of Third Order Coherence by In Situ Simultaneous Second and Third Order Autocorrelation, Aaron LaViolette[1], Mihailo R. Rebec[2], Chris Xu[1]; [1]*School of Applied and Engineering Physics, Cornell Univ., USA;* [2]*Mirem Inc., USA.* We devise and experimentally demonstrate a method for measuring third order temporal coherence at zero delay of light within a fluorescent sample by simultaneous second and third order autocorrelation, without assumptions about the pulse shape.

JW2A.53

Short-Pulse Generation from Active Mode Locking with RF Frequency Comb, D. Pavitra Varsha[1], Siva Subramaniyam C N[1], Balaji Srinivasan[1], Deepa Venkitesh[1]; [1]*Department of Electrical Engineering, Indian Inst. of Technology Madras, India.* We demonstrate superior performance of active harmonic mode locked laser driven with RF frequency comb in terms of shorter pulse width, better phase noise, side mode suppression and timing jitter compared to single RF tone.

JW2A.54

Five Coherent Dispersive Waves Generation of OAM Mode in a Dispersion-engineered Double-ring-core Fiber, Wenpu Geng[1], Yuxi Fang[1], Changjing Bao[2], Zhongqi Pan[3], Yang Yue[4]; [1]*Nankai Univ., China;* [2]*Univ. of Southern California, USA;* [3]*Univ. of Louisiana at Lafayette, USA;* [4]*X"an Jiaotong Univ., China.* We design a Ge-doped double-ring-core fiber to generate five OAM dispersive waves when pumped within the normal dispersion regime. This configuration holds promise for the development of highly coherent OAM supercontinuum sources.

JW2A.55

Modeling and fabrication of various optic fiber microlenses with the use of a large diameter splicing system, Szymon Matczak[1], Dorota Stachowiak[1], Grzegorz J. Sobon[1]; [1]*Faculty of Electronics, Photonics and Microsystems, Wroclaw Univ. of Science and Technology, Poland.* We developed various types of microlenses on optical fiber end facets using a large diameter splicing (LDS) system and analyzed the achieved beam profiles. The results are supported with numerical simulations.

JW2A.56

Beam Cleaning in a Graded-index Ring-core Multimode Fiber, Bohao Xu[1], Hu Zhang[1], Jiaqi Wang[1], Xiaosheng Xiao[1], Lixia Xi[1], Xiaoguang Zhang[1]; [1]*Beijing Univ. of posts and telecommunications, China.* We demonstrate beam cleaning of picosecond pulses in a graded-index ring-core multimode fiber with a high fundamental mode content more than 50%, accompanied by Raman sideband generation.

JW2A.57

Cascaded Fiber Loop Mirrors Enabled Random Lasing, Ming Shen[1], Yanxin Li[1], Qianying Li[1], Xuewen Shu[1]; [1]*Huazhong Univ. of Science and Technology, China.* We report a novel random fiber laser enabled by a cascaded fiber loop mirrors (FLMs). The random feedback characteristics of the cascaded FLMs are discussed from both simulation and experimental perspectives.

JW2A.58

Temperature Sensitivity of Modulation Depth in a SWCNT/PDMS Saturable Absorber, Rhona Hamilton[1], Moeri Horiuchi[1], Takuma Shirahata[1], Sze Y. Set[1], Shinji Yamashita[1]; [1]*The Univ. of Tokyo, Japan.* Threshold pump power for modelocking decreased by 18% over 75^{o}C when a temperature dependent SWCNT/PDMS coated tapered fiber was used as the saturable absorber in a fiber laser.

JW2A.59

Machine Learning Framework for Loss Range Prediction of Hollow-core Anti-resonant Fibers, Yordanos Jewani[2], Michael Petry[3], Rei Sanchez-Arias[2], Md Selim Habib[1]; [1]*Florida Inst. of Technology, USA;* [2]*Florida Polytechnic Univ., USA;* [3]*Univ. of Applied Sciences, Germany.* A supervised machine learning framework is implemented to predict the propagation loss of randomly structured nested hollow-core anti-resonant fiber for the first time. The random forest classifier outperforms other methods in accurately predicting the loss.

JW2A.60

Unified theory of Raman scattering in gas-filled hollow-core fiber across temporal regimes, Yi-Hao Chen[1], Frank Wise[1]; [1]*Applied Physics, Cornell Univ., USA.* We present a theory of Raman scattering in gas-filled hollow-core fiber, connecting different temporal regimes. The theory provides new insights into Raman gain and Raman-induced index changes, and strategies on frequency conversion.

JW2A.61

Experimental Evidence of Replica Symmetry Breaking in Mode Disparities of Raman Random Fiber Laser, Yifei Qi[1], Longqun Ni[1], Xingyu Bao[1], Pan Wang[1], Jiaojiao Zhang[1], Ernesto P. Raposo[2], Anderson S. Gomes[2], Zinan Wang[1]; *[1]Univ. Electronic Sci. & Tech. of China, China; [2]Universidade Federal de Pernambuco, Brazil.* In this work, the RSB phase transition of Raman random fiber laser (RFL) is experimentally demonstrated, and the relationship between different modes of Raman RFL and RSB phase transition is explored for the first time.

JW2A.62
Principal Modes of Multimode Fibers Resisting Fiber Bending, Jiawei Xu[1], Nan Cui[1], Hu Zhang[1], Xiaoguang Zhang[1], Xiaosheng Xiao[1]; *[1]Beijing Univ. of Posts and Telecommunications, China.* We demonstrate that multimode fibers possess curved principal modes (CPMs) that can withstand significant fiber bending. These CPMs, derived from an extension of the Wigner-Smith operator, exhibit excellent bending resistance even in arbitrarily shaped fibers.

JW2A.63
One-sided Slotted Photonic Crystal Nanofiber for Cavity QED, Subrat Sahu[2], Kaliprasanna Nayak[1], Rajan Jha[2]; *[1]Department of Engineering Science, Univ. of Electro-Communications, Japan; [2]Nanophotonics and Plasmonics Laboratory, SBS, IIT Bhubaneswar, India.* A one-sided slotted photonic crystal cavity structure on an optical nanofiber is proposed to realize cavity quantum electrodynamics. The device can unidirectionally couple single photons with an efficiency of ~90% into the nanofiber fundamental mode.

JW2A.64
Withdrawn

JW2A.65
Optical soliton sideband manipulation based on nonlinear Fourier transform, Fanglin Chen[2], Andrey Komarov[1], Xiahui Tang[2], Ming Tang[2], Luming Zhao[2]; *[1]Inst. of Automation and Electrometry, Russian Academy of Sciences, Russian Federation; [2]Huazhong Univ. of Sci. & Tech, China.* The control of sideband characteristics has been successfully achieved through the Nonlinear Fourier Transform, contributing to the improvement of fiber laser performance and a deeper understanding of the internal structure of dissipative solitons.

JW2A.66
Imaging of Localized Whispering-Gallery-Modes in a Cylindrical Fiber, Nitzan Shani[2], Fan Cheng[2], Lev Deych[1], Tal Carmon[2]; *[1]CUNY Queens College, USA; [2]Electrical Engineering, Tel Aviv Univ., Israel.* Using fluorescence of dye molecules, we image whispering gallery modes in a cylindrical fiber. Scanning the wavelength of the exciting laser we observed interference fringes formed by whispering-gallery-modes counterpropagating along the axis of the cylinder.

JW2A.67
Large-mode area, single-mode, and normal dispersion solid-core anti-resonant fiber design for high power applications at 2 µm, Md Selim Habib[1], Md Abu Sufian[2], Mohammad Al Mahfuz[1], Rodrigo Amezcua Correa[2], Axel Schulzgen[2]; *[1]Florida Institutue of Technology, USA; [2]CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA.* For the first time, we explore the applicability of negative curvature anti-resonant solid-core large mode area fibers to achieve single-mode, normal dispersion (-7.5 ps/nm/km) and minimal propagation losses at the 2 µm wavelength.

JW2A.68
Stable Dual Vector Soliton Generation in a Single Cavity, Alberto R. Cuevas[2], Dmitrii Stoliarov[2], Igor Kudelin[3,1], Sergey Sergeyev[2]; [1]*Univ. of Colorado at Boulder, USA;* [2]*Aston Univ., UK;* [3]*Time and Frequency Division, National Inst. of Standards and Technology, USA.* Portable ring-cavity fiber laser producing two orthogonally polarized vector solitons stable over 125 hours, with minimal frequency drift (0.0002319 Hz/s) and low SSB phase noise (-95 dBc/Hz at 100Hz offset), showcasing potential for dual-comb ranging.

JW2A.69
Impact of Bending Angle on Antiresonant Hollow Core Fiber Performance, Rania A. Abouelela[1], Steeve Morency[1], Younès Messaddeq[1], Sophie LaRochelle[1], Leslie Rusch[1]; [1]*Laval Univ., Canada.* The performance under bending of an antiresonant nodeless fiber (ANF) can vary greatly with bending angle, even for symmetric ANF designs. We examine several designs to identify those that are robust to bending angle

JW2A.70
Soliton molecules with manipulated temporal separation in fiber lasers, Chuangkai Li[1], Feng Ye[1], Xuanyi Liu[2], H. Y. Fu[2], Qian Li[1]; [1]*School of Electronic and Computer Engineering, Peking Univ., China;* [2]*Tsinghua Shenzhen International Graduate School, Tsinghua Univ., China.* A soliton molecules fiber laser with tunable temporal separation is demonstrated. The temporal separation could be controlled from ~15 ps to over 75 ps by adjusting the pump injections and polarization state in laser cavity.

JW2A.71
Femtosecond Laser Inscribing an Ultra-compact Dual-effect LBL-FBG, Rong Zhao[1], JiaMing Wu[1], Xuewen Shu[1]; [1]*Huazhong Univ of Science and Technology, China.* An ultra-compact dual-effect line-by-line inscribed fiber Bragg grating (LBL-FBG) has been fabricated in a single-mode fiber by femtosecond laser direct writing through the coating. The dual-effect LBL-FBG has the characteristics of both FBG and Mach-Zehnder interferometer.

JW2A.72
Excitation of $LP_{0,m}$ Modes in Large-Core Step-Index Fibers using Binary Phase Plates, Rasmus Hvidberg[1], Radu Malureanu[1], Andrea Arduin[1], Jesper Lægsgaard[1], Andrei Lavrinenko[1], Lars Rishøj[1]; [1]*Technical Univ. of Denmark, Denmark.* Glass-etched binary phase plates are demonstrated as a novel method for broad-band excitation of $LP_{0,m}$ modes (m=3-7) in a 50μm core step-index fiber, with modal purities > 10 dB and coupling efficiencies > 65%.

JW2A.73
Coupling into higher order modes of a hollow-core fiber due to fusion splicing, Thomas W. Kelly[1], Mohammad Mousavi[1], Bo Shi[1], Francesco Poletti[1], Natalie V. Wheeler[1], Radan Slavík[1]; [1]*Univ. of Southampton, UK.* We investigate the impact of fusion-splicing on the modal purity when splicing nested antiresonant nodeless hollow-core fiber to standard solid-core fiber (SMF). By optimizing the procedure, unwanted cross-coupling below -27 dB is achieved.

JW2A.74
Withdrawn

JW2A.75

Directional Bending Sensor based on LP_{11} Mode from Few-Mode Ring-Core Fiber with Long-Period Grating, Yunhe Zhao[1], Shiqi Chen[1], Chengbo Mou[2], Yunqi Liu[2], Zuyuan He[3]; *[1]Shanghai Maritime Univ., China; [2]Shanghai Univ., China; [3]Shanghai Jiao Tong Univ., China.* We propose a directional bending sensor based on LP_{11} mode from few-mode ring-core fiber with CO_2-laser-inscribed long-period grating. One-side inscription enhances asymmetric index modulation in fiber, resulting in directionally sensitive to bend by intensity interrogation.

JW2A.76

Fiber Specklegram Sensor based on Reflective LP_{31} Mode Rotation in Few-Mode Fiber, Yunhe Zhao[2], Shiqi Chen[1], Chengbo Mou[3], Yunqi Liu[3], Lin Zhang[4]; *[1]Shanghai Maritime Univ., China; [2]Shanghai Maritime Univ., China; [3]Shanghai Univ., China; [4]Aston Univ., UK.* We propose an LP_{31} mode-based fiber specklegram sensor based on twist-induced effect in few-mode tilted fiber Bragg grating with high accuracy using speeded-up robust feature algorithm, which would be helpful in the specklegram sensing fields.

JW2A.77

Enhanced Supercontinuum generation by a dispersion-managed L-band ultrafast fiber laser pump, Feng Ye[1], Xuanyi Liu[2], H. Y. Fu[2], Qian Li[1]; *[1]Peking Univ., China; [2]Tsinghua Univ., China.* We propose the scheme using the dispersion-managed L-band mode-locked pulse (near-zero normal net-cavity dispersion) to subtly enable a distinct enhancement of octave-spanning supercontinuum with a broader bandwidth and flatter spectra.

JW2A.78

Frequency multiplication and spectral purification of microwave signals by an in-resonance pumped fiber Brillouin cavity, Shanzhuo Chen[1], Yuyan Chen[1], Yihan Li[1]; *[1]Beihang Univ., China.* A microwave photonics system incorporating a resonantly pumped fiber Brillouin cavity is proposed to multiply the frequency and to suppress the phase noise of an input microwave carrier.

JW2A.79

Single Polarization, Single Mode Solid Antiresonant Fiber, Charu Goel[1], Seongwoo Yoo[2], Wonkeun Chang[1]; *[1]Nanyang Technological Univ., Singapore; [2]Univ. of Glasgow, UK.* We report an all-solid antiresonant fiber design possessing broadband, single polarization, fundamental mode light guidance with a high birefringence of 1.3×10^{-4} and polarization dependent loss exceeding 10 dB/m over >300 nm bandwidth.

JW2A.80

Normal Dispersion Anti-resonant Fiber Design at 2 µm for Higher Power Applications: A Genetic Algorithm Approach, Md Abu Sufian[1], Mohammad Al Mahfuz[2], Xiaowen Hu[1], Ameen Alhalemi[1], Md Selim Habib[2], Axel Schulzgen[1]; *[1]CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA; [2]Florida Institutue of Technology, USA.* We explore the applicability of anti-resonant solid-core large mode area fibers to attain single-mode and normal dispersion at the 2 µm wavelength. The design parameters are optimized using the Genetic Algorithm methodology.

JW2A.81

A Brillouin amplified recirculating frequency shifter loop for generating high signal-to-noise ratio optical frequency comb, Yihan Wang[1], Xiang Zhang[1], Yin Xu[1], Hualong

Bao[1]; *[1]Soochow Univ., China.* We demonstrate a scheme for generating high signal-to-noise ratio optical frequency combs based on a Brillouin amplified recirculating frequency shifter loop. The SNR of the comb teeth is improved from 12 dB to 30 dB.

JW2A.82
A fan-in fan-out device for seven-core ten-mode fiber based on commercial multi-mode fiber tapering, Xuchen Hua[1], Zheng Gao[1], Haoze Du[1], Zheng Zhu[1], Boyu Tan[1], Ming Tang[1]; *[1]Huazhong Univ. of Science and Techn., China.* We designed, simulated and fabricated a fan-in fan-out device for 7-core 10-mode fiber, which was conveniently fabricated with commercial multi-mode fiber utilizing fused tapered techniques with a mode insertion loss no more than 2.57 dB.

JW2A.83
Observation of mode-locking dynamics of a fiber laser incorporating a photoelastic modulator (PEM), Xuecheng Wu[1], Haoyun Zhang[1], Qianchao Wu[2], Fengqiu Wang[1]; *[1]Nanjing Univ., China; [2]Nanjing Univ. of Information Science and Technology, China.* We introduce a photoelastic modulator into a conventional passive mode-locked fiber oscillator to provide fast polarization perturbations. The mode-locking dynamics under different magnitudes of intracavity fast polarization perturbations is observed for the first time.

JW2A.84
Withdrawn

JW2A.85
Design and Fabrication of Silicon-based Light Extractors for NV Centers in Diamond, Minjeong Kim[1], Chengyu Fang[1], Zhaoning Yu[1], Wenxin Wu[1], Raymond A. Wambold[1], Maryam Zahedian[1], Matthew C. Cambria[1,2], Shimon Kolkowitz[1,2], Jennifer Choy[1], Mikhail A. Kats[1]; *[1]Univ. of Wisconsin–- Madison, USA; [2]Univ. of California, Berkeley, USA.* We present a silicon-based nanoscale light extractor (NLE) optimized for enhancing emission of nitrogen-vacancy centers in diamond. The NLE was designed to overcome total internal reflection due to diamon''s high refractive index.

JW2A.86
Quantum Pulse Position Modulation using Entangled States for Communication Security, Tahereh Rezaei[1], Chitra Vadlamani[1], Amir Kalev[1], Jonathan Habif[1]; *[1]USC, Information Science Inst., USA.* Introducing Quantum Pulse Position Modulation (QPPM): an entanglement-based, secure pulse position modulation approach using two-mode entangled light and thermal noise for stealthy data transmission. Quantum bounds ensure secure symbol decoding, baffling eavesdroppers.

JW2A.87
Generation of Entangled Squeezed Light in a Multimode Coupled-Cavity Photonic Crystal, Dylan van Eeden[1], Marc M. Dignam[1]; *[1]Physics, Engineering Physics and Astronomy, Quee''s Univ., Canada.* We present a design for a photonic crystal coupled-cavity system to generate entangled two-mode squeezed states of light on-chip and model it with a basis of non-orthogonal leaky quasi-modes to account for scattering loss.

JW2A.88

Design of a MEMS-Enabled Quantum Socket for the Control of All Photonic and Spin Degrees of Freedom of an Artificial Atom in a High-Cooperativity Diamond Microdisk, Aileen Zhai[1], Mark Dong[2], Johnathan Mack[1], Matt Eichenfield[1]; *[1]Univ. of Arizona, USA; [2]The MITRE Corporation, USA.* We design and simulate the performance of a diamond microdisk resonator hosting group-IV defects heterogeneously integrated with MEMS-enabled piezo-optomechanical Si3N4 photonics, allowing control over all the degrees of freedom of both the vacancy center and emitted photons.

JW2A.89

Modified Superconducting Single Flux Quantum Two Photon Coincidence Correlator for Single-Photon Measurements, Ivan Komissarov[1], Amir J. Salim[2], Oleg A. Mukhanov[2], Timothy Rambo[3], Aaron Miller[3], Roman Sobolewski[1]; *[1]Univ. of Rochester, USA; [2]SEEQC, USA; [3]Quantum Opus, USA.* A design and performance of a single-flux-quantum–based digital correlator is presented to trace independent signals from two superconducting single-photon detectors, triggering its inputs.

JW2A.90

Miniaturized Laser Distribution Module for Compact Sr-Based Optical Atomic Clocks, Jonas Hamperl[1], Nora Goossen-Schmidt[1], Bassem Arar[1], Marcel Bursy[1], Sriram Hariharan[1], Norbert Müller[1], Max Schiemangk[1], Sandy Szermer[1], Christoph Tyborski[1], Dian Zou[1], Andreas Wicht[1]; *[1]Ferdinand-Braun-Institut gGmbH, Leibniz-Institut für Höchstfrequenztechnik, Germany.* We present the layout of a miniaturized laser distribution module as part of a ^{88}Sr optical lattice clock. It consists of distributed Bragg reflector lasers (679 and 707 nm) combined with specifically developed, miniaturized electro-optical components.

JW2A.91

Integrating Thin-Film Lithium Niobate Photonics and Surface-Electrode Ion Traps, Thomas Kessler[1,2], Simon Gorbaty[1,2], Lingfei Zhao[1,2], Joseph Ryan[1,3], Crystal Noel[2,3]; *[1]Duke Quantum Center, Duke Univ., USA; [2]Electrical and Computer Engineering, Duke Univ., USA; [3]Physics, Duke Univ., USA.* Integrated photonics offers trapped-ion experiments scalable performance advantages and opportunities for monolithic optical control. We present plans for adding thin-film lithium niobate to the trapped-ion photonics toolkit, enabling on-chip modulator integration.

JW2A.92

Creation of High-Density Nitrogen-Vacancy Centers in CVD Diamond using High-Energy Photons from Ar+ Plasma, Prem B. Karki[1], Rupak Timalsina[2], Mohammadjavad Dowran[2], Ayodimeji E. Aregbesola[1], Abdelghani Laraoui[2,3], Kapildeb Ambal[1]; *[1]Department of Mathematics, Statistics, and Physics, Wichita State Univ., USA; [2]Department of Mechanical & Materials Engineering, Univ. of Nebraska-Lincoln, USA; [3]Department of Physics and Astronomy and the Nebraska Center for Materials and Nanoscience, Univ. of Nebraska-Lincoln, USA.* We use high-energy photons generated from Ar^+ plasma source to create a high-density and thick (up to a thickness of 150 mm) nitrogen-vacancy centers layer in a commercially available type-iIa CVD-grown diamond substrate.

JW2A.93

Satellite Radio Detection via Dual-Microwave Rydberg Spectroscopy, Joshua Hill[1], Peter Elgee[1], Kermit-James LeBlanc[1], Gabriel Ko[1], Paul D. Kunz[1], Kevin C. Cox[1], David H.

Meyer[1]; *[1]US Army Research Laboratory, USA.* We present a resonant Rydberg electric field sensor operating in the UHF band using a dual-optical-dual-microwave spectroscopy scheme. We measure Sirius XM satellite radio, and compare the sensitivity to other contemporary implementations of the technology.

JW2A.94
Development of a Rydberg Atom-based Charged Particle Beam Tracker, Robert Behary[1], Nicolas DeStefano[1], Irina Novikova[1], Eugeniy Mkhailov[1], Seth Aubin[1], Todd Averett[1], Saeed Pegahan[1], Kevin Su[1], Shukui Zhang[2], Alexandre Camsonne[2]; *[1]William & Mary, USA; [2]Jefferson Lab, USA.* We present the development of a Rydberg-atom based optical sensor for detecting an electron beam with the goal of determining its position and width via a non-invasive electric field measurement.

JW2A.95
Fractal superconducting nanowire single-photon detector coupled with multi-mode optical fiber, Kai Zou[1], Yun Meng[1], Zifan Hao[1], Jing Li[1], Adrian Iovan[2], Thomas Descamps[2], Val Zwiller[2], Xiaolong Hu[1]; *[1]Tianjin Univ., China; [2]Royal Inst. of Technology (KTH), Sweden.* Optical absorptance of fractal SNSPDs is insensitive to the speckles in multimode fiber (MMF). We demonstrate 73% system detection efficiency at 1540 nm and 69 ps timing jitter with a MMF-coupled fractal SNSPD.

JW2A.96
Withdrawn

JW2A.97
Optically Detected Magnetic Resonance with Light-sheet Microscopy, Shuo Wang[1], Mingzhong Ai[1], Jingwei Fan[1,2], Junchen Ye[1], Chao Lin[1], Quan Li[1,3], Ren-Bao Liu[1,3]; *[1]Department of Physics, The Chinese Univ. of Hong Kong, Hong Kong; [2]School of Physics, Hefei Univ. of Technology, China; [3]Centre for Quantum Coherence, The Chinese Univ. of Hong Kong, Hong Kong.* To overcome the phototoxicity in diamond-based bio-sensing, we applied light sheet microscopy to optically detected magnetic resonance measurement. Three-dimensional imaging and nano-thermometry with sensitivity ~3 K/sqrt(Hz) are achieved.

JW2A.98
Two-Crystal Configuration for Frequency-Converted Spontaneous Parametric Down Conversion, Adrien Green[1], Md Mehdi Hassan[1], Noah A. Crum[1], Kazi Reaz[1], George Siopsis[1]; *[1]Univ. of Tennessee, Knoxville, USA.* Frequency-converted spontaneous parametric down conversion (SPDC) produces polarization entangled photons with high purity, visibility, and heralding efficiency over many wavelengths. Our two-crystal setup simplifies focusing optimization allowing for ideal brightness while achieving 99% purity and visibility.

JW2A.99
Characterization of grating couplers for $^{40}Ca^{+}$ based integrated surface ion traps, Kentaro Furusawa[1], Kazuhiro Hayasaka[1,2], Issei Watanabe[1], Norihiko Sekine[1], Utako Tanaka[1,2]; *[1]National Inst of Information & Comm Tech, Japan; [2]School of Engineering Science, Osaka Univ., Japan.* We report fabrication and characterization of grating couplers designed for 40Ca+ based planar surface traps. The wavelengths include 866, 854 and 729 nm and focusing at 100 um from the surface is demonstrated.

JW2A.100

Overcoming Pyroelectricity to Improve Integrated Superconducting Detector Fabrication Yield on Lithium Niobate, Johanna Biendl[1], Felix Dreher[1], Maximilian Protte[1], Jan Philipp Höpker[1], Varun B. Verma[2], Tim J. Bartley[1]; *[1]Inst. for Photonic Quantum Systems, Paderborn Univ., Germany; [2]National Institue of Standards and Technology, USA.* When integrating superconducting detectors on lithium niobate, pyroelectricity can cause irreversible damage to th190trathclyde190cting films. We investigate several schemes to overcome this issue including different detector designs, coatings and shorting schemes.

JW2A.101

Chirped pulse excitation scheme for the efficient generation of frequency multiplexed photons, Ali Binai motlagh[1], Grant Wilbur[2], Alison Clarke[2], Ajan Ramachandran[2], Kimberley Hall[2]; *[1]Columbia Univ., USA; [2]Physics, Dalhousie Univ., Canada.* State-inversion of multiple quantum dot (QD) single photon emitters is demonstrated using a spectrally-notched, chirped optical pulse. Simultaneous excitation of multiple QDs enables the generation of single photons at multiple frequencies, allowing high data rates for quantum communication.

JW2A.102

Hong-Ou-Mandel Interference with a Diode-pumped 1-GHz Ti:sapphire Laser, Imogen Morland[2], Hanna Ostapenko[1], Feng Zhu[1], Derryck T. Reid[1], Jonathan Leach[1]; *[1]Heriot-Watt Univ., UK; [2]Fraunhofer UK Research Limited, UK.* We demonstrate correlated photon pair generation at 790 nm using a diode-pumped Kerr-lens-modelocked 1-GHz Ti:sapphire laser and verify the presence of indistinguishable photons using Hong-Ou-Mandel interferometry, showing a dip in coincidence counts with 81.8% visibility.

JW2A.103

Inverse-designed Structure for Photon Extraction from Color Centers in Diamond, Mohammad Soltani[2,1], Behrooz Semnani[2,1], Supratik Sarkar[3], Vinodh Raj Rajagopal Muthu[2,1], Abdolreza Pasharavesh[2,1], Christopher Wilson[2,1], Michal Bajcsy[2,1]; *[1]Electrical and Computer Engineering, Univ. of Waterloo, Canada; [2]Inst. for Quantum computing (IQC), Canada; [3]Joint Quantum Inst., Univ. of Maryland, USA.* We report on the design, fabrication, and experimental testing of a monolithic diamond structure which is topology-optimized based on the adjoint inverse technique to selectively excite NV centers and efficiently capture fluorescence radiations from color- centers in diamond.

JW2A.104

Tracing the history of a photon: excitation times and group delays, Daniela Angulo[1], Kyle Thompson[1], Vida M. Nixon[1], Andy Jiao[1], Aephraim Steinberg[1,2]; *[1]Univ. of Toronto, Canada; [2]Canadian Inst. For Advanced Research, Canada.* Do photons decelerate in a medium due to spending time as atomic excitations? We measured the atomic excitation time for transmitted photons and found it to be the group delay, even when negative.

JW2A.105

Higher-dimensional HOM effect and quantum state routing with directionally-unbiased linear-optical devices, Christopher Schwarze[1], David S. Simon[1,2], Shuto Osawa[1], Alexander V. Sergienko[1]; *[1]Boston Univ., USA; [2]Physics, Stonehill College, USA.* A four-port beam-splitter only maps between two input and output modes. We introduce a more general four-port scatterer that supports a broader class of state transformations, enabling a higher-dimensional HOM effect and quantum state routing.

JW2A.106
Characterization of Chirped Bragg Grating for Ultrafast Excitation of Rydberg Atoms, Arnab Maity[1,2], Takuya Matsubara[1], Tirumalasetty P. Mahesh[1,3], Yeelai Chew[1], Takafumi Tomita[1,3], Sylvain de Léséleuc[1,3], Kenji Ohmori[1,3]; [1]*Inst. for Molecular Science (IMS), Japan;* [2]*Department of Physical Sciences, Indian Inst. of Science Education and Research Kolkata, India;* [3]*SOKENDAI (The Graduate Univ. for Advanced Studies), Japan.* We precisely determine the chirp rate of a chirped Bragg grating, a highly dispersive optics with promising applications for spectral shaping of picosecond pulsed laser used for ultrafast Rydberg excitation.

JW2A.107
Imaging Quantum Spatial Modes, Charris Gabaldon[1], Pratik Barge[2], Savannah Cuozzo[1], Li Cohen[3], Hwang Lee[2], Irina Novikova[1], Eugeniy Mkhailov[1]; [1]*College of William & Mary, USA;* [2]*Hearne Inst. for Theoretical Physics and Department of Physics & Astronomy, Louisiana State Univ., USA;* [3]*Department of Electrical, Computer and Energy Engineering, Univ. of Colorado Boulder, USA.* We expand on classical single pixel camera methods using a set of structured spatial masks to image quantum field spatial modes in a combination of a single squeezed and thermal mode via quadrature homodyne measurements.

JW2A.108
Perfect Two-Photon State Transfer in a Trimer of Three-Level Systems using Laser Pulses, Abuenameh Aiyejina[2], Ethan A. Wyke[1], Roger Andrews[1], Andrew Greentree[3]; [1]*Department of Physics, The Univ. of the West Indies, Trinidad and Tobago;* [2]*School of Science, Computing and Artificial Intelligence, The Univ. of the West Indies, Antigua and Barbuda;* [3]*ARC Centre of Excellence for Nanoscale BioPhotonics, School of Science, RMIT Univ., Australia.* We investigate two-photon transfer in a trimer of coupled three-level systems excited by laser pulses. We show that perfect state transfer and maximal entanglement are possible for certain detunings on the central site.

JW2A.109
Quantum Interference Enhancement and Fluorescence Spectra Modification via Dielectric Mie Resonances, Qi Liu[1,2], Lingxiao Shan[1], Yali Jia[1], Yun Ma[1], Qihuang Gong[1,2], Ying Gu[1,2]; [1]*State Key Laboratory for Mesoscopic Physics, School of Physics, Peking Univ., China;* [2]*Beijing Academy of Quantum Information Sciences, China.* By placing a four-level system near a high-index dielectric nano-sphere, we find Mie resonances can induce almost maximum quantum interference (QI) factor. The large QI can be flexibly modulated and generate a sub-natural-linewidth fluorescence spectrum.

JW2A.110
Coherence Controlled Non-Local Quantum Metamaterial, Maor Carmi[1], Nadav Antman Ron[1], Rivka Bekenstein[1]; [1]*Hebrew Univ. of Jerusalem, Israel.* We present an atomic metamaterial exhibiting exotic behaviour, such as nonlocal coherence control and negative absorption, by utilizing Rydberg and exchange interactions in a three-level system along with electromagnetic induced transparency.

JW2A.111

Wi-Fi Detection via Room-Temperature Rydberg Atoms, Jan Nowosielski[1,2], Marcin Jastrzebski[1,2], Pavel Halavach[1,2], Wojciech Wasilewski[1,2], Matuesz Mazelanik[1,2], Michal Parniak[1,3]; *[1]Center of New Technologies, Univ. of Warsaw, Poland; [2]Faculty of Physics, Univ. of Warsaw, Poland; [3]Niels Bohr Inst., Univ. of Copenhagen, Denmark.* We present a detection scheme for Wi-Fi signals using room-temperature Rydberg atoms. We compare the Rydberg-atoms sensor with its classical counterpart. Finally, we discuss the microwave-to-optical conversion of Wi-Fi signals using the wave mixing process.

JW2A.112

Atomic Qubits Entanglement Generation via Collective Atomic Excitations, Nadav Antman Ron[1], Maor Carmi[1], Rivka Bekenstein[1]; *[1]The Hebrew Univ. of Jerusalem, Israel.* We present a high-fidelity entanglement generation method of distinct atomic qubits by initializing specific atom'' states within a ring lattice and the employment of collective atomic excitations.

JW2A.113

Optical Fractional Fourier Transform in the time-frequency domain based on quantum-memory, Bartosz Niewelt[1], Marcin Jastrzebski[1], Stanislaw Kurzyna[1], Jan Nowosielski[1], Wojciech Wasilewski[1], Matuesz Mazelanik[1], Michal Parniak[1]; *[1]Centre for Quantum Optical Technologies, Poland.* Operations in the time-frequency domain of light are widely used in communication. Transformations such as fractional Fourier transform are indispensable tool for noise reduction. We present a protocol for quantum memories to perform this operation.

JW2A.114

Withdrawn

JW2A.115

Light Absorption Properties in the LH1-RC Photosynthetic Complex Using a Laser Pulse, Ethan A. Wyke[1], Abuenameh Aiyejina[2], Roger Andrews[1]; *[1]Univ. of the West Indies, Trinidad and Tobago; [2]Univ. of the West Indies, Antigua and Barbuda.* We analytically derive the wavefunction for the LH1-RC photosynthetic complex excited by a laser pulse. We demonstrate that the light absorption process with a resonant pulse is marginally less efficient than the single photon case.

JW2A.116

Toward High-Fidelity Ultrafast Excitation of Atoms to Rydberg States, Mahesh T.P.[1,2], Yeelai Chew[1], Seiji Sugawa[3], Takafumi Tomita[1,2], Takuya Matsubara[1], Sylvain de Léséleuc[1,2], Kenji Ohmori[1,2]; *[1]Inst. for Molecular Science (IMS), NINS, Japan; [2]SOKENDAI (The Graduate Univ. for Advanced Studies), Japan; [3]The Univ. of Tokyo, Japan.* We are developing frequency conversion system using non-linear optics to generate 480 nm picosecond pulsed laser for ultrafast Rydberg excitation. This new system outperforms a previously-used commercial device in terms of pulse-to-pulse fluctuation and energy

JW2A.117

The Transition from Independent to Collective Quantum Emission, Aliaksei Horlach[1], Offek Tziperman[1], Ron A. Ruimy[1], Ido Kaminer[1]; *[1]Technion, Israel.* Collective spontaneous emission by quantum emitters appears only below critical temperatures in a manner that was not fully explained theoretically. We develop the theory that captures this independent-to-collective transition beyond the Dicke-superradiance model.

JW2A.118
The Multimode Quantum Optical Nature of Free-Electron Radiation, Madlene Haddad[1], Offek Tziperman[1], Ron A. Ruimy[1], Ido Kaminer[1]; *[1]Technion, Israel.* We find the full multimode quantum state of light radiated by free electrons. Our findings provide new possibilities for creating quantum light, and reveal a novel type of electron-photon entanglement in the time domain.

JW2A.119
Stabilized Fabry-Perot Filters for Enhancing Nonclassical Correlations of Light Scattered by an Ensemble of Cold Two-Level Atoms, Alexandre Almeida[1], Lucas S. Marinho[1], Wellington Martins[1], Gabriel C. Borges[1], Daniel Felinto[1]; *[1]UFPE, Brazil.* We present a design of an actively stabilized Fabry-Perot cavity to filter the biphotons generated via spontaneous four-wave mixing in cold two-level atoms. Preliminary results show that quantum correlations are enhanced within the filtered signal.

JW2A.120
A Fiber-based Microcavity for Color Centers in Diamond Membranes, Julius Fischer[1], Yanik Herrmann[1], Julia M. Brevoord[1], Colin Sauerzapf[1], Leonardo G. C. Wienhoven[1], Laurens J. Feije[1], Matteo Pasini[1], Martin Eschen[1,2], Maximilian Ruf[1], Matthew J. Weaver[1], Ronald Hanson[1]; *[1]QuTech, Delft Univ. of Technology, Netherlands; [2]Netherlands Organisation for Applied Scientific Research (TNO), Netherlands.* We report on the realization of a fiber-based microcavity, exhibiting low cavity length fluctuations in combination with full spatial and spectral tunability. The microcavity is used to demonstrate Purcell-enhancement of diamond Tin-Vacancy centers.

JW2A.121
LO-free microwave receiver based on Rydberg atoms and nonlinear interferometry, Mateusz Mazelanik[1], Sebastian Borówka[1], Michal Parniak[1]; *[1]Uniwersytet Warszawski, Poland.* We propose a new optically-biased Rydberg-atoms detection of microwave fields, that allows truly all-optical operation, while retaining most of the sensitivity. We tackle the issue of laser phase noise, emerging in this type of detection, by facilitating separate measurement of this noise in a nonlinear process.

JW2A.122
A Space-borne Ultra-stable Laser System, Qiyue Wu[1], Jialu Chang[1], Zhiyuan Wang[1], Jingxuan Zhang[1], Qiang Wei[1], Wen Hao Yuan[1], Jiarui Zhang[1], Xuying Li[1], Deyuan Zhu[1], Ze Huang Lu[1], Jie Zhang[1]; *[1]Huazhong Univ. of Science and Technology, China.* We present a space-borne ultra-stable laser system, and its frequency noise of the laser system is well below 10 $Hz/Hz^{1/2}$ at 6 mHz~10 Hz, which reaches the target of Tianqin space gravitational wave detection program.

JW2A.123
Evaluation of an $^{27}Al^{+}$ ion optical clock systematic uncertainty with a value of 2×10^{-18}, Li Ren Pang[1], Zhi Yu Ma[1], Biao Wang[1], Hong Li Liu[1], Wen Hao Yuan[1], Ke Deng[1], Ze Huang Lu[1]; *[1]MOE Key Laboratory, HUST, China.* We describe the development of an aluminum ion

optical clock. The total systematic uncertainty is evaluated to be 2.0×10^{-18}. A self-comparison of the servo locked optical clock indicates stability of $3.9\times10^{-15}/\sqrt{\tau}$ for a single clock.

JW2A.124
A Low-Vibration Cryogenic Sapphire Cavity-Stabilized Laser for an Al+ Optical Clock, Jingxuan Zhang[1], Zhiyuan Wang[1], Qiang Wei[1], Jialu Chang[1], Qiyue Wu[1], Ze Huang Lu[1], Jie Zhang[1]; *[1]Huazhong Univ. of Science and Technology, China.* We develop a rotatable cryogenic sapphire reference cavity enclosed in a split designed low-vibration cryostat. With vibrational noise suppressed, a frequency instability of 10^{-17} is expected.

JW2A.126
Phase stabilization of a long optical interferometer for entanglement distribution, Yohei Sugiyama[1], Riho Amaki[1], Yuto Shiaka[1], Tomoki Tsuno[1,2], Daisuke Yoshida[1,2], Koji Nagano[2], Tomoyuki Horikiri[1,2], Feng-Lei Hong[1], Daisuke Akamatsu[1]; *[1]Yokohama National Univ., Japan; [2]LQUOM Inc., Japan.* We demonstrated phase stabilization of a long optical interferometer by using two lasers at different wavelengths aiming for entanglement distribution between remote quantum nodes.

JW2A.127
Heralded Noiseless Transmission of Path-Entangled Quantum States Over Lossy Channels, Cory M. Nunn[1,2], Daniel Jones[3], Todd Pittman[2], Brian Kirby[3,4]; *[1]NIST, USA; [2]Physics, Univ. of Maryland Baltimore County, USA; [3]DEVCOM Army Research Laboratory, USA; [4]Tulane Univ., USA.* We show that noiseless attenuation combined with noiseless amplification allows multi-partite entangled states to be conditionally transmitted across lossy channels with arbitrarily high fidelity. In special cases (e.g., W states), noiseless amplification alone is sufficient.

JW2A.128
Optimized Entanglement Distribution among Quantum Memories, Joseph G. Richardson[1,2], Prajit Dhara[1,2], Saikat Guha[1,2], Yousef K. Chahine[3]; *[1]Wyant College of Optical Sciences, Univ. of Arizona, USA; [2]NSF-ERC Center for Quantum Networks, The Univ. of Arizona, USA; [3]NASA Glenn Research Center, USA.* We evaluate entanglement distribution performance when an optimized quantum memory encoding method is used for two sources, the standard spontaneous parametric down conversion source and the zero added loss multiplexing source. Physical non-idealities are considered.

JW2A.129
Quantum repeater scheme based on single-photon interference with mild stabilization, Daisuke Yoshida[1,2], Tomoyuki Horikiri[1,2]; *[1]Yokohama National Univ., Japan; [2]LQUOM Inc., Japan.* We propose a quantum repeater scheme based on single-photon interference, which utilizes multimode quantum memories and two-photon sources. Our proposed scheme significantly reduces stability requirements by several orders of magnitude compared to the conventional scheme.

JW2A.130
Quantum Network Utilizing Mutiple Channels Based on Cavity-QED and Continuous-Variable Codes, Peizhe Li[2,1], Josephine Dias[3], William Munro[3], Peter van Loock[4], Kae Nemoto[3], Nicolò Lo Piparo[3]; *[1]National Inst. of Informatics, Japan; [2]SOKENDAI (the Graduate*

Univ. for Advanced Studies), Japan; [3]Okinawa Inst. of Science and Technology Graduate Univ., Japan; [4]Johannes Gutenberg-Universität Mainz, Germany. We present quantum repeater networks utilizing rotation-symmetric bosonic codes to enhance the performance of long-distance quantum communication. By adding multiple channels, it can be further improved and the requirements are within state-of-art technology.

JW2A.131

Deterministic polarization entanglement generation via wavelength division multiplexing for long distance distribution, Xiang Cheng[1], Yujie Chen[1], Kai-Chi Chang[1], Murat C. Sarihan[1], Chee Wei Wong[1]; *[1]Univ. of California Los Angeles, USA.* We demonstrated deterministic polarization entanglement generation via wavelength division multiplexing, and prepared four polarization Bell states over three frequency channel pairs. Wavelength-multiplexed polarization entangled states are distributed over 50 km fiber with high fidelity.

JW2A.132

Partially coherent entangled qubits for applications in quantum communication and imaging, Bhaskar Kanseri[1], Preeti Sharma[1], Sakshi Rao[1]; *[1]Indian Inst. of Technology Delhi, India.* Partially coherent entangled qubits containing multimode nature are an excellent choice for free-space quantum communication and imaging. We experimentally realize and characterize such qubits demonstrating simultaneously their partial spatial coherence and quantum entanglement features.

JW2A.133

Classical Microwave Constellation to Quantum Optical Phase-space Mapping, Niloy Ghosh[1], Sarang Pendharker[1]; *[1]Department of Electronics & Electrical Communication Engineering, Indian Inst. Of Technology, Kharagpur, India.* Encoding quantum optical states with digitally modulated classical wireless microwave electric-field is shown for the first time. This paves the way for seamless integration of classical digital wireless links and quantum optical communication links in future.

JW2A.134

Orbital Angular Momentum Wave-Particle Duality in a Few-Mode Optical Fiber Platform, Santiago Gómez[2,1], Daniel Spegel-Lexne[1], Joakim Argillander[1], Hilma Karlsson[1], Marcin Pawlowski[3], Pedro R. Dieguez[3], Alvaro Alarcon[1], Guilherme Xavier[1]; *[1]Linköpings universitet, Sweden; [2]Universidad de Concepción, Chile; [3]Univ. of Gdansk, Poland.* We demonstrate wave-particle duality of orbital angular momentum (OAM) photonic quantum states in a few-mode optical fiber interferometer with a dynamic tunable beam-splitter, opening new possibilities for fundamental and practical applications using OAM photonic states.

JW2A.135

Toward bi-chromatic intensity squeezing at telecom wavelength using Four-Wave Mixing in Rb Vapor, Ziqi Niu[1], Jianming Wen[2], Chuanwei Zhang[3], Shengwang Du[3], Irina Novikova[1]; *[1]College of William&Mary, USA; [2]Kennesaw State Univ., USA; [3]The Univ. of Texas at Dallas, USA.* We demonstrated an off-resonance intensity gain of more than 1.3 via double-ladder Four-Wave Mixing (FWM) process, and indicated preliminary evidence of beam noise correlation, suggesting the possibility of achieving bi-chromatic intensity squeezing.

JW2A.136

Asymmetric Hong-Ou-Mandel Revival Interferences in a Singly-Filtered Biphoton Frequency Comb, Kai-Chi Chang[1], Xiang Cheng[1], Yujie Chen[1], Hsiao-Hsuan Chin[1], Murat Can Sarihan[1], Sophi Chen Song[1], Chee Wei Wong[1]; [1]*Univ. of California, Los Angeles, USA.* We observed first asymmetric Hong-Ou-Mandel (HOM) revival interferences in a singly-filtered biphoton frequency comb. We measure up to 10 time-bins, and the witnessed central HOM dip has an accidental-subtracted visibility of 72.95 ± 0.8%.

JW2A.137

Bright Source of Visible Entangled Photon Pairs for Satellite QKD, Colin Vendromin[1], John Sipe[1], Marco Liscidini[2], Daniele Bajoni[2]; [1]*Univ. of Toronto, Canada;* [2]*Univ. of Pavia, Italy.* We propose a source of visible entangled photon pairs encoded in multiple frequency bins of a ring resonator, with predicted generation rates of ~10 MHz/(mW)^{2}, offering potential applications in satellite QKD.

JW2A.138

Polarization and Frequency-Bin Hyperentangled States on Chip, Colin Vendromin[1], John Sipe[1], Marco Liscidini[2]; [1]*Univ. of Toronto, Canada;* [2]*Univ. of Pavia, Italy.* We present a programmable integrated source of polarization and frequency-bin hyperentangled states with a predicted purity of 99.96% and a generation rate of $\sim 10^5$ Hz.

JW2A.139

Foundry-fabricated photonic integrated circuit for flex-grid entanglement distribution, Alexander Miloshevsky[1], Hsuan-Hao Lu[1], Lucas M. Cohen[2], Karthik V. Myilswamy[2], Saleha Fatema[2], Muneer Alshowkan[1], Andrew M. Weiner[2], Joseph M. Lukens[3,1]; [1]*Oak Ridge National Laboratory, USA;* [2]*Purdue Univ., USA;* [3]*Arizona State Univ., USA.* We demonstrate a silicon photonic integrated circuit fabricated through the CMOS manufacturing process which features a bidirectionally pumped microring to achieve over 116 high-fideltiy polarization entangled channels covering the entire optical C+L-band for flex-grid entanglement distribution.

JW2A.140

Study on the effect of discrepancy information in the high-dimensional domain on resolution improvement of the ghost imaging camera, Chenyu Hu[1], ShenSheng Han[1,2], Zhentao Liu[2], Haitao Xue[1,2]; [1]*Hangzhou Inst. for Advanced Study, China;* [2]*Shanghai Inst. of Optics and Fine Mechanics, Chinese Academy of Sciences, China.* Imaging resolution limit of the ghost imaging camera is investigated via the statistical resolution framework. Both theoretical and simulation results confirm that the resolution improvement can be achieved by utilizing the discrepancy information in the high-dimensional domain.

JW2A.141

Popper's Conjecture: Using Angular Ghost Diffraction to Investigate the Uncertainty Principle, Neelan N. Gounden[1], Jenna Epstein[1], Pedro Ornelas[1], Geoff Beck[1], Isaac Nape[1], Andrew Forbes[1]; [1]*Univ. of Witwatersrand, South Africa.* Angular position and orbital angular momentum (OAM) states of photons are used to show that the uncertainty principle for an entangled photon passing through a 'ghost' slit has a finite limit which is source dependent.

JW2A.142

Fresnel Diffraction of High-Dimensional Biphoton Wavefunctions: Computational Method and Characterization, Charlotte Brown[1], Jake Dunham[1], Hao-Qi Zhao[2], Chenfei Hu[3], Liang Feng[2], Zihe Gao[1]; *[1]Auburn Univ., USA; [2]Univ. of Pennsylvania, USA; [3]Applied Materials, Inc., USA.* Nonclassical biphoton wavefunctions reside in a higher-dimensional Hilbert space than classical or single-photon wavefunctions. Using the separability that holds for both spatial and multi-photon dimensions, we generalize FFT-based computational Fourier optics techniques to biphoton wavefunctions.

JW2A.143
Efficient General Waveform Catching by a cavity at an Absorbing Exceptional Point, Asaf Farhi[1,2], Wei Dai[1], Seunghwi Kim[3], Andrea Alù[3], A. Douglas Stone[1]; *[1]Yale Univ., USA; [2]Physics, Tel Aviv Univ., Israel; [3]CUNY, USA.* We show that a cavity at an absorbing exceptional point captures additional temporal orders of any incoming waveform, resulting in efficient passive state transfer and photon detection.

JW2A.144
Temporal phase characterization of picosecond pulsed squeezed vacuum, Zicong XU[1], Sho Nitanai[1], Yasuyuki Ozeki[1]; *[1]the Univ. of Tokyo, Japan.* We propose a method to measure the temporal phase of ultrashort pulsed squeezed vacuum. We verified that the temporal chirp has limited influence on pulsed squeezing level.

JW2A.145
Photon-Number-Counting-Enabled Super-Resolution Imaging, Ivan A. Burenkov[1,2], Alexandra Semionov[2], Sergey Polyakov[2,3]; *[1]Joint Quantum Inst., USA; [2]NIST, USA; [3]UMD, USA.* We experimentally demonstrate super-resolution of up to 3 overlapping pseudo-thermal optical modes. The supper-resolution is achieved by mode reconstruction of photon-number distributions for each pixel of the photon-number-resolving camera.

JW2A.146
Ultra-compact, Tunable Photon Pair Source for Pulsed Temporal-mode Encoding, Liao Ye[1], Haoran Ma[1], Yuehai Wang[1], Jianyi Yang[1]; *[1]College of Information Science and Electronics Engineering, Zhejiang Univ., China.* We demonstrate the generation of pulsed temporal-mode encoding quantum states via spontaneous four-wave mixing using two micro-ring resonators on the silicon-on-insulator (SOI) platform. The output is tunable between separable states and two-dimensional entangled states.

JW2A.147
Temperature Tolerant Quantum Entangled Light Source, Andrew D. Rockovich[1], Daniel Gauthier[1]; *[1]The Ohio State Univ., USA.* Spontaneous parametric down-conversion sources are typically highly temperature sensitive. Periodically poled waveguides with two cascading regions that are phase-matched to different temperatures can potentially more than double the operating temperature bandwidth.

JW2A.148
Refractive Index Measurement by the Plasmonic Hong-Ou-Mandel Interferometry, Seungjin Yoon[1,2], Yu Sung Choi[3], Mark S. Tame[4], Jae Woong Yoon[3], Sergey Polyakov[2,5], Changhyoup Lee[6]; *[1]Joint Quantum Inst., USA; [2]National Inst. of Standards and Technology, USA; [3]Department of Physics, Hanyang Univ., Korea (the Republic*

of); [4]Department of Physics, Stellenbosch Univ., South Africa; [5]Department of Physics, Univ. of Maryland, USA; [6]Korea Research Inst. of Standards and Science, Korea (the Republic of). We theoretically propose a quantum plasmonic sensor using Hong-Ou-Mandel interferometry to measure a refractive index embedded in the plasmonic beamsplitter. There is quantum advantage in terms of the Fisher information.

JW2A.149
Quantum effects in two-photon interactions from stimulated Parametric down-conversion, Thomas C. Dickinson[1], Ivi Afxenti[2], Giedre Astrauskaite[3], Lenny Hirsch[2], Samuel Nerenberg[3], Ottavia Jedrkiewicz[4], Alessandra Gatti[4], Daniele Faccio[3], Marie-Caroline Muellenbroich[3], Matteo Clerici[5,2], Lucia Caspani[1]; *[1]Inst. of Photonics, Univ. of198trathclydee, UK; [2]James Watt School of Engineering, Univ. of Glasgow, UK; [3]School of Physics and Astronomy, Univ. of Glasgow, UK; [4]Istituto di Fotonica e Nanotecnologie del CNR, Italy; [5]Dipartimento di Scienze e Alta Tecnologia, Università dell'Insubria, Italy.* Quantum-enhanced nonlinear interactions driven by parametric down-conversion (PDC) have long been investigated, mainly in the spontaneous (photon pairs) regime. We report observations of a quantum effect in two-photon interaction in the stimulated regime of PDC.

JW2A.150
Quantum Enhanced Mechanical Rotation Sensing using Wavefront Photonic Gears, Ofir Yesharim[1], Guy Tshuva[1], Ady Arie[1]; *[1]Tel Aviv Univ., Israel.* We demonstrate a compact and efficient rotation sensing mechanism that uses structured light, and is enhanced by bright N00N states. It uses two opposite spiral phase plates that convert mechanical rotation to wavefront phase shifts.

JW2A.151
Generation of squeezed light with two-photon processes in rubidium vapor, Sutapa Gosh[1], Gadi Eisenstein[1]; *[1]Technion, Israel.* Pulsed squeezed light was generated through a two-photon process in rubidium vapor using polarization rotation resulting from a nonlinear light-atom interaction. A squeezing level of 5 dB, detected through a balanced homodyne measurement, was demonstrated.

JW2A.152
Experimental reconstruction of the“"push-and-pul”" associated with damping and diffusion Wigne''s currents in quantum phase space, Yi-Ru Chen[1], Hsien-Yi Hsieh[1], Jingyu Ning[1], Hsun-Chung Wu[1], Hua Li Chen[1], Popo Yang[1], Ole Steuernagel[1], Chien-Ming Wu[1], Ray-Kuang Lee[1]; *[1]National Tsing Hua Univ., Taiwan.* We experimentally reconstruct Wigner's current of quantum phase space dynamics for the first time, revealing the “push-and-pull” associated with damping and diffusion due to the environmental coupling of a squeezed vacuum state.

JW2A.153
Characterization of thermal degraded optical cat states by non-Gaussianity, PO HAN Wang[1], Ray-Kuang Lee[1]; *[1]National Tsing Hua Univ., Taiwan.* We apply the non-Gaussianity measure to degraded optical states, based on the Hilbert-Schmidt distance to thermal squeezed states, and reveal a counter-intuitive increase of non-Gaussianity when the coupled thermal states at a low average photon number.

JW2A.154

Direct Observation of the Mechanism Behind Spectral Diffusion in Semiconductor Quantum Dots, Frieder Conradt[1], Vincent Bezold[1], Volker Wiechert[1], Steffen Huber[1], Stefan Mecking[1], Alfred Leitenstorfer[1], Ron Tenne[1]; *[1]Univ. of Konstanz, Germany.* Using high-resolution spectroscopy at cryogenic temperatures for single quantum dots under an external electric bias, we quantitatively show that the quantum-confined Stark effect is the cause of spectral diffusion. As a consequence, spectral fluctuations may be minimized by applying an adequate counter bias.

JW2A.155

Phase Dependent Hanbury-Brown and Twiss effect, Xuan Tang[1], Yuanxiao Zhang[2], Xueshi Guo[2], Liang Cui[2], Xiaoying Li[2], Zhe-Yu J. Ou[1]; *[1]City Univ. of Hong Kong, Hong Kong; [2]Tianjin Univ., China.* We report a phase sensitive two-photon interference effect when the incoming thermal fields are mixed with weak coherent reference fields. The complex second-order coherence function of the input thermal fields can be extracted.

JW2A.156

Exploiting Quadratic and Cubic Nonlinearities in Developing Novel Integrated Heralded Single-Photon Sources, Mahmoud H. Almassri[1], Mohammed F. Saleh[1]; *[1]Heriot-Watt Univ., UK.* We develop a quantum model to study and characterize a novel integrated single-photon source that is based on the interplay of two simultaneous nonlinear parametric processes. The model predicts the generation of high-pure single photons.

JW2A.157

Photon-pair generation in hybrid photonic crystal fibre, Will Smith[1], Alex O. Davis[1], Peter J. Mosley[1]; *[1]Univ. of Bath, UK.* We discuss the design, fabrication, and deployment of hybrid photonic crystal fibre for photon-pair generation. Loss bands are created to reduce noise by coupling to the cladding at the peak of the Raman gain spectrum.

JW2A.158

Untraceable In-situ Channel Monitoring via Quantum Measurement, Jabir M. V.[1], N. Fajar R. Annafianto,[1], Ivan A. Burenkov[1,2], Abdella Battou[1], Sergey Polyakov[1,2]; *[1]NIST, USA; [2]Univ. of Maryland, USA.* We demonstrate an in-situ scheme for monitoring conditions of a classical communications channel via regular data transmission, and with no auxiliary communication. Employing quantum state discrimination confidence, we experimentally observe amplitude and phase noise detection.

JW2A.159

Broadband loop-based quantum memories for storing entangled photons, Carson J. Evans[1], Cory M. Nunn[1], Sandra Cheng[1], James Franson[1], Todd Pittman[1]; *[1]Univ. of Maryland, Baltimore County, USA.* We experimentally demonstrate storage of polarization entangled photons in the“"loop-and-switc”" quantum memory platform. We highlight the utility of the broadband nature of this platform, and discuss progress towards small-scale multi-memory networks.

JW2A.160

Machine Learning-Enhanced Quantum State Tomography with Direct Parameter Estimations, Hsien-Yi Hsieh[1], Yi-Ru Chen[1], Jingyu Ning[1], Hsun-Chung Wu[1], Hua Li Chen[1], Zi-

Hao Shi[1], Po-Han Wang[1], Popo Yang[1], Ole Steuernagel[1], Chien-Ming Wu[1], Ray-Kuang Lee[1]; *[1]National Tsing Hua Univ., Taiwan.* Instead of using the reconstruction model in training a truncated density matrix, we develop a high-performance, lightweight, and easy-to-install supervised characteristic model by generating the target parameters directly.

JW2A.161
Wigner's Phase Space Current for the Conditional Dynamics in Entangled Two Mode Systems — Seeing Beam Splitters in a New Light —, Ole Steuernagel[1]; *[1]Inst. of Photonics Technologies, National Tsing Hua Univ., Taiwan.* We study Wigner distribution dynamics in terms of its current J. Specifically, the strongly mode mixing dynamics of a variable beam splitter. We provide some theory and examples illustrating the visual power of this approach.

JW2A.162
Many-Body Entanglement of Free Electrons via 'Which-Path', Ron A. Ruimy[1], Offek Tziperman[1], Alexey Gorlach[1], Ido Kaminer[1]; *[1]Technion Israel Inst. of technology, Israel.* We propose a novel free-electron double-slit experiment using a photonic cavity to measure the 'which-path' information. Instead of causing the paths to collapse, the cavity entangles the electrons, creating intriguing interference patterns and many-body correlations.

JW2A.163
Single-Mode squeezed light generated by Four-Wave Mixing for enhanced phase sensing, Patrick Tritschler[1,2], Peter Degenfeld-Schonburg[3], Torsten Ohms[1], Andre Zimmermann[2,4]; *[1]Bosch Sensortec GmbH, Germany; [2]Inst. for Micro Integration (IFM), Univ. of Stuttgart, Germany; [3]Robert Bosch GmbH, Germany; [4]Hahn-Schickard, Germany.* This work shows the possibility to generate single-mode squeezed light using four-wave mixing in micro-ring resonators and determines the phase sensitivity in a lossy Mach-Zehnder Interferometer. It is shown that sub-shot noise measurements can be achieved.

JW2A.164
Single-Photon Entangled W-States in Discrete Dimension of a Waveguide, Amir Sivan[1], Amit Kam[2], Guy Bartal[1], Meir Orenstein[1]; *[1]Andrew and Erna Viterbi department of Electrical & Computer Engineering, Technion – Israel Inst. of Technology, Israel; [2]Physics department, Technion – Israel Inst. of Technology, Israel.* We generate W-states from single photons in a single waveguide by employing modes as a discrete synthetic dimension. This is realized by a structure enabling hopping in the modes ladder.

JW2A.165
Correlated photon pairs generation with 3D integrated SiN circuit, Xiaotian Zhu[1], Xiaoying Li[2], Liang Cui[2], Brent Little[3], Sai CHU[1]; *[1]City Univ. of Hong Kong, Hong Kong; [2]Tianjin Univ., China; [3]qxp Inc., China.* For the photon pairs generated from SiN waveguide, the measured heralding efficiency is 18%, coincidence-to-accidental ratio is up to 149, and photon-pair rate is up to 0.6 MHz under the pump power of 2.9 mW.

JW2A.166
All-to-All Connected Photonic Ising Machine with Arbitrary Spin Number Based on Mach-Zehnder Interferometers, Yuan Gao[1], Luo Qi[1], Hong-Lin Lin[1], Guanyu Chen[1], Wujie Fu[1], Yuchi Lan[1], Aaron Danner[1]; *[1]College of Design and Engineering, National Univ. of Singapore, Singapore.* We experimentally realized a photonic Ising machine with arbitrary spin number and

allto-all connection using Mach-Zehnder interferometry and specially designed phase detection region, serving as a general combinatorial optimization problem solver.

JW2A.167
Perfect pulsed inline twin-beam squeezers, Martin Houde[1], Nicolás Quesada[1]; *[1]Polytechnique Montreal, Canada.* We obtain analytical results for the input and output temporal-modes of three different waveguided twin-beam squeezers. Double-pass configurations give perfect inline squeezers where the input and output modes are identical while single-pass configurations do not.

JW2A.168
Withdrawn

JW2A.169
Spectral Property Engineering of Photon Pairs in Different Spatial Modes from Few-Mode Fiber, Shengjie Zhu[1], Liang Cui[2], Xiaoying Li[3]; *[1]College of Precision Instrument and Opto-electronics Engineering,Tianjin Univ., Tianjin Univ., China; [2]Tianjin Univ., China.* Frequency uncorrelated or negatively correlated signal and idler photon pairs, respectively in LP11 and LP01 modes, are created via inter-spatial-mode spontaneous four-wave mixing process with two pulsed pump.

JW2A.170
Withdrawn

JW2A.171
Shaping Super-Poissonian Photon Statistics of Spatial Light Modes, Mingyuan Hong[1], Ashe Miller[1], Roberto d. Leon Montiel[2], Chenglong You[1], Omar S. Magana-Loaiza[1]; *[1]Louisiana State Univ., USA; [2]Instituto de Ciencias Nucleares, Universidad Nacional Autonoma de Mexico, Mexico.* We demonstrate the possibility of producing light with various photon statistics through the spatial modulation of coherent light. Our scheme allows for the shaping of spatial light modes with engineered photon statistics at different positions.

JW2A.172
A Platform for Designing Bipartite Entangled Quantum Frequency Combs via Silicon Nitride Microring Resonators, Nianqin Li[1], Bo Ji[1], Yang Shen[1], Guangqiang He[1]; *[1]Shanghai Jiao Tong Univ., China.* We build a platform for designing bipartite entangled quantum frequency combs via on-chip Si_3N_4 microresonators. Our platform supports 12 continuous-variable quantum modes, of which the entanglement degree can be finely regulated by adjusting cavity temperature.

JW2A.173
Spatiotemporal Optical Two- and Three-Vortex Reconnections, Jordan Adams[1,2], Imad Agha[1,3], Andy Chong[4]; *[1]Electro-Optics and Photonics, Univ. of Dayton, USA; [2]Optics and Photonics, Riverside Research Inst., USA; [3]Physics, Univ. of Dayton, USA; [4]Department of Physics, Pusan National Univ., Korea (the Republic of).* Spatiotemporal optical vortex reconnections between two and three vortices in a wavepacket can occur under propagation with diffraction or dispersion.

JW2A.174
Reservoir-induced linewidth broadening of exciton-poalriton laser, Bianca Rae S. Fabricante[1], Mateusz Krol[1], Matthias Wurdack[1], Andrew Truscott[1], Elena Ostrovskaya[1], Eliezer Estrecho[1]; *[1]Australian National Univ., Australia.* We create ultra-narrow linewidth polariton laser with a coherence time greatly exceeding the polariton lifetime by confining a polariton BEC in an optical ring trap to minimize condensate-reservoir overlap. We also show the detrimental role of the reservoir in the polariton coherence.

JW2A.175
The Investigation of Dissipative Soliton Dynamics via SA/RSA transition within saturable absorber, Hsuan-Sen Wang[1], Ahmed F. M. El-Mahdy[1], Shiao-Wei Kuo[1], Gong-Ru Lin[2], Chao Kuei Lee[1]; *[1]National Sun-Yat-sen Univ., Taiwan; [2]National Taiwan Univ., Taiwan.* Pump-dependent dissipative soliton dynamics were investigated using a muti-saturable absorption behavior covalent-organic frameworks saturable absorber. This work provides a guideline for implications for the design of high-pulse energy fiber lasers by saturable absorbers.

JW2A.176
Spatial Chirp and Measurement Time in the Interference of Narrowband Sources, Joscelyn van der Veen[1], Daniel F. James[1]; *[1]Univ. of Toronto, Canada.* We reconcile the results of two papers on the interference of narrowband sources with a general equation that accounts for measurement time and spatial variations. This result can be applied to spatially chirped fields.

JW2A.177
Mid-infrared dark soliton combs and telecom bright soliton combs in silicon nitride microring resonators, You Wu[1], Feng Ye[1], Qian Li[1]; *[1]Peking Univ., China.* We propose a dual-CW pumping approach to generate a mid-infrared dark soliton comb and a telecom bright soliton comb by the cross-phase modulation effect in a SiN microresonator.

JW2A.178
Dispersion Engineered Silicon Nitride Microring Resonators for Pure-Quartic Soliton Frequency Comb Generation, Jie Zhao[1], Andrea Blanco-Redondo[2]; *[1]Nokia Bell Labs, USA; [2]Univ. of Central Florida, USA.* We propose realistic designs and numerically demonstrate pure-quartic soliton generation from silicon nitride microring resonators. Pure quartic dispersion is achieved through resonant mode coupling between two concentric rings with segmented width.

JW2A.179
Femtosecond pulse generation from a cw-driven degenerate optical parametric oscillator, Alfredo Sanchez[1], Chaitanya Kumar Suddapalli[2], Majid Ebrahim-Zadeh[1,3]; *[1]ICFO - Institut de Ciencies Fotoniques, Spain; [2]Tata Inst. of Fundamental Research Hyderabad, India; [3]Instituciò Catalana de Recerca i Estudis Avancats, Spain.* We describe a novel configuration of bulk $\chi^{(2)}$ OPO providing near-transform-limited sub-100 fs pulses with coherent broadband phase-locked spectrum when driven with a cw laser by deploying an intracavity electro-optic-modulator together with dispersion control.

JW2A.180
Mean-field equation for phase-modulation mode-locked optical parametric oscillator with dispersion control, Alfredo Sanchez[1], Chaitanya Kumar Suddapalli[2], Majid Ebrahim-

Zadeh[1,3]; *[1]ICFO -Institut de Ciencies Fotoniques, Spain; [2]Tata Inst. of Fundamental Research Hyderabad, India; [3]Instituciò Catalana de Recerca i Estudis Avancats, Spain.* We derive a mean-field equation for degenerate optical parametric oscillator driven by a continuous-wave laser with intracavity electro-optic modulator, including dispersion compensation. The equation predicts femtosecond-pulse formation in both normal and anomalous dispersion regimes.

JW2A.181
Topologically Protected Wavelength Conversion in a Photonic Valley Hall Insulator, Byoung-uk Sohn[1], Ju Won Choi[1], George F. Chen[1], Hongwei Gao[1], William Mitchell[2], Doris K. Ng[3], Dawn T. Tan[1]; *[1]SUTD, Singapore; [2]Univ. of California Santa Barbara, USA; [3]A*STAR, Singapore.* We explore nonlinear effects in a topological photonic valley Hall insulator with a Kagome system at telecommunications wavelengths, we achieve topologically protected -12dB parametric conversion with sub-milliwatt input and 7dB enhancements at slow light region.

JW2A.182
Study of optical nonlinearity with single-shot waveform measurement, Dipendra S. Khatri[1], Chris Lantigua[1], Tran C. Truong[1], Troie D. Journigan[1], Yangyang Liu[1,2], S. Novia Berriel[1], Parag Banerjee[1], Michael Chini[1]; *[1]Univ. of central florida, USA; [2]Huazhong Univ. of Science and Technology, China.* Electronic excitations in matter responds to the sub-cycle optical field variation rather than the pulse envelope, resulting in sub-cycle optical nonlinearity. Here, we employ single-shot waveform measurement to investigate sub-cycle nonlinearity in a ZnO film.

JW2A.183
Robust Biphoton Entanglement of Three Topological Modes, Mohammad Javad Zakeri[1], Andrea Blanco-Redondo[1]; *[1]CREOL (College of Optics and Photonics), USA.* We numerically show the generation of three-mode biphoton entanglement in silicon photonic topological superlattices. Our results show signatures of robustness to disorder in the resulting entangled state, highlighting a route toward robust complex photonic entanglement.

JW2A.184
Predator-prey Behaviors In Optical Solitons, Juan Wu[1], Yu H. Zhuang[1], Jiaxin Li[1], Siyu Li[1], Chenyang Zhan[1], Yi Hu[1], Jingjun Xu[1]; *[1]Nankai Univ., China.* We demonstrate "predator-prey" behaviors of two components in an optical soliton where internal interactions are non-reciprocal. Counter-intuitively, the soliton moves against a momentum initially applied to one component that plays the role of a predator.

JW2A.185
Two-Photon Process in Free Electron Radiation, Hongteng Lin[1], Fang Liu[1], Kaiyu Cui[1], Xue Feng[1], Wei Zhang[1], Yidong Huang[1]; *[1]Department of Electronic Engineering, Tsinghua Univ., China.* We propose and investigate analytically the new phenomenon of two-photon emission by free electrons. It's found two-photon emission can be greatly enhanced by increasing transverse field of light in a specific photonic structure.

JW2A.186
Mid-IR femtosecond laser induced filamentation dynamics in polycrystalline ZnS using time-resolved pump-probe microscopy, Justin D. Twardowski[1], Milo Eder[1], Z. A. Marra[2], Michael Chini[2], Zenghu Chang[2], Enam Chowdhury[1]; *[1]Ohio State Univ., USA; [2]Univ. of Central*

Florida, USA. A 250fs 4.07µm laser driven filamentation in polycrystalline ZnS is imaged by a synchronous orthogonal femtosecond 520nm probe. Multiple filaments are visible for each power, where larger filaments appear at the highest intensity.

JW2A.187
Effects of positive and negative group velocity dispersion on the generation of a noise-like pulse and its effectiveness for supercontinuum generation, Kuan-Yuan Chang[1], Jia-Ming Liu[1,2]; [1]*National Yang Ming Chiao Tung Univ., Taiwan;* [2]*Electrical and Computer Engineering, Univ. of California, Los Angeles, USA.* Generation of noise-like pulses by the intrapulse Raman process alone doesn't enhance the efficiency of supercontinuum generation. Instead, utilization of a fiber with a negative group-velocity dispersion to induce pulse breakup is necessary.

JW2A.188
Period-halving Effect in Floquet Photonic Lattices, Qianqian Kang[1], Zhaoyuan Wang[1], Xiaoqin Huang[1], Qing Guo[1], Yu H. Zhuang[1], Zeyu Gong[1], Minglei Wang[1], Yi Hu[1], Jingjun Xu[1]; [1]*Nankai Univ., China.* We report a light-intensity oscillation with a half-period of Floquet drives applied on photonic lattices. Such an effect, achieved by chiral symmetry of any two half-period separated instantaneous Hamiltonians, is manifested only for zero-energy modes.

JW2A.189
The Effects of Correlated Dephasing on Multidimensional Spectroscopy of Interacting Systems, Kelsey M. Bates[1], Steven T. Cundiff[1]; [1]*Physics, Univ. of Michigan, USA.* We simulate multiquantum multidimensional coherent spectra of an interacting system with correlated dephasing. Depending on the correlation parameters, the many-body dephasing rate can be much shorter than the single-body dephasing rate.

JW2A.190
Multicolor Solitons with and without Phase-Locking, Justin Widjaja[1], Antoine Runge[1], Martijn de Sterke[1]; [1]*Univ. of Sydney, Australia.* We report the observation in a fiber laser of a new class of soliton comprised of multiple frequency components with the same group velocity but different propagation constants, which exhibit small periodic pulse-to-pulse energy variations.

JW2A.191
Optical Stern-Gerlach Effect of Two Waveguide Modes, Jiaxin Li[1], Zhaoyuan Wang[1], Yi Hu[1], Jingjun Xu[1]; [1]*Nankai Univ., China.* We utilize spatial dimension of optical fields to demonstrate a Stern-Gerlach effect. The optical splitting, independent of polarization/wavelength, is realized with a spatially dependent optical coupling that plays the role of a non-uniform magnetic field.

JW2A.192
Color Switching in a Mode-Locked Optical Phase-Conjugate Resonator, Brielle E. Anderson[1], Jie Zhao[2], Zhifan Zhou[3], Rory Speirs[3], Kevin Jones[4], Paul Lett[3,5]; [1]*American Univ., USA;* [2]*The Australian National Univ., Australia;* [3]*Univ. of Maryland, USA;* [4]*Williams College, USA;* [5]*National Inst. of Standards and Technology, USA.* We construct a phase-conjugate resonator which passively mode-locks, pro- duces pulsing, and is unconditionally stable. The resonator uses non-degenerate four-wave mixing in rubidium vapor and the output switches between the two non-degenerate colors.

JW2A.193

Targeted Enhancement of Nonlinear Response in Layered Transition Metal Dichalcogenides, Russell L. Berger[1], Edgar Dimitrov[2], Alex Mavian[1], Nazifa Rumman[1,3], Pascal Bassène[1,3], Mauricio Terrones[2], Moussa N'Gom[1,3]; *[1]Department of Physics, Applied Physics, and Astronomy, Rensselaer Polytechnic Inst., USA; [2]Department of Physics, The Pennsylvania State Univ., USA; [3]The Shirley Ann Jackson, Ph.D. Center for Biotechnology and Interdisciplinary Studies, Rensselaer Polytechnic Inst., USA.* We experimentally reveal and enhance weak second harmonic (SH) generation probed by a femtosecond pulse in monolayer WS2 polycrystals using a feedback based Wavefront Shaping (WFS) technique.

JW2A.194

Floquet–Bloch Oscillations in Photonic Lattices, Zhen Zhang[1], Yuan Li[2], Xiankai Sun[2], Xuewen Shu[1]; *[1]Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, China; [2]Department of Electronic Engineering, The Chinese Univ. of Hong Kong, China.* We propose a general theory concerning optical Bloch oscillations in photonic Floquet lattices and report the first experimental demonstration and visual observation of the Bloch-like oscillations, which are termed the "Floquet–Bloch oscillations."

JW2A.195

Spectral characteristics and application of multiphoton absorption in cooling single-photon detector, Zhengyong Li[1], Changyong Tian[2]; *[1]Beijing Jiaotong Univ., China; [2]Technical Inst. of Physics and Chemistry, Chinese Academy of Sciences, China.* We demonstrate the spectral blue-shift of multiphoton absorption in cooling single-photon detector, and obtain the mixture exponent of 2.25 then achieve the blue-shift of 0.18 nm/K with error of ~5.3% related to theoretical result.

JW2A.196

Universality of Linear Wave Emission from Perturbed Solitons, Justin Widjaja[1], Long Qiang[1], Amelie Skelton[1], Lasse Sweetland[1], Antoine Runge[1], Christopher Lustri[1], Martijn de Sterke[1]; *[1]Univ. of Sydney, Australia.* We report experimental time- and phase-resolved measurements of pure-quartic solitons radiating dispersive waves in the presence of weak positive sixth-order dispersion. These results imply that a universal radiation mechanism exists across all of wave physics.

JW2A.197

Time-Domain Analysis of the Coupling between Free-Electrons and Photonic Waveguides, Omer Emre Ates[1], Benjamin Slayton[1], William Putnam[1]; *[1]Univ. of California Davis, USA.* We investigate how free-electrons can excite modes in nearby photonic waveguides. Using particle-in-cell simulations, we explore how a free-electron packet can couple energy into multiple, velocity-matched modes of an adjacent silicon waveguide.

JW2A.198

Dynamics of Pump Power-Dependent Soliton Molecules in Yb-Doped Mode-Locked Fiber Laser, Yingchu Xu[1], Karol Krzempek[2], Wonkeun Chang[1]; *[1]School of Electrical and Electronic Engineering, Nanyang Technological Univ., Singapore; [2]Department of Electronics, Photonics and Microsystems, Wroclaw Univ. of Science and Technology, Poland.* We numerically demonstrate soliton molecule formation dynamics in a Yb-doped mode-locked fiber laser under

varying levels of pump power. These soliton molecules comprise equally spaced sub-pulses, each possessing the same energy.

JW2A.199

An In-Depth Analysis of Entangled Photon-Pair Generation in Nonlinear Thin Films, Elkin A. Santos[1], Maximilian A. Weissflog[1,3], Frank Setzpfandt[1,2], Sina Saravi[1]; *[1]Friedrich-Schiller-Universität Jena, Germany; [2]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany; [3]Max Planck School of Photonics, Germany.* We present a general theoretical formalism of spontaneous parametric down-conversion in nonlinear thin films. Based on a Green-function approach, we study emission directionality and polarization entanglement of photon pairs generated by a thin GaAs slab.

JW2A.200

Photon-Dressed Exciton States and Terahertz Gain unveiled by THz Spectroscopy, Daniel Anders[1], Markus Stein[1], Sangam Chatterjee[1]; *[1]Justus-Liebig-Univ. Giessen, Germany.* We investigate a GaAs multi quantum well structure with ultra fast optical pump-terahertz probe spectroscopy. Exciting the sample energetically below the 1s exciton resonance leads photon-dressed exciton states.

JW2A.201

Prediction of the Period-4 Modulation Instability in Ring Fiber Cavities, Minji Shi[1], Matteo Conforti[2], Arnaud Mussot[2], Auro M. Perego[1]; *[1]Aston Univ., UK; [2]Univ. of Lille, France.* We predict the occurrence of a novel form of modulation instability in passive ring fiber cavities. This instability, characterized by a period-4 pattern, can be observed using experimentally accessible parameters.

JW2A.202

Nonlinear modulational instability: is it really a Fermi-Pasta-Ulam-Tsingou phenomenon?, Andrea Armaroli[1], Stefano Trillo[1]; *[1]Universita degli Studi di Ferrara, Italy.* The nonlinear Schrodinger equation models mixing phenomena such as modulational instability in fibers. Its regular behavior was associated to Fermi-Pasta-Ulam-Tsingou recurrence. We rigorously compare their behaviors and clarify this analogy, settling a long-lasting debated problem.

JW2A.203

Giant Oscillations of Vector Solitons Driven by Nonreciprocal Interactions, Pawel Jung[1,2], Mohammad Javad Zakeri[1], Aliaksandr Ramaniuk[3], Andrea Blanco-Redondo[1], Aristide Dogariu[1], Demetrios Christodoulides[1], Gaetano Assanto[4], Wieslaw Krolikowski[5], Marek Trippenbach[3]; *[1]CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA; [2]Faculty of Physics, Warsaw Univ. of Technology, Poland; [3]Faculty of Physics, Univ. of Warsaw, Poland; [4]NooEL-Nonlinear Optics and OptoElectronics Lab, Univ. Roma Tre, Italy; [5]Department of Quantum Science and Technologies, Research School of Physics, Australia.* We discover and discuss the giant oscillations of stable soliton-molecules as induced by the violation of the action-reaction principle in optical systems ruled by competing nonlinear nonlocal interactions.

JW2A.204
Surface Acoustic Waves for Acousto-optic Modulation in Silicon Nitride Plaform, Zheng Zheng[1], Peter J. van der Slot[1], David Marpaung[1]; *[1]Univ. of Twente, Netherlands.* We present novel design of thermally driven acousto-optic modulation with surface acoustic wave (SAW) in silicon nitride (Si_3N_4) platform. Buried waveguide with metal grating on the surface is optimized for intramodal and intermodal modulation optomechanics.

JW2A.205
Dual-Pumped Supercontinuum Generation in Molecular-Gas Filled Hollow-Core Fibers, Athanasios Lekosiotis[1], Balazs Plosz[1], Federico Belli[1], Amir Abdolvand[2], John Travers[1]; *[1]Heriot-Watt Univ., UK; [2]ASML Research, Netherlands.* We report the efficient generation of broadband and ultra-flat supercontinuum using deuterium-filled anti-resonant hollow-core fibers dual-pumped with pulses centered at 515 nnm and 1030 nm wavelength.

JW2A.206
Beyond the parametric approximation: pump depletion, entanglement and squeezing in down-conversion, Karthik R. Chinni[1], Nicolás Quesada[1]; *[1]Polytechnique Montreal, Canada.* We study the dynamics of the down conversion process in the pump-depleted region using the cumulant expansion method and perturbation theory. We find the time scales associated with pump-mode depletion, squeezing and entanglement.

JW2A.207
Differentiating Theoretical Frameworks in the Subcycle Regime, Joscelyn van der Veen[1]; *[1]Univ. of Toronto, Canada.* The quantum description of subcycle optical pulses differs from classical even for coherent states in the subcycle regime. We describe the two different frameworks and propose experiments to determine which framework accurately describes pulse detection.

JW2A.208
Surface amplification in dissipative lattices, Konstantinos Makris[1,2]; *[1]Univ. of Crete, Greece; [2]IESL, FORTH, Greece.* For a dissipative lattice, with few gainy channels, we study the best possible configurations for maximum power growth. Based on a paramagnetic crystal analogy, we examine when the amplification on the surface is higher.

JW2A.209
Withdrawn

JW2A.210
Reversible nonreciprocal light transmission based on slow-light waveguide, Jun-Fang Wu[1], Da-Liu Zheng[2], Chao Li[3]; *[1]South China Univ. of Technology, China.* We realize high-contrast, and reversible nonreciprocal light transmission based on a nonlinear nanocavity asymmetrically side-coupled to a slow-light waveguide.

JW2A.211
Floquet Analysis of Photonic Time Crystals with Polaritonic Band Structures, Mustafa Goksu Ozlu[1], Vahagn Mkhitaryan[1], Colton Fruhling[1], Alexandra Boltasseva[1], Vladimir M. Shalaev[1]; *[1]Purdue Univ., USA.* We modeled dispersive photonic time crystals (PTCs) that support polaritonic band structures and investigated the effect of the dispersion parameters. We

explored the coupling between the branches with dipole and plane wave excitation. The polaritonic PTC enables source amplification with a much smaller modulation frequency.

JW2A.212
Engineering nonlinear optical process with random exploration of the optimal phase relationships, Chiaki Ohae[1], Weiyong Liu[1], Shuhei Kamakura[1], Shoki Tajima[1], Masaru Suzuki[1], Masayuki Katsuragawa[1]; *[1]Univ. of Electro-Communications, Japan.* We report an experimental demonstration of the conceptual idea of engineering nonlinear optical processes, where optical phases of electromagnetic fields relevant to the nonlinear optical processes are arbitrarily manipulated as a function of interaction length.

JW2A.213
Realization of Non-Hermitian Antichiral Currents in Synthetic Dimensions, Rui Ye[1], Yanyan He[1], Guangzhen Li[1], Luqi Yuan[1], Xianfeng Chen[1]; *[1]Shanghai Jiao Tong Univ., China.* We report on the theoretical and experimental demonstration of non-Hermitian antichiral currents based on a tunable non-Hermitian Hall ladder in the synthetic frequency dimension implemented by two coupled optical ring resonators.

JW2A.214
The Optical Spectrum of Two Coexisting Limit Cycles in Injected Photonic Oscillators, Johanne Hizanidis[1], Vassilios Kovanis[2]; *[1]Department of Physics, Univ. of Crete, Greece; [2]National Security Inst., Virginia Tech, USA.* We compute the spectrum of two coexisting periodic limit cycles, a P3 Isola and FWM signal. We record that this P3 limit cycle tends to draw most of the orbits on its phase space path.

JW2A.215
Free-phase-matching and tunable-gain phase-sensitive amplification based on thin-film lithium niobate, Yanqun Wang[1], Xiaoyue Liu[1], Xinlun Cai[1], Lin Liu[1], Zhenda Xie[2], Shining Zhu[2], Zhongjin Lin[1], Fujin Huang[1], Mengwen chen[2], Yuntao Zhu[1], Siyuan Yu[1]; *[1]Sun Yat-sen Univ., China; [2]Nanjing Univ., China.* Based on substrate-removed thin-film lithium niobate, we demonstrate a tunable phase-sensitive amplification, which can achieve an extinction ratio of 30.6 dB and a maximum gain of 23 dB in wavelength ranges of 1530-1550 nm

JW2A.216
Third-order Optical Nonlinearity Response of N-doped Carbon Quantum Dots, Yuxing Yang[1], Yi Han[1], Mingrui Zhang[1], Pengfei Xue[1]; *[1]Inner Mongolia Univ., China.* We measure the third-order optical nonlinearity response of the prepared N-doped carbon quantum dots by the Z-scan technique. An important reverse saturable absorption and large negative nonlinear refractivity of N-doped carbon quantum dots are demonstrated.

JW2A.217
Compact and robust common-path scheme for Fourth Harmonic Generation of deep UV ultrashort laser pulses, Peter Susnjar[1], Alexander Demidovich[1], Gabor Kurdi[1], Paolo Cinquegrana[1], Ivaylo Nikolov[1], Paolo Sigalotti[1], M B. Danailov[1]; *[1]Elettra-Sincrotrone Trieste S.C.p.A., Italy.* The presented new scheme for Fourth Harmonic Generation by 800 nm pulses utilizes delayed collinear replicas of the fundamental pulse to generate consecutive harmonics minimizing high order nonlinear effects and obtaining short 200 nm pulses.

JW2A.218
Stably locking a photonic molecule by extending Pound-Drever-Hall feedback with higher-order derivatives, Dhruv Srinivasan[3,2], Sashank K. Sridhar[3], Alexander Miller[3], Avik Dutt[3,1]; *[1]Inst. for Physical Science and Technology, Univ. of Maryland, USA; [2]Physics, Univ. of Maryland, USA; [3]Mechanical Engineering, Univ. of Maryland, USA.* We introduce and experimentally demonstrate a technique to mutually lock two 5.6-meter-long cavities using filtered higher-order derivatives of the transmission. The cavities remain coupled and hybridized in a regime where conventional Pound-Drever-Hall feedback is insufficient.

JW2A.219
Broadband microcombs in silica microspheres in normal and anomalous dispersion regime, Jiamin Bai[1], you gao[1], Suwan Sun[1], Xukun Lin[1], Kailin Wu[1], Xiaoying Wang[1], Haiyun Yuan[1], Siyu Wang[1], Hairun Guo[1]; *[1]Shanghai Univ., China.* By controlling the size of high-Q silica microspheres, we introduced dispersive waves (DWs) and achieved broadband kerr frequency microcombs with bandwidths of 300 nm and 350 nm under normal and anomalous dispersion, respectively.

JW2A.220
Chirped Solitary Wave Solutions for Optical Frequency Comb Applications, Sanjana Bhatia[1], C N Kumar[1]; *[1]Panjab Univ., India.* We demonstrate that the interplay of higher-order dispersion and nonlinear effects excites propagation of ultrashort, nonlinearly-chirped signals in an optical fiber. These undamped excitations reproduce characteristics of Kerr-comb systems, including bright-solitons and periodic wavetrains.

JW2A.221
Clock Synchronization with Weak Coherent Pulses, Noah A. Crum[1], Kazi Reaz[1], Adrien Green[1], Md Mehdi Hassan[1], George Siopsis[1]; *[1]Univ. of Tennessee Knoxville, USA.* We propose a simulated protocol for performing clock synchronization between two spatially separated parties utilizing weak coherent pulses (WCPs) and balanced Hong-Ou-Mandel (HOM) interferometers as opposed to spontaneous parametric down converted photons (SPDC).

JW2A.222
An Effective Countermeasure against Time-Shift Attack Using a Combination of Passive Quenched and Gated Detectors, Toshitsugu Kato[1], Akihisa Tomita[1]; *[1]Graduate School of Information Science and Technology, Hokkaido Univ., Japan.* We have devised an effective countermeasure against time-shift attack in quantum key distribution. The attack is completely neutralized by combining passive quenched and gated detectors, resulting in a threefold improvement in the transmission distance.

JW2A.223
Noise-robust Quantum Coherence Near Infrared Imaging, Bochen Wang[1], Yansheng Bao[1], Zemin Wu[1], Zhengyong Li[1], Changyong Tian[2]; *[1]Key Lab of Education Ministry on Luminescence and Optical Information Technology, Beijing Jiaotong Univ., China; [2]Technical Inst. of Physics and Chemistry, Chinese Academy of Sciences, China.* We propose and demonstrate a near-infrared imaging scheme based on induced quantum coherence in nondegenerate parametric down conversion, while obtain high-quality images of interdigital electrode and silicon chip even in strong background noise.

JW2A.224

Experimental Implementation of Quantum Steganography Using Coherent States, Haley A. Weinstein[1,2], Bruno Avritzer[3], Todd Brun[3,1], Jonathan Habif[2,1]; *[1]Electrical and Computer Engineering, Univ. of Southern California, USA; [2]Information Sciences Inst., USA; [3]Physics and Astronomy, Univ. of Southern California, USA.* We devise a system to measure the quantum density matrix of different noises and then control these noises to achieve positive rate covert communications. This is demonstrated for thermal noise in an optical communication link.

JW2A.225

Enhancing Photon Information Capacity in High-Dimensional Arrival-time-bin QKD through Polarization Hyperentanglement, Murat C. Sarihan[1], Kai-Chi Chang[1], Yujie Chen[1], Xiang Cheng[1], Hsiao-Hsuan Chin[1], Chee Wei Wong[1]; *[1]Univ. of California Los Angeles, USA.* We used frequency-polarization hyperentanglement to eliminate global errors in high-dimensional arrival time-bin encoding and reached a 34% increase in photon information efficiency at a higher frame limit.

JW2A.226

Enhanced Optical Entanglement Distribution Through Noisy Channels by Temporal Mode Filtering, Jack H. Lichtman[1], Neil Sinclair[2], Michael G. Raymer[1], Brian J. Smith[1]; *[1]Univ. of Oregon, USA; [2]Harvard Univ., USA.* We show that a single temporal mode filter can improve the quality of photonic entanglement distributed across a noisy, multi-mode channel.

JW2A.227

Withdrawn

JW2A.228

Multiwavelength Distributed Bragg Reflector Laser Platform for Quantum Applications, Luukas Kuusela[1], Mika Mähönen[1], Timo Aho[1], Riina Ulkuniemi[1], Andreas Schramm[1], Soile Talmila[1], Jussi Hämelahti[1], Pekko Sipilä[1], Kalle Palomäki[1], Petteri Uusimaa[1]; *[1]Modulight Corporation, Finland.* Distributed Bragg reflector lasers are presented at various wavelengths relevant to quantum information science and technology applications; 650 nm, 760 nm, 780 nm, 795 nm, and 935 nm. The lasers exhibit reliable high-power operation with down to below 500 kHz linewidth.

JW2A.125

Femtosecond Pulsed Laser Fabricated Erbium-Doped Non-Invasive Thin Film Photonic Biosensors, Tarun Kakkar[2], Benjamin Dawson[2,1]; *[1]NIQS Tech (Leeds) Ltd., UK; [2]School of Chemical and Process Engineering, Univ. of Leeds, UK.* A clinical feasibility study for the use of photoluminescent erbium-doped thin films, created via femtosecond laser-induced plasma doping techniques, as potential noninvasive biosensors performed on 12 Type I diabetics showed a clinical acceptability of 92.3%.

13:00 -- 15:00
Room: W201AB
SW3A • Advances in High Power Femtosecond Amplifiers
Presider: Shu-Wei Huang; Univ. of Colorado at Boulder, USA

SW3A.1 • 13:00 (Invited)
Shaping Driving Pulses for Efficient Intrapulse Difference Frequency Generation, Marc Hanna[3], Quentin Bournet[1], Michele Natile[1], Mindaugas Jonusas[2], Florent Guichard[1], Yoann Zaouter[1], Manuel Joffre[2], Adeline Bonvalet[2], Frédéric Druon[3], Patrick Georges[3]; *[1]Amplitude, France; [2]Laboratoire Optique et Biosciences, France; [3]Laboratoire Charles Fabry, France.* We discuss and demonstrate methods that allow efficient generation of tunable, carrier-envelope phase-stable few-cycle pulses in the mid-infrared, through the process of intrapulse difference frequency generation.

SW3A.2 • 13:30
Record-High 10.3 W Average Power at 3.1 µm From a Synchronously-Pumped OPO, Vito F. Pecile[1,2], Michael Leskowschek[1], Norbert Modsching[3], Valentin J. Wittwer[3], Thomas Südmeyer[3], Oliver H. Heckl[1]; *[1]Faculty of Physics, Faculty Center for Nano Structure Research, Christian Doppler Laboratory for Mid-IR Spectroscopy, Univ. of Vienna, Austria; [2]Vienna Doctoral School in Physics, Univ. of Vienna, Austria; [3]Institut de Physique, Laboratoire Temps-Fréquence (LTF), Université de Neuchâtel, Switzerland.* We investigate power scaling with a signal singly-resonant OPO pumped with a 125 MHz Yb:fiber CPA. We achieve an average power of 10.3 W at 3.1 µm with a free-running power stability of 0.84%.

SW3A.3 • 13:45
Sub-8-fs Pulses in the Visible to Near Infrared from a Degenerate Optical Parametric Amplifier, Thomas Deckert[1], Aline Vanderhaegen[1], Daniele Brida[1]; *[1]Department of Physics and Materials Science, Univ. of Luxembourg, Luxembourg.* A single-stage optical parametric amplifier (OPA) operating at degeneracy delivers sub-8-fs pulses with excellent shot-to-shot stability. It complements the existing array of OPAs in the visible to near infrared for advanced multidimensional spectroscopy.

SW3A.4 • 14:00
Modelocked Thin-Disk Laser Oscillator With 475 W of Average Output Power, Moritz Seidel[1], Lukas Lang[1], Christopher R. Phillips[1], Ursula Keller[1]; *[1]ETH Zurich, Switzerland.* We present an ultrafast thin-disk laser oscillator providing a record power of 475 W with 86-µJ, 808-fs pulses at a repetition rate of 5.50 MHz. This is enabled by a six-pass cavity and sapphire-bonded SESAMs.

SW3A.5 • 14:15
Single-Shot, High-Repetition Rate Carrier-Envelope-Phase Detection of Ultrashort Laser Pulses, Chen Guo[1], Miguel Miranda[2,3], Ann-Kathrin Raab[1], Anne-Lise Viotti[1], Paulo Tiago Guerreiro[3], Rosa Romero[3], Helder Crespo[3,4], Anne L'Huillier[1], Cord L. Arnold[1]; *[1]Atomic Physics, Lund Univ., Sweden; [2]Departamento de Fisica e Astronomia, IFIMUP-IN, Portugal; [3]Sphere Ultrafast Photonics, Portugal; [4]Blackett Laboratory, UK.* We propose a single-shot Carrier-Envelope Phase measurement scheme, based on evaluating f-2f fringes by means of optical Fourier transform. The method is suitable for measuring at high-repetition rate (200 kHz) and low pulse energy.

SW3A.6 • 14:30

Broadband Ho:CALGO regenerative amplifier at 2.1 µm, Anna Suzuki[1], Shahwar Ahmed[1], Yicheng Wang[1], Clara J. Saraceno[1]; *[1]PULS, Ruhr-Universität Bochum, Germany.* We present a Ho:CALGO crystal based regenerative amplifier at 2.1 µm. A pulse energy of 210 µJ was obtained at a 1 kHz repetition rate with a broadband spectrum indicating sub-picosecond transform-limited pulse duration.

SW3A.7 • 14:45

Single-Mode Amplification in a Multimode Fiber Regenerative Amplifier, Henry Haig[1], Nicholas Bender[1], Yishai Eisenberg[1], Frank Wise[1]; *[1]Cornell Univ., USA.* **We show that regenerative amplification enables a femtosecond fiber amplifier with an unprecedented combination of features: single-mode operation (M^2≤** 1.3) **despite multimode (100 µm) fiber, high-gain (> 55 dB), and high pulse energy (> 50 µJ).**

13:00 -- 15:00
Room: W201CD
FW3B • Advances in Ultrafast Techniques and Optoelectronic Applications
Presider: Hanyu Zhu; Rice Univ., USA

FW3B.1 • 13:00

Following phase transition in niobium dioxide by time-resolved harmonic spectroscopy, Zhonghui Nie[1], Leo Guey[1], Eduardo B. Molinero[2], Peter Juergens[1,3], Thomas Hooven[1], Yuhan Wang[4], Álvaro J. Galán[3], Paul Planken[1,5], Rui Silva[2,3], Peter Kraus[1,6]; *[1]Advanced Research Center for Nanolithography, Netherlands; [2]Instituto de Ciencia de Materiales de Madrid, Consejo Superior de Investigaciones Científicas, Spain; [3]Max-Born-Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany; [4]School of physics and electronic engineering, Taishan Univ., China; [5]Van der Waals-Zeeman Inst., Univ. of Amsterdam, Netherlands; [6]Department of Physics and Astronomy, and LaserLaB, Vrije Universiteit, Netherlands.* Robust experimental evidence of ultrafast insulator-to-metal transition in niobium dioxide has been found in time-resolved high harmonic spectroscopy and such sensitive methodology based on extreme nonlinearity could be generalized to any phase transitions.

FW3B.2 • 13:15

Many-Body Effects in Copropagating Multidimensional Coherent Spectroscopy of Microcavity Polaritons, Giuseppe Fumero[1,2], Hunter L. Louscher[2], Jared K. Wahlstrand[1], Alan Bristow[2,1]; *[1]NIST, USA; [2]Department of Physics and Astronomy, West Virginia Univ., USA.* We measure multidimensional coherent spectra of an InGaAs nanostructure in a collinear geometry varying fluence, polarization and detuning, and obtaining distinctive signatures of many-body interactions between polaritons and pure excitonic states.

FW3B.3 • 13:30

Ultrafast Nanoscopy of Single-Grain Morphology and Charge Carrier Dynamics in Metal Halide Perovskites, Svenja Nerreter[1], Martin Zizlsperger[1], Qimu Yuan[2], Kilian B. Lohmann[2], Fabian Sandner[1], Felix Schiegl[1], Christian Meineke[1], Yaroslav A. Gerasimenko[1], Laura M. Herz[2], Thomas Siday[2,1], Markus A. Huber[1], Michael B. Johnston[2], Rupert Huber[1]; *[1]Universität Regensburg, Germany; [2]Univ. of Oxford, UK.* Deep-subcycle shifts of terahertz near-field waveforms reveal the interplay of ultrafast carrier dynamics and nano-morphology in metal halide perovskites. A surprising robustness of out-of-plane diffusion against structural and chemical variations is found on the nanoscale.

FW3B.4 • 13:45
Superradiance from Molecular J-aggregates Coupled to Dielectric Metasurfaces, Marco Marangi[1], Yutao Wang[1], Mengfei Wu[2], Febiana Tjiptoharsono[2], Arseniy Kuznetsov[2], Giorgio Adamo[1], Cesare Soci[1]; *[1]Nanyang Technological Univ., Singapore; [2]Agency for Science, Technology and Research (A*STAR), Singapore.* Coupling of molecular J-aggregates with resonant dielectric metasurfaces induces Purcell enhancement with cooperative fluorescence and reduced decoherence in the weak coupling regime, and the formation of polaritonic states in the strong coupling regime, all at room temperature.

FW3B.5 • 14:00
Ultrafast scanning tunneling spectroscopy of a phonon-driven atomic vacancy in a monolayer crystal, Yaroslav A. Gerasimenko[1], Carmen Roelcke[1], Lukas Kastner[1], Maximilian Graml[1], Andreas Biereder[1], Jan Wilhelm[1], Jascha Repp[1], Rupert Huber[1]; *[1]Department of Physics and Regensburg Center for Ultrafast Nanoscopy (RUN), Univ. of Regensburg, Germany.* Understanding the interplay of atomic and electronic motion requires probing at intrinsic space-time-energy scales. We resolve phonon modulations of defect-bound states by sampling electronic spectra with atomic and sub-ps precision, faster than a vibration period.

FW3B.6 • 14:30
Guided organic exciton-polaritons on patterned distributed Bragg reflectors at room temperature, Bin Liu[1], Jeffrey Horowitz[1], Stephen Forrest[1]; *[1]Univ. of Michigan, USA.* We demonstrate guided long-range excitation energy transport mediated by excitonpolaritons on different patterned distributed Bragg reflectors at room temperature, which results from strong coupling between organic excitons and low-loss Bloch surface wave (BSW) modes.

FW3B.7 • 14:45
Serial Carrier-Envelope Phase Detection and Modulation for PHz Optoelectronics, Vaclav Hanus[1], Beatrix Fehér[1], Zsuzsanna Pápa[1,2], Judit Budai[2], Pallabi Paul[3,4], Adriana Szeghalmi[3,4], Péter Dombi[1,2]; *[1]Wigner Research Centre for Physics, Hungary; [2]ELI-ALPS Research Inst., Hungary; [3]Inst. of Applied Physics, Friedrich Schiller Univ., Germany; [4]Fraunhofer Inst. for App. Opt. and Prec. Eng., Centre of Excellence in Photonics, Germany.* This study demonstrates a serialized carrier-envelope phase (CEP) measurement using a 250-nm 2D heterostructure, revealing measurable CEP shifts suitable for PHz optoelectronics, advancing the potential for CEP-based communication networks.

13:00 -- 15:00
Room: W204AB
FW3C • Methods for Future Extreme Light Sources
Presider: To be Announced

FW3C.1 • 13:00
Laser-Based Undulator Design for Soft X-ray Free Electron Laser, Sean Tilton[1], Elena L. Ros[1], Kevin E. Schmidt[1], Sudeep Banerjee[1,2], Arvinder Sandhu[3], Arya Fallahi[4], Robert A.

Kaindl[1], William Graves[5], Samuel Teitelbaum[1]; *[1]Physics, Arizona State Univ., USA; [2]KLA Tencor, USA; [3]Physics, Univ. of Arizona, USA; [4]DESY Center for Free Electron Science, Germany; [5]Biodesign Inst., Arizona State Univ., USA.* We present an optical undulator design of a soft X-ray compact free electron laser with a laser-based undulator feasible with commercially available laser systems. We simulate the Inverse Compton Scattering process and investigate engineering constraints.

FW3C.2 • 13:15
Toward high-gain laser-driven electron undulation, Amnon Balanov[1], Ron A. Ruimy[1], Ido Kaminer[1]; *[1]Technion, Israel.* We find an unexplored regime of inverse Compton scattering, achieving high-gain undulation as in FELs. We show the potential for soft-X-ray and extreme ultraviolet radiation sources based on next-generation electron sources and state-of-the-art laser sources.

FW3C.3 • 13:30
Anomalous Relativistic Reflectivity in Near-critical Density Femtosecond Laser-plasma Interactions, Sida Cao[1], Zheng Gong[1], Matthew Edwards[1]; *[1]Stanford Univ., USA.* We report an anomalous opacity effect in relativistic near-critical density laser-plasma interactions due to a drifting electron density spike. Orders-of-magnitude higher reflectivity than the relativistic transparency expectation is demonstrated by particle-in-cell simulations.

FW3C.4 • 13:45
Electron Acceleration in a Petawatt-Class Laser Focus Under Various Conditions, Smrithan Ravichandran[1], Anthony Raymond[2], Andrew Longman[3], Luis Roso[4], Robert Fedosejevs[5], Wendell T. Hill[1]; *[1]Univ. of Maryland College Park, USA; [2]Univ. of Rochester, USA; [3]Lawrence Livermore National Laboratory, USA; [4]Universidad de Salamanca, Spain; [5]Univ. of Alberta, Canada.* We report on electron-acceleration dynamics in the focus of petawatt-class (PWC) lasers, and its role in directly assessing the aberrations and peak intensity at full power, with experimental measurements and simulations.

FW3C.5 • 14:00
Investigation of Shock-waves Generated by Laser-Induced Discharges Triggered by UV Filaments, Ali Rastegari[1], Jean-Claude Diels[1]; *[1]Univ. of New Mexico, USA.* Shock-waves generated by UV filament induced electrical discharges are investigated. A nonlinear supersonic regime is followed by linear shock wave propagation at a sound velocity affected by the total energy deposited into the electrical.

FW3C.6 • 14:15
Cascaded Plasma Mirrors for Two-Color-Driven Harmonic Generation, Nicholas M. Fasano[1], Vedin Dewan[2], Matthew Edwards[3], Andreas Giakas[2], Timothy Bennett[2], Julia M. Mikhailova[2]; *[1]Mechanical and Aerospace Engineering, Princeton Univ., USA; [2]Princeton Univ., USA; [3]Stanford Univ., USA.* We experimentally demonstrate enhanced third and fourth harmonic energy using a phase-controlled two-color beam in a multi-pass plasma mirror set-up. Maximum enhancement of 1.6× was measured for on-target intensity of $1 \times 10^{19} Wcm^{-2}$.

FW3C.7 • 14:30
A Novel Idea of Plasma-based Pulse Compression for Compact Exawatt Lasers, Minsup Hur[1], Dino Jaroszynski[2], Hyyong Suk[3]; *[1]Physics, UNIST, Korea (the Republic of); [2]Physics,*

Univ. of Strathclyde, UK; [3]Physics and Photon Science, Gwangju Inst. of Science and Technology, Korea (the Republic of). A negatively chirped pulse can be compressed in a density gradient plasma. Compression of a 2.35 picosecond pulse into a 10.3 femtosecond pulse with peak intensity up to 10^{17} W/cm^2 was demonstrated by particle-in-cell simulations.

FW3C.8 • 14:45
Optimization of Diffraction Efficiency for Ionization-Induced Plasma Gratings, Michelle M. Wang[1], Nicholas M. Fasano[1], Victor M. Perez-Ramirez[2], Andreas Giakas[1], Ke Ou[2], Sida Cao[2], Pierre Michel[3], Julia M. Mikhailova[1], Matthew Edwards[2]; *[1]Princeton Univ., USA; [2]Stanford Univ., USA; [3]Lawrence Livermore National Laboratory, USA.* A plasma grating is generated by temporally crossing and interfering two femtosecond beams to create modulated ionization. We achieve maximum Bragg diffraction efficiency of 35% by tuning grating transverse size, length, and incident beam configurations.

13:00 -- 15:00
Room: W205AB
AW3D • Quantum Key Distribution (QKD) I
Presider: Nate Gemelke; QuEra Computing Inc., USA

AW3D.1 • 13:00
Real-time CV-QKD Reception Resilient to Urban Atmospheric Turbulence, João R. Frazão[1], Vincent v. Vliet[1], Sjoerd v. Heide[1], Menno van den Hout[1], Kadir Gümus[1], Aaron Albores-Mejia[1], Boris Skoric[1], Chigo Okonkwo[1]; *[1]TU/e, Netherlands.* We show a real-time CV-QKD receiver realization over a turbulent optical free-space channel with secret key rates up to 2.2 Mbit/s. The real-time GPU receiver evaluated quantum signal integrity under various turbulence scenarios, emulating an 800m urban terrestrial FSO link.

AW3D.2 • 13:30
Improving Twin-Field QKD With Optical Clock Technologies, Filippo Levi[1], Gianluca Bertaina[1], Cecilia Clivati[1], Simone Donadello[1], Carlo Liorni[2], Alice Meda[1], Salvatore Virzì[1], Marco Gramegna[1], Marco Genovese[1], Davide Calonico[1], Massimiliano Dispenza[2], Ivo P. Degiovanni[1]; *[1]INRIM, Italy; [2]Leonardo Labs, Italy.* Coherent lasers interferometry, developed for optical clock comparisons, can improve real world performance of TF-QKD links. We quantify the performance achievable in various link conditions using common protocols, considering advanced fiber noise reduction strategies.

AW3D.3 • 13:45
Withdrawn

AW3D.4 • 14:00
Quantum Key Distribution (QKD) Multiplexing by Using the Attenuation Method, Ondrej Klicnik[1], Petr Munster[1], Tomas Horvath[1]; *[1]VUT, Czechia.*
In this paper a novel approach to multiplexing quantum and classical channels into a single fiber is presented. A so-called attenuation method is used, that is mainly focused on suppressing the influence of Raman noise.

AW3D.5 • 14:15

Quantum Spread Spectrum, Bernardo A. Huberman[1], Bob Lund[1], Jing Wang[1], Lin Cheng[1]; *[1]CableLabs, Inc., USA.* We propose and experimentally demonstrate frequency hopping spread spectrum communication that uses a quantum key distribution network to securely deliver random frequency hopping patterns for wireless communications. Results show low interception and jamming probabilities.

AW3D.6 • 14:30
Visibility of Long-Fiber Sagnac Interferometers, Reem Mandil[1], Li Qian[1], Hoi-Kwong Lo[1]; *[1]Univ. of Toronto, Canada.* We measure visibility in fiber Sagnac interferometers up to 200 km using CW light. Results show visibility is backscattering-limited after 60 km. We obtain 90% visibility in 200 km fiber using a burst-patterning technique.

AW3D.7 • 14:45
Real-time 12.5-Gbit/s Quantum Random Number Delivery over Field-installed Fiber via Coherent Light Transmission, Ken Tanizawa[1], Kentaro Kato[1], Fumio Futami[1]; *[1]Tamagawa Univ., Japan.* We propose and demonstrate quantum random number generation based on vacuum fluctuation at a distance from the laser source. 12.5-Gbit/s unpredictable random numbers are distributed without optical transceivers over 4-km fiber installed in campus.

13:00 -- 15:00
Room: W205CD
JW3E • Symposium: Spectroscopic Advances in Biophotonics I
Presider: Joseph Mastron; TOPTICA Photonics Inc., USA

JW3E.1 • 13:00 (Invited)
Multimodal Spectroscopic and Imaging Methods for Skin Diagnostics, Anatoly Fedorov Kukk[1], Di Wu[1], Rüdiger Panzer[2], Steffen Emmert[2], Bernhard Roth[1,3]; *[1]Hanover Centre for Optical Technologies, Leibniz Univ. Hannover, Germany; [2]Univ. Medical Center Rostock, Germany; [3]Cluster of Excellence PhoenixD, Leibniz Univ. Hannover, Germany.* We combine spectroscopic and imaging techniques to realize an optical biopsy as alternative to invasive skin diagnostics. We demonstrate the potential of our multimodal approach for in vivo measurement on melanoma and discuss future applications.

JW3E.2 • 13:30 (Invited)
Vibrational Photothermal Microscopy, Ji-Xin Cheng[1]; *[1]Boston Univ., USA.* Vibrational excitation and subsequent relaxation on the picosecond scale efficiently generates local heat, making pump-probe photothermal detection a sensitive means of imaging chemical bonds. Vibrational photothermal microscopy principle, instrumentation, and applications will be discussed.

JW3E.3 • 14:00 (Invited)
2D IR Spectroscopy and Hyperspectral Imaging: Applicaton to Amyloid Aggregation and Cataract Lens Tissues, Martin Zanni[1]; *[1]Univ. of Wisconsin-Madison, USA.* The technology of 2D IR spectroscopy and its application to amyloid diseases will be covered, including a pulse sequence for resolving competing aggregation pathways and hyperspectral 2D IR imaging to human cataract lens tissues.

JW3E.4 • 14:30 (Invited)
Surface Enhanced Infrared Absorption Spectroscopy by Nanostructures, Xia Yu[1], Donglai An[1], Jing Ni[1], Zhouzhuo Tang[1]; *[1]Beihang Univ., China.* Surface enhanced infrared absorption (SEIRA) spectroscopy is presented by deploying different novel nanostructure arrays as SEIRA substrates. A group of nanostructures are designed and fabricated with a precision resonance control to achieve surface enhancement covering a broadband bio-molecular "finger-print" region.

13:00 -- 15:00
Room: W206A
SW3F • Nonlinear Optics in Microresonators I
Presider: Dmitry Skryabin; Univ. of Bath, UK

SW3F.1 • 13:00 (Tutorial)
Low Loss Hybrid Silicon Nitride Based Integrated Photonics: from Chipscale Combs, Erbium Amplifiers to Cryogenic Quantum Interconnects, Tobias J. Kippenberg[1]; *[1]Swiss Federal Inst of Tech Lausanne, Switzerland.* Abstract not available.

SW3F.2 • 14:00
Second-Harmonic Generation via All-Optical Poling in Linearly Uncoupled Silicon Nitride Microresonators, Marco Clementi[1], Luca Zatti[2], Ji Zhou[1], Marco Liscidini[3], Camille Brès[1]; *[1]Photonic Systems Laboratory, École Polytechnique Fédérale de Lausanne, Switzerland; [2]Dipartimento di Ingegneria Industriale e dell'Informazione, Università di Pavia, Italy; [3]Dipartimento di Fisica, Università di Pavia, Italy.* We present a novel device consisting of two microring resonators coupled by the second-order nonlinear interaction. By independently controlling the microresonators' linear properties, we engineer efficient second-harmonic generation through photo-induced nonlinearity in silicon nitride.

SW3F.3 • 14:15
Reducing Frequency Noise in Dark-Pulse Kerr Combs, Anamika Nair Karunakaran[1,2], Angelo Manetta[2], Poul Varming[2], Minhao Pu[1], Victor Torres-Company[3], Kresten Yvind[1], Patrick Montague[2]; *[1]DTU elektro, Denmark; [2]NKT Photonics, Denmark; [3]Chalmers Univ. of Technology, Sweden.* This paper investigates the impact of pump-resonance detuning on various soliton properties in dual ring microresonators. Bandwidth, conversion efficiency, repetition frequency, spectral envelope and comb line noise are 217haracterizat and low noise states are identified.

SW3F.4 • 14:30
Spectrally Flat Normal-GVD Kerr Combs via Opposite-Polarity Comb Synchronization, Swarnava S. Sanyal[1], Bok Y. Kim[1], Yoshitomo Okawachi[1], Yun Zhao[1], Karl J. McNulty[1], Michal Lipson[1], Alexander L. Gaeta[1]; *[1]Columbia Univ., USA.* We demonstrate all-optical on-chip synchronization of opposite polarity Kerr combs in the normal group-velocity dispersion regime. Coherent combining of such combs with different spectral profiles allows us to efficiently achieve a near-unity ($\Gamma = 0.90$) spectral flatness.

SW3F.5 • 14:45
Dual comb generation in triple normal dispersion coupled microresonators using avoided mode crossing, Wei Wu[1,2], Dongmei Huang[1,2], P. K. A. Wai[3,2]; *[1]Department of*

Electrical and Electronic Engineering, The Hong Kong Polytechnic Univ., Hong Kong; [2]The Hong Kong Polytechnic Univ. Shenzhen Research Inst., China; [3]Hong Kong Baptist Univ., Hong Kong. Repetition-rate-synchronized dual-combs are generated in triple coupled microresonators operating in the normal dispersion by exploiting avoided mode crossing, opening up new possibilities for dual-comb generation and integrated applications.

13:00 -- 15:00
Room: W206B
JW3G • Symposium: Nonlinear Terahertz Photonics
Presider: Chiara Trovatello; Columbia Univ., USA

JW3G.1 • 13:00 (Invited)
Observing and Enhancing Terahertz Nonlinear Effects Using Guided Modes and Plasmonic Structures, Thomas E. Murphy[1]; *[1]Electrical and Computer Engineering, Univ. of Maryland, USA.* Terahertz nonlinear effects are often too weak to observe in practice. We review recent work to increase the terahertz nonlinear interaction with materials through the use of optical waveguide structures and plasmon resonances.

JW3G.2 • 13:30 (Invited)
Nonlinear Optics of Graphene and Other Post-2000 Materials, Nathalie Vermeulen[1]; *[1]Vrije Universiteit Brussel, Belgium.* Since 2000 various new nonlinear-optical materials have emerged, including 2D materials such as graphene. After highlighting graphene's nonlinear response at optical and THz frequencies, I will briefly discuss a new data table for post-2000 nonlinear-optical materials.

JW3G.3 • 14:00 (Invited)
Terahertz Doppler-Free Spectroscopy with UTC-PD Emitter, Koichiro Tanaka[1], Kohei Eguchi[1]; *[1]Kyoto Univ., Japan.* Doppler-free spectroscopy with a counter-illuminated pump-and-probe configuration was performed using a uni-traveling-carrier photodiode. From the pump light intensity and pressure dependence of the Lamb-dip, the homogeneous width under zero pressure is estimated to be 32 kHz. This value is consistent with the transit time width (~36 kHz) estimated from the experimental configuration.

JW3G.4 • 14:30 (Invited)
Terahertz Photonics On-chip, Ileana-Cristina Benea-Chelmus[1]; *[1]Ecole Polytechnique Federale de Lausanne, Switzerland.* Abstract not available.

13:00 -- 15:00
Room: W207A
SW3H • Semiconductor Lasers for Neural Networks and Data Communication
Presider: Yating Wan; King Abdullah Univ of Sci & Technology, Saudi Arabia

SW3H.1 • 13:00
On-Chip Quantum Dot Lasers Driven High-Speed Optical Neural Networks, Zhican Zhou[1], Yuetong Fang[2], Xiangpeng Ou[1], William He[1], Xuhao Wu[1], Renjing Xu[2], David Z. Pan[3], Yating Wan[1]; *[1]King Abdullah Univ. of Science and Technology, Saudi Arabia; [2]Hong Kong Univ. of*

Science and Technology (Guangzhou), China; [3]The Univ. of Texas at Austin, USA. We present an optical neural network architecture driven by on-chip quantum dot lasers, achieving 3.5 TOPS/mm^2 theoretical computational density. With an optimized model (reducing programming operations by over 75%), our architecture attains 91.128% MNIST accuracy.

SW3H.2 • 13:15
Red VCSEL Array for Optical Parallel-Interconnected Links with Ultra-Low Energy Consumption, Nawal Almaymoni[1], Omar Alkhazragi[1], Fabian Finkbeiner[1], Tien Khee Ng[1], Boon S. Ooi[1]; *[1]KAUST, Saudi Arabia.* We demonstrated a high data rate of 4.7 Gb/s based on a single 650-nm vertical-cavity surface-emitting laser with 2-pJ/bit energy consumption, potentially enabling Tb/s parallel interconnects based on a 14×16 array.

SW3H.3 • 13:30
Machine Learning for Quantum Cascade Laser Design and Optimization, Andres Correa Hernandez[1], Claire Gmachl[1]; *[1]Princeton Univ., USA.* A machine learning framework is used to predict the laser performance of 10^9 quantum cascade laser designs in 8 hours. The algorithm demonstrates how to optimize the layer structure, yielding a 2-fold increase in performance.

SW3H.4 • 13:45
Artificial Neural Networks for Laser Frequency Stabilization, Lisa V. Winkler[1], Christian Noelleke[1]; *[1]TOPTICA Photonics AG, Germany.* We present a machine learning approach to automatic frequency locking of lasers based on artificial neural networks. We show that this method reliably identifies the target line under a wide range of operating conditions.

SW3H.5 • 14:00 (Invited)
Large-scale Optical Neural Networks with VCSEL Arrays, Zaijun Chen[1]; *[1]Univ. of Southern California, USA.* Abstract not available.

SW3H.6 • 14:30
40-Gbps Direct Modulation of Electrically Driven 1D Photonic-Crystal Nanolaser on SiO_2/Si, Takuma Tsurugaya[1], Koji Takeda[1], Takuro Fujii[1], Toru Segawa[1], Shinji Matsuo[1]; *[1]NTT Device Technology Labs, Japan.* We demonstrate 40-Gbps, 16.6-fJ/bit direct modulation of a one-dimensional photonic-crystal (1D-PhC) nanolaser on SiO_2/Si with 180-μA bias current. Very strong optical confinement in the laterally-current-injected 1D-PhC nanocavity is a key for the high-speed, high-modulation-efficiency operation.

SW3H.7 • 14:45
Terahertz squeezed light and self-pulsing in semiconductor lasers with nonlinear loss, Sahil Pontula[1], Jamison Sloan[1], Nicholas Rivera[1,2], Marin Soljačić[1]; *[1]Massachusetts Inst. of Technology, USA; [2]Harvard Univ., USA.* We show how the combination of dispersive outcoupling and Kerr nonlinearity in semiconductor lasers creates regimes of self-pulsing and intensity-squeezed states of light from optical to terahertz wavelengths.

13:00 -- 15:00
Room: W206BC
FW3I • Sensing and Manipulating Quantum Phases in 2D Materials and Quantum Wells
Presider: Matthias Florian; Univ. of Michigan, USA

FW3I.1 • 13:00 (Tutorial)
Excitons and Quantum Phase Transitions in 2D, Xiaoyang Zhu[1]; *[1]Columbia Univ., USA.* The Coulomb and exchange interactions are poorly screened in 2D, resulting in tightly bound excitons and strong exciton-exciton and exciton-carrier interactions. I will discuss 2D excitonic quantum phases and sensing of quantum phases by excitons.

FW3I.2 • 14:00
Interplay of near band-edge excitations with unbound charge-carriers, Daniel Anders[1], Markus Stein[1], Sangam Chatterjee[1]; *[1]Institue of Experimental Physics I, Justus-Liebig-Univ., Germany.* Electron-exciton scattering in semiconductor quantum wells is investigated by ultrafast optical pump-terahertz probe spectroscopy. The energy of the electron-hole plasma is varied, revealing a strong energy dependence of elastic and inelastic scattering.

FW3I.3 • 14:15
Lightwave-Driven Valley Control in Graphene, Daniel M. Lesko[1], Tobias Weitz[1], Simon Wittigschlager[1], Peter Hommelhoff[1]; *[1]Physics, Friedrich-Alexander-Universitat, Germany.* With circular/linearly polarized bi-chromatic electric fields we drive $\omega - 2\omega$ phase dependent currents in graphene. Comparison with theory reveals the generation of valley specific currents critical to lightwave electronics.

FW3I.4 • 14:30
Efficient Valleytronic Switches for High-Sensitivity Electric-Field Measurements, Markus Borsch[1], Zetian Mi[1], Rupert Huber[2], Mackillo Kira[1]; *[1]Univ. of Michigan, USA; [2]Univ. of Regensburg, Germany.* We study the efficiency of lightwave-induced valleytronic switching of coherent excitons using quantum-dynamic cluster expansion computations and apply a sequence of valleytronic switches for high-sensitivity detection of electric-field fluctuations.

FW3I.5 • 14:45
Control of Many-Particle States in $MoSe_2$ Monolayer Observed by Double-Quantum Spectroscopy, Adam Alfrey[1], Blake Hipsley[1], Chenxi Liu[2], Hui Deng[1], Steven T. Cundiff[1]; *[1]Physics, Univ. of Michigan, USA; [2]Nuclear Engineering and Radiological Science, Univ. of Michigan, USA.* Atomically-thin semiconductors host strongly-correlated states due to the reduced Coulombic screening. Using double-quantum coherent spectroscopy, we observe interacting doubly-excited exciton states in monolayer $MoSe_2$. Electrostatically injected electrons are observed to screen long-range interactions.

13:00 -- 15:00
Room: W207D
AW3J • Photonic Foundry Development
Presider: Tingyi Gu; Univ. of Delaware, USA

AW3J.1 • 13:00
Ultralow Voltage Folded Electro-Optical Modulators in Thin-Film Lithium Niobate Foundry Process, Alberto Della Torre[1], Homa Zarebidaki[1], Jacopo Leo[1], Arno Mettraux[1], Andrea Volpini[1], Davide Grassani[1], Ivan Prieto[1], Olivier Dubochet[1], Michel Despont[1], Hamed Sattari[1]; *[1]Swiss Center for Electronics and Microtechnology (CSEM), Switzerland.* Electro-optical modulators at 1550 nm wavelength with a V_π as low as 0.21 V are presented. The folded devices, occupying an effective length of 1.5 cm, are manufactured in a foundry process following design rules.

AW3J.2 • 13:15
Monolithically Integrated High Performance Silicon Nitride Passive Optical Components, Sujith Chandran[1], Yusheng Bian[1]; *[1]GlobalFoundries, USA.* We demonstrate low-loss SiN passive optical components, encompassing straight and bend waveguides, 1×2MMI, 2×2MMI, directional-coupler, waveguide crossings and cWDM, on a monolithic silicon photonics platform. Statistical hardware performance data validates the mass manufacturability of these building-blocks.

AW3J.3 • 13:30 (Invited)
Heterogeneous Photonics in Visible and Beyond, Minh Tran[1], Zeyu Zhang[1], Boqiang Shen[1], Yang Shen[1], Ali E. Dorche[1], Woonghee Lee[1], Kaustubh Asawa[1], Glenn Kim[1], Nathan Kim[1], Chong Zhang[1], Tin Komljenovic[1]; *[1]Nexus Photonics, Inc., USA.* We present some recent advancements related to extending the wavelength range of heterogeneous silicon nitride photonic platform, achieved by integrating indium-phosphide, gallium-arsenide and gallium-nitride based active components in a wafer scale process.

AW3J.4 • 14:00
AlGaN on AlN/Sapphire: A New Material Platform in Integrated Photonics Technology, Sinan Gundogdu[1,2], Tommaso Pregnolato[2,1], Sofia Pazzagli[1], Tim Kolbe[2], Sylvia Hagedorn[2], Markus Weyers[2], Tim Schroder[1,2]; *[1]Humboldt Universität zu Berlin, Germany; [2]Ferdinand Braun Inst., Germany.* AlGaN on AlN/Sapphire stands out in photonics for its strong nonlinearity, electro-optic modulability, and low loss in the visible spectrum. We fabricate and characterize AlGaN photonic devices, including ring resonators, directional couplers, and tapers.

AW3J.5 • 14:15
Silicon Nitride-based CMOS-photonic Devices Using High-Q Resonators, Rakesh M. Krishna[1], Zhongdi Peng[1], Amir Hosseinnia[1], Shane Oh[1], Muhannad Bakir[1], Ali Adibi[1]; *[1]Georgia Tech, USA.* We present silicon-nitride (SiN) resonators designed in a CMOS-photonic platform which offers both electronics and photonics on the same chip. The taped-out devices provide high-quality (Q) factors of up to 10^5

AW3J.6 • 14:30

An Open-Access Platform for Thin Film Lithium Niobate Photonic Integrated Circuits (TFLN PICs), Hamed Sattari[1], Ivan Prieto[1], Homa Zarebidaki[1], Jacopo Leo[1], Gregory Choong[1], Fatemeh Arefi[1], Mattia Orvetiani[1], Alberto Della Torre[1], Yves Petremand[1], Michele Palmieri[1], Olivier Dubochet[1], Michel Despont[1]; [1]*Centre Suisse d'Electronique et de Micro, Switzerland.* We introduce an open, standardized TFLN PICs platform available to PIC designers through a fabless scheme. Several technology steps have been established, providing a reliable process design kit (PDK) in the telecommunication C-band.

AW3J.7 • 14:45

Narrow-linewidth and frequency-agile FMCW laser on the Si_3N_4-on-SOI photonic platform, Chuxin Liu[1], Xinhang Li[1], Yuyao Guo[1], Liangjun Lu[1,2], Linjie Zhou[1,2], Jianping Chen[1,2]; [1]*Shanghai Jiao Tong Univ., China;* [2]*SJTU-Pinghu Inst. of Intelligent Optoelectronics, China.* We demonstrate a hybrid-integrated self-injection-locked laser on the Si_3N_4-on-SOI platform to generate FMCW signal with 9 kHz linewidth, 2 MHz repetition rate, and high linearity, supporting FMCW-LiDAR with refresh rate up to megapixels per second.

13:00 -- 15:00
Room: W208
FW3K • Hybrid Quantum Photonics
Presider: Navin Lingaraju; JHU Applied Physics Laboratory, USA

FW3K.1 • 13:00

Quantum Entanglement of Microwave and Optical Photonic Qubits with a Chip-Scale Transducer, David lake[1], Srujan Meesala[1], Steven Wood[1], Piero Chiappina[1], Changchun Zhong[2], Andrew Beyer[3], Matthew Shaw[3], Liang Jiang[2], Oskar Painter[1,4]; [1]*Kavli Nanoscience Inst. and Thomas J. Watson, Sr., Laboratory of Applied Physics and Inst. for Quantum Information and Matter, California Inst. of Technology, USA;* [2]*Pritzker School of Molecular Engineering, The Univ. of Chicago, USA;* [3]*Jet Propulsion Laboratory, California Inst. of Technology, USA;* [4]*Center for Quantum Computing, Amazon Web Services, USA.* We generate entangled microwave and optical photonic qubits with a chip-scale piezo-optomechanical transducer. We envision such an entangled pair source as an important building block for optical quantum networks of superconducting quantum processors.

FW3K.2 • 13:30

Heterogeneous Integration of Spin-photon Interfaces with a Scalable CMOS Platform, Linsen Li[1], Lorenzo De Santis[2], Isaac Harris[1], Kevin Chen[1], Ian Christen[1], Matthew Trusheim[1], Ruonan Han[1], Dirk Englund[1]; [1]*Massachusetts Inst. of Technology, USA;* [2]*Delft Univ. of Technology, Netherlands.* We introduce a quantum system-on-chip (QsoC) architecture based on (I) a co-designed diamond quantum memory array, (II) a custom CMOS backplane, and (III) a protocol for fully connected cluster state generation.

FW3K.3 • 13:45

Free-electron ponderomotive guiding for strong coupling and single-photon nonlinearity, Aviv Karnieli[1], Nicholas Rivera[2], Charles Roques-Carmes[1], Shanhui Fan[1]; [1]*Stanford Univ., USA;* [2]*Harvard Univ., USA.* We show how ponderomotive guiding of free electrons inside hollow optical fibers enables strong electron-photon coupling, together with exceptionally high single photon nonlinearities.

FW3K.4 • 14:00
Telecom-to-Visible Frequency Conversion in a SiN Microresonator, Sidarth Raghunathan[1], Richard Oliver[1], Yun Zhao[1], Karl J. McNulty[1], Michal Lipson[1], Alexander L. Gaeta[1]; *[1]Columbia Univ., USA.* We demonstrate frequency conversion between 1283 nm and 705 nm using Bragg scattering four-wave mixing in a microresonator, which represents the largest frequency span demonstrated. Our noise measurements suggest it is suitable for quantum applications.

FW3K.5 • 14:15
Strong interactions between integrated microresonators and alkali atomic vapors: towards single-photon-level operation, Roy T. Zektzer[1,2], Xiyuan Lu[1,2], Khoi Tuan Hoang[1], Rahul Shrestha[1], Sharoon Austin[1,3], Feng Zhou[1,2], Ashish Chanana[2], Daron Westly[2], Paul D. Lett[1,4], Alexey V. Gorshkov[1,3], Kartik Srinivasan[1,2]; *[1]Joint Quantum Inst., Univ. of Maryland, USA; [2]Microsystems and Nanotechnology Division, National Inst. of Standards and Technology, USA; [3]Joint Center for Quantum Information and Computer Science, National Inst. of Standards and Technology (NIST) – Univ. of Maryland, USA; [4]Quantum Measurement Division, National Inst. of Standards and Technology, USA.* We demonstrate strong coupling between an ensemble of ≈50 atoms interacting with a high-Q (>4x105) atomic-cladded microring-resonator, yielding a many-atom cooperativity C≈3.6. We further discuss photonic crystal ring defect resonator development for high single-atom-level cooperativity

FW3K.6 • 14:45
Bidirectional Microwave-optical Frequency Conversion via Itinerant Optomechanics, I-Tung Chen[1], Haoqin Deng[1], Mo Li[1]; *[1]Univ. of Washington, USA.* An itinerant optomechnical system is introduced using silicon-on-sapphire platform. By selecting different input configurations, efficient bidirectional microwave-to-optical conversion can be achieved, opening a new paradigm for optomechanical quantum transduction.

13:00 -- 15:00
Room: W209A
JW3L • Symposium: Warm Vapor Quantum Devices I
Presider: Paul Kunz; Army Research Labs, USA

JW3L.1 • 13:00 (Invited)
Warm Vapor Four-wave Mixing for Generating Optical Quantum States, Paul D. Lett[1,2]; *[1]National Inst of Standards & Technology, USA; [2]Joint Quantum Inst., NIST/Univ. of Maryland, USA.* Warm atomic vapors make good, high-density, and highly nonlinear media for generating entangled quantum states. One- and two-mode squeezed states generated in this way are useful for quantum information processing and sensor applications.

JW3L.2 • 13:15 (Invited)
Efficient, Broadband Quantum Memory in Atomic Barium Vapor, Virginia O. Lorenz[1]; *[1]Univ. of Illinois Urbana-Champaign, USA.* I will present a hot atomic barium vapor quantum memory with a record storage efficiency for ultrashort photons of 95.6±0.3% and very low noise and discuss its prospects for quantum information science applications.

JW3L.3 • 13:30 (Invited)
Quantum Networking with Microfabricated Atomic Vapor Cells, Roberto Mottola[1], Gianni Buser[1], Suyash Gaikwad[1], Philipp Treutlein[1]; [1]*Department of Physics, Univ. of Basel, Switzerland.* Quantum memories for photons are building blocks of quantum networks. Memories implemented in hot alkali vapor are attractive as they operate without cryogenics or ultra-high vacuum. We demonstrated single-photon storage and retrieval in such memories and for the first time implemented them in microfabricated cells compatible with wafer-scale mass production – a crucial step towards scalability. [PRX Quantum 3, 020349 (2022)] and [PRL 131, 260801 (2023)].

JW3L.4 • 13:45 (Invited)
Title to be Announced, Uriel Levy[1]; [1]*Hebrew Univ. of Jerusalem, Israel.* Abstract not available.

JW3L.5 • 14:00 (Invited)
Laser-Actuated Sealing for Microfabricated Alkali Vapor Cells, Vincent Maurice[1], Linda Péroux[1], Arthur Dewilde[1], Andrei Mursa[2], Clément Carlé[2], Ravinder Chutani[1], Samuel Queste[2], Jean-François Clément[1], Rémy Vicarini[2], Abdelkrim Talbi[1], Philippe Pernod[1], Rodolphe Boudot[2], Nicolas Passilly[2]; [1]*Univ. Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, UMR 8520 – IEMN – Institut d'Electronique de Microélectronique et de Nanotechnologie, France;* [2]*FEMTO-ST Inst., Université de Franche-Comté, CNRS, France.* We report on a novel way of realizing microfabricated alkali vapor cells for miniature atomic devices. Reminiscent of the w–ll-established glass-blowing techniques, it consists in implementing "make-seal" and "break-seal" features -commonly found in cell filling setups- within microfabricated devices. We show how single-use sealing structures can be laser-actuated, either to hermetically isolate cavities from each other, or to connect them together. We discuss some use cases in atomic devices.

JW3L.6 • 14:15 (Invited)
Precision Spectroscopy in Microfabricated Vapor Cells, Matthew T. Hummon[1]; [1]*National Inst of Standards & Technology, USA.* Microfabricated vapor cells offer a path toward low size, weight, and power devices for applications in atomic timing. I will discuss recent developments in our group for precision optical spectroscopy using microfabricated vapor cells.

JW3L.7 • 14:30 (Invited)
Improvements of the Pulsed Optically Pumped Rb Clock, Michele Gozzelino[1], Filippo Levi[1], Salvatore Micalizio[1], Claudio Calosso[1]; [1]*INRIM, Italy.* Pulsed Optically Pumped Rb is a clock technology that allowed record stability in vapor cells. We show a clock stability entering in the E-16 range, and propose a new laser stabilization scheme simplifying the set-up

JW3L.8 • 14:45 (Invited)
Molecular Iodine Optical Atomic Clocks, Jonathan Roslund[1], Arman Cingoz[1], Abijith Kowligy[1], Micah Ledbetter[1], Sean Moore[1], Guthrie Partridge[1], Parth Patel[1], Frank Roller[1], Dan Sheredy[1], Evan Atchison[1], Paul Carney[1], Omar Husain[1], Mary-Kate Pasha[1], Elton Pashollari[1], Akash Rakholia[1], Gunnar Skulason[1], joe song[1], Andy Dowd[1], Jamil Abo-Shaeer[1], Martin Boyd[1]; [1]*Vector Atomic, USA.* Vector Atomic has developed optical clocks using iodine vapor cells. These clocks provide excellent short-term instability, require neither laser cooling nor

cavity pre-stabilization, are insensitive to motion, and maintain holdovers of <1ns for several days.

13:00 -- 15:00
Room: W209B
FW3M • Topological Processes I
Presider: Matthias Heinrich; Univ. of Rostock, Germany

FW3M.1 • 13:00
Photonic Weyl Points on Non-Orientable Brillouin Zones, Sachin Vaidya[3], André Grossi Fonseca[3], Thomas Christensen[1], Mikael C. Rechtsman[2], Taylor L. Hughes[4], Marin Soljačić[3]; *[1]Department of Electrical and Photonics Engineering, Technical Univ. of Denmark, Denmark; [2]Department of Physics, Pennsylvania State Univ., USA; [3]Department of Physics, Massachusetts Inst. of Technology, USA; [4]Department of Physics, Univ. of Illinois at Urbana-Champaign, USA.* Weyl points are topological degeneracies that occur in the momentum space of three-dimensional lattices. Using a photonic system, we explore the fate of Weyl-point topology when the underlying manifold (i.e., the Brillouin zone) is non-orientable.

FW3M.2 • 13:15
Topological Photonic Cavities on the III-N Platform for the Second Harmonic Generation in the UV-visible Spectrum, Tao Li[1], Rui Xu[1], Zhaobo Mei[1], Jingan Zhou[1], Mingfei Xu[1], Shisong Luo[1], Cheng Chang[1], Ziyi He[2], Hanyu Zhu[1], Yuji Zhao[1]; *[1]Rice Univ., USA; [2]Arizona State Univ., USA.* 1D topological photonic cavities supporting a single resonance around the wavelength of 800 nm were fabricated from a gallium nitride on silicon wafer for highly polarized second harmonic generation around the wavelength of 400 nm.

FW3M.3 • 13:30
Higher-Order Topological Corner and Edge Defects in Polaritonic 2D-SSH and Breathing Kagome Lattices, Philipp Gagel[1], Johannes Düreth[1], Simon Betzold[1], Alexia Landry[1], Christian G. Mayer[1], David Laibacher[1], Siddhartha Dam[1], Johannes Beierlein[1], Monika Emmerling[1], Sven Hoefling[1], Sebastian Klembt[1]; *[1]Univ. of Würzburg, Germany.* We demonstrate lasing from higher-order topological corner and edge modes in polaritonic 2D-SSH and breathing Kagome lattices. Novel hybrid III/V-dielectric microcavities are implemented, ensuring precise inter-site couplings and thus topologically protected laser modes.

FW3M.4 • 13:45
Topological Protection of Bell States in Two-Dimensional Quantum Walk, Liat Nemirovsky Levy[1], Mark Lyubarov[1], Ohad Segal[1], Mordechai Segev[1]; *[1]Technion, Israel.* We present a method to protect the entanglement of a Bell-state encoded on a single photon performing a two-dimensional discrete-time quantum walk. We show an edge-state at the boundary of two distinct quantum walk domains.

FW3M.5 • 14:00
Observation of Topological Singularity Mapping in Photonic Kagome Lattice, Yihan Wang[1], Domenico Bongiovanni[1,2], Zhichan Hu[1], Junqian Wang[1], Sihong Lei[1], Xiuying Liu[3], Daohong Song[1], Roberto Morandotti[2], Zhigang Chen[1]; *[1]School of Physics, Nankai Univ., China; [2]EMT, INRS Univ., Canada; [3]College of Physics and Materials Science, Tianjin Normal*

Univ., China. We report momentum-to-real-space topological singularity mapping in photonic Kagome lattice, where selective excitation of pseudospin states around the Dirac point leads to direct observation of pseudospin-dependent optical vortex generation.

FW3M.6 • 14:15
Topological Protected Transport of Broadband Quantum Frequency Comb in Valley Photonic Crystals, Zhen Jiang[1], Hongwei Wang[1], Yikai Su[1], Chun Jiang[1], Guangqiang He[1]; *[1]Shanghai Jiao Tong Univ., China.* We propose on-chip topological transport of quantum frequency comb (10 THz) with frequency entanglement in valley photonic crystals. Our proposal could open new avenues for high-dimensional information processing utilizing topology in quantum system.

FW3M.7 • 14:30
Quantized Pumping in Disordered Nonlinear Thouless Pumps, Abhijit P. Chaudhari[1], Marius Jürgensen[1], Mikael C. Rechtsman[1]; *[1]Physics, Pennsylvania State Univ., USA.* Solitons have been shown to exhibit rigorously quantized motion in Thouless pumps, despite not uniformly populating a band. Here we experimentally demonstrate that they maintain that quantization even in the presence of disorder up to a critical threshold, unlike Wannier functions.

FW3M.8 • 14:45
Is Photonic Band Topology Common?, Ali Ghorashi[1], Sachin Vaidya[1,2], Mikael C. Rechtsman[2], Wladimir Benalcazar[3], Marin Soljačić[1], Thomas Christensen[1,4]; *[1]Massachusetts Inst. of Technology, USA; [2]Physics, Pennsylvania State Univ., USA; [3]Physics, Emory Univ., USA; [4]Electrical and Photonics Engineering, Technical Univ. of Denmark, Denmark.* Yes. Using high-throughput screening of randomly generated samples, we determine how symmetry, dielectric contrast, and other design parameters influence the prevalence of two-dimensional photonic crystal band topology, across stable, fragile, and higher-order topological varieties.

13:00 -- 15:00
Room: W209C
SW3N • Free Space Communications and Satellite Networks
Presider: Christina Lim; Univ. of Melbourne, Australia

SW3N.1 • 13:00 (Tutorial)
Optical Satellite Networks, Vincent W. Chan[1]; *[1]Massachusetts Inst. of Technology, USA.* Abstract not available.

SW3N.2 • 14:00
Design and Performance of a Multi-mode Photon-counting Receiver for the NASA Orion Artemis II Optical Communications System, Matthew E. Grein[1], Robert Schulein[1], Farzana Khatri[1], Steven Constantine[1], Zachary Darling[1], Bryan Robinson[1], Daniel Murphy[1], Matthew Shaw[2], Emma Wollman[2], Ryan Rogalin[2], Nathaniel Richard[2], Vikas Anant[5], Jennifer Nappier Downey[3], Nikki Desch[4], Steve Hall[4]; *[1]Lincoln Laboratory, Massachusetts Inst of Technology, USA; [2]Jet Propulsion Laboratory, California Inst. of Technology, USA; [3]Glenn Research Center, USA; [4]NASA Goddard Space Flight Center, USA; [5]Photon Spot, Inc., USA.* A multi-mode photon-counting optical receiver was designed and tested for the NASA Orion Artemis II Optical

Communications System downlink. The receiver achieved error-free communications from 20 Mb/s to 267 Mb/s with single-photon-level sensitivity.

SW3N.3 • 14:15

A Real-time Demonstration of Bidirectional Multi-format/Rate-adjustable Integrated Laser Communication/Ranging for Satellite Communication, Yizhou Wang[1], Yuanxiang Wang[1], Zhen Luo[1], Linsheng Zhong[1], Yang Zou[1], Xueyuan Ao[1], Jiale Liu[1], Feng Fan[2], Xiaoliang Li[2], Xiaoxiao Dai[1], Qi Yang[1], Deming Liu[1]; *[1]Huazhong Univ. of Science and Techn, China; [2]Beijing Research Inst. of Telemetry, China.* A multi-format/rate-adjustable integrated laser communication/ranging system is proposed, achieving adjustable rates between 0.625-10Gbit/s. Real-time experiment shows that at 1e-4 BER the ranging error is only 0.29% of the width of the code element.

SW3N.4 • 14:30

Enhancement of Physical Layer Security in FSO Links by Longitudinally Tailoring the Noise Power to Overwhelm the Signal Power, Xinzhou Su[1], Huibin Zhou[1], Zile Jiang[1], Abdulrahman Alhaddad[1], Muralekrishnan Ramakrishnan[1], Moshe Tur[2], Andreas F. Molisch[1], Alan Willner[1]; *[1]Univ. of Southern California, USA; [2]Tel Aviv Univ., Israel.* We experimentally demonstrate a 120-Gbit/s 16-QAM free-space optical link with enhanced physical-layer security by co-propagating a “noise” channel with tailored 227haracteri profile along propagation direction. 20-dB signal-to-interference ratio difference can be achieved at different longitudinal locations.

SW3N.5 • 14:45

14 Bits per Photon Detection in the Photon-Starved Regime for Deep-Space Optical Communication, Sai Kanth Dacha[1,2], René-Jean Essiambre[2], Alexei Ashikhmin[2], Andrea Blanco-Redondo[2], Yuanhang Zhang[2], Cheng Guo[2], Frank R. Kschischang[3], Konrad Banaszek[4], Roland Ryf[2], Matthew Weiner[2], Nicolas Fontaine[2], Thomas E. Murphy[5], Ellsworth Burrows[2]; *[1]Columbia Univ., USA; [2]Nokia Bell Labs, USA; [3]Department of Electrical and Computer Engineering, Univ. of Toronto, Canada; [4]Centre for Quantum Optical Technologies, Univ. of Warsaw, Poland; [5]Inst. for Research in Electronics and Applied Physics, Univ. of Maryland, USA.* We demonstrate a record 14 bits-per-incident-photon Photon Information Efficiency (PIE) detection. The new transmitter produces an average extinction ratio of 89~dB, operates at four times higher rates than previous high-PIE demonstrations.

13:00 -- 15:00
Room: W209DE
SW3O • Advanced Lasers on Chip
Presider: Lan Li; Westlake Univ., China

SW3O.1 • 13:00

Titanium:Sapphire-on-Insulator Tunable Chip-Scale Laser, Joshua Yang[1], Kasper S. Van Gasse[1], Daniil M. Lukin[1], Melissa Guidry[1], Geun Ho Ahn[1], Alex D. White[1], Jelena Vuckovic[1]; *[1]Stanford Univ., USA.* We demonstrate the first tunable integrated Titanium:Sapphire laser. The Titanium:Sapphire-on-insulator waveguide lasers achieve coarse tuning of up to 24.7 THz and operate at threshold powers as low as 6.9 mW, allowing for diode-pumped single-mode operation.

SW3O.2 • 13:15

Titanium-sapphire-on-insulator (Ti:SaOI) nanophotonic waveguide amplifier, Kasper S. Van Gasse[1], Joshua Yang[1], Daniil Lukin[1], Melissa A. Guidry[1], Geun Ho Ahn[1], Alex D. White[1], Jelena Vuckovic[1]; [1]*Stanford Univ., USA.* We present a thin-film titanium-sapphire-on-insulator (Ti:SaOI) nanophotonic waveguide amplifier, achieving 19 dB net on-chip gain and picosecond-pulse amplification to a record 1 kW peak power and 2.3 nJ pulse energy.

SW3O.3 • 13:30

Erbium-doped lithium niobate waveguide amplifier with internal net gain exceeding 20 dB, Minglu Cai[1], Tianyi Li[1], Xujia Zhang[1], Xianyi Cao[1], Long Wang[1], Yuanbin Liu[1], Jianping Chen[1], Kan Wu[1]; [1]*Shanghai Jiao Tong Univ., China.* The 10-cm long erbium-doped lithium niobate waveguide amplifier can achieve 52.2 dB signal enhancement with a 22.2 dB internal net gain at 1531 nm, which exceeds 20 dB at 45% wavelengths of the C-band.

SW3O.4 • 13:45 (Invited)

Heterogeneous Lasers for Advanced Integrated Photonic Platforms, Chao Xiang[1]; [1]*Univ. of Hong Kong, Hong Kong.* Abstract not available.

SW3O.5 • 14:15

On-chip InP/LiNbO3 microcomb laser, Jingwei Ling[1], Zhengdong Gao[1], Shixin Xue[1], Qili Hu[1], Mingxiao Li[1], Kaibo Zhang[1], Usman Javid[1], Raymond L. Rios[1], Jeremy Staffa[1], Qiang Lin[1]; [1]*Univ. of Rochester, USA.* We report a chip-scale InP/LiNbO3 laser that directly emits mode-locked microcomb on demand, with spectral bandwidth ~50 nm, individual comb linewidth ~600 Hz, frequency tuning rate > 2.4 × 1017 Hz/s, and 100% utilization of optical power for comb generation.

SW3O.6 • 14:30

Kerr Microresonator Optical Parametric Oscillation with Wide Continuous Frequency Tuning, Jordan R. Stone[1], Xiyuan Lu[1], Grégory Moille[1], Daron Westly[2], Kartik Srinivasan[1]; [1]*Joint Quantum Inst., USA;* [2]*NIST, USA.* We leverage wavenumber-selective Kerr microresonator optical parametric oscillation to demonstrate nonlinear wavelength converters whose output frequencies are controlled via integrated heater technology and are continuously tunable over 1.5 THz.

SW3O.7 • 14:45

High efficiency Raman Lasing in integrated GaN microresonators, ZhaoQin He[1], Changzheng Sun[1], Bing Xiong[1], Jian Wang[1], Zhibiao Hao[1], Lai Wang[1], Yanjun Han[1], Hongtao Li[1], Lin Gan[1], Yi Luo[1]; [1]*Department of Electronic Engineering, Tsinghua Univ., China.* We demonstrate high efficiency integrated Raman laser based on high-*Q* GaN microresonators. A threshold pump power of ~ 21 mW and a slope efficiency of ~ 44.5% are recorded.

13:00 -- 15:00
Room: W209F
FW3P • Free Electron Physics
Presider: Ofer Kfir; Tel Aviv Univ., Israel

FW3P.1 • 13:00
Free-Electron Computed Tomography of Near-Fields, Tamir Shpiro[1], Ron A. Ruimy[1], Tomer Bucher[1], Avner Shultzman[1], Ido Kaminer[1]; *[1]Technion, Israel.* We propose a reconstruction method of 3D electromagnetic near-fields in nanostructures, which can be realized using ultrafast transmission electron microscopes. We develop a Radon-like algorithm extracting the complex field's vectorial nature.

FW3P.2 • 13:15
Upper limit to quantum interaction strength between free electrons and electromagnetic single modes, Zetao Xie[1], Zeling Chen[1], Hao Li[2], Qinghui Yan[3], Hongsheng Chen[4], Xiao Lin[4], Ido Kaminer[3], Owen Miller[2], Yi Yang[1]; *[1]The Univ. of Hong Kong, China; [2]Yale Univ., USA; [3]Technion – Israel Inst. of Technology, Israel; [4]Zhejiang Univ., China.* Free–electron quantum optics facilitates electron-photon entanglement for quantum information processing. The challenge is finding specialized photonic-structures optimizing electron-photon interactions. We present a first-principle upper limit on the interaction strength, guiding the design of future structures.

FW3P.3 • 13:30
Probing the Formation of Nonlinear Optical States with Free Electrons, Jan-Wilke Henke[1,2], Yujia Yang[3,4], F. Jasmin Kappert[1,2], Arslan S. Raja[3,4], Germaine Arend[1,2], Guanhao Huang[3,4], Armin Feist[1,2], Zheru Qiu[3,4], Rui N. Wang[3,4], Aleksandr Tusnin[3,4], Alexey Tikan[3,4], Tobias J. Kippenberg[3,4], Claus Ropers[1,2]; *[1]Max Planck Inst. for Multidisciplinary Sciences, Germany; [2]4th Physical Institutions, Univ. of Göttingen, Germany; [3]Inst. of Physics, Swiss Federal Inst. of Technology Lausanne (EPFL), Switzerland; [4]Center for Quantum Science and Engineering, Swiss Federal Inst. of Technology Lausanne (EPFL), Switzerland.* Combining nonlinear integrated photonics with electron microscopy, we probe the formation of optical dissipative structures in Si_3N_4 microresonators with free electrons and find unique spectral fingerprints in the electron spectrum that enable new electron beam modulation schemes.

FW3P.4 • 14:00
Theory and Experiment of Nanoscale Heterostructure Scintillators, Avner Shultzman[1], Orr Beer[1], Rotem Strassberg[1], Georgy Dosovitskiy[1], Roman Schütz[1], Noam Veber[1], Charles Roques-Carmes[2], Yehonadav Bekenstein[1], Ido Kaminer[1]; *[1]Technion, Israel; [2]Stanford, USA.* We develop a framework modeling nanoscale heterostructure scintillators, predicting their light yield quantitatively and comparing with new fabricated multilayer polymer-scintillators. This combined theory-experiment approach unveils the prospects of controlling secondary-electrons for future enhanced scintillators.

FW3P.5 • 14:15
Light emission from sub-keV free electrons, Dolev Roitman[4,1], Aviv Karnieli[2], Shai Tsesses[3], Zahava Barkay[1], Ady Arie[5,1]; *[1]Center of Nanoscience and Nanotechnology, Tel Aviv Univ., Israel; [2]Department of Applied Physics, Stanford, USA; [3]Department of Physics, MIT-Harvard Center for Ultracold Atoms and Research Laboratory of Electronics, Massachusetts Inst. of*

technology, USA; [4]Raymond and Beverly Sackler School of Physics and Astronomy, Tel aviv Univ., Israel; [5]School of Electrical Engineering, Fleischman Faculty of Engineering, Tel Aviv Univ., Israel. We demonstrate coherent free-electron radiation in visible wavelengths with electron energies as low as 300 eV – a major step towards broadband, tunable, energy efficient on-chip light sources and observation of quantum emission recoil effects.

FW3P.6 • 14:30
Imprinting Chirality on Free-Electrons by Breaking All Mirror Symmetries, Qinghui Yan[1], Arthur Niedermayr[1], Ron A. Ruimy[1], Tomer Bucher[1], Harel Nahari[1], Hanan H. Sheinfux[2], Raphael Dahan[1], Yuval Adiv[1], Michael Yannai[1], Eli Janzen[3], James H. Edgar[3], Guy Bartal[1], Shai Tsesses[1], Frank Koppens[2,4], Giovanni Vanacore[5], Ido Kaminer[1]; *[1]Andrea & Erna Viterbi Department of Electrical and Computer Engineering, Technion – Israel Inst. of Technology, Israel; [2]ICFO-Institut de Ciències Fotòniques, The Barcelona Inst. of Science and Technology, Spain; [3]Tim Taylor Department of Chemical Engineering, Kansas State Univ., USA; [4]ICREA-Institució Catalana de Recerca I Estudis Avanats, Spain; [5]Department of Materials Science, Univ. of Milano-Bicocca, Italy.* We experimentally demonstrate the generation of chiral electron beams in an ultrafast transmission electron microscope without chiral light or chiral-shaping structures, instead breaking all mirror symmetries in the light-electron interaction.

13:00 -- 15:00
Room: W210
FW3Q • Optical Computation and Synthetic Dimensions
Presider: Joshua Feis; Univ. of Rostock, Germany

FW3Q.1 • 13:00 (Invited)
Analog Information Processing on a Photonic Chip with Programmable Photonic Integrated Circuits, Mohammad-Ali Miri[1], Kevin Zelaya[1], Matthew Markowitz[1]; *[1]Queens College of CUNY, USA.* We introduce a circuit architecture for efficient integrated photonic implementation of arbitrary discrete linear operators. The proposed architecture is built on interlacing discrete fractional Fourier transform layers with programmable phase shifter arrays.

FW3Q.2 • 13:30
Deep learning empowered synthetic dimension dynamics, Shiqi Xia[1], Sihong Lei[1], Daohong Song[1], Luigi Di Lauro[2], Imtiaz Alamgir[2], Liqin Tang[1], Jingjun Xu[1], Roberto Morandotti[2], Hrvoje Buljan[1,3], Zhigang Chen[1]; *[1]Teda College of Nankai Univ., China; [2]INRS-EMT, Canada; [3]Univ. of Zagreb, Croatia.* We propose and demonstrate a scheme for light manipulation in synthetic mode dimensions with deep learning, leading to unusual mode dynamics and, particularly, the morphing of light into topological modes in an ANN-designed photonic platform.

FW3Q.3 • 13:45
Fast-gain for photonic emulation of synthetic lattices with fully populated bands, Alex Dikopoltsev[1], Ina Heckelmann[1], Mathieu Bertrand[1], Giacomo Scalari[1], Mattias Beck[1], Oded Zilberberg[2], Jerome Faist[1]; *[1]ETH Zurich, Switzerland; [2]Konstanz Univ., Germany.* Photonic emulators facilitate solid-state phenomena exploration and optical quantum-inspired device development. We propose and demonstrate fast-gain semiconductor ring lasers as coherent lattice emulators with fully populated reciprocal space, harnessing interactions unique to synthetic space.

FW3Q.4 • 14:00

A Compact Photonic Architecture for General Linear Transformations, Kevin Zelaya[1], Matthew Markowitz[1,2], Mohammad-Ali Miri[1,2]; *[1]Department of Physics, Queens College of CUNY, USA; [2]Physics Program, Graduate Center, CUNY, USA.* This letter introduces a photonic architecture that enables the realization of arbitrary complex-valued matrices. This is achieved by interlacing amplitude-and-phase diagonal matrices combined with unitary DFrFT matrices. Numerical convergence and resilience to defects are discussed.

FW3Q.5 • 14:15

Creating edge states within a synthetic dimension of orbital angular momentum, Yu-wei Liao[1]; *[1]Univ. of Sci. and Tech.of China, China.* We establish a sharp boundary within an SSH lattice of orbital angular momentum. The band structures with edge states are measured directly. Furthermore, various other boundary effects are observed.

FW3Q.6 • 14:30

Stochastic logic in biased coupled photonic probabilistic bits, Michael Horodynski[1], Charles Roques-Carmes[2,3], Yannick Salamin[1,3], Seou Choi[3], Jamison Sloan[3], Di Luo[1,4], Marin Soljačić[1,3]; *[1]Department of Physics, Massachusetts Inst. of Technology, USA; [2]E. L. Ginzton Laboratory, Stanford Univ., USA; [3]Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA; [4]Department of Physics, Harvard Univ., USA.* We propose an experimentally viable photonic approach to solve arbitrary probabilistic computing problems. Our proposition relies on a network of coupled optical parametric oscillators that are controlled with a bias field.

13:00 -- 15:00
Room: W211
SW3R • Electro-optic Modulators
Presider: Avik Dutt, USA

SW3R.1 • 13:00

Hybrid integration of silicon slot photonics with ferroelectric nematic liquid crystal for poling-free Pockels-effect modulation, Deniz Onural[1], Imbert Wang[1], Li-Yuan Chiang[2], Shiva Raja[1], Xinchang Zhang[1], Manuj Singh[1], Dingning Li[1], Howard Dao[1], Spencer Pajk[2], Jason W. Sickler[2], Cory Pecinovsky[2], Miloš Popović[1]; *[1]Boston Univ., USA; [2]Polaris Electro-Optics, Inc., USA.* Recently discovered ferroelectric nematic liquid crystal promises to enable both strong phase shifters and fast Pockel'' effect modulation without poling. We demonstrate the first silicon slot-waveguide hybrid integration and demonstrate modulation up to 35 GHz.

SW3R.2 • 13:15

60 GHz Adiabatic Microring Modulator with ultra-wide 80nm operation wavelength range, David Chan[1], Hon K. Tsang[1]; *[1]The Chinese Univ. of Hong Kong, Hong Kong.* A novel adiabatic silicon microring modulator with >20dB extinction across 80nm wavelength range is demonstrated for the first time. The modulator has over 60GHz modulation bandwidth and supports up to 250Gb/s (125Gbaud) PAM-4.

SW3R.3 • 13:30

Novel Electro-Optic Modulation via PT Symmetry Breaking on a Hybrid Silicon Oxynitride on Lithium Niobate Platform, Shriddha Chaitanya[1], Ipshita Datta[1], Janderson R. Rodrigues[1], Michal Lipson[1]; *[1]Columbia Univ., USA.* We demonstrate a new electro-optic modulator via PT symmetry breaking on a hybrid silicon oxynitride on lithium niobate platform. We show an EO efficiency of 1.56 pm/V at a low propagation loss of < 0.2 dB.

SW3R.4 • 13:45

Nanophotonic spectral translation of electro-optic frequency combs, David Long[1], Jordan R. Stone[1,2], Yi Sun[1,2], Daron Westly[1], Kartik Srinivasan[1,2]; *[1]NIST, USA; [2]Joint Quantum Inst., NIST/Univ. of Maryland, USA.* Here we show that an electro-optic frequency comb can be used as the pump laser in a nanophotonic optical parametric oscillator, allowing for efficient and accurate spectral translation through much of the visible and near-infrared.

SW3R.5 • 14:00

Cryogenic Operation of Hetero-Integrated Thin-Film Lithium Niobate Modulators, Nicholas Boynton[1], Thomas A. Friedmann[1], Shawn C. Arterburn[1], Katherine Musick[1], Matthew S. Boady[1], Andrew Starbuck[1], Douglas C. Trotter[1], Andrew S. Pomerene[1], Anthony L. Lentine[1], Michael Gehl[1]; *[1]Sandia National Laboratories, USA.* Cryogenic operation of hetero-integrated TFLN/SiPh modulators is reported for the first time. V_π is quantified at cryogenic temperatures and compared to behavior at 300K. Enhancement of V_π at low frequencies compared to 300K is observed.

SW3R.6 • 14:15

Low voltage chip-scale electro-optic comb generation and photonic readout, David Long[1], Kyunghun Han[1,2], Sean M. Bresler[1,3], Junyeob Song[1,2], Yiliang Bao[1,2], Benjamin J. Reschovsky[1], Kartik Srinivasan[1,3], Jason J. Gorman[1], Vladimir A. Aksyuk[1], Thomas W. LeBrun[1]; *[1]NIST, USA; [2]Theiss Research, USA; [3]Univ. of Maryland, USA.* We present a frequency agile, integrated electro-optic comb spectrometer based on thin-film lithium niobate which can operate with ultralow radiofrequency voltages. As a demonstration we used this platform to simultaneously interrogate two chip-scale photonic sensors.

SW3R.7 • 14:30

High-speed, sub-volt silicon microring modulator driven by high-mobility transparent conducting oxide, Wei-Che Hsu[1], Alan X. Wang[2], Nabila Nujhat[1], Benjamin Kupp[1], John F. Conley[1]; *[1]Oregon State Univ., USA; [2]Baylor Univ., USA.* We demonstrated a MOSCAP silicon microring modulator integrated with high-mobility titanium-doped indium oxide, achieving sub-volt 0.8 V_{pp} modulation up to 25 Gb/s, marking a milestone in transparent conducting oxide modulators for efficient optical communication.

SW3R.8 • 14:45

Electro-optic Analog-to-Digital Converter Using Spectral Interferometry, Linbo Shao[1], Joseph Thomas[1], Bernadeta Srijanto[2], Kevin Lester[2], Ivan Kravchenko[2], Yizheng Zhu[1]; *[1]Virginia Tech, USA; [2]Oak Ridge National Laboratory, USA.* We demonstrate an optical analog-to-digital converter (ADC) leveraging spectral interferometry of an integrated electro-optic Mach-Zehnder interferometer on thin-film lithium niobate. The ADC features a high dynamic range of 118 dB/Hz with a 3-Vpp input range.

16:00 -- 18:00
Room: W201AB
SW4A • Spatial and Temporal Control of Femtosecond Laser Pulses
Presider: Murat Yessenov; Univ. of Central Florida, CREOL, USA

SW4A.1 • 16:00
Practical guide for programmable control of ultrashort laser pulse propagation dynamics along any trajectory, Enar Franco[1], Óscar Martínez-Matos[1], José A. Rodrigo[1]; *[1]Universidad Complutense de Madrid, Spain.* Curved-Shaped Laser (CSL) pulses are a new kind of structured ultrashort laser pulses whose spatiotemporal properties along any trajectory are controlled on demand. We present a practical guide to design and experimentally create CSL pulses.

SW4A.2 • 16:30
Experimental Demonstration of Longitudinally Tailored Dynamic Motion of a Spatiotemporal Wave Packet, Yingning Wang[1], Xinzhou Su[1], Ruoyu Zeng[1], Zile Jiang[1], Huibin Zhou[1], Abdulrahman Alhaddad[1], Wing Ko[1], Yuxiang Duan[1], Muralekrishnan Ramakrishnan[1], Yue Zuo[1], Moshe Tur[2], Alan Willner[1]; *[1]Univ. of Southern California, USA; [2]Tel Aviv Univ., Israel.* We experimentally demonstrate a longitudinally controllable STWP with dynamic rotation. Measurement shows the generated packet rotates counterclockwise with a 4.8-ps period at 0.05 m and clockwise with a 2.4-ps period at 0.15 m.

SW4A.3 • 16:45
Generation of high-order femtosecond vortices up to the 1^{0t}h order from a powerful mode-locked Hermite-Gaussian laser, Hongyu Liu[1], Lisong Yan[1], Hongshan Chen[1], Xin Liu[1], Heyan Liu[1], Qing Wang[2], Jinwei Zhang[1]; *[1]Huazhong Univ. of Science and Techn, China; [2]Beijing Inst. of Technology, China.* We present a mode-locked Hermite-Gaussian Yb:KGW laser oscillator. The average powers and pulse durations of vortex pulses up to 10th via astigmatic mode conversion are several hundred milliwatts and less than 500 fs, respectively.

SW4A.4 • 17:00
Generation of ultrashort twisted light pulses with arbitrary polarization using a vortex plate retarder, Tlek Tapani[1], Haifeng Lin[1], Aitor De Andres[1], Spencer W. Jolly[2], Hinduja Bhuvanendran[1], Nicolò Maccaferri[1]; *[1]Umeå Univ., Sweden; [2]Université libre de Bruxelles, Belgium.* We use a vortex retarder approach to generate few optical cycles light pulses carrying orbital angular momentum and arbitrary polarization. The optical vortices' structure is then reconstructed in the spatio-temporal domain.

SW4A.5 • 17:15
Representation of Spatiotemporal Wave Packets Having Dynamic Motion on a Modified Poincaré Sphere, Ruoyu Zeng[1], Xinzhou Su[1], Yingning Wang[1], Zile Jiang[1], Hongkun Lian[1], Huibin Zhou[1], Wing Ko[1], Muralekrishnan Ramakrishnan[1], Abdulrahman Alhaddad[1], Moshe Tur[2], Demetrios Christodoulides[1], Alan Willner[1]; *[1]Univ. of Southern California, USA; [2]Tel Aviv Univ., Israel.* Spatiotemporal wave packets having dynamic motion are represented as points on a modified Poincaré sphere. Wave packets having different motion trajectories and 4.8-ps period can be experimentally synthesized by combining 208-GHz spaced frequencies having different modes.

SW4A.6 • 17:30

Hybrid Air-Bulk Multipass Cell Compressor for High Pulse Energies with Spatio-temporal Characterization, Alan Omar[1], Martin Hoffmann[1], Geoffrey Galle[2], François Sylla[2], Clara J. Saraceno[1]; *[1]Ruhr Universitat Bochum, Germany; [2]SourceLAB, France.* We present a simplified high-energy multipass cell (MPC) compression setup operated at ambient air at 400 µJ pulse energy. We compress 220 fs pulses to 27 fs, enhancing the peak power to 10.2 GW. We fully characterize spatio-temporal couplings and geometrical aberrations, using the INSIGHT device, revealing excellent spatio-temporal properties.

SW4A.7 • 17:45

Temporal Compression of a Vortex Pulse in a Gas-Filled Capillary, Mekha Vimal[1], Michele Natile[2], Jean-François Lupi[3], Florent Guichard[2], Dominique Descamps[3], Marc Hanna[1], Patrick Georges[1]; *[1]Laboratoire Charles Fabry, France; [2]Amplitude, France; [3]CELIA, France.* We study nonlinear propagation of a pulse propagating over a set of four capillary modes that carries an orbital angular momentum. This results in compression from 640 to 74 fs, while preserving the spatial structure.

16:00 -- 18:00
Room: W201CD
FW4B • Excitons in Two-dimensional Materials and van der Waals Heterostructures
Presider: Adam Alfrey; Umich, USA

FW4B.1 • 16:00

Correlation-driven Nonequilibrium Exciton Site Transition in a wSe_2/WS_2 Moiré Supercell, Jinjae Kim[1,2], Jiwon Park[1,2], Hyojin Choi[1,2], Taeho Kim[3,4], Soonyoung Cha[5], Lee Yewon[3,4], Kenji Watanabe[6], Takashi Taniguchi[6], Jonghwan Kim[3,4], Moon-ho Jo[3,4], Hyunyong Choi[1,2]; *[1]Seoul National Univ., Korea (the Republic of); [2]Inst. of Applied Physics, Korea (the Republic of); [3]Department of Materials Science and Engineering, Pohang Univ. of Science and Technology, Korea (the Republic of); [4]Center for van der Waals Quantum Solids, Inst. for Basic Science (IBS), Korea (the Republic of); [5]Department of Physics and Astronomy, Univ. of California, USA; [6]National Inst. for Materials Science, Japan.* We have investigated the site-dependent nonequilibrium exciton correlations in wSe_2/WS_2 heterobilayers. Near-zero angles exhibit intriguing polarization switching and enhanced Pauli blocking, while a 60° twist angle shows no such correlations, emphasizing moiré supercell configuration dependence.

FW4B.2 • 16:15

Moiré Localization Induced Enhancement in the Decoherence Time of Interlayer Excitons in wSe_2-$MoSe_2$ Heterobilayers, Ibrahim Sarpkaya[1], Mehmet A. Durmus[1], Kaan Demiralay[1], Muhammad M. Khan[1], Seyma E. Atalay[1]; *[1]National Nanotechnology Research Center (UNAM), Bilkent Univ., Turkey.* We show that prolonged dephasing times can be obtained from the emission of an ensemble of moiré-localized iXs in hBN-encapsulated wSe_2-$MoSe_2$ heterobilayers under moderate pump powers, which would be critical for quantum photonics applications.

FW4B.3 • 16:30
Moire excitons confined by twisted hBN substrates, Xiaoqin Li[1]; *[1]Univ. of Texas at Austin, USA.* We demonstrate a new approach to confining excitons in a MoSe2 monolayer via the electrostatic potential from a twisted hBN substrate, which offers more flexibility in controlling exciton properties in a moire superlattice.

FW4B.4 • 17:00
Enhanced Drift Transport in 1D Excitonic Guides at Room Temperature, Matthias Florian[1], Zidong Li[1], Kanak Datta[1], Zhaohan Jiang[1], Markus Borsch[1], Qiannan Wen[1], Mackillo Kira[1], Parag B. Deotare[1]; *[1]Univ. of Michigan, USA.* Local strain engineering is used to confine and direct exciton transport in a wSe_2 monolayer at room temperature. We demonstrate that local Auger- and Seebeck effects enhance the directional exciton drift velocity at elevated excitation densities.

FW4B.5 • 17:15
Long-range spin transport in indirect excitons in $MoSe_2/wSe_2$ heterostructure, Zhiwen Zhou[1], Erik A. Szwed[1], Darius Choksy[1], Lewis Fowlergerace[1], Leonid Butov[1]; *[1]Univ. of California San Diego, USA.* We observed spin transport with decay distances exceeding 100 microns and diverging in indirect excitons (iXs) in $MoSe_2/wSe_2$ heterostructure. With increasing IX density, we observed spin localization, then long-range spin transport, then spin localization.

FW4B.6 • 17:30
Withdrawn

FW4B.7 • 17:45
Modulation and Trapping of 2D Excitons Using Surface Acoustic Wave Resonators, Adina Ripin[1], Hannah Boyer[1], Mo Li[1]; *[1]Univ. of Washington, USA.* We aim to trap exciton in monolayer and homobilayer wSe_2 using an on-chip surface acoustic wave resonator. Trapping of excitons is detected from the spatial pattern of the photoluminescence (PL) of the excitons.

16:00 -- 18:00
Room: W204AB
FW4C • High Harmonic Generation in Condensed Matter
Presider: To be Announced

FW4C.1 • 16:00 (Invited)
Control and Imaging of Extreme Ultraviolet Radiation at the Nanoscale, Aleksey Korobenko[2], Sabaa Rashid[3], Christian Heide[4], Andrei Naumov[2], David M. Villeneuve[2], David A. Reis[4], Pierre Berini[1,3], Paul B. Corkum[2], Giulio Vampa[2]; *[1]Department of Physics, Univ. of Ottawa, Canada; [2]Joint Attosecond Science Laboratory, National Research Council of Canada and Univ. of Ottawa, Canada; [3]Center for Research in Photonics, Univ. of Ottawa, Canada; [4]Stanford PULSE Inst., SLAC National Accelerator Laboratory, USA.* We develop a novel approach to generation, shaping and characterization of extreme ultraviolet from a chip sized source, opening possibilities of addressing matter on nanometer scale, a corner stone of modern technology.

FW4C.2 • 16:30

Solid High Harmonic Enhancement Near the Band Gap Edge, Katarzyna Kowalczyk[1], Hortense Allegre[1], Joseph Broughton[1], Adam S. Wyatt[2], Yu Zhang[2], John W. tIsch[1], Emma Springate[2], Jon P. Marangos[1], Mary Matthews[1]; *[1]Physics, Imperial College, UK; [2]Central Laser Facility, STFC Rutherford Appleton Laboratory, UK.* We present a SWIR wavelength dependence study of high harmonics from MgO and α-Al_2O_3 We report robust enhancement for harmonic energies corresponding to the widest bandgap accompanied by gradual changes to the harmonic anisotropy.

FW4C.3 • 16:45
Ponderomotive detuning of excitonic high harmonics in GaN, You Wu[1], Zhaopin Chen[2], Christopher Ayala[1], Mark Levit[2], Ido Nisim[2], Yuanpeng Wu[1], Zetian Mi[1], Steven T. Cundiff[1], Mackillo Kira[1], Michael Krueger[2]; *[1]Univ. of Michigan, Ann Arbor, USA; [2]Technion, Israel.* Quantitative theory–experiment analysis demonstrates that ponderomotive detuning reveals a set of excitonic resonances in high harmonics emitted by a 200nm-thick GaN crystal. We show that these dynamical resonances are sensitive to electronic many-body effects.

FW4C.4 • 17:00 (Invited)
High-order Harmonic Generation in Solids Driven by Mid-infrared and Terahertz Two-color Field, Sha Li[1], Yaguo Tang[1], lun yue[2], Vyacheslav Leshchenko[1], Lisa Ortmann[1], Bradford Talbert[1], Cosmin Blaga[1], yu hang Lai[1], Zhou Wang[1], Yang Cheng[1], Fengyuan Yang[1], Alexandra Landsman[1], Pierre Agostini[1], Mette Gaarde[2], Louis DiMaruo[1]; *[1]Ohio State Univ., USA; [2]Louisiana State Univ., USA.* We introduce a bichromatic approach for high harmonic generation (HHG) in solids that combines an intense mid-infrared driving field with a weak sub-terahertz dressing field, to study the laser-driven strong field process subjected to a Keldysh extreme low-frequency perturbation.

FW4C.5 • 17:30
Disentangling the low-order harmonic generation from bulk and thin films, Mukhtar Hussain[1,2], Gareth Williams[2], Tayyab Imran[3], Marco Peres[4], Katharina Lorenz[4], Marta Fajardo[2]; *[1]Arizona State Univ., USA; [2]Instituto de Plasmas e Fusão Nuclear-Laboratório Associado, Instituto Superior Técnico, Portugal; [3]Extreme Light Infrastructure-Nuclear Physics (ELI-NP), Romania; [4]Campus Tecnológico e Nuclear, Instituto Superior Técnico, Portugal.* We have explored the process of second harmonic generation (SHG) and third harmonic generation (THG) in thin films at 800 nm driving wavelength to disentangle the bulk and thin fil''s contribution of harmonics

FW4C.6 • 17:45
Plasma Mirrors for Generating Co- and Counter-Rotating Harmonics, Nicholas M. Fasano[1], Vedin Dewan[1], Julia M. Mikhailova[1]; *[1]Princeton Univ., USA.* We show that plasma mirrors driven by elliptically polarized laser beams emit harmonics that either co- or counter-rotate with the reflected fundamental, depending on the polarization state of the driving laser.

16:00 -- 18:00
Room: W205AB
AW4D • Quantum Key Distribution (QKD) II and Deployed Quantum Systems
Presider: Nate Gemelke; QuEra Computing Inc., USA

AW4D.1 • 16:00

Integrated Room Temperature Single Photon Source in Hexagonal Boron Nitride for Quantum Key Distribution, Helen Zeng[1], Ali Al-Juboori[1], Minh Nguyen[1], Xiaoyu Ai[2], Adam Bennet[3], Arne Laucht[2], Alexander Solntsev[1], Milos Toth[1], Richard Mildren[3], Robert Malaney[2], Igor Aharonovich[1]; *[1]Univ. of Technology Sydney, Australia; [2]Univ. of New South Wales, Australia; [3]Macquarie Univ., Australia.* Quantum Key Distribution (QKD) is important for a variety of quantum technologies. Here we demonstrate a free-space room temperature, discreet-variable QKD system using a bright Single photon sources (SPS) in hexagonal Boron Nitride (hBN).

AW4D.2 • 16:15

Dispersiveness of Faraday Mirrors Used to Compensate Random Polarization Distortion is Mitigated by the Randomness Itself, Salem F. Hegazy[1], Salah S. Obayya[1], Bahaa E. Saleh[2]; *[1]Cairo Univ., Egypt; [2]Univ. of Central Florida, USA.* Faraday mirrors, widely used to compensate random polarization distortion in retracing fibers, as in quantum key distribution, may be operated with shorter pulses than previously thought, since their dispersion is remarkably mitigated by randomness itself.

AW4D.3 • 16:30 (Invited)

Quantum Sensors for Space Exploration, Lisa Woerner[1]; *[1]DLR, Germany.* Abstract not available.

AW4D.4 • 17:00

Vehicle-to-Vehicle Quantum Key Distribution (V2V-QKD), Andrew C. Conrad[2], Samantha Isaac[3], Roderick Cochran[1], Daniel Sanchez-Rosales[1], Timur Javid[2], Daniel Gauthier[1], Paul Kwiat[3,2]; *[1]Physics, The Ohio State Univ., USA; [2]Electrical and Computer Engineering, Univ. of Illinois Urbana-Champaign (UIUC), USA; [3]Physics, Univ. of Illinois Urbana-Champaign (UIUC), USA.* Secure communication is required for future smart infrastructure networks. We demonstrate the first Quantum Key Distribution (QKD) link between two moving cars. Our system operates at low-speeds and at high-speeds on a U.S. Interstate Highway.

AW4D.5 • 17:15

Withdrawn

AW4D.6 • 17:30 (Invited)

Quantum Inertial Sensors for Field Applications, Vincent Menoret[2,1], Laura Antoni-Micollier[2], Maxime Arnal[2], Romain Gautier[2], Camille Janvier[1], Jérémie Richard[2], Pierre Vermeulen[2], Quentin "Armagnac de Castanet[1,2], Cyrille Des Cognets[1], Vincent Jarlaud[2,1], Baptiste Battelier[1], Peter Rosenbusch[2], Cédric Majek[2], Bruno Desruelle[2]; *[1]Institut "Optique Graduate School, France; [2]Exail, France.* Cold atom quantum sensors have now left laboratories. We have operated several gravimeters in field conditions, for example on a volcano, and are working on next generation onboard devices for geophysics and inertial navigation.

16:00 -- 18:00
Room: W205CD
JW4E • Symposium: Spectroscopic Advances in Biophotonics II
Presider: Mike Mirov, IPG Photonics, USA

JW4E.1 • 16:00 (Invited)
Withdrawn

JW4E.2 • 16:30 (Invited)
An Ultra-broadband Approach For Breath Analysis, Simona M. Cristescu[1]; [1]*Radboud Universiteit Nijmegen, Netherlands.* We present a breath analysis system using an intrapulse difference frequency generation-based (IDFG-based) supercontinuum source in the 2 – 11.5 µm wavelength range for simultaneous detection of metabolites in exhaled breath using Fourier transform spectroscopy.

JW4E.3 • 17:00 (Invited)
High-Resolution Dual-Comb Spectroscopy from 1 THz to 1 PHz, Konstantin L. Vodopyanov[1]; [1]*Univ. of Central Florida, CREOL, USA.* Starting from two phase-locked frequency combs based on Kerr-lens mode-locked Cr:ZnS lasers (2.35µm), we use various up- and down-conversion strategies to perform dual-comb spectroscopy across 1THz–1PHz range with up to some 1,000,000 comb-teeth resolved.

JW4E.4 • 17:30 (Invited)
Frequency Comb Breathomics Powered by Artificial Intelligence, Qizhong Liang[1]; [1]*JILA, USA.* Abstract not available.

16:00 -- 18:00
Room: W206A
SW4F • Nonlinear Optics in Microresonators II
Presider: Amy Foster; Johns Hopkins Univ., USA

SW4F.1 • 16:00
Linear and Nonlinear Interactions in Hybrid Microresonators with Controllable Coupling, Arghadeep Pal[1,2], Alekhya Ghosh[1,2], Hao Zhang[1,3], George Ghalanos[1], Toby Bi[1,2], Shuangyou Zhang[1], Lewis J. Hill[1], Pascal De''Haye[1,2]; [1]*Max-Planck-Inst Physik des Lichts, Germany;* [2]*Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany;* [3]*National Key Laboratory of Microwave Photonics, Nanjing Univ. of Aeronautics and Astronautics, China.* We investigate linear and nonlinear dynamics of light in coupled resonators. In our experiments, we can adjust the coupling gap between two resonators in real-time to study symmetry breaking of hybridized counterpropagating modes.

SW4F.2 • 16:15
Nonequilibrium Phase Transitions in a Dual-pumped Silicon Nitride Kerr Optical Parametric Oscillator, Yichen Shen[1], Sashank K. Sridhar[1], Grégory Moille[1], Kartik Srinivasan[2], Avik Dutt[1], Fahad A. Shaikh[1]; [1]*Univ. of Maryland, USA;* [2]*National Inst. of Standards and Technology, USA.* We demonstrate spectral phase transitions in dual-pumped Si_3N_4 nanophotonic Kerr optical parametric oscillators with anomalous dispersion. Through

pump-power modulation, we observe real-time switching between a near-degenerate signal (0-FSR separation) and non-degenerate signals (4-FSR separation).

SW4F.3 • 16:30

Towards UV-Visible Dual-Comb Spectroscopy with Lithium Niobate Nanophotonic Waveguides, Carter R. Mashburn[4,1], Kristina F. Chang[1], Tsung-Han Wu[1,4], Luis Ledezma[3], Ryoto Sekine[3], Alireza Marandi[3], Scott Diddams[2]; *[1]Time and Frequency Division, National Inst. of Standards and Technology, USA; [2]Electrical Engineering, Univ. of Colorado at Boulder, USA; [3]Electrical Engineering, California Inst. of Technology, USA; [4]Physics, Univ. of Colorado at Boulder, USA.* We present a dual-comb spectrometer that employs thin-film lithium niobate nanophotonic waveguides for UV-visible light generation. The potential for broadband and high-resolution spectroscopy spanning 350-850 nm is explored

SW4F.4 • 16:45

Bright Microresonator Solitons in the Normal Dispersion Regime, Shuangyou zhang[1], Toby Bi[1,2], Pascal De''Haye[1,2]; *[1]Max-Planck-Inst Physik des Lichts, Germany; [2]Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany.* We report the first experimental observation of bright single soliton states in the normal dispersion regime of a microresonator. The soliton generation can be explained by higher order dispersion.

SW4F.5 • 17:00

28 THz soliton frequency comb in a continuous-wave pumped fiber Fabry-Perot resonator, Thomas Bunel[1], Matteo Conforti[1], Zoheir Ziani[1], Julien Lumeau[2], Antonin Moreau[2], Arnaud Fernandez[3], Olivier Llopis[3], Germain Bourcier[3,4], Arnaud Mussot[1]; *[1]Univ. of Lille, CNRS, UMR 8523-PhLAM, France; [2]Aix Marseille Univ., CNRS, Centrale Marseille, France; [3]LAAS-CNRS, Universite de Toulouse, CNRS, 7 avenue de Colonel Roche, France; [4]CNES, 18 Avenue Edouard Belin, France.* We report the generation of a stable and broadband optical frequency comb, spanning a 28 THz bandwidth, sustained by a single 80 fs cavity soliton recirculating in a continuous-wave pumped fiber Fabry-Perot resonator.

SW4F.6 • 17:15

On-chip optical parametric oscillation aided multiple frequency combs generation in a single Si_3N_4 microresonator, Haizhong Weng[1], Vikash Kumar[1], Huilan Tu[2], Qiaoyin Lu[2], Weihua Guo[2], John Donegan[1]; *[1]Univ. of Dublin Trinity College, Ireland; [2]School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China.* Multiple Kerr frequency combs are demonstrated within a single pumped Si_3N_4 microresonator, facilitated by optical parametric oscillation. These coexisting frequency combs hold significant potential for applications in spectroscopy and sensing.

SW4F.7 • 17:30 (Invited)

Multi-mode and Multi-octave chi-2 Photonics, Dmitry V. Skryabin[1]; *[1]Dept. of Physics, Univ. of Bath, UK.* Dissipative chi-2 solitons in microresonators promise to provide unique solutions for generating tuneable frequency combs from ultraviolet to mid-infrared and complement dissipative Kerr solitons in applications. Generally, modelocking in chi-2 microresonators, where the small size of the structure matters, and chi-2 and chi-3 effects compete across the comb spectrum, makes a case for widening the soliton concept beyond the boundaries of traditional intuition.

16:00 -- 18:00
Room: W206B
JW4G • Symposium: Disruptive Photonic Detectors: Recent Advancement and Development with Novel Optical Materials
Presider: Muhammad Birowosuto and Shuwen Zeng; French National Centre for Scientific Re, France

JW4G.1 • 16:00 (Invited)
Perovskite Single Crystals for Direct Conversion Radiation Detectors, Makhsud Saidaminov[1]; [1]*Univ. of Victoria, Canada.* I will talk about our efforts in robotic-growth of $MAPbBr_3$ and $CsPbBr_3$ crystals for flat-panel radiation detectors. I will also share our concerns about potential overestimation of detection sensitivity in our field, originated from air-ionization.

JW4G.2 • 16:30 (Invited)
Tailoring light-matter interactions in perovskite scintillators with nanophotonics, Liang Jie Wong[1]; [1]*Nanyang Technological Univ., Singapore.* We theoretically show and experimentally demonstrate that plasmon-polariton modes can substantially enhance the decay rate and light yield of ultrafast perovskite scintillators, revealing nanoplasmonics as a potential key to greater timing resolution in X-ray detectors.

JW4G.3 • 17:00 (Invited)
Polaritons in Two -Dimensional Materials for Surface Enhanced Infrared Spectroscopy, Xiaoxia Yang[1]; [1]*National center for nanoscience & Tech, China.* Abstract not available.

JW4G.4 • 17:30 (Invited)
Quantum Dots for Short Wave Infrared (SWIR) Sensing, Lutfan Sinatra[1], Sergio Lentijo-Mozo[1], Alexander Bessonov[1], Marat Lutfullin[1]; [1]*Quantum Solutions, UK.* Quantum dot (QDs) offer cost-effective and scalable production of thin-film semiconductors with adjustable band gaps. Particularly intriguing are certain infrared-active QDs, which hold great promise for sensing applications beyond conventional silicon-based sensors. Our presentation will focus into the development of of PbS and InAs QDS for SWIR photodetectors and image sensors.

16:00 -- 18:00
Room: W207A
AW4H • Quantum and Nonlinear Photonics
Presider: Tingyi Gu; Univ. of Delaware, USA

AW4H.1 • 16:00
Heterogeneous Integration of Lithium Niobate and Silicon Photonics for Nonlinear Optics, Alexandra M. Palici[1], Xiyuan Lu[2,3], Kartik Srinivasan[2,3], Xinda Lu[1], Fabien Labbe[1], Yunhong Ding[1], Hugo Laroque[4], Ryan Hamerly[4], Carlos Errando Herranz[5], Minhao Pu[1], Dirk Englund[4], Mikkel Heuck[1]; [1]*Department of Electrical and Photonics Engineering, Technical Univ. of Denmark, Denmark;* [2]*Joint Quantum Inst., NIST/Univ. of Maryland, USA;* [3]*Microsystems and Nanotechnology Division, Physical Measurement Laboratory, National Inst. of Standards and Technology, USA;* [4]*Research Laboratory of Electronics, Massachusetts Inst. of Technology,*

USA; [5]Electrical Engineering, Mathematics and Computer Science, Delft Univ. of Technology, Netherlands. We demonstrate a hybrid device consisting of a thin film lithium niobate membrane transfer-printed onto a silicon nitride ring resonator. We measure quality factors in the 10^5 range at telecom wavelengths.

AW4H.2 • 16:15

An Integrated, Two-Colour Photon-Pair Source in Thin-Film Lithium Niobate, Silia Babel[1,2], Laura Bollmers[1,2], Werner Ridder[1,2], Bernhard Reineke[2], Benjamin Brecht[1,2], Christof Eigner[2], Laura Padberg[1,2], Christine Silberhorn[1,2]; *[1]Integrated Quantum Optics, Paderborn Univ., Germany; [2]Inst. for Photonic Quantum Systems (PhoQS), Germany.* We design and fabricate an integrated frequency-non-degenerate photon-pair source in thin-film lithium niobate. Our source generates high quality photon pairs with a brightness of 2.31×10^{13} pairs/(sWcm^2) and low heralded $g^{(2)}_h(0)$ of 0.084±0.034.

AW4H.3 • 16:30

Bright Heralded Single-photon Source with Ideal Purity based on Silicon Chip via Spontaneous Four Wave Mixing, Haoyang Wang[2], Huihong Yuan[1], Qiang Zeng[1], Lai Zhou[1], Haiqiang Ma[2], Zhiliang Yuan[1]; *[1]Beijing Academy of Quantum Info Sciences, China; [2]Beijing Univ. of Posts and Telecommunications, China.* We derive an explicit theoretical limit of purity for any heralded single-photon source, and subsequently demonstrate the ideal purity on an unprecedentedly bright source exceeding 1.5 MHz coincidence rate with the lowest $g^{(2)}_h(0)$ value of 0.000945.

AW4H.4 • 16:45

Passively Isolated On-Chip Comb Dynamics Enabled by Photonic Crystal Microresonators, Jakob Grzesik[1], Geun Ho Ahn[1], Alex D. White[1], Dominic Catanzaro[1], Jelena Vuckovic[1]; *[1]Stanford Univ., USA.* Dissipative Kerr Solitons are generated in silicon nitride photonics using microring resonators. Backscattered light, due to bidirectionally-propagating hybridized modes, are detrimental to the pump. We mitigate these effects with an on-chip passive optical isolator.

AW4H.5 • 17:00 (Invited)

Mid-infrared Photonic Integration and Nonlinear Optics on InP, Mikhail A. Belkin[1]; *[1]Technische Universität Munchen, Germany.* Due to its transparency and intersubband devices compatibility, InP platform is well-suited for mid-infrared photonic integration. We characterize mid-infrared losses and nonlinearities, demonstrate supercontinuum generation, and present functional components and device integration on this platform.

AW4H.6 • 17:30

Microwave Resonator Enhanced On-chip Electro-optic Frequency Comb Generation, Zhaoxi C. Chen[1], Yiwen Zhang[1], Hanke Feng[1], Ke Zhang[1], Cheng Wang[1]; *[1]City Univ. of Hong Kong, Hong Kong.* We realize a microwave resonator-enhanced electro-optical frequency comb generator with >4.6dB microwave power reduction compared with lumped capacitive electrodes. We generate up to 93 comb lines spaced at 25GHz at moderate microwave power of 26.6dBm.

AW4H.7 • 17:45

Sub-micron Ferroelectric Domain Control in Thin Film Lithium Niobate for Backward Second-harmonic Generation, Fengyan Yang[1], Juanjuan Lu[1], Mohan Shen[1], Guangcanlan Yang[1], Hong Tang[1]; [1]*Electrical Engineering, Yale Univ., USA.* We demonstrate reliable electric control of periodic domains in thin film lithium niobate with poling period down to 370nm, thus realizing first-order quasi-phase-matched backward SHG which exhibits an exceptional efficiency of 1400%/W/cm2.

16:00 -- 17:45
Room: W206BC
FW4I • THz Spectroscopy of Light-matter Interactions
Presider: Daniel Lesko; Friedrich-Alexander-Universitat, Germany

FW4I.1 • 16:00 (Invited)
Engineering Non-equilibrium Magnetic Order with THz Light, Ankit S. Disa[1]; [1]*Cornell Univ., USA.* Resonantly exciting THz frequency phonons provides a way to dynamically manipulate crystal structures in complex solids. I will show how we exploit this to engineer optically driven magnetic phases that do not exist in equilibrium.

FW4I.2 • 16:30
Terahertz nonlinear magnetic control of coherent magnon modes, Zhuquan Zhang[1], Frank Y. Gao[2], Edoardo Baldini[2], Keith A. Nelson[1]; [1]*Massachusetts Inst. of Technology, USA;* [2]*The Univ. of Texas at Austin, USA.* We demonstrate terahertz field-induced nonlinear couplings between two different magnon modes in an antiferromagnet, which manifest as magnon upconversion and coherent photon emissions at the difference and sum frequencies.

FW4I.3 • 16:45
Optical Pump THz Probe Spectroscopy on Metal-Organic Frameworks, Jens Neu[1]; [1]*Univ. of North Texas, USA.* Optical Pump THz Probe (OPTP) Spectroscopy is an outstanding technique to understand photoconductivity in emerging materials. We utilized OPTP to explore the photoconductivity in porous crystalline metal-organic frameworks (MOFs).

FW4I.4 • 17:00
Withdrawn

FW4I.5 • 17:15
Identifying Anharmonic Coupling Pathways using 2D THz Spectroscopy, Megan F. Nielson[1], Brittany E. Knighton[1], Aldair Alejandro[1], Abby Hassler[1], Claire Rader[1,2], Seyyed Jabbar Mousavi[3], Jeremy A. Johnson[1]; [1]*Brigham Young Univ., USA;* [2]*MIT, USA;* [3]*Univ. of Zurich, Switzerland.* We combine Raman scattering, terahertz transmission, sample angle dependences, and two-dimensional THz scans to determine 16 possible anharmonic couplings in x-cut beta-barium borate, but are limited in further analysis by overlapping coupling signals.

FW4I.6 • 17:30
Tailoring Ultrastrong Light-Matter Coupling Through Spatial Matter Design, Joshua Mornhinweg[2,1], Laura K. Diebel[2], Maike Halbhuber[2], Josef Riepl[2], Erika Cortese[3], Simone De Liberato[3,4], Dominique Bougeard[2], Rupert Huber[2], Christoph Lange[1]; [1]*Department of Physics, TU Dortmund Univ., Germany;* [2]*Department of Physics, Univ. of Regensburg, Germany;* [3]*School*

of Physics and Astronomy, Univ. of Southampton, UK; [4]3IFN–- Istituto di Fotonica e Nanotecnologie, CNR, Italy. Controlling the spatial overlap of multiple modes of planar THz resonators ultrastrongly coupled to cyclotron resonances of Landau-quantized electrons allows us to design coupling pathways, similarly to the selection rules of classical optics.

16:00 -- 18:00
Room: W207D
FW4J • Quantum Many-Body Systems and Collective Effects
Presider: Brielle Anderson; American Univ., USA

FW4J.1 • 16:00
Towards many-body Hamiltonian tomography from multi-mode quantum light emission, Chen Mechel[1], Offek Tziperman[1], Alexey Gorlach[1], Andrea Pizzi[2], Nicholas Rivera[2], Norman Y. Yao[2], Ido Kaminer[1]; *[1]Technion, Israel; [2]Harvard, USA.* We show that quantum many-body systems can transfer information about their Hamiltonians onto multi-mode quantum light states via collective spontaneous emission, opening new paths towards tomographic reconstruction of many-body Hamiltonians in complex configurations.

FW4J.2 • 16:15
Optical pumping of electronic quantum Hall states with vortex light, Deric Session[1], Mahmoud Jalali Mehrabad[1], Nikil Paithankar[1], Tobias Grass[1], Christian Eckhardt[1], Bin Cao[1], Daniel Suarez Forero[1], Kevin Li[1], Mohammad S. Alam[1], Kenji Watanabe[1], Takashi Taniguchi[1], Glenn S. Solomon[1], Nathan Schine[1], Jay Sau[1], Roman Sordan[1], Mohammad Hafezi[1]; *[1]Univ. of Maryland, USA.* We present a novel mechanism for the transfer of orbital angular momentum from optical vortex beams to electronic quantum Hall states. Specifically, we identify a robust contribution to the radial photocurrent in an annular graphene sample within the quantum Hall regime that depends on the vorticity of light.

FW4J.3 • 16:30 (Invited)
Magnetic polarons in a triangular Fermi-Hubbard Quantum Simulator, Zoe Yan[1]; *[1]Univ. of Chicago, USA.* Itinerant spin polarons–- bound quasiparticles of magnons and charge dopants–- have been predicted to emerge in Fermi-Hubbard models with frustration. I present results from Princeton's atomic triangular Hubbard quantum simulator on the detection of these polarons.

FW4J.4 • 17:00
Towards Nanophotonic Cavity-Enhanced Telecom-Compatible Quantum Memory on Thin-Film Lithium Niobate, Priyash Barya[1], Ogulcan Orsel[1], Elizabeth A. Goldschmidt[2]; *[1]Electrical and Computer Engineering, Univ. of Illinois Urbana Champaign, USA; [2]Department of Physics, Univ. of Illinois Urbana-Champaign, USA.* We demonstrate Purcell-enhanced emission from erbium doped in thin film lithium niobate using low-loss microring resonators which would enable improved performance of telecom-compatible atomic frequency comb quantum memory.

FW4J.5 • 17:15
Stoichiometric Rare-Earth Materials in Solids as a Platform for Quantum Memory Devices, Donny R. Pearson[1], Zachary W. Riedel[1], Selvin Tobar[1], Ashwith V. Prabhu[1], Elizabeth A. Goldschmidt[1], Daniel P. Shoemaker[1]; *[1]Univ. of Illinois, Urbana-Champaign, USA.* We present

the characterization of stoichiometric europium materials as progress towards realizing long-lived, ensemble-based quantum memory devices. The candidate materials demonstrate inhomogeneous optical linewidths similar to those in doped materials with 1000x larger densities.

FW4J.6 • 17:30
Adding Photon Entanglement and Quantum Beating to Superradiance by Using Multilevel Atoms, Amir Sivan[1], Meir Orenstein[1]; [1]*Andrew and Erna Viterbi Faculty of Electrical & Computer Engineering, Technion, Israel Inst. of technology, Israel.* Entanglement is added to the multiphoton state emanated by superradiance. It is achieved by employing multilevel atoms, via a multipath Dicke ladder. Additional quantum effects like beating between collective states are exhibited.

FW4J.7 • 17:45
Spontaneously Squeezing Superradiant Laser, Da-Wu Xiao[1], Chong Chen[1], Ren-Bao Liu[1]; [1]*Department of Physics, The Chinese Univ. of Hong Kong, Hong Kong.* We investigate a superradiant lasing system with atom-atom interaction. We find that this interaction induces a squeezed lasing phase, demonstrating the importance of coherent many-body interactions in lasing.

16:00 -- 18:00
Room: W208
SW4K • Microcavities for Quantum Photonics
Presider: To be Announced

SW4K.1 • 16:00 (Tutorial)
Tunable Fabry-Perot Microcavities for Quantum Technologies, David Hunger[1]; [1]*Karlsruhe Inst. of Technology, Germany.* Microcavities are a powerful tool to enhance light-matter interactions and enable efficient spin-photon interfaces. I will introduce the basics and the technology of open-access microcavities and report experiments with condensed-matter quantum emitters.

SW4K.2 • 17:00
Nanodiamonds With Group IV Defects Coupled to Fabry-Perot Resonators, Robert Berghaus[1], Gregor Bayer[1], Selene Sachero[1], Florian Feuchtmayr[1], Viatcheslav Agafonov[2], Alexander Kubanek[1]; [1]*Univ. Ulm, Quantum optics, Germany;* [2]*GREMAN, UMR 7347 CNRS, INSA-CVL, Tours Univ., France.* Using color center in diamond (e.g. silicon vacancy) coupled to an open Fabry-Perot cavity, we present an efficient spin-photon interface. We demonstrate optical coherent driving of a silicon vacancy transition and Purcell enhancement.

SW4K.3 • 17:15
Strong coupling between a single artificial atom and an integrated silicon carbide microresonator, Daniil M. Lukin[1], Dominic Catanzaro[1], Melissa Guidry[1], Eran Lustig[1], Misagh Ghezellou[2], Joshua Yang[1], Hiroshi Abe[3], Takesi Ohshima[3], Jawad Ul-Hassan[2], Jelena Vuckovic[1]; [1]*Stanford Univ., USA;* [2]*Linkoping Univ., Sweden;* [3]*National Insts. for Quantum and Radiological Science and Technology, Japan.* The strong coupling regime between a photonic

cavity and an artificial atom in 4H-Silicon Carbide-on-insulator photonics is demonstrated, using a high-finesse whispering gallery mode resonator and a single silicon vacancy center.

SW4K.4 • 17:30
High-Q photonic crystals cavities in visible wavelength using a thin film diamond, SophieWeiyi Ding[1], Michael Haas[1], Xinghan Guo[2], Kazuhiro Kuruma[1], Chang Jin[1], Zixi Li[2], David Awschalom[2], Nazar Delegan[2], F. Joseph Heremans[2], Alex High[2], Marko Loncar[1]; *[1]Harvard Univ., USA; [2]Univ. of Chicago, USA.* **We report photonic crystal cavities fabricated in a thin film diamond, featuring quality factors as high as ~2 x10^5 in visible wavelengths, and we demonstrate coupling between the cavity mode and a single silicon-vacancy center.**

16:00 -- 18:00
Room: W209A
JW4L • Symposium: Warm Vapor Quantum Devices II
Presider: Ricardo Jimenez-Martinez; FieldLine Industries, USA

JW4L.1 • 16:00 (Invited)
Title to be Announced, Eugene S. Polzik[1]; *[1]Kobenhavns Universitet, Denmark.* Abstract not available.

JW4L.2 • 16:15 (Invited)
Vapor Cell Rydberg Electrometry with Pulsed Interrogation, Michael Romalis[1]; *[1]Princeton Univ., USA.* Conventional Rydberg electrometry uses EIT with microwave Autler-Townes splitting. We describe a new method with sequential excitation to the Rydberg state, evolution under microwave fields in the dark and detection of the final state population.

JW4L.3 • 16:30 (Invited)
Drone Based Atomic Gradiometry, Ilja Gerhardt[1]; *[1]Inst. for Solid State Physics, Leibniz Univ. Hannover, Germany.* An atomic quantum sensor will be build to work on a drone to detect landmines and unexploded ordnance in soil.

JW4L.4 • 16:45 (Invited)
Withdrawn

JW4L.5 • 17:00 (Invited)
Omiband Atomic Receivers, Kevin C. Cox[1]; *[1]US Army Research Laboratory, USA.* Rydberg atoms are nature's antennas, with one nearly free electron and an enormous dipole moment (for an atom!). We utilize Rydberg atoms' compelling properties to develop wide-band and multi-band atomic receivers.

JW4L.6 • 17:15 (Invited)
Terahertz Imaging Using Thermal Atomic Vapour, Kevin J. Weatherill[1]; *[1]Durham Univ., UK.* We demonstrate full-field terahertz imaging at kilohertz frame rates using Rydberg states in atomic vapour. The atoms provide an efficient terahertz to optical conversion, allowing images to be captured using standard optical cameras.

JW4L.7 • 17:30 (Invited)
From Dipolar to Rydberg Photonics, Hadiseh Alaeian[1]; *[1]Purdue Univ., USA.* In this study, I present spectroscopic absorption and photoluminescence investigations focused on Rydberg excitons in synthetic Cu2O grown. Our observations reveal a series of Rydberg excitons. Furthermore, I present promising preliminary results from coupling Rydberg excitons to photonic circuitry, marking a significant advancement in the field of Rydberg photonics. These discoveries open up new avenues for the development of scalable and integrated quantum Rydbeg nano-photonics.

16:00 -- 18:00
Room: W209B
FW4M • Topological Processes II
Presider: Zhigang Chen; Teda College of Nankai Univ.; China

FW4M.1 • 16:00
Classifying Nonlinear Topological Materials Using Real-Space Invariants, Stephan Wong[1], Terry A. Loring[2], Alexander Cerjan[1]; *[1]Center for Integrated Nanotechnologies, USA; [2]Department of Mathematics and Statistics, Univ. of New Mexico, USA.* A real-space framework is developed to classify nonlinear topological insulators. By incorporating on-site Kerr terms into standard models, we show that topological nonlinear modes can create topological interfaces inside the lattice and resolve topological dynamics.

FW4M.2 • 16:15
Eigenenergy braids in two-dimensional photonic crystals, Janet Zhong[1], Charles Wojcik[1], Dali Cheng[1], Shanhui Fan[1]; *[1]Stanford Photonics Research Center, USA.* We show that two-dimensional non-Hermitian photonic crystals made of lossy material can exhibit nontrivial eigenenergy braids for non-contractible loops in the 2D Brillouin zone.

FW4M.3 • 16:30
1D Topological Laser with A Topological Bulk, Dayang Lin[1], Zhitong Li[2], Xi-Wang Luo[2], Abouzar Gharajeh[2], Jiyoung Moon[2], Junpeng Hou[2], Chuanwei Zhang[2], Qing Gu[1]; *[1]North Carolina State Univ., USA; [2]the Univ. of Texas at Dallas, USA.* We demonstrate a 1D topological laser with well-defined non-Hermitian topological bulk, implemented on the III-V compounds platform using the micro-ring array. This system results in high efficiency and robust edge-lasing.

FW4M.4 • 16:45
Demonstration of minimal higher-order topological insulators in strained photonic graphene, Yongsheng Liang[1], Shiqi Xia[1], Daohong Song[1], Zhigang Chen[1]; *[1]Teda College of Nankai Univ., China.* We propose and experimentally demonstrate higher-order topological insulator (HOTI) states in strained photonic graphene, representing a two-band minimal HOTI model, where zero-energy corner and edge states are degenerated due to preserved inversion and chiral symmetries.

FW4M.5 • 17:00 (Invited)

Topological and Non-Hermitian Photonics in Coupled Optical Fiber Loops, Joshua Feis[1], Sebastian Weidemann[1], Andrea Steinfurth[1], Julia Görsch[1], Alexander Szameit[1]; *[1]Inst. of Physics, Univ. of Rostock, Germany.* Optical gain and loss give rise to non-Hermitian and topological physics in the evolution of light. Along these lines, we experimentally demonstrate induced transparency, triple phase transitions and topological funneling in coupled optical fiber loops.

FW4M.6 • 17:30

Topological Soliton Formation in a Nanophotonic Optical Parametric Oscillator, Nicolas Englebert[1], Robert M. Gray[1], Luis Ledezma[1], Alireza Marandi[1]; *[1]California Inst. of Technology, USA.* We theoretically describe and experimentally observe signatures of spontaneous topological soliton formation through the locking of domain walls in a quadratic nonlinear resonator. These dark pulses can have a temporal duration of 65 fs.

FW4M.7 • 17:45

Extending Topological Edge States to Visible Wavelengths in a Silicon Nitride Ring-Resonator Lattice, David Sharp[1], Christopher Flower[2], Arnab Manna[1], Hannah Rarick[1], Mahmoud Jalali Mehrabad[2], Rui Chen[3], Mohammad Hafezi[2], Arka Majumdar[1,3]; *[1]Physics, Univ. of Washington, USA; [2]Electrical Engineering, Univ. of Maryland, USA; [3]Electrical and Computer Engineering, Univ. of Washington, USA.* Previous work in topological ring-resonator lattices has focused on infrared wavelengths where imaging technology is limited. In this work, this concept is extended to the visible regime with a silicon nitride platform.

16:00 -- 18:00
Room: W209C
SW4N • Optical Networks for Future Wireless Systems
Presider: Deepa Venkitesh; Indian Inst. of Technology Madras, India

SW4N.1 • 16:00 (Invited)

Towards Multi-Pbps Backbone Optical Networks in Support of Future 6G Networks, Tomkos Ioannis[1]; *[1]ECE, Univ. of Patras, Greece.* We describe innovative concepts associated with optical switching nodes and their transceiver interfaces that enable energy-efficient flexible capacity scaling (≥10 Tb/s per interface, ≥1 Pb/s capacity per link and ≥10 Pb/s throughput per node).

SW4N.2 • 16:30

MMW/Sub-THz/THz Signal through Bi-Directional Fiber-Optical/RF Wireless Transmission Employing Two Cascaded RSOAs, Yan-Zhen Xu[1], Wei-Xiang Chen[1], Chih-Hong Lin[1], Jia-Lian Jin[1], Tsai-Man Wu[1], Hai-Han Lu[1]; *[1]National Taipei Univ. of Technology, Taiwan.* MMW/Sub-THz/THz signals through bi-directional fiber-optical/RF wireless transmission with two cascaded RSOAs is implemented. By cascading RSOA, the downstream data are virtually eliminated for upstream. It shows potential for MMW/sub-THz/THz signals through bi-directional fiber-optical/RF wireless transmission.

SW4N.3 • 16:45

Approaching Theoretical Performance of 6G Distributed MIMO with Optical Analog Fronthaul, Rafael Puerta[2,1], Armands Ostrovskis[3], Kristaps Rubuls[3], Fabio Pittala[4], Markus Gruen[4], Hadrien Louchet[4], Mahdieh Joharifar[1], Anders Djupsjöbacka[5], Richard Schatz[1], Toms Salgals[3], Sandis Spolitis[3], Vjaceslavs Bobrovs[3], Oskars Ozolins[3,5], Xiaodan Pang[1,3]; *[1]Kungliga Tekniska Hogskolan, Sweden; [2]Ericsson Research, Ericsson, Sweden; [3]Riga Technical Univ., Latvia; [4]Keysight Technologies GmbH, Germany; [5]RISE Research Insts. of Sweden, Sweden.* We experimentally validate coherent joint transmission (CJT) in a D-MIMO system with four transmitters using analog fronthaul and RoF links, fulfilling CJT stringent synchronization requirements. MIMO gains close to theoretical values are demonstrated.

SW4N.4 • 17:00

Joint-design of Ultra High Resolution Vibration Sensing and Optical Heterodyne mm-wave RoF, Jingchuan Wang[1], Liwang LU[1], Yaxi Yan[1], Alan Pak Tao Lau[1], Chao Lu[1]; *[1]The Hong Kong Polytechnic Univ., Hong Kong.* We for the first time demonstrate simultaneous 0.5 m resolution distributed acoustic sensing and optical heterodyne dual polarization 16 Gb/s 16QAM 56 GHz mm-wave RoF front-haul communication over 10 km fiber by using linear frequency modulated subcarriers.

SW4N.5 • 17:15

Hybrid Analog and Digital RF Fronthaul Transmission over Low Cost VCSEL-APD based Free Space Optics link, Tongyun Li[1], Wajahat Ali[1], Shuai Yang[1], Ryan Jones[1], Rui Chen[1], Yi Liu[1], Michael Crisp[1], Richard Penty[1]; *[1]The Electrical Division, Department of Engineering, Univ. of Cambridge, UK.* A novel hybrid analog-digital free space optical fronthaul is proposed. Wideband spectral nulls in the digitized fronthaul allow analog RF insertion, enabling cost-effective simultaneous transmission.

SW4N.6 • 17:30

4K Real-Time Video Transmission in Invisible Infrared-band Underwater-Airborne Bidirectional Optical Wireless System Using a Single Silver Mirror as an Aerial Repeater, Kiichiro Kuwahara[1], Hyuga Nagami[1], Keita Tanaka[1], Fumiya Kobori[1], Ayumu Kariya[1], Hodaka Amano[1], Shogo Hayashida[2], Takahiro Kodama[1]; *[1]Kagawa Univ., Japan; [2]LED Backhaul Project, Sangikyo Corporation, Japan.* We demonstrated real-time 4K video transmission over an underwater-to-air optical wireless channel in a bidirectional class 1 eye-safe communication system with an aerial relay mirror and frequency-domain adaptive modulation in the complete non-visible light band.

16:00 -- 18:00
Room: W209DE
SW4O • Metasurfaces and Photonics Crystals
Presider: Vien Van; Univ. of Alberta, Canada

SW4O.1 • 16:00

Non-Hermitian248haracteriy of electrically tunable interusbband polaritonic metausrfaces, Hyeongju Chung[1], Jongwon Lee[1], Mikhail A. Belkin[2], Beomjoon Kim[1], Gerhard Boehm[2]; *[1]UNIST, Korea (the Republic of); [2]Technical Univ. of Munich, Germany.* We propose non-hermitian degeneracies in the mid-infrared using two orthogonal and electrically tunable

plasmonic split-ring resonators. These resonators are coupled to intersubband transitions in multiple-quantum wells and can be individually controlled by two bias voltages.

SW4O.2 • 16:15

Upconversion Enhancement Using Dielectric Metasurfaces, Nima Sefidmooye Azar[1], Matthew Parry[2], Xiao Qi[3], Changhwan Lee[4], Wendy S. Lee[1], Wei Luo[1], Robert de Gille[1], Duk-Yong Choi[2], Paul Mulvaney[1], P. James Schuck[4], Emory Chan[3], Bruce Cohen[3], Dragomir Neshev[2], Kenneth Crozier[1]; *[1]Univ. of Melbourne, Australia; [2]Australia National Univ., Australia; [3]Lawrence Berkeley National Laboratory, USA; [4]Columbia Univ., USA.* We integrate infrared-to-visible upconverting nanoparticles with an asymmetric dielectric metasurface to enhance their upconversion efficiency. An upconversion enhancement of up to ~100 times is achieved. We also demonstrate infrared-to-visible upconversion imaging using fabricated devices.

SW4O.3 • 16:30

Unidirectional Dispersive Grating Emitters for Silicon Photonic Beam Steerers, Fa-lun Chen[1], Gow-Zin Yiu[1], You-Chia Chang[1]; *[1]National Yaming Chiaotung Univ., Taiwan.* We demonstrate unidirectional grating emitters in which the phase-matching condition is satisfied only for the upward diffraction. The fabricated device shows unidirectionality of 83% and strong angular dispersion of 0.81°/nm, enabling efficient beam steering.

SW4O.4 • 16:45

Active twistoptics: on-chip multidimensional dynamic control for data hypercube reconstruction, Haoning Tang[1], Beicheng Lou[2], Fan Du[1], Guangqi Gao[1], Mingjie Zhang[1], Xueqi Ni[1], Amir Yacoby[1], Yuan Cao[3], Shanhui Fan[2], Eric Mazur[1]; *[1]Harvard Univ., USA; [2]Stanford Univeristy, USA; [3]Univ. of California, Berkeley, USA.* Our MEMS-integrated twistoptics device enables precise control of interlayer gaps and twist angles in photonic crystals, achieving high-accuracy, multidimensional light manipulation with significant potential in reconfigurable nanophotonics.

SW4O.5 • 17:15

Silicon Photonic Beam Steerer Based on Metalens Focal Plane Array with Direction Fine-tuning, Ping-Yen Hsieh[1], You-Chia Chang[1]; *[1]National Yang Ming Chiao Tung Univ., Taiwan.* We demonstrate a resolution-enhanced silicon photonic beam steerer that combines coarse steering with a focal plane array and fine-tuning with serpentine microheaters. The steerer allows 3N resolvable points with N waveguide channels.

SW4O.6 • 17:30

Scalable and Robust Beam Shaping Using Apodized Fish-bone Grating Couplers, Chad Ropp[1,2], Dhriti Maurya[1,2], Alexei Azarov[1,3], Alexander Yulaev[1,2], Daron Westly[1], Vladimir A. Aksyuk[1]; *[1]Physical Measurement Laboratory, National Inst. of Standards and Technology, Gaithersburg, Maryland 20899, USA, USA; [2]Department of Chemistry and Biochemistry, Univ. of Maryland, College Park, MD 20742, USA, USA; [3]Thesis Research, La Jolla, CA 92037, USA, USA.* We present a fish-bone grating coupler for precision beam shaping and millimeter-scale beam generation at 461 nm wavelength. Our design efficiently decouples scattering strength from minimal feature size, ensuring seamless turn-on and continuous emission control.

SW4O.7 • 17:45

Waveguide-fed Metasurfaces for High NA Focusing at Ultrashort Distances, Hrishikesh T. Iyer[1], Yurii Vlasov[1]; *[1]Univ. of Illinois Urbana-Champaign, USA.* We experimentally demonstrate high-confinement waveguide-fed metasurfaces that produce nearly diffraction-limited spots at numerical apertures (nAs) as high as 0.95 with focal lengths as small as 15λ and sustain their efficiencies through high nAs.

16:00 -- 18:00
Room: W209F
SW4P • Mid-infrared On-Chip Photonics
Presider: Yuriko Maegami; Natl Inst of Adv Industrial Sci & Tech, Japan

SW4P.1 • 16:00 (Invited)
HADAR: Machine Perception Through Pitch Darkness like Broad Daylight, Fanglin Bao[1], Xueji Wang[1], Shree Hari Sureshbabu[1], Gautam Sreekumar[2], Liping Yang[1], Vaneet Aggarwal[1], Vishnu Boddeti[2], Zubin Jacob[1]; *[1]Purdue Univ., USA; [2]Michigan State Univ., USA.* We introduce heat-assisted detection and ranging (HADAR) overcoming open challenges in thermal sensing. HADAR sees texture and depth through the darkness as if it were day and perceives physical attributes beyond RGB or thermal vision.

SW4P.2 • 16:30
Ultraviolet to Mid-Infrared Supercontinuum Generation in Thin Film Lithium Niobate Nanophotonic Waveguides, Marin Hamrouni[1], Marc Jankowski[3,2], Alexander Y. Hwang[2], Noah Flemens[2], Jatadhari Mishra[2], Carsten Langrock[2], Amir Safavi-Naeini[2], Martin M. Fejer[2], Thomas Südmeyer[1]; *[1]Laboratoire Temps Fréquence, Switzerland; [2]E. L. Ginzton Laboratory, Stanford Univ., USA; [3]Inc. Physics & Informatics Laboratories, NTT Research, USA.* We demonstrate ultraviolet-to-mid-infrared supercontinuum generation driven inside thin-film lithium niobate on sapphire nanowaveguides. With only 40 pJ from pump pulses centered around 2100 nm, we record a broad spectrum spanning from 380 to 2700 nm.

SW4P.3 • 16:45
On-chip mid-infrared supercontinuum generation with dispersive wave designed for gas spectroscopy, Soobong Park[1], Seong Cheol Lee[1], Daewon Suk[1], Won Bae Cho[2], Duk-Yong Choi[3], Kwang-Hoon Ko[4], Fabian Rotermund[1], Hansuek Lee[1]; *[1]KAIST, Korea (the Republic of); [2]ETRI, Korea (the Republic of); [3]Australian National Univ., Australia; [4]KAERI, Korea (the Republic of).* We demonstrate on-chip supercontinuum generation with tailored dispersive waves up to 4600 nm in wavelength. We used the dispersive waves to perform gas spectroscopy on the $^{12}CO_2$ and $^{13}CO_2$ gases and determine their pressures.

SW4P.4 • 17:00
Mid-Infrared Integrated Electro-Optic Modulator on a Suspended Lithium Niobate Platform, Chun-Ho Lee[1], Xinyi Ren[1], Shaoyuan Ou[1], Reshma Kopparapu[1], Zaijun Chen[1], Mengjie Yu[1]; *[1]Univ. of southern250haracteria, USA.* We demonstrate an integrated electro-optic (EO) modulator with a record $V_\pi L$ of 5.68 Vcm in the mid-infrared on a suspended thin-film-lithium-niobate platform and EO frequency comb generation at 2.55-µm with a line-spacing of 28-GHz.

SW4P.5 • 17:15

Long-Wave Infrared Electro-Optic Frequency-Combs Generation Using SiGe Schottky-Based Modulators, Victor Turpaud[1,2], Thi-Hao-Nhi Nguyen[1], Natnicha Koompai[1], Jonathan Peltier[1], Jacopo Frigerio[3], Stefano Calcaterra[3], Carlos Alonso-Ramos[1], Laurent Vivien[1], Giovanni Isella[3], Delphine Marris-Morini[1]; *[1]C2N, France; [2]École Normale Supérieure Paris-Saclay, France; [3]L-NESS, Italy.* An experimental demonstration of electro-optic frequency-comb generation around 8 µm wavelength, spanning more than 200 lines around the optical carrier was carried out, using integration-compatible RF sources, reaching an acquisition-time limited linewidth.

SW4P.6 • 17:30
Demonstration and Analysis of the very first Mid-infrared Sub-mW Threshold Brillouin Laser, Kiyoung Ko[1], Daewon Suk[1], Dohyeong Kim[1], Rongping Wang[2,3], Byung Jae Chun[4], Kwang-Hoon Ko[4], Duk-Yong Choi[3], Hansuek Lee[1]; *[1]KAIST, Korea (the Republic of); [2]The Research Inst. of Advanced Technologies, Ningbo Univ., China; [3]Laser Physics Centre, Research School of Physics, Australian National Univ., Australia; [4]Korea Atomic Energy Research Inst., Korea (the Republic of).* We demonstrate and analyze the first mid-infrared on-chip Brillouin laser generated using chalcogenide resonators. Q-factor of 2.91e7, phonon gain bandwidth of 14.51 MHz and threshold power of 93.3 uW were measured.

SW4P.7 • 17:45
High Performance Waveguide Integrated Tellurium-based Mid-Infrared Photodetector, Hui Ma[1], Jiang h. Wu[2], Shuo Lin[1], Yun p. Wang[3], Lan Li[2], Hongtao Lin[1]; *[1]College of Information Science and Electronic Engineering, Zhejiang Univ., China; [2]Westlake Univ., China; [3]College of Materials Science and Engineering, Zhejiang Univ., China.* Tellurium is a promising van der Waals material for high performance MIR detection due to its excellent properties. Large-bandwidth and low-noise tellurium-based mid-infrared detectors are achieved, promising future applications in sensing and optical communications.

16:00 -- 18:00
Room: W210
FW4Q • Machine Learning for Metamaterial Design
Presider: Yu Yao; Arizona State Univ., USA

FW4Q.1 • 16:00 (Tutorial)
Machine Learning Methods for Photonic Simulation and Design, Jonathan A. Fan[1], Chenkai Mao[1], Tianxiang Dai[1], Robert Lupoiu[1]; *[1]Stanford Univ., USA.* In this tutorial, I will discuss how deep learning can be utilized in photonics to accelerate fullwave simulations, perform inverse design, specify photonic device layouts with differentiable representations, and support multi-scalar systems modeling.

FW4Q.2 • 17:00
Physics-guided hierarchical Neural Networks for Maxwel''s equations in metamaterials, Sean V. Lynch[2], Jacob LaMountain[2], Bo Fan[2], Jie Bu[3], Amogh Raju[4], Daniel Wasserman[4], Anuj Karpatne[3], Viktor Podolskiy[1]; *[1]Univ. of Massachusetts Lowell, USA; [2]Physics and Applied Physics, Univ. of Massachusetts Lowell, USA; [3]Computer Science, Virginia Tech Univ., USA; [4]Electrical and Computer Engineering, Univ. of Texas Austin, USA.* We develop a hierarchical approach to building a Physics-guided neural network (PGNN) for scalable

solutions of Maxwell equations with high spatial resolution and illustrate the developed formalism on a metamaterial photonic funnel example.

FW4Q.3 • 17:15

Machine learning discovers parsimonious equations governing incoherent emission steering from semiconductor metasurfaces, Saaketh Desai[1], Remi Dingreville[1], Prasad Padmanabha Iyer[1]; *[1]Center for Integrated Nanotechnologies, Sandia National Labs, USA.* We develop neural network based equation learners to discover governing equations relating metasurface incoherent emission steering to critical features defining its spatial refractive index profiles.

FW4Q.4 • 17:30

Photonic Neural Network and In-Situ Training in a Synthetic Frequency Dimension, Felix Gottlieb[1], Kai Wang[1]; *[1]McGill Univ., Canada.* We develop a scalable photonic neural network utilizing the discrete frequency degree of freedom of light with the ability to train itself based on an in-situ backpropagation method with minimal reliance on external computers.

FW4Q.5 • 17:45

Coherence Awareness in Diffractive Neural Networks, Matan Kleiner[1], Lior Michaeli[2], Tomer Michaeli[1]; *[1]Faculty of Electrical and Computer Engineering, Technion, Israel; [2]Division of Engineering and Applied Science, California Inst. of Technology, USA.* We demonstrate the significant influence of the illumination coherence on diffractive networks, and propose a framework for network optimization with any prescribed degree of spatial and temporal coherence. We analyze performance for varied coherence properties.

16:00 -- 18:00
Room: W211
SW4R • New Materials for Advanced Modulators
Presider: Lan Li; Westlake Univ., China

SW4R.1 • 16:00

Strong phase modulation in integrated O-band GeSi-QCSE waveguide modulators, Chih-Kuo Tseng[1], Ahmed Kandeel[1,2], Mathias Berciano[1], Dharmander Malik[1], Hakim Kobbi[1], Didit Yudistira[1], Dries Van Thourhout[1,2], Maumita Chakrabarti[1], Dimitrios Velenis[1], Peter Verheyen[1], Yoojin Ban[1], Filippo Ferraro[1], Joris Van Campenhout[1]; *[1]IMEC, Belgium; [2]Ghent Univ., Belgium.* A phase modulation efficiency of 0.036 V-cm is obtained in O-band GeSi-based QCSE waveguide modulators integrated in a 300 mm silicon photonics platform.

SW4R.2 • 16:15 (Invited)

BTO Technology for Fast and Efficient Photonic Integrated Circuits, Wouter Diels[1]; *[1]Fraunhofer HHI, Germany.* Abstract not available.

SW4R.3 • 16:45

Ultra-Wide FSR Vertical-Junction Microdisk Modulator With Efficient External Heater, Michael Cullen[1], Asher Novick[1,2], Songli Wang[1], Vignesh Gopal[1], Anthony Rizzo[3], Robert Parsons[1], Keren Bergman[1]; *[1]Columbia Univ., USA; [2]Xscape Photonics, USA; [3]Air Force Research Laboratory Information Directorate, USA.* We describe a wide FSR vertical-junction microdisk modulator design (radius=2μm) featuring an efficient, external half-height doped-silicon heater that affords aggressive size reductions. We measure FSR=58.6 nm and demonstrate data transmission at 16 Gb/s.

SW4R.4 • 17:00
Barium Titanate Racetrack Modulator on Silicon Nitride for 200 GBd Data Communication in the O-band, Manuel Kohli[1], Daniel Chelladurai[1], Laurenz Kulmer[1], Andreas Messner[1], Killian Keller[1], Tobias Blatter[1], Joel Winiger[1], David Moor[1], Tatiana Buriakova[2], Michael Zervas[2], Clarissa Convertino[3], Felix Eltes[3], Yuriy Fedoryshyn[1], Ueli Koch[1], Juerg Leuthold[1]; *[1]Inst. of Electromagnetic Fields (IEF), ETH Zürich, Switzerland; [2]Ligentec SA, Switzerland; [3]Lumiphase AG, Switzerland.* We demonstrate the first O-band $BaTiO_3$-plasmonic modulator on SiN. Featuring symbol rates of up to 200 GBd, 2 dB on-chip loss and 70 GHz bandwidth, this approach proves suitable for low-loss, high-speed, and low-complexity communication.

SW4R.5 • 17:30
High-Performance Thin-Film Lithium Niobate Modulator with Low-k Underfill for over 110 GHz Electro-Optic Response, Hao Liu[1], Yutong He[1], Bing Xiong[1], Changzheng Sun[1], Zhibiao Hao[1], Lai Wang[1], Jian Wang[1], Yanjun Han[1], Hongtao Li[1], Lin Gan[1], Yi Luo[1]; *[1]Tsinghua Univ., China.* A thin-film lithium niobate modulator featuring low-k underfill is experimentally demonstrated. The 7-mm-long device exhibits a low half-wave voltage of 2 V and only 1.2 dB electro-optic roll-off up to 110 GHz.

SW4R.6 • 17:45
Single-mode waveguides in barium titanate-on-insulator platform fabricated by wet etching, Hong-Lin Lin[1], Pragati Aashna[1], YU CAO[1], Aaron Danner[1]; *[1]National Univ. of Singapore, Singapore.* We present, for the first time, single-mode single-crystal barium titanate waveguides on insulator, achieved through a wet-etching method. This etching approach opens new possibilities for the development of barium-titanate-based integrated optical devices.

Thursday, 9 May

08:00 -- 09:30
Room: W201AB
ATh1A • Frequency Combs and Their Applications
Presider: Nazanin Hoghooghi; NIST, USA

ATh1A.1 • 08:00
Electro-optic frequency combs carrying orbital angular momentum, Jz He[1], Xingyu Jia[1], Bingyan Wei[2], Guanhao Wu[1], Yang Li[1]; *[1]Tsinghua Univ., China; [2]Northwestern Polytechnical Univ., China.* We report the generation of electro-optic frequency comb carrying orbital angular momentum, based on which we demonstrate the simultaneous measurement of the rotational speed and absolute distance of a rough object.

ATh1A.2 • 08:15
Design and Characterization of Octave Spanning, 1-THz Kerr Frequency Microcombs in Silicon Nitride, Tristan Melton[1], Alwaleed Aldhafeeri[1], Hsiao-Hsuan Chin[1], Lala Rukh[2], Gabriel M. Colacion[2], Tara E. Drake[2,3], Chee Wei Wong[1]; *[1]UCLA, USA; [2]Optical Science and Engineering Program, Univ. of New Mexico, USA; [3]Physics and Astronomy, Univ. of New Mexico, USA.* We design microresonators for octave-spanning soliton frequency comb generation in silicon nitride. We lock the repetition rate via an electro-optic comb and achieve phase noise of -130-dBc/Hz, with the resultant modulated tone tunable over 1-GHz.

ATh1A.3 • 08:30
Self-referenced frequency comb operation at 85 °C, Abijith Kowligy[1], Elton Pashollari[1], Jonathan Roslund[1], Mary-Kate Pasha[1], Gunnar Skulason[1], Jamil Abo-Shaeer[1], Martin Boyd[1], Arman Cingoz[1]; *[1]Vector Atomic, USA.* We demonstrated a fully stabilized, self-referenced optical frequency comb at 85 °C ambient temperature that consumes less than 5 W of electrical power. Individual comb sub-components were operated from -40-85 °C without performance degradation.

ATh1A.4 • 09:00
Generation of Terahertz Optical Microwave Generation by Optical Frequency Comb Synthesizer/Analyzer and its Application to TOF Distance Measurement, Ryo Uchiyama[1], Daisuke Noso[1], Tatsutoshi Shioda[1]; *[1]Saitama Univ., Japan.* Terahertz optical frequency comb has been applied to micrometer resolution distance measurement with dual-heterodyne mixing, which can complete the distance in time scale of electronics response limit. It was experimentally confirmed to be 2 ns.

ATh1A.5 • 09:15
Intensity Noise and Linewidth of Kerr Optical Frequency Combs, Wenting Wang[1], XIN HAO DU[2]; *[1]Xiongan Innovation Inst., Chinese Academy of Sciences, China; [2]Inst. of Semiconductors, Chinese Academy of Sciences, China.* This study analyzes Kerr soliton microcomb'' intensity noise and linewidth, revealing the single-soliton stat''s superior noise performance with a low RIN and narrow linewidths

08:00 -- 10:15
Room: W201CD
ATh1B • New Technologies for Diagnosis and Treatment of Cancer
Presider: Judith Su; Univ of Arizona, Coll of Opt Sciences, USA

ATh1B.1 • 08:00
Melanin imaging with pump-probe microscopy for diagnosis of metastatic melanoma, David Grass[1], Georgia M. Beasley[2,3], Martin C. Fischer[1,4], M. A. Selim[5], Warren S. Warren[1,3]; *[1]Chemistry, Duke Univ., USA; [2]Surgery, Duke Univ., USA; [3]Duke Cancer Inst., USA; [4]Physics, Duke Univ., USA; [5]Pathology, Duke Univ., USA.* Melanoma, the most aggressive skin cancer, is responsible for around 10,000 deaths annually. We are developing a diagnostic biomarker based on femtosecond pump-probe microscopy of melanin, a natural pigment found in most melanoma.

ATh1B.2 • 08:15
Optical Fiber Based Cell Picking Module for Identification and Isolation of Individual Single Cells or Clusters, Achar V. Harish[1,4], Joao Varela[2], Pawel Maniewski[1], Rainer Heuchel[3], Matthias Lohr[3], Walter Margulis[4], Aman Russom[2], Fredrik Laurell[1]; *[1]KTH-Royal Inst. of Technology, Sweden; [2]2Division of Nanobiotechnology, Department of Protein Science, Science for Life Laboratory, KTH Royal Inst. of Technology, Solna, Sweden, Sweden; [3]Department of Cancer Medicine, Division for Upper GI, Karolinska Univ. Hospital, Stockholm, Sweden, Sweden; [4]Research Insts. of Sweden (RISE), Stockholm, Sweden, Sweden.* We present an optical fiber-based selective cell picking module capable of picking up and transferring single cells or clusters. Our Lab-in-a-fiber (LIF) module detects labelled cancer cells (MCF-7) and picks them up for further analysis.

ATh1B.3 • 08:30 (Invited)
High-speed and Ultra-compact Metasurface Muller Matrix Microscope, Yu Yao[1], Jiawei Zuo[1]; *[1]Arizona State Univ., USA.* We will present recent progress on ultra-compact and high-speed metasurface polarimetric imaging and Muller Matrix Microscope based on metasurface devices as well as their applications in biomedical imaging and material characterization.

ATh1B.4 • 09:00
Terahertz Time-Domain Imaging for Radiotherapy Treatment Monitoring in Pancreatic Ductal Adenocarcinoma, Debamitra Chakraborty[1], Bradley Mills[1], Jing Cheng[1], Ivan Komissarov[1], Scott Gerber[1], Roman Sobolewski[1]; *[1]Univ. of Rochester, USA.* Terahertz time-domain imaging was performed of stereotactic body radiotherapy-treated murine pancreatic ductal adenocarcinoma (PDAC) with a high spatial resolution. The results demonstrated that terahertz imaging can probe physical changes with high sensitivity in the tissue post treatment.

ATh1B.5 • 09:15
Optical Biosensing Using Whispering Gallery Mode Microspherical Shell Resonators, Soheil Farazi[1], Vedant Sumaria[1], Anantdeep Kaur[2], Zheyuan Zhang[1], Jared Auclair[2], Srinivas Tadigadapa[1]; *[1]Department of Electrical and Computer Engineering, Northeastern Univ., USA; [2]Department of Chemistry and Chemical Biology, Northeastern Univ., USA.* Novel biosensors employing whispering-gallery-mode microshell resonators are demonstrated. Thermo-optical biosensing detects urea, while refractive index-based biosensors

show high sensitivity to gold coated nanoparticles, promising applications in biochemical sensing for medical, environmental, and food safety.

ATh1B.6 • 09:30

Characterization of Binary Liposome with Raman Spectroscopy for Targeted Nanomedicine, Aneesh V. Veluthandath[1], Waseem Ahmed[1], Ahilanandan Dushianthan[2], Anthony D. Postle[3], James S. Wilkinson[1], Senthil G. Murugan[1]; *[1]Optoelectronics Research Centre, Univ. of Southampton, UK; [2]NIHR Biomedical Research Centre, Univ. Hospital Southampton NHS Foundation Trust, UK; [3]Academic Unit of Clinical & Experimental Sciences, Faculty of Medicine, Southampton General Hospital, UK.* Liposomes are versatile nanocarriers vital for targeted drug delivery in nanomedicine. Understanding their composition is crucial for precise delivery and assessing carrier quality. Our study demonstrates Raman spectroscop''s effectiveness in assessing binary liposome lipid composition.

ATh1B.7 • 09:45

Deep Learning-Enabled Classification of HER2 Score in Breast Cancer Using Pyramid Sampling, Sahan Yoruc Selcuk[1], Xilin Yang[1], Bijie Bai[1], Yijie Zhang[1], Yuzhu Li[1], Musa Aydin[1], Aras Firat Unal[1], Aditya Gomatam[1], Zhen Guo[1], Darrow Morgan Angus[2], Goren Kolodney[3], Karine Atlan[4], Tal K. Haran[4], Nir Pillar[1], Aydogan Ozcan[1]; *[1]Univ. of California, Los Angeles, USA; [2]Univ. of California, Davis, USA; [3]Bnai-Zion Medical Center, Israel; [4]Hedassah Hebrew Univ. Medical Center, Israel.* We present an automated, deep learning-based method for HER2 score classification in breast cancer, achieving 85.47% accuracy on tissue microarrays from 300 patients. This method can significantly improve the HER2 evaluation process, saving diagnostician time.

ATh1B.8 • 10:00

Surface oxygen vacancy-mediated photothermal treatment of cervical cancer by PEG-coated CeO_2 nanostructures – a non-invasive approach, Sayoni Sarkar[1], Rohit Srivastava[1], Ajit Kulkarni[1]; *[1]Indian Inst. of Technology Bombay, India.* We demonstrate $V_O^{\bullet}$-driven photothermal response of PEG-CeO_2 nanostructures for cervical cancer theranostics. Under laser irradiation, an unprecedented 86.8% reduction in HeLa cells within 48 hours is achieved, with no adverse effects on adjacent healthy cells.

08:00 -- 10:00
Room: W204AB
STh1C • Ultrafast Optics and Wave Mixing
Presider: Katia Shtyrkova; MIT Lincoln Laboratory, USA

STh1C.1 • 08:00

Quantitative Pulse Characterization of Octave Spanning Pulses in the MIR, Felix Ritzkowsky[1], Fabian Scheiba[1], Maximilian Kubullek[1], Huseyin Cankaya[1], Giulio Rossi[1], Franz Kaertner[1]; *[1]DESY, Germany.* We report on the pulse characterization of octave spanning pulses in the mid-infrared. By adapting two-dimensional shearing interferometry, we achieve precise quantitative measurements of octave spanning pulses.

STh1C.2 • 08:15

30 fs UV Laser Pulse Generation Using a Multi-pass Cell, Victor Hariton[1], Yujiao Jiang[1], Arthur Schönberg[1], Marcus Seidel[1], Marek Wieland[2], Markus Drescher[2], Mark Prandolini[2], Ingmar Hartl[1], Christoph M. Heyl[1,3]; *[1]DESY, Germany; [2]Univ. of Hamburg, Germany; [3]Helmholtz-Inst. Jena, Germany.* We present a simple method for generating microjoule-level UV laser pulses with ultrashort duration using an air-based multi-pass cell. Through spectral broadening and compression, we achieve a 7-fold reduction in pulse duration while maintaining high output beam quality.

STh1C.3 • 08:30

Ultrafast Mid-Infrared Pulse Generation by Band-Edge-Mediated Four-Wave Mixing in Gas-Filled Antiresonant Hollow-Core Fiber, Ruhai Bai[1], Trivikramarao Gavara[1], Yuixi Wang[1], Xiong Daiqi[1], Ang Deng[1], Kevin Hean[1], Shuaihao Ji[1,2], xu wu[1], Wonkeun Chang[1]; *[1]NTU, Singapore; [2]Xiamen Univ., China.* We demonstrate the generation of ultrashort pulses at 4.57 µm in the mid-infrared region. This is achieved through band-edge-induced four-wave mixing in a gas-filled antiresonant hollow-core fiber when the system is pumped at 2 µm.

STh1C.4 • 08:45

Hybrid Pulse-Burst-Pumped NOPCPA for the Generation of High Energy Long-Wave Infrared Pulses, Rokas Jutas[1], Joris Roman[1], Ignas Astrauskas[1], Aref Imani[1], Paolo Carpeggiani[1], Pavel Polynkin[2], Edgar Kaksis[1], Tobias Floery[1], Jonas Kolenda[3], Tadas Bartulevičius[3], Kirilas Michailovas[3], Andrejus Michailovas[3,4], Andrius Baltuška[1,4], Audrius Pugzlys[1,4]; *[1]Technische Universität Wien, Austria; [2]Univ. of Arizona, USA; [3]Ekspla, Lithuania; [4]FTMC, Lithuania.* Pulse-bursts from Nd:YAG amplifier are converted into angularly separated multicolor pulses that are used to non-collinearly pump LWIR ZGP OPCPA. LWIR pulses are amplified to 80 mJ energy, which is potentially scalable to >10 mJ.

STh1C.5 • 09:00

Enhanced Ultraviolet Generation in Gas-Filled Antiresonant Hollow-core Fiber via Post-Processing, Xiong Daiqi[1], Yuxi Wang[1], Ruhai Bai[1], Zhixun Wang[1], Alexander Si Kai Yong[2], Kaicheng Liang[2], Wonkeun Chang[1]; *[1]NTU, Singapore; [2]Inst. of Molecular and Cell Biology, Agency for Science, Research and Technology (A*STAR), Singapore.* We significantly enhance the dispersive wave generation-driven ultraviolet conversion efficiency from 3.4% to 11% in a post-processed gas-filled antiresonant hollow-core fiber by thinning the cladding-tube wall thickness from 470 nm to 115 nm through wet-etching.

STh1C.6 • 09:15

Stable Supercontinuum Generation in Water at High Repetition Rates, Aline Vanderhaegen[1], Kilian R. Keller[1], Ricardo Rojas-Aedo[1], Markus ludwig[2], Daniele Brida[1]; *[1]Univ. of Luxembourg, Luxembourg; [2]DESY, Germany.* Water is an effective nonlinear medium for supercontinuum (SC) generation. We demonstrate high SC signal stability through precise liquid velocity control and superior spectral broadening compared to established solids at multi-kilohertz (kHz) repetition rates.

STh1C.7 • 09:30

Control of cascaded four-wave mixing via dynamic dispersion, Shree R. Thapa[1], James Drake[1], Darren D. Hudson[1]; *[1]CREOL, Univ. of Central Florida, USA.* We demonstrate control of cascaded four-wave mixing by programmable dispersion tuning. With modification of only the group delay dispersion (no higher-order terms), we are able to achieve a 250% increase in the spectral bandwidth.

STh1C.8 • 09:45
Experimental Demonstration of Optical Transcoding of 5-Gbit/s OOK Data Signal by Recovering One of The Two Channels of 10-Gbit/s QPSK Data Signal Using Wave-Mixing, Narek Karapetyan[1], Amir Minoofar[1], Abdulrahman Alhaddad[1], Wing Ko[1], Huibin Zhou[1], Muralekrishnan Ramakrishnan[1], Moshe Tur[2], Jonathan Habif[1,3], Alan Willner[1,4]; *[1]Electrical Engineering, Univ. of Southern California, USA; [2]School of Electrical Engineering, Tel Aviv Univ., Israel; [3]Information Sciences Inst., Univ. of Southern California, USA; [4]Dornsife Depart. of Physics & Astronomy, Univ. of Southern California, USA.* We demonstrate optical transcoding of 5-Gbit/s OOK data signal from 10-Gbit/s QPSK data signal. A BPSK signal is first generated by constellation squeezing through four-wave-mixing, and then it is shifted to the OOK signal through coherent vector addition.

08:00 -- 10:00
Room: W205AB
FTh1D • Nonlinearity in Fibers and Waveguides
Presider: Rivka Bekenstein; Hebrew Univ. of Jerusalem, Israel

FTh1D.1 • 08:00
Bright-Dark Pulses in Coupled Ring Lasers, Theodore P. Letsou[1,2], Dmitry Kazakov[1], Pawan Ratra[1,3], Lorenzo Columbo[4], Sandro Dal Cin[5], Nikola Opacak[5], Marco Piccardo[6], Benedikt Schwarz[5], Federico Capasso[1]; *[1]Harvard Univ., USA; [2]Electrical Engineering and Computer Science, Massachusetts Inst. of Technology, USA; [3]Electrical and Electronic Engineering, Imperial College London, UK; [4]Elettronica e Telecomunicazioni, Politecnico di Torino, Italy; [5]Inst. of Solid State Electronics, TU Wien, Austria; [6]Department of Physics, Instituto Superior Técnico, Portugal.* Coupling semiconductor laser together unlocks new optical states unstable in uncoupled lasers. Here, we present one such state which manifests itself as a pair of bright and dark optical pulses.

FTh1D.2 • 08:15
High-coherence hybrid-integrated 780 nm source by self-injection-locked second-harmonic generation in a high-Q silicon-nitride resonator, Zhiquan Yuan[1], Bohan Li[1], Warren Jin[2], Lue wu[1], Joel Guo[3], Qingxin Ji[1], Avi Feshali[2], Mario Paniccia[2], John Bowers[3], Kerry Vahala[1]; *[1]Caltech, USA; [2]Anello Photonics, USA; [3]ECE Department, Univ. of California Santa Barbara, USA.* A hybrid-integrated visible laser source is demonstrated using the photogalvanic effect. Self-injection locking of a 1560 nm semiconductor laser to a high-Q Si_3N_4 resonator generates high-coherence 780 nm emission (4 Hz^2/Hz frequency noise floor).

FTh1D.3 • 08:30
Tunable Mode-Locking Laser via a Nested Microring Resonator, Luigi Di Lauro[1], Aadhi Rahim[1], Imtiaz Alamgir[1], Celine Mazoukh[1], Bennet Fischer[2], Nicolas Perron[1], Pavel Dmitriev[1], Piotr Roztocki[1,3], Cristina Rimoldi[4], Mario Chemnitz[2], Armaghan Eshaghi[5], Viktorov Evgeny[6], Kovalev Anton[6], Brent Little[7], Sai Chu[8], David Moss[9], Roberto Morandotti[1]; *[1]INRS-EMT, Canada; [2]Leibniz Inst. of Photonic Technology, Germany; [3]Ki3 Photonics Technologies, Canada; [4]Politecnico di Torino, Italy; [5]Huawei Technologies Canada, Canada; [6]ITMO Univ.,*

Russian Federation; [7]QXP Technology Inc., China; [8]City Univ. of Hong Kong, Hong Kong; [9]Optical Sciences Centre, Swinburne Univ. of Technology, Australia. We demonstrate an ultra-stable, tunable mode-locked laser cavity featuring a nested microring resonator for generating and switching between different repetition rates. Our approach offers a solution for spectroscopy, metrology, and communications applications.

FTh1D.4 • 09:00
The Pure-quartic Bragg Soliton, Ju Won Choi[1], Byoung-Uk Sohn[1], Ezgi Sahin[1], George F. Chen[1], Peng Xing[1], Doris K. Ng[2], Benjamin J. Eggleton[3,4], Dawn T. Tan[1,2]; *[1]Photonics Devices and System Group, Singapore Univ. of Technology and Design, Singapore; [2]Inst. of Microelectronics (IME), Agency for Science, Technology and Research (A*STAR), Singapore; [3]Inst. of Photonics and Optical Science, School of Physics, The Univ. of Sydney, Australia; [4]The Univ. of Sydney Nano Inst. (Sydney Nano), The Univ. of Sydney, Australia.* We report a new class of Bragg soliton, the pure-quartic Bragg soliton, which arises from the balance between self-phase modulation and the extraordinarily strong negative fourth-order dispersion induced by integrated Bragg gratings.

FTh1D.5 • 09:15
Tunable Brillouin-based Microwave Photonic Bandpass Filter with sub-MHz Bandwidth, Wendao Xu[1], Maxime Zerbib[2], Arjun Iyer[1], Jean-Charles Beugnot[2], William H. Renninger[1]; *[1]Univ. of Rochester, USA; [2]FEMTO-ST, France.* A continuously tunable microwave-photonic filter with ultranarrow bandwidth is enabled by forward inter-modal Brillouin interactions with a fundamental acoustic mode of a fiber taper. Sub-MHz bandwidth is demonstrated over >10 GHz, limited by current components.

FTh1D.6 • 09:30 (Invited)
Spatiotemporal Dynamics of Lasing in Semiconductor Microcavities, Hui Cao[1]; *[1]Yale Univ., USA.* We experimentally investigate spatiotemporal dynamics of semiconductor microlasers with various cavity geometries. The intracavity ray dynamics directly impacts the lasing dynamics. Engineering the microcavity geometry enables control over the ray dynamics and the lasing dynamics.

08:00 -- 10:00
Room: W205CD
ATh1E • From the Lab to the Field-Laser Based Atmospheric Sensing
Presider: Scott Davis; Vescent Photonics, USA

ATh1E.1 • 08:00 (Invited)
Trends in Idustrial Methane Monitoring: Benefits of Optical Appraches and Pressure, Sean Coburn[1]; *[1]LongPath Technologies Inc., USA.* Abstract not available.

ATh1E.2 • 08:30
Multi-month observations of spatial and temporal variation of CH_4 and CO_2 over km-scale paths in New York City using open-path dual-comb spectroscopy, Kevin Cossel[1], Nathan Malarich[1], Griffin Mead[1], James Kasic[1], Esther Baumann[1], Saad Syed[1], Brian R. Washburn[1], Ian Coddington[1]; *[1]NIST Boulder, USA.* We deploy an open-path dual-comb spectrometer to

measure CO2 and CH4 across multiple paths at an urban site in New York City. The system operated remotely for more than 3 months.

ATh1E.3 • 08:45

VOC Analysis by Mid-IR Laser Spectroscopy at High Spectral Resolution, Miloš Selaković[1,2], Béla Tuzson[1], Raphael Brechbühler[1], Akshay Nataraj[1], Philipp Scheidegger[1], Herbert Looser[1], André Kupferschmid[1], Lukas Emmenegger[1]; *[1]EMPA, Switzerland; [2]Department of Chemistry and Applied Biosciences, ETH, Switzerland.* VOC analysis by mid-IR laser spectroscopy strongly profits from spectral fine- structures for selective and sensitive detection. This is shown for a wealth of organic molecules (C1-C6) that have unique fingerprints at reduced gas pressure.

ATh1E.4 • 09:00

QCL-QEPAS sensor for Rapid Multispecies Detection in the MIR region: Case studies CH_4, C_2H_2, NH_3 and N_2O, Herve Tatenguem Fankem[1], Christian Assmann[1], Sebastian Schmidtmann[2], Patricia Sacher[1], Martin Honsberg[2], Joachim Sacher[1]; *[1]Sacher Lasertechnik GmbH, Germany; [2]Sensor Photonics GmbH, Germany.* To meet the requirements for multi-species gas analysis, QEPAS is used in combination with a QC-based external cavity laser system.Results on the detection of multiple trace gases by sequential quasi-simultaneous measurements are presented.The requirements of multi-species detection, widely tuning range, fast switching, and low-cost system are met.

ATh1E.5 • 09:15

Fiber-coupled, quantum cascade laser-based, open-path airborne sensor for atmospheric ammonia measurements, Hongming Yi[1], Yunseo Choi[1], Nathan Li[1], Daniel P. Moore[1], Vladislav Sevostianov[1], Lei Tao[1,3], Da Pan[1,2], Ryan Boyd[1], James McSpiritt[1], Lars Wendt[1], Mark Zondlo[1]; *[1]Princeton Univ., USA; [2]Atmospheric sciences, Corado state Univ., USA; [3]Onto Innovation, USA.* A hollow core fiber was coupled to a c-mount, quantum cascade laser for open-path detection of atmospheric ammonia onboard the NASA DC-8 aircraft. In-flight measurements demonstrated sub-ppbv precision for NH_3 at 1s in the troposphere.

ATh1E.6 • 09:30 (Invited)

Aerial Gas Mapping Lidar for Methane Emission Source Localization, Quantification, and Large-Scale Statistical Characterization, William (Mint) Kunkel[1], Christopher Donahue[1], Dominic Altamura[1], Cameron Dudiak[1], Benjamin Moscona-Remnitz[1], Nelson Goldsworth[1], Brandon Kennedy[1], Michael Thorpe[1]; *[1]Bridger Photonics, Inc., USA.* Bridger Photonics measures methane emissions throughout the oil and natural gas supply chain. We describe sensor operation and requirements for large-scale emission inventories, including equipment identification, emission rate quantification accuracy, detection sensitivity, and sample coverage.

08:00 -- 10:00
Room: W206A
STh1F • Hardware for Quantum Networks
Presider: To be Announced

STh1F.1 • 08:00 (Invited)
Quantum Networks with Atom Arrays as Processing Nodes, Hannes B. Bernien[1]; [1]*Univ. of Chicago, USA.* Atom arrays are one of the most promising quantum processor architectures. I will show how these processors can be augmented with high-speed photonic interconnects that enable scaling of the architecture in a distributed quantum network.

STh1F.2 • 08:30
Large Optical Tweezer Arrays Generated by Integrated Optical Meta-Microscopes, Okan Koksal[1,2], Ting-Wei Hsu[3,4], Junyeob Song[1], Zi Wang[1,2], Mark O. Brown[3,4], Cindy Regal[3,4], Amit Agrawal[1], Henri Lezec[1], Wenqi Zhu[1]; [1]*NIST Inst for Physical Science & Tech, USA;* [2]*Univ. of Maryland, USA;* [3]*JILA, USA;* [4]*Univ. of Colorado Boulder, USA.* We demonstrate meta-microscopes based on doublet metalenses that form high-quality optical dipole trap arrays capable of trapping single atoms and discuss how these microscopes can be designed to robustly for maximum performance.

STh1F.3 • 08:45
Metasurfaces That Enable Bottle-Beam Arrays for Neutral Atom Trapping, Chengyu Fang[1], Minjeong Kim[1], David Czaplewski[2], Hongyan Mei[1], Sanket Deshpande[1], Zhaoning Yu[3], Yuzhe Xiao[4], Xuting Yang[5], Alan Dibos[2], Mark Saffman[3], Mikhail A. Kats[1]; [1]*Department of Electrical and Computer Engineering, Univ. of Wisconsin–- Madison, USA;* [2]*Center for Nanoscale Materials, Argonne National Laboratory, USA;* [3]*Department of Physics, Univ. of Wisconsin–- Madison, USA;* [4]*Department of Physics, Univ. of North Texas, USA;* [5]*Department of Material Science and Engineering, Univ. of Wisconsin–- Madison, USA.* We report optical metasurfaces that enable bottle-beam arrays for blue-detuned trapping of neutral atoms. Our approach only requires a single metasurface which significantly reduces the complexity of the trapping experiments.

STh1F.4 • 09:00
Tailored Beam-Forming for Atomic Systems with Integrated Optics, Gillenhaal J. Beck[1], Karan K. Mehta[2], Jonathan Home[1]; [1]*Inst. of Quantum Electronics, ETH Zurich, Switzerland;* [2]*Electrical and Computer Engineering, Cornell Univ., USA.* We demonstrate micron-scale focusing of fundamental and higher-order modes, including Laguerre-Gaussian "vortex" beams, from waveguide-to-free-space grating outcouplers at ultraviolet and visible wavelengths.

STh1F.5 • 09:15
Near-Unity-Efficiency Frequency Conversion on a Silicon-Nitride Chip, Yun Zhao[1], Karl J. McNulty[1], Michal Lipson[1], Alexander L. Gaeta[1]; [1]*Columbia Univ., USA.* We demonstrate on-chip frequency conversion with Bragg scattering four-wave mixing that reaches an on-chip efficiency of 95%.

STh1F.6 • 09:30
Tunable liquid-crystal source of photon pairs, Vitaliy Sultanov[1,2], Aljaz Kavcic[3,4], Manolis kokkinakis[5], Matjaz Humar[3,4], Maria Chekhova[2,1]; [1]*FAU Erlangen-Nürnberg,*

Germany; [2]Chekhova research group, Max-Planck Inst. for the Science of Light, Germany; [3]Jozef Stefan Inst., Slovenia; [4]Univ. of Ljubljana, Slovenia; [5]Univ. of Crete, Greece. We demonstrate a liquid-crystal broadband source of entangled photons, whose flux and polarization are tunable through the electric field or molecular twist. This opens a path to a new generation of tunable quantum light sources.

STh1F.7 • 09:45
Optimizing the Generation of Large Cluster States With Residual Visibility Measurements, Leonid Vidro[1], Valentin Guichard[2], Dario Fioretto[2], Nadia Belabas[2], Pascale Senellart[2], Hagai Eisenberg[1]; *[1]HUJI, Israel; [2]Centre de Nanosciences et Nanotechnologi, France.* We demonstrate a 6-photon linear cluster state measurement using a resource-efficient quantum dot single photon source and linear optics setup. Shorter, high-rate, states created in the process give useful indications on the quality of alignment and interference for optimization.

08:00 -- 10:00
Room: W206B
ATh1G • Advances in Quantum Sensing
Presider: Susannah Dickerson; Charles Stark Draper Laboratory, USA

ATh1G.1 • 08:00 (Invited)
Magnetocardiography (MCG) in the Hospital Emergency Department, Ethan Pratt [1], Geoffrey Iwata[1], Christian Nguyen[1], Amelia Solon[1], Kevin Tharratt[1], Madelaine Liddy[1], Hailey Trier[1], Simon Tam[1], Brian Cottle[1], Max Ruf[1], Tucker Reinhardt[1], Vikas Sewani[1], Alison Rugar[1], Frances Lu[1], Stefan Bogdanovic[1], Priyanka Shah[1], Kit Yee Au-Yeung[1]; *[1]SandboxAQ, USA.* Doctors need sensitive, accurate cardiac measurement tools for millions of patients in emergency departments with indistinct chest pain and uncertain diagnoses. We present our development of a new quantum sensor based medical device, with alkali vapor optically pumped magnetometers (OPMs) at its heart. We demonstrate its ability to quickly and accurately image cardiomagnetic function, while seamlessly integrating into the emergency workflow.

ATh1G.2 • 08:30
Characterization of Optically Pumped Magnetometers for Biomagnetic Sensing, Ricardo Jimenez-Martinez[1], Dean Allison[2], Vanessa Lechuga[2], Orang Alem[1,2], K. Jeramy Hughes[1,2], Svenja Knappe[1,2]; *[1]FieldLine Industries, USA; [2]FieldLine Inc., USA.* We characterize the performance of several hundreds optically pumped magnetometers capable of measuring human brain activity. Large-scale manufacturing of quantum sensors with tight tolerances is critical in the transition from research laboratories to real-world applications.

ATh1G.3 • 08:45
Quantum-enhanced Optical Beat-note Detection beyond 3-dB Noise Penalty of Image Band, Keitaro Anai[1], Yutaro Enomoto[1], Hiroto Omura[1], Koji Nagano[2], Kiwamu Izumi[2], Mamoru Endo[1], Shuntaro Takeda[1]; *[1]The Univ. of Tokyo, Japan; [2]Inst. of Space and Astronautical Science (JAXA), Japan.* We propose and demonstrate a method to, in principle, completely remove shot noise of optical beat-note detection using squeezed light. This leads to improving the sensitivity of various spatial/temporal measurements.

ATh1G.4 • 09:00 (Invited)
Radio Frequency Measurement with Rydberg Atom-Based Sensors, James P. Shaffer[1]; [1]*Quantum Valley Ideas Lab, Canada.* Abstract not available.

ATh1G.5 • 09:30
Single-pixel Compressive Imaging with Single Photon Counting, Lili Li[1], Matthew Thomas[1], Santosh Kumar[1], Yuping Huang[1]; [1]*Stevens Inst. of Technology, USA.* We experimentally demonstrate a compressive imaging system by utilizing single-pixel detection at a single-photon level and a deep neural network. As a benchmark test, MNIST handwritten digits could be reconstructed at -27 dB signal to noise ratio.

ATh1G.6 • 09:45
Loss-tolerant All-optical Distributed Sensing, Rajveer Nehra[2], Changhun Oh[3], Liang Jiang[3], Alireza Marandi[1]; [1]*California Inst. of Technology, USA;* [2]*Electrical and Computer Engineering and Physics, Univ. of Massachusetts-Amherst, USA;* [3]*Univ. of Chicago, USA.* We investigate a resource-efficient distributed quantum sensing (DQS) scheme using phase-sensitive optical parametric amplifiers and linear optics, achieving sensitivity levels close to the optimal limit determined by the quantum Fisher information of the resource state.

08:00 -- 10:00
Room: W207A
ATh1H • A&T Topical Review on Shaping the Future of Laser-Plasma Applications with Structured Light Fields I
Presider: Marco Piccardo; Técnico Lisboa, Portugal

ATh1H.1 • 08:00 (Invited)
Structured Light and Light Induced Structures in Attosecond Science, Subhendu Kahaly[1]; [1]*Extreme Light Infrastructure, ALPS, Hungary.* Abstract not available.

ATh1H.2 • 08:30 (Invited)
Intense Laser-plasma Interactions with Structured Light, Camilla Willim[1]; [1]*Técnico Lisboa, Portugal.* We study the nonlinear interaction of ultra-intense structured light with plasma analytically and through three-dimensional particle-in-cell simulations, focusing on low divergence proton acceleration and spatiotemporal control of intense magnetic fields.

ATh1H.3 • 09:00 (Invited)
Efficient Generation of Intense Spatial and Spatiotemporal Vortex Harmonics Using Plasma Mirrors, Yipeng Wu[1]; [1]*Univ. of California Los Angeles, USA.* We propose an efficient scheme that can generate intense spatial and spatiotemporal vortex harmonics from plasma mirrors. The proposed scheme also allows independent control over the frequency and orbital angular momentum of the vortex harmonics.

ATh1H.4 • 09:30 (Invited)
Structured Light from Structured Plasma: Manipulating Extreme Lasers with Plasma Optics, Matthew Edwards[1], Nicholas M. Fasano[2], Victor M. Perez-Ramirez[1], Michelle M. Wang[2], Ke Ou[1], Sida Cao[1], Devin Seyler[1], Andreas Giakas[2], Pierre Michel[3], Julia M.

Mikhailova[2]; *[1]Stanford Univ., USA; [2]Princeton Univ., USA; [3]Lawrence Livermore National Laboratory, USA.* Plasma volume diffraction optics enable the holographic manipulation of highintensity beams of light. By varying plasma density with micron precision, high-damage-threshold gratings, lenses, and holograms can be created for compact ultra-high-power laser systems.

08:00 -- 10:00
Room: W206BC
STh1I • Quantum and Light Matter Interactions
Presider: Masato Takiguchi; NTT Basic Research Laboratories, Japan

STh1I.1 • 08:00 (Invited)
A Chiral Light-Matter Interface with Superconducting Qubits, Chaitali Joshi[1,2]; *[1]Google, USA; [2]California Inst. of Technology, USA.* I will discuss our work on realizing nonreciprocal light-matter interactions in the microwave domain. Applications of this platform include photon-mediated gates between distant qubits and the preparation of many-body dark states in chiral atom arrays.

STh1I.2 • 08:30
Near-Infrared Thin Film Lithium Niobate Platform for Multiplexed Quantum Nodes, Dylan L. Renaud[1], Daniel R. Assumpcao[1], Aida Baradari[1], Beibei Zeng[2], Amirhassan Shams-Ansari[1], Bartholomeus Machielse[2], Marko Loncar[1]; *[1]Harvard Univ., USA; [2]AWS, USA.* We report on near-infrared thin-film lithium niobate components for scaling up quantum nodes. We demonstrate integrated low-insertion loss couplers, frequency shifters, laser pulse generators, switches, and more.

STh1I.3 • 08:45 (Invited)
Microcavity Exciton-Polaron-Polaritons in 2D Materials: Physics and Applications, Farhan Rana[1], Okan Koksal[2,1]; *[1]Cornell Univ., USA; [2]NIST Inst. for Physical Science and Technology, USA.* In doped 2D materials, the two dominant peaks in the optical spectra correspond to superpositions of 2-body-exciton and 4-body-trion states, also called exciton-polarons. The strong coupling of these many-body excitations to photons in microcavities result in exciton-polaron-polaritons whose properties can be controlled via a variety of different techniques. We will discuss the physics and applications of these polaritons.

STh1I.4 • 09:15
High Efficiency InGaN/GaN Nanowire LED Using Exciton Recombination Dynamics, Yakshita Malhotra[1], Ayush Pandey[1], Jungwook Min[1], Maddaka Reddeppa[1], Yixin Xiao[1], Zidong Li[1], Yuchen Kan[1], Yifu Guo[1], Kai Sun[1], Parag B. Deotare[1], Zetian Mi[1]; *[1]Univ. of Michigan, USA.* Facet formation in InGaN disc-in-wire LEDs leads to increased exciton binding energy due to strain relaxation and reduced polarization fields resulting in an ultra-high efficiency of 25.2% for green emission utilizing excitonic recombination dynamics.

STh1I.5 • 09:30
High-gain Wavelength-specific Opposite Photoresponses in a PMMA-modified Graphene Photodetector, Jinhua Wu[1,3], Hao Sun[1,2], Ruiling Zhang[1,3], Shipeng Yao[1,3], Zhangyu Hou[1,3], Cun-zheng Ning[1,3]; *[1]Department of Electronic Engineering, Tsinghua Univ., China; [2]International*

Center for Nano-Optoelectronics, Tsinghua Univ., China; [3]College of Integrated Circuits and Optoelectronic Chips, Shenzhen Technology Univ., China. We demonstrated wavelength-specific opposite photoresponses on a PMMA-modified graphene photodetector with response wavelengths ranging from 405 to 1650 nm. A record-high normalized gain for the negative response of 1.88×10^{-3} m^2V^{-1} was achieved.

STh1I.6 • 09:45

L- to U-Band Wavelength Conversion Based on Intermodal Four-Wave Mixing on-Chip, Valerio Vitali[1,2], Kyle R. Bottrill[1], Thalía Domínguez Bucio[1], Hao Liu[1], José Manuel Luque González[3], Francisco Jurado-Romero[3], Alejandro Ortega-Moñux[3], Glenn Churchill[1], James C. Gates[1], James A. Hillier[4], Nikolaos Kalfagiannis[4], Daniele Melati[5], Jens H. Schmid[6], Ilaria Cristiani[2], Pavel Cheben[6], J. Gonzalo Wangüemert-Pérez[3], Íñigo Molina-Fernández[3], Frederic Gardes[1], Cosimo Lacava[2], Periklis Petropoulos[1]; *[1]Optoelectronics Research Centre, Univ. of Southampton, UK; [2]Univ. of Pavia, Italy; [3]Universidad de Málaga, Spain; [4]Nottingham Trent Univ., UK; [5]Université Paris-Saclay, France; [6]National Research Council Canada, Canada.* We report here a broadband Si-rich silicon nitride wavelength converter based on intermodal four-wave mixing with on-chip mode multiplexing and de-multiplexing functionalities. L- to U-band wavelength conversion of 40-Gbps QPSK optical signals is demonstrated.

08:00 -- 10:00
Room: W207D
STh1J • Photonic Integration
Presider: Xian Xiao; Hewlett Packard Enterprise, USA

STh1J.1 • 08:00

Broadband Back-Excitation Suppressor with On-chip Asymmetric Metasurface, Heijun Jeong[1], Yahui Xiao[1], Zi Wang[2], Tingyi Gu[1]; *[1]Univ. of Delaware, USA; [2]NIST, USA.* We demonstrated an insertion loss of 2.2 dB and a back-excitation suppression of 5.1 dB over the 35 nm bandwidth with on-chip asymmetric metasurface

STh1J.2 • 08:15

3D Photonic Integrated Circuit Imagers with Embedded 45-degree Reflectors, Yichi Zhang[1], Shun-Hung Lee[1], Yi-Chun Lin[1], S. J. Ben Yoo[1]; *[1]Univ. of California Davis, USA.* We design, fabricate, and characterize compact 3D photonic integrated circuits (PICs) based on a multi-layer silicon nitride (Si_3N_4) platform with embedded 45º reflectors for vertical viewing. The resulting PICs can lead to a wafer-scale imager.

STh1J.3 • 08:30

Grating Coupled Attachment of Optical Fiber Arrays for *in situ* Photonics Experimentation, Kellen P. Arnold[1], Joel Slaby[2], Hannah Dattilo[3], Clay A. Kaylor[2], Ronald Schrimpf[3], Daniel Fleetwood[3], Stephen Ralph[2], Robert Reed[3], Sharon Weiss[3,1]; *[1]Interdisciplinary Materials Science, Vanderbilt Univ., USA; [2]Electrical and Computer Engineering, Georgia Inst. of Technology, USA; [3]Electrical and Computer Engineering, Vanderbilt Univ., USA.* We report a simple, vacuum-compatible fiber attach process for *in situ* study of grating-coupled photonic devices. The robustness of this technique is demonstrated on grating-coupled waveguides exposed to multiple X-ray irradiations for aerospace studies.

STh1J.4 • 08:45

Structured Light Projection Devices Based on Metasurface Optoelectronic Integration, Xianzi Pei[1], Lei Bao[1], Pan Fu[1], Bo Wu[1], Yiyang Xie[1]; *[1]Beijing Univ. of Technology, China.* We report an ultracompact wafer-level laser emission chip through integration of metasurface with vertical cavity surface-emitting lasers for structured light generation. There are ~2k light spots over 180°field of view in the far field.

STh1J.5 • 09:00

Lithium tantalate photonic integrated circuits for high volume manufacturing, Chengli Wang[1,2], Zihan Li[1,2], Johann Riemensberger[1,2], Grigory Lihachev[1,2], Mikhail Churaev[1,2], Xinru Ji[1,2], Kai Huang[3], Xin Ou[3], Tobias J. Kippenberg[1,2]; *[1]Inst. of Physics, Swiss Federal Inst. of Technology Lausanne, Switzerland; [2]Center of Quantum Science and Engineering, Switzerland; [3]National Key Laboratory of Materials for Integrated Circuits, Shanghai Inst. of Microsystem and Information Technology, Chinese Academy of Sciences, China.* We demonstrate the first photonic integrated circuit platform using Lithium Tantalate, achieving waveguides with low losses 5dB/cm, Mach-Zehnder modulators with a 40 GHz electro-optical bandwidth and a 1.96 Vcm voltage-length product, along with microresonators supporting dissipative Kerr soliton generation.

STh1J.6 • 09:30

The World of Microphotonic Arrays Enabled by Anisotropic Wet Etching of Silicon, Grant W. Bidney[1,2], Joshua M. Duran[2], Gamini Ariyawansa[2], Igor Anisimov[2], Vasily N. Astratov[1,2]; *[1]Physics and Optical Science, Univ. of North Carolina at Charlotte, USA; [2]Air Force Research Laboratory, USA.* It is shown that microphotonic arrays fabricated by anisotropic wet etching of silicon have properties which make them uniquely suitable for enhancing photodetector, emitter, or resonator arrays in different silicon photonics applications.

STh1J.7 • 09:45

Hybrid Integration of Semiconductor Lasers: Impact of Matching Laser AR Coatings to Photonic Wire Bonds, Omid Esmaeeli[1], Matthew Mitchell[2], Justin Bickford[4], Frédéric Grillot[3,5], Lukas Chrostowski[1,2], Sudip Shekhar[1]; *[1]Electrical and Computer Engineering, The Univ. of British Columbia, Canada; [2]Stewart Blusson Quantum Matter Inst., The Univ. of British Columbia, Canada; [3]Telecom Paris, Inst. Polytechnique de Paris, France; [4]Army Research Laboratory, US Army Combat Capabilities Development Command, USA; [5]Center for High Technology Materials, Univ. of New Mexico, USA.* We investigate the influence of anti-reflection (AR) coating index on the performance of distributed feedback (DFB) lasers when integrated to a fiber using photonic wire bonds (PWBs). We compare the performance of air and polymer-matched AR-coated DFB lasers.

08:00 -- 10:00
Room: W208
STh1K • Packaging and New Functionalities in Silicon Photonics
Presider: Kyoko Kitamura; Tohoku Univ., Japan

STh1K.1 • 08:00 (Tutorial)

Scalable Fiber Packaging for Silicon Photonics, Jaime Cardenas[1]; *[1]Univ. of Rochester, USA.* Packaging silicon photonic devices remains a major challenge. Fiber attach is the major bottleneck. This tutorial discusses scalable approaches to package optical fibers to silicon photonic devices and future trends and requirements.

STh1K.2 • 09:00
Non-Hermitian Non-Blocking Switching on a Silicon Integrated Photonic Chip, Xilin Feng[1], Tianwei Wu[2], Zihe Gao[2], Hao-Qi Zhao[1], Yichi Zhang[2], Shuang Wu[2], Li Ge[3,4], Liang Feng[2,1]; [1]*Electrical and Systems Engineering, Univ. of Pennsylvania, USA; [2]Material Science and Engineering, Univ. of Pennsylvania, USA; [3]Engineering Science and Physics, Collage of Staten Island, CUNY, USA; [4]The Graduate Center, CUNY, USA.* Applying parity-time (PT) symmetry, we demonstrate a large-scale non-blocking optical switch array on a III–V/Si integrated photonic chip. Light is routed between the vertically coupled waveguides by gain/loss control of the III–V layer.

STh1K.3 • 09:15
Deep Neural Network Enhanced Chip-on-board Hybrid-Packaged Photonic-Electrical Silicon Transceiver for High-speed Optical Interconnects, Jun Qin[2], Qipeng Yang[1], Changhao Han[1], Yan Zhou[1], Yunhao Zhang[1], Yichen Wu[1], Yu Sun[2], Junde Lu[2], Siming Liu[4], Yueqin Li[2], Jian Sun[2], Min Miao[2], Weiwei Hu[1], Zhixue He[3], Lei Wang[3], Shaohua Yu[3], Haowen Shu[1], Xingjun Wang[1]; [1]*Peking Univ., China; [2]Beijing Information Science and Technology Univ., China; [3]Peng Cheng Laboratory, China; [4]State Key Laboratory of Information Photonics and Optical Communications, BUPT, China.* We explore implementing a multilevel deep neural network to enhance the performance of a 4-channel photonic-electrical hybrid-packaged silicon transceiver. Stable transmission and reception of 150 Gbps/λ PAM4 signals are achieved, which shows the potential for beyond-400G optical interconnects.

STh1K.4 • 09:30
Nonlinear Silicon Photonic Passive Device for Edge Computing, Makoto Nakai[1], Isamu Takai[1]; [1]*Toyota Central R&D Labs Inc., Japan.* A silicon photonic passive device which performs nonlinear optical phase-to-amplitude signal conversion is proposed for edge computing applications. Classification of Iris and Wine datasets are demonstrated with accuracy of 100% and 97.75%, respectively.

STh1K.5 • 09:45
Silicon Photonic Physical Unclonable Functions Based on an Actively-tuned Waveguide Array, Gow-Zin Yiu[2], Chung-Yu Hsu[2], Chia-Heng Sun[1], Pai-yen Chen[1], You-Chia Chang[2]; [1]*Department of Electrical and Computer Engineering, Univ. of Illinois Chicago, USA; [2]Department of Photonics, National Yang Ming Chiao Tung Univ., Taiwan.* We demonstrate experimentally physical unclonable functions based on an 8-channel waveguide array with embedded phase shifters to actively generate challenge-response pairs. We generate 128 challenges and show unclonability between 6 copies on the same wafer.

08:00 -- 10:00
Room: W209A
FTh1L • Time Crystals and Temporal Interfaces
Presider: Eran Lustig; Stanford Univ.

FTh1L.1 • 08:00
Second Harmonic Generation in Photonic Time Crystals, Noa Konforty[1], Moshe-Ishay Cohen[1], Ohad Segal[1], Yonatan Plotnik[1], Mordechai Segev[1]; *[1]Technion, Israel.* We study the process of second harmonic generation in photonic time-crystals. We find the phase matching condition of the process and show it can be tailored by the photonic time-crystal band structure.

FTh1L.2 • 08:30
Using Temporal Reflection for Probing the Trajectory of Raman Solitons inside a Photonic Crystal Fiber, Junchi Zhang[1], William Donaldson[2], Govind Agrawal[1]; *[1]Inst. of Optics, Univ. of Rochester, USA; [2]Laboratory for Laser Energetics, Univ. of Rochester, USA.* We discuss experiments employing temporal reflection inside a photonic crystal fiber to probe the trajectory of a decelerating short soliton undergoing Raman-induced red shift along the fiber's length.

FTh1L.3 • 08:45
Temporal Knife-Edge: Epsilon-Near-Zero Characterization Tool, Adam Ball[1], Ray Secondo[2,3], Dhruv Fomra[1], Jingwei Wu[1], Sampriy Saha[1], Nathaniel Kinsey[1]; *[1]Virginia Commonwealth Univ., USA; [2]Azimuth Corporation, USA; [3]Materials and Manufacturing Directorate, Air Force Research Laboratory, USA.* Using the nonlinear optical characterization technique beam deflection, we utilize an off-axis excitation scheme in order to characterize input pulses for their temporal and spatial widths, angle, and relative offset with femtosecond and micron resolution.

FTh1L.4 • 09:00
Time-Domain Bound States in the Continuum, Oded M. Schiller[1], Ohad Segal[1], Yonatan Plotnik[1], Mordechai Segev[1]; *[1]Technion Israel Inst. of Technology, Israel.* We present the concept of temporal Bound States in the Continuum (BIC): bound states in the time dimension embedded in the spatial frequency continuum. These BICs are analytic solutions to Maxwell's equations in time-varying media.

FTh1L.5 • 09:15
Time-reflection in a discrete synthetic photonic lattice, Alexander Palatnik[1], Yonatan Plotnik[1], Julia Görsch[2], Andrea Steinfurth[2], Alexander Szameit[2], Mordechai Segev[1]; *[1]Solid State Inst., The Technion, Israel; [2]Institut für Physik, Universität Rostock, Germany.* We demonstrate time-reflection of optical wavepackets propagating in time-modulated synthetic lattice based on coupled optical fiber loops. Time-reflection arises from a temporal boundary created by an abrupt change in the lattice parameters.

08:00 -- 10:00
Room: W209B
FTh1M • Nonlinear Phenomena in Quantum Systems
Presider: Markus Gräfe; Technische Universität Darmstadt, Germany

FTh1M.1 • 08:00 (Tutorial)
Bright squeezed vacuum and its applications in strong-field physics, Maria Chekhova[1,2]; *[1]Max-Planck-Inst Physik des Lichts, Germany; [2]Friedrich-Alexander Universität Erlangen-Nürnberg, Germany.* Strongly pumped parametric down-conversion produces a macroscopic quantum state of light that is intense enough to drastically modify the dynamics of strong-field effects: non-perturbative harmonics generation, electron ejection from nanotips, and some others.

FTh1M.2 • 09:00
An ab initio framework for understanding and controlling quantum fluctuations in complex light-matter systems, Nicholas Rivera[2,1], Shiekh Zia Uddin[1], Devin Seyler[1], Yannick Salamin[1], Jamison Sloan[1], Charles Roques-Carmes[4,1], Shutao Xu[3], Michelle Sander[3], Marin Soljačić[1]; *[1]Massachusetts Inst. of Technology, USA; [2]Physics, Harvard Univ., USA; [3]Boston Univ., USA; [4]Stanford Univ., USA.* We develop a new general theory of quantum noise in photonics. As an example, we demonstrate strong quantum correlations and squeezing in supercontinuum generation. Our results enable overcoming quantum noise limits in many optoelectronic systems.

FTh1M.3 • 09:15
Multimode amplitude squeezing through cascaded nonlinear processes, Sahil Pontula[1], Yannick Salamin[1], Marin Soljačić[1]; *[1]Massachusetts Inst. of Technology, USA.* We show how engineering a multimode nonlinear cavity with cascaded three wave mixing processes creates significant intracavity and output amplitude noise squeezing over 10 dB below the shot noise limit for multiple frequency modes.

FTh1M.4 • 09:30
Photon Correlations of Scintillation Light and its Application to Scintillator Characterizatio, Noam Kasten[1], Shaul Katznelson[1], Offek Tziperman[1], Avner Shultzman[1], Rotem Strassberg[3], Georgy Dosovitskiy[1], Yehonadav Bekenstein[3], Charles Roques-Carmes[2], Ido Kaminer[1]; *[1]Solid State Inst., Technion–- Israel Inst. of Technology, Israel; [2]E.L. Ginzton Laboratories, Stanford Univ., USA; [3]Faculty of Materials Science and Engineering, Technion–-Israel Inst. of Technology, Israel.* We measure the second-order coherence function of scintillators and show how this measurement enables extracting important scintillator properties: lifetime, scintillation yield, and energy resolution, all extracted using a simple X-ray tube.

FTh1M.5 • 09:45
Ultrafast Bright Squeezed Vacuum in Nearly Single Spatio-Temporal Mode, Patrick Cusson[1], Andrei Rasputnyi[2,3], Francesco Tani[2], Denis Seletskiy[1], Maria Chekhova[2,3]; *[1]Polytechnique Montréal, Canada; [2]Max Planck Inst. for the Science of Light, Germany; [3]Friedrich-Alexander-Universität, Germany.* We demonstrate nearly single-mode bright squeezed vacuum sources with unprecedentedly high peak power (with mean values up to tens of MW) and few-cycle durations, which enable accessing the non-perturbative regime of light-matter interaction.

08:00 -- 10:00
Room: W209C
JTh1N • Symposium: Photonics Meets Free-Electron Science I
Presider: Charles Roques-Carmes; Stanford Univ., USA

JTh1N.1 • 08:00 (Invited)
Coupling Swift Electrons and Light over Long Distances: the Particle Accelerator on a Photonic Chip, Stefanie Kraus[1], Leon Brückner[1], Tomas Chlouba[1], Roy Shiloh[1,2], Julian Litzel[1], Zhexin Zhao[1], Peter Hommelhoff[1]; [1]*Friedrich-Alexander-Universität Erlangen, Germany;* [2]*Hebrew Univ., Israel.* Particle accelerators accelerate electron bunches and keep them together simultaneously, requiring complex electron control schemes. We have demonstrated this in a 0.5mm long and 225nm narrow photonic accelerator structure and will present a status update.

JTh1N.2 • 08:30 (Invited)
Studying Classical and Quantum Interactions Between Electrons and Photons in a Scanning Electron Microscope, Phillip D. Keathley[1]; [1]*Massachussetts Inst. of Technology, USA.* We present a customized SEM testbed for the study of classical and quantum interactions between electrons and photons mediated by nanoscale structures.

JTh1N.3 • 09:00 (Invited)
Prospects for Compact Radiation Sources Using On-Chip Accelerators, Joel England[1], Andrzej Szczepkowicz[2], Yenchieh Huang[3], Levi Schachter[4], Robert Byer[5]; [1]*SLAC National Accelerator Laboratory, USA;* [2]*Wroclaw Univ., Poland;* [3]*National Tsing Hua Univ., Taiwan;* [4]*Technion, Israel;* [5]*Stanford Univ., USA.* We review recent developments in laser driven particle accelerators and discuss potential applications for generation of tunable coherent radiation sources employing the attosecond optically spaced electron bunches that are intrinsic to these systems.

JTh1N.4 • 09:30 (Invited)
An Upper Limit to the Quantum Interactions Between Free Electrons and Photons, Yi Yang[1]; [1]*Univ. of Hong Kong, Hong Kong.* We present an upper limit to the quantum coupling strength g_{qu} between free electrons and photons in arbitrary photonic environments. The electron-structure separation and frequency requirement for the important condition $g_{qu}>1$ is obtained under various electron velocities.

08:00 -- 10:00
Room: W209DE
STh1O • Widely Tunable Semiconductor Lasers
Presider: Zaijun Chen; Univ. of Southern California, USA

STh1O.1 • 08:00 (Invited)
Design and Applications of Low-Coherence Semiconductor Light Emitters, Boon S. Ooi[1], Omar Alkhazragi[1], Hang Lu[1]; [1]*King Abdullah Univ of Sci & Technology, Saudi Arabia.* Despite its numerous advantages, high coherence degrades the performance of many applications due to unintentional interference effects. We review the recent advances in low-coherence semiconductor light emitters and how they can revolutionize those applications.

STh1O.2 • 08:30

Continuous Wave Interband Cascade Lasers Near 13 µm, Yixuan Shen[1], Rui Q. Yang[1], Samuel D. Hawkins[2], Aaron Muhowski[2]; *[1]Univ. of Oklahoma, USA; [2]Sandia National Laboratories, USA.* We report continuous wave (cw) operation of interband cascade lasers (ICLs) with innovative active region operating near 13 µm, the longest cw emission wavelength among ICLs, showing the further potential of ICLs.

STh1O.3 • 08:45

Self-injection-locking FMCW Laser Source on the Lithium Niobate Platform, Xinhang Li[1], Minglu Cai[1], Reyang Xu[1], Yihao Fan[1], Yuyao Guo[1], Siyu E[1], Minhui Jin[1], Kan Wu[1], Yu Li[1], Liangjun Lu[1], Jianping Chen[1], Linjie Zhou[1]; *[1]Shanghai Jiao Tong Univ., China.* We demonstrate a hybrid-integrated linear-chirp frequency-modulated continuous wave laser based on self-injection locking to a high-Q lithium niobate multimode microring resonator with a 1 kHz linewidth and 1 MHz modulation speed.

STh1O.4 • 09:00

Dual-wavelength DFB Laser Based on Four Phase-shifted Sampled Moiré Grating for MMW Generation, Yizhe FAN[1], Bocheng Yuan[1], Mohanad Al-Rubaiee[1], John Marsh[1], Lianping Hou[1]; *[1]Univ. of Glasgow, UK.* A dual-wavelength DFB laser is demonstrated utilizing 4-phase-shifted sampled Moiré gratings, which maintains stable operation across an 80 mA current span. It produces a high-quality 39.4 GHz RF signal with an approximate 5 MHz linewidth.

STh1O.5 • 09:15

L Band Thermo-Optically Tuned Multi-Channel Interference Widely Tunable Laser, Zifeng Chen[1], Jiajun Lou[1], Quanan Chen[1], Chun Jiang[1], Juan Xia[1], Qiaoyin Lu[1], Weihua Guo[1]; *[1]Huazhong Univ. of Science and Techn, China.* A L-band multi-channel interference widely tunable laser was demonstrated for the first time. The laser exhibited excellent performances with tuning range > 50nm, SMSR > 46dB, output power > 18.8dBm, and linewidth < 100kHz.

STh1O.6 • 09:30

Widely tunable, integrated blue diode laser using the Si_3N_4 platform, Cornelis A. Franken[1], Lisa V. Winkler[1,2], Adriano R. do Nascimento Jr.[3], Albert van Rees[1], Ronald Dekker[4], Marcel Hoekman[4], Philip Schrinner[4], Joost van Kerkhof[3], Peter J. van der Slot[1], Klaus Boller[1]; *[1]Univ. of Twente, Netherlands; [2]TOPTICA Photonics, Germany; [3]PHIX B.V., Netherlands; [4]Lionix International B.V., Netherlands.* We present the first hybrid integrated, extended cavity diode laser (ECDL) in the blue wavelength range. Integrating a CMOS-compatible silicon nitride (Si_3N_4) feedback circuit with a gallium nitride amplifier, we obtain 8.5 nm wide tuning around 454 nm.

08:00 -- 10:00
Room: W209F
FTh1P • Nonlinear Effects in Metasurfaces

Presider: Ileana-Cristina Benea-Chelmus; Ecole Polytechnique Federale de Lausanne, Switzerland

FTh1P.1 • 08:00

Enhancement and Wavefront Control of Third Harmonic Generation with a Local High-Q Metasurface, Claudio U. Hail[1], Lior Michaeli[1], Harry A. Atwater[1]; *[1]Caltech, USA.* We report on simultaneous strong enhancement and local spatial control of the third harmonic generation process using high-Q metasurfaces relying on higher-order Mie-resonant modes.

FTh1P.2 • 08:15

Self-Tunable Nonlinear Generation in Metasurfaces, Euclides Almeida[1,2], Matthew D. Feinstein[1,2], Yael Blechman[3], Alexander Adronikides[1]; *[1]Queens College, CUNY, USA; [2]The Graduate Center of CUNY, USA; [3]Technion – Israel Inst. of Technology, Israel.* We realize a frequency-converting nonlinear metasurface that can be self-tuned by pumping with strong fields. The tunability is attained via quantum nonlinearities, opening up new ways of engineering quantum effects in nonlinear metasurfaces.

FTh1P.3 • 08:30

Enhanced Nonlinear Up-Conversion Imaging by Lithium Niobate Metasurfaces, Rocio Camacho-Morales[1], Laura Valencia Molina[1], Jihua Zhang[1], Isabelle Staude[2], Andrey Sukhorukov[1], Dragomir Neshev[1]; *[1]Australian National Univ., Australia; [2]Friedrich Schiller Univ. Jena, Germany.* Infrared imaging has several applications including surveillance and healthcare. However, conventional infrared imaging devices have some limitations. Here, we demonstrate up-conversion of infrared images to the visible, by a resonant metasurface supporting high-quality resonant modes.

FTh1P.4 • 08:45

Generation of odd and even optical harmonics from resonant silicon metasurfaces, Pavel Tonkaev[1], Fangxing Lai[2], Sergey Kruk[1], Qinghai Song[2], Kirill Koshelev[1], Yuri S. Kivshar[1]; *[1]Australian National Univ., Australia; [2]Harbin Inst. of Technology, China.* We observe the generation of odd and even harmonics from resonant silicon metasurfaces. We demonstrate at least three orders of magnitude enhancement of second and third harmonics at the resonances, and also non-perturbative behaviour of the resonantly generated second and fourth harmonics.

FTh1P.5 • 09:00

Resonant harmonic generation from nonlinear chiral van der Waals metasurfaces, Zhuoyuan Lu[1], Ivan Toftul[1], Yilin Tang[1], Pavel Tonkaev[1], Kirill Koshelev[1], Yuerui Lu[1], Yuri S. Kivshar[1]; *[1]Australian National Univ., Australia.* We employ van der Waals heterostructures for a design and nanofabrication of dielectric nonlinear metamaterials. We analyse resonant the generation of chiral third-harmonic signal from hBN metasurfaces and second-harmonic signal from 3R-MoS2 metasurfaces.

FTh1P.6 • 09:15

Electrical Tuning of Four-Wave Mixing in Nonlinear Metasurfaces, Matthew D. Feinstein[2], Alexander Adronikides[1], Euclides Almeida[1]; *[1]Queens College CUNY, USA; [2]Graduate Center CUNY, USA.* We demonstrate a broadband, electrically tunable nonlinear metasurface utilizing hybrid gold-graphene plasmons. The metasurface device converts electromagnetic radiation from mid-infrared to visible through four-wave mixing, and the conversion can be electrically modulated more than graphene.

FTh1P.7 • 09:30

Dual-Modal Nanoplasmonic Light Upconversion in Broadband Multiresonant Plasmonic Metasurfaces, Seied Ali Safiabadi Tali[1], Wei Zhou[1]; *[1]Virginia Tech, USA.* This study investigates dual-modal plasmon-enhanced light upconversion, combining anti-Stokes photoluminescence (ASPL) and second-harmonic generation (SHG) in Ag/SiO_2/Ag nanolaminate plasmonic crystal metasurfaces. It highlights the distinct emission behaviors of ASPL and SHG in multiresonant plasmonic nanocavities.

FTh1P.8 • 09:45

Dynamics of Second-Harmonic Generation in Bilayer Nonlinear Metamaterial, Danielle Ben Haim[1,2], Tal Ellenbogen[1,2]; *[1]Tel Aviv Univ., Israel; [2]Center for Light-Matter Interaction, Israel.* We study the dynamics of second-harmonic generation from a nonlinear plasmonic metamaterial composed of two layers with geometric phase difference, as a foundation for designing efficient and tunable multilayered nonlinear metamaterials.

08:00 -- 10:00
Room: W210
STh1Q • Integrated Photonics for Signal Processing and Communications
Presider: Chaoran Huang; Chinese Univ. of Hong Kong, Hong Kong

STh1Q.1 • 08:00

Application of a High Power Fabry-Perot QW Laser Diode on Multi-Channel Coherent Optical System, Shalmoli Ghosh[1], Sharmila Raisa[1], Maurice O'Sullivan[2], Charles Laperle[2], Rongqing Hui[1]; *[1]Univ. of Kansas, USA; [2]Ciena Corporation, Canada.* We investigate the property of a Fabry-Perot quantum-well laser diode which emits multiple spectral lines with a total power exceeding 120mW. We show its application as an optical source in a multi-channel coherent optical system.

STh1Q.2 • 08:15

Fully-integrated silicon wavelength converter with on-chip idler filtering, Hao Liu[1], Kyle R. Bottrill[1], Valerio Vitali[1,2], Iosif Demirtzioglou[1,3], Martin Skenderas[1], Nura Adamu[1], Cosimo Lacava[1,2], Xingzhao Yan[1], Mehdi Banakar[1], Ying Tran[1], Martin Ebert[1], James L. Besque[1], Callum Littlejohns[1], David J. Thomson[1], Periklis Petropoulos[1]; *[1]Univ. of Southampton, UK; [2]Electrical, Computer and Biomedical Engineering Department, Univ. of Pavia, Italy; [3]Huawei Technologies, Paris Research Center, Optical Communication Technology Lab, France.* We demonstrate a fully-integrated silicon wavelength converter utilizing four-wave mixing, featuring tunable idler filtering with >59 dB out-of-band signal suppression. Conversion of a 32-Gbaud 16-QAM signal with around 2 dB power penalty is demonstrated.

STh1Q.3 • 08:30 (Invited)

Monolithically Integrated III-V Quantum Dot Comb Lasers on Silicon for Chip-to-chip Optical I/O, Wang Ting[1]; [1]*Inst. of Physics CAS, China.* High performance computing and machine learning have increased the demand of chip-to-chip data transmission capacity via optical interconnects. Here, we demonstrated monolithically integrated III-V quantum dot comb lasers on silicon integrated with silicon photonic modulators for high bandwidth and low power consumption optical I/O.

STh1Q.4 • 09:00

Optical Fiber Communication System Based On an Ultrahigh-Q Packaged Fused Silica Microrod, Jun Hu[1], Tingyang Pan[1], Chang Li[1], Bing Duan[1], Huashun Wen[2], Daquan Yang[1]; [1]*Beijing Univ. of Posts and Telecommunications, China;* [2]*Inst. of Semiconductors, Chinese Academy of Sciences, China.* We generate a low-threshold Kerr optical frequency comb in the 2.2×10<sup _mstmutation””””>9 quality factor packaged microrod resonator and implement coherent optical communication with transmission rates of 500 Gb/s and bit error ratios of 10<sup _mstmutation””””>-7.

STh1Q.5 • 09:15

Spectral Convolution Technique for Highest-Bandwidth Ultra-Flat Comb Generation Using Dual-Stage Modulator, Shun Harada[1], Tatsuki Ishijima[1], Takahide Sakamoto[1]; [1]*Tokyo metropolitan Univ., Japan.* We demonstrate spectral convolution technique for ultra-flat comb generation using dual-stage electro-optic modulators. Both modulators broaden comb's spectrum, maximizing spectral width with excellent spectral flatness. Using narrow-linewidth comb lines, high-speed QPSK modulation/demodulation is also demonstrated.

STh1Q.6 • 09:30

Optic-Electronic-Optic Interferometer on an Indium Phosphide Platform, Md Salek Mahmud[1], Patrick Matalla[1], Joel Dittmer[1], Alexander Schindler[3], Patrick Runge[2], Christian Koos[1], Sebastian Randel[1]; [1]*Karlsruhe Inst. of Technology (KIT), Germany;* [2]*Fraunhofer Heinrich Hertz Institut, Germany;* [3]*Technical Univ. Berlin, Germany.* We present an Indium-Phosphide-based optic-electronic-optic (OEO) interferometer module and demonstrate interferometric optical add/drop multiplexing of optical QPSK signals with endless active phase stabilization.

STh1Q.7 • 09:45

Dynamic Demultiplexing of Low-Loss Spatial Modes in Strong Turbulence Using Reconfigurable Photonics, Ultan J. Daly[1], Aleksandr Boldin[1], Lubomir Skvarenina[1], Maziyar Milanizadeh[2], Andrea Melloni[2], David Miller[3], Marc Sorel[1], Francesco Morichetti[2], Martin Lavery[1]; [1]*Univ. of Glasgow, UK;* [2]*Politecnico di Milano, Italy;* [3]*Stanford Univ., USA.* A reconfigurable-SOI-photonics platform capable of dynamically multiplexing and demultiplexing an orthogonal basis of low-loss optical-modes through a 1 km equivalent free-space channel is demonstrated. The channel-defined orthogonal basis is determined by utilizing singular value decomposition.

08:00 -- 10:00
Room: W211
FTh1R • Plasmonics and Photonic Structure and Devices
Presider: Ofer Kfir; Tel Aviv Univ., Israel

FTh1R.1 • 08:00 (Tutorial)
Using Light-driven Nanomotors to Propel Microrobots, Bert Hecht[1]; [1]*Universität Würzburg, Germany.* Abstract not available.

FTh1R.2 • 09:00
Optical Trapping with Inversely Designed Plasmonic Nanotweezers with Multiple Resonances, Damian Nelson[1], Anders J. Barlow[2], Xiao Qi[3], Emory Chan[3], Bruce Cohen[3], Gus Bonin[1], Robert de Gille[1], Nima Sefidmooye Azar[1], Wei Luo[4], Paul Mulvaney[4], Sejeong Kim[5], Kenneth Crozier[1,5]; [1]*School of Physics, Univ. of Melbourne, Australia;* [2]*Materials Characterisation and Fabrication Platform, Univ. of Melbourne, Australia;* [3]*The Molecular Foundry, Lawrence Berkeley National Laboratory, USA;* [4]*School of Chemistry, Univ. of Melbourne, Australia;* [5]*Department of Electrical and Electronic Engineering, Univ. of Melbourne, Australia.* We optically trap 20 nm polystyrene nanospheres with inversely designed plasmonic aperture nanotweezers. These have two resonances that produce strong near-field enhancement across a common nanogap, with the goal of simultaneously enhancing absorption and emission.

FTh1R.3 • 09:15
High-Efficiency High-NA Metalens Designed by Maximizing the Efficiency Limit, Shiyu Li[1], Ho-Chun Lin[1], Chia Wei Hsu[1]; [1]*Univ. of Southern California, USA.* We identify optimal system parameters that maximize the upper limit of transmission efficiency and then perform inverse design to find high-NA wide-field-of-view metalenses with a record-high efficiency (98% transmission, 92% Strehl ratio, NA = 0.9).

FTh1R.4 • 09:30
Inverse Design of Plasmonic Phase-Contrast Image Sensors Using Denoising Diffusion Probabilistic Model, Keisuke Kojima[1], Jianing L. Liu[2], Roberto Paiella[2]; [1]*Boston Quantum Photonics LLC, USA;* [2]*Boston Univ., USA.* We use a generative deep learning method based on denoising diffusion probabilistic model to improve the design of plasmonic phase-imaging sensors for broadband operation. This flexible method enables optimized inverse design for a wide range of target specifications.

FTh1R.5 • 09:45
Photonic Device Designs Assisted by Reinforcement Learning, Zi Wang[1,2], Junyeob Song[1], Okan Koksal[1], Lu Chen[1,2], Amit Agrawal[1], Wenqi Zhu[1]; [1]*NIST, USA;* [2]*Univ. of Maryland, College Park, USA.* We use reinforcement learning algorithms to design a variety of photonic devices that can be used for miniaturized atomic systems. Such algorithms generate high efficiency photonic devices without the requirement of a training dataset.

11:30 -- 13:00
CLEO Hub
JTh2A • Joint Poster Session III

JTh2A.1

Second Harmonic Generation in Bulk $AgScP_2S_6$ and $CuScP_2S_6$ Metal Thiophosphates, Ryan P. Siebenaller[1,2], Mohamed Yaseen Noor[1], Conrad Kuz[1], Adam Fisher[1], Michael A. Susner[2], Enam Chowdhury[1]; *[1]Ohio State Univ., USA; [2]Air Force ResearchIy, Materials and Manufacturing Directorate, USA.* Metal thiophosphates (MTPs) $AgScP_2S_6$ and $CuScP_2S_6$ are characterized structurally and optically using polarization dependent transmission second harmonic generation (SHG), c-stacking X-ray diffraction (XRD), and single crystal XRD. Notable SHG signal from centrosymmetric $CuScP_2S_6$ is seen.

JTh2A.2

Metal Etch Mask Morphology for Silica Optical Windows Verified by Transmission Spectra, Benjamin A. Vaca[1], Jude Yoshino[1], William E. Genet[1], Tyler A. Benge[1], Ishwar D. Aggarwal[1], Thomas C. Hutchens[1]; *[1]Univ of North Carolina at Charlotte, USA.* This study focuses on the formation of gold islands on silica substrates via dewetting, for use as etching masks for anti-reflective structured surface fabrication, and corresponding analysis of optical transmission spectra of the gold masks.

JTh2A.3

Temperature Dependence of the Second Harmonic Generation Efficiency in $Sn_2P_2(S_{1-x}Se_x)_6$ Powders, Gary A. Sevison[1,2], P Shiv Halasyamani[3], Jonathan Slagle[1], Mariacristina Rumi[1]; *[1]US Air Force Research Laboratory, USA; [2]UES Inc., USA; [3]Chemistry, Univ. of Houston, USA.* Powder-based second harmonic generation measurements are a fast way to characterize semi-quantitatively non-linear properties of crystalline materials. Here, we include temperature control to study the behavior of chalcophosphates across phase transitions.

JTh2A.4

Engineering magnetism in layered antiferromagnets metal thiophosphates MPX_3 for novel photonic processes, Rabindra Basnet[1], Manoj K. Shah[1], Joel B. Ruzindana[1], Jin Hu[1], Mansour Mortazavi[1]; *[1]Univ. of Arkansas at Pine Bluff, USA.* This work focuses on engineering magnetism in magneto-optical materials MPX_3 by substitution and intercalation, which reveals efficient tuning of magnetic interactions and anisotropies. Such tunable magnetism provides platforms for novel photonic processes in layered magnets.

JTh2A.5

Exploiting Ferroionic 2D Materials for Enhanced Electro-Optic Functionality in Silicon Photonics, Ghada Dushaq[1], Mahmoud Rasras[1]; *[1]New York Univ. Abu Dhabi, United Arab Emirates.* We demonstrate the strong electro-refractive response of $CuCrP_2S_6$ (CCPS)-integrated SiPh microring resonators in the near-infrared wavelength. Results show significant refractive index tuning of 2.8×10^{-3} RIU with low optical losses and high modulation efficiency, outperforming earlier TMDs-based phase shifters.

JTh2A.6

The Reduction behavior of Eu ions Doped AlN Thin Films with Annealing Temperature Increasing, Yingda Qian[1], Mariko Murayama[1], Sujun Guan[2], Kazuto Miyano[1], Xinwei

Zhao[1]; *[1]Department of Physics, Tokyo Univ. of Science, Japan; [2]Research Center for Space System Innovation, Tokyo Univ. of Science, Japan.* The 21.7 at% reduction of Eu^{3+} to Eu^{2+} in the AlN host material was observed by XANES, while the R distance of Eu ions exhibited a variation from 1.80 to 1.34 Å.

JTh2A.7

Thin-film ferroelectric material qualification for on-chip electro-optic applications, Anupama T. Vasudevan[1], Sandeep Vura[1], Sri Harsha Molleti[1], Pavan Nukala[1], Srinivasan Raghavan[1], Shankar Kumar Selvaraja[1]; *[1]Centre for Nanoscience and Engineering, Indian Inst. of Science, India.* We present a comprehensive insight into ferroelectric material development and characterization required for next-generation electro-optic modulators. We show that simple material and electric characterization of277haracterizalarisation is insufficient. Even electro-optic characteristics are subject to the nature of the ferroelectric material.

JTh2A.8

Free Electron Emission from Two-dimensional Material Heterostructures, Zhexuan Wang[1], Fang Liu[1], Kaiyu Cui[1], Xue Feng[1], wei zhang[1], Yidong Huang[1]; *[1]Tsinghua Univ., China.* We achieved free electron emission based on planar-type two-dimensional material heterostructures experimentally. By applying electric voltage of only 20V, maximum emission current density over $7mA/cm^2$ and steady operation for hours is realized.

JTh2A.9

Structurization of Full Surface Emissive $MAPbBr_3$ Crystals: from Fluorescent Tags to Resonant Nanostructures, Dominik Kowal[1], Somnath Mahato[1], Krzysztof Rola[1], Krzysztof Czyz[1], Muhammad Birowosuto[1]; *[1]Lu–asiewicz - PORT, Poland.* MAPbBr3 perovskites are known for bright green surface emission. We utilize the micromachining and nanofabrication tools to alter the photoluminescence properties of this perovskite and create fluorescent patterns and diffraction or resonant nanostructures.

JTh2A.10

Complex Dielectric Function of Photochromic Thiazolothiazole Embedded Polymers Determined by Spectroscopic Ellipsometry, Nuren Z. Shuchi[1], Tyler Adams[2], V. Paige Stinson[1], Micheal J. McLamb[1], Dustin Louisos[1], Glenn D. Boreman[1], Michael G. Walter[2], Tino Hofmann[1]; *[1]Department Physics and Optical Science, Univ. of North Carolina at Charlott, USA; [2]Department of Chemistry, Univ. of North Carolina at Charlotte, USA.* The complex dielectric function of photochromic thiazolo[5,4-d]thiazole embedded in polymer is reported in the spectral range from 0.8 to 2.5 eV. Strong absorption bands in the measured spectral range are observed depending upon its redox states.

JTh2A.11

Temperature-dependent Mechanical Losses of Eu:YSO for Applications in Ultra-stable Lasers, Nico Wagner[1,2], Bess Fang[3], Michael Hartman[3], Johannes Dickmann[1,2], Stefanie Kroker[1,2]; *[1]Technische Universität Braunschweig, Germany; [2]Laboratory for Emerging Nanometrology, Germany; [3]LNE-SYRTE, Observatoire de Paris, France.* Here, we present our first measurements of temperature-dependent mechanical losses of Eu:YSO, a promising candidate for ultra-stable lasers through the spectral hole burning technique. At cryogenic temperatures, we reached a mechanical loss of $\Phi=2.9(1)x10^{-4}$.

JTh2A.12

Impact of the Gain Recovery Time of a QD-SOA on Transmission System Amplification, Charles St-Arnault[1], Santiago Bernal[1], Ramón Gutiérrez-Castrejón[1,2], Essam Berikaa[1], Zixian Wei[1], Janina Rautert[3], Sergey V. Poltavtsev[3], Alexey E. Gubenko[3], Vasilii V. Belykh[3], Vladimir S. Mikhrin[3], Alexey R. Kovsh[4], David V. Plant[1]; [1]*McGill Univ., Canada;* [2]*Inst. of Engineering, Universidad Nacional Autónoma de México UNAM, Mexico;* [3]*Innolume GmbH, Germany;* [4]*Alphalume Inc., USA.* We experimentally evaluate the influence of the gain recovery time of a QD-SOA on IM/DD in the O-band and establish a way to estimate the gain recovery time of an SOA.

JTh2A.13

Pyroelectricity in Lithium Niobate Waveguides in the Thermal Transition to Cryogenic Temperatures, Frederik Thiele[1], Thomas Hummel[1], Nina Lange[1], Felix Dreher[1], Maximilian Protte[1], Felix vom Bruch[1], Sebastian Lengeling[1], Harald Herrmann[1], Christof Eigner[1], Christine Silberhorn[1], Tim J. Bartley[1]; [1]*Universität Paderborn, Germany.* Lithium niobate serves as a key quantum photonics integration platform, hosting cryogenic quantum optical devices such as SNSPDs and quantum dots. We explore the impact of pyroelectricity in the cryogenic environment in lithium niobate waveguides.

JTh2A.14

Impact of Mechanical Strain on Auger Recombination in InGaAs/InP, Yonge L. Simmons[1], Killian Dickson[1], Amberly F. Ricks[2], Alec M. Skipper[2], Andrew F. Briggs[2], Aaron Muhowski[2], Seth R. Bank[2], Juliet Gopinath[3,1]; [1]*Department of Physics, Univ. of Colorado Boulder, USA;* [2]*Department of Electrical and Computer Engineering, Univ. of Texas Austin, USA;* [3]*Department of Electrical, Computer, and Energy Engineering, Univ. of Colorado Boulder, USA.* We characterized the impact of mechanically-applied biaxial strain on Auger recombination in InGaAs quantum wells using time-resolved photoluminescence. Our results support that Auger recombination is reduced by mechanical distortion introduced by strained-layer epitaxy.

JTh2A.15

Incremental Plasma Etching and Depletion of Metal Mask for Generating ARSS on Fused Silica Optical Windows, Benjamin A. Vaca[1], Jude Yoshino[1], William E. Genet[1], Tyler A. Benge[1], Ishwar D. Aggarwal[1], Thomas C. Hutchens[1]; [1]*Univ of North Carolina at Charlotte, USA.* This study explores transmission enhancement and limitations for fabrication of anti-reflective structured surfaces (ARSS) by plasma etching gold nanoparticle mask on silica substrates. Etching time and depth were incremented to witness evolution of ARSS production.

JTh2A.16

Random laser emission at 1348 nm from Nd:YVO_4 crystal powder, Jessica Dipold[1], Niklaus Wetter[1]; [1]*IPEN, Brazil.* Nd:YVO4 powder random lasers have shown high efficiency in 1064 nm emission with 806 nm excitation. Here, by using 585 nm excitation, we show laser emission for 1348 nm for the first time.

JTh2A.17

Optical Spectroscopy Unravels the Spin-Lattice Interplay in Doped $NiPS_3$ Systems, Tai C. Trinh[1], Rabindra Basnet[2], Vigneshwaran Chandrasekaran[1], Michael Pettes[1], Rahul Rao[3], Andrew Jones[1], Jin Hu[2], Han Htoon[1]; [1]*Los Alamos National Laboratory, USA;* [2]*Uniersity of*

Arkansas, USA; [3]Air Force Research Laboratory, USA. Our PL study revealed a strong suppression of the ultrasharp excitonic emission in $Ni_{1-x}Mn_xPS_3$ with the increase of Mn impurity concentration x. Additionally, the suppression of the two-magnon scattering peak under Raman spectroscopy, further highlights the intricate interplay between impurity-induced lattice distortion and the spin order of $NiPS_3$

JTh2A.18

Nd:YLF Laser Emitting at 1370 nm, while Side-Pumped by 797 nm VBG-Equipped Diode, Felipe M. Prado[1], Tomás J. Franco[2,1], Niklaus Wetter[1]; *[1]Nuclear and Energy Research Inst., Brazil; [2]Department of Physic, RWTH Aachen Univ., Germany.* In this study, we demonstrate Nd:YLF laser emission at 1370 nm while pumped by a diode emitting at 797 nm. The presented laser emission is showcased within a simple and compact side-pumped laser cavity.

JTh2A.19

Enhanced Anti-Stokes Photoluminescence from Yb:YLF Nanoparticles with YLF Shell, Shruti Gharde[1], Mia I. Baca[1], Kyo Torres-Chen[2], Erum Jamil[1], Sergei A. Ivanov[3], Winson C. Kuo[3], Dale L. Huber[4], Marek A. Osinski[1]; *[1]Univ. of New Mexico, USA; [2]Albuquerque Academy, USA; [3]Center for Integrated Nanotechnologies, Los Alamos National Laboratory, USA; [4]Center for Integrated Nanotechnologies, Sandia National Laboratories, USA.* We report on investigations of anti-Stokes photoluminescence (ASPL) from YLF nanoparticles doped with 10% Yb, comparing core-only and core/shell structures. Addition of the YLF shell to Yb:YLF core significantly increases ASPL from the nanoparticles.

JTh2A.20

Silicon Ring Modulator Insertion Loss and Electro-optic 279haracterizatimisation through junction engineering, Vadivukkarasi Jeyaselvan[1], Shankar Kumar Selvaraja[1]; *[1]Indian Inst. of Science, India.* In this work, we propose a method of improving the electro-optic bandwidth and insertion loss of silicon microring modulator through embedding PN and PIN junction.

JTh2A.21

Thin film chalcogenides and optical design for mid-infrared sensing applications, Ibrahim ElKholy[1], Al Alexis[1], Mohammad A. Khan[1]; *[1]Delaware State Univ., USA.* Constituent elements of Ge-Se-S glasses were chosen with different compositions such as Ge_2Se_8, Ge_2S_8, Se_2S_8, and $GeSe_2S_2$ to study their optical properties for UV, visible, and Mid-IR range using different optical tools like UV-Vis, FTIR, and Raman spectroscopy for mid-infrared thin film applications.

JTh2A.22

Strong Third-order Nonlinearity in Silicon-rich Amorphous Silicon Carbide Integrated Platforms, Yaoqin Lu[1], Xiaodong Shi[1], Adnan A. Afridi[1], Didier Chaussende[2,3], Karsten Rottwitt[1], Haiyan Ou[1]; *[1]Technical Univ. of Denmark, Denmark; [2]Université Grenoble Alpes, France; [3]CNRS, France.* We experimentally demonstrate efficient four-wave mixing in silicon-rich amorphous silicon carbide waveguides, and characterize its nonlinear refractive index, which is 6.83×10^{-18} m^2/W, one order of magnitude higher than crystalline silicon carbide.

JTh2A.23

Topology Optimization for Layer-Conforming and Multi-Etch Integrated Photonic Processes, Michael Probst[1], Joel Slaby[1], Arjun Khurana[1], Prankush Agarwal[1], Stephen

Ralph[1]; *[1]Georgia Inst. of Technology, USA.* We present a novel constraint for a topology optimization paradigm to produce devices compatible with multi-etch processes and multi-layer processes with unintended conformal layering. We experimentally validate this technique on a commercial silicon photonics process.

JTh2A.24
On-Chip Silicon Mach-Zehnder Interferometer with Ultra-High Sensitivity, Yueyang Hu[1], Peiji Zhou[1], Yuhan Sun[1], Xiaopeng Dong[2], Yi Zou[1]; *[1]ShanghaiTech Univ., China; [2]Xiamen Univ., China.* We propose and demonstrate an asymmetric Mach-Zehnder Interferometer (MZI) with a critical wavelength of around 1550 nm. The peaks near the critical wavelength shift in opposite directions with a sensitivity of +1360pm/K and -430pm/K, respectively.

JTh2A.25
Significant substrate leakage loss reduction with hybrid Si-SiN waveguides on a monolithic SiPh platform, Yusheng Bian[1]; *[1]GLOBALFOUNDRIES, USA.* We present hybrid Si-SiN waveguides as a solution to mitigate substrate leakage in a monolithic SiPh platform. Experimental results show an ~80% reduction in TM-waveguide-loss (leading to ~0.3 dB/cm-attenuation) and a 9-fold decrease in TM-bend-loss.

JTh2A.26
10-Gbit/s All-Optical Free Carrier Absorption Switching Induced by Two-Photon Absorption in Silicon Carbide Micro-ring on Silicon Platform, Chih-Hsien Cheng[1], Atsushi Matsumoto[1], Naokatsu Yamamoto[1], Kouichi Akahane[1], Gong-Ru Lin[2]; *[1]National Inst. of Information and Communications Technology, Japan; [2]National Taiwan Univ., Taiwan.* 10-Gbit/s all-optical free carrier absorption switching based on the two-photon absorption is demonstrated by the silicon carbide micro-ring with a carrier lifetime of 20 ps for future synchronous OC-192 optical networking on the silicon platform.

JTh2A.27
A Path to Ultra-Fast Non-Volatile Amplitude-Only Spatial Light Modulation using Phase-Change Materials, Joe Shields[1], Carlota Ruiz de Galarreta[2,1], Harry Penketh[1], Jacopo Bertolotti[1], C. David Wright[1]; *[1]Univ. of Exeter, UK; [2]Instituto de Optica (IO-CSIC), Spain.* The design, fabric280haracterizationterisation of an amplitude-only, constant-phase spatial light modulator which exhibits high relative reflection contrast (220%) and near zero phase contrast ($< \pi/50$) is shown, with potential application to dynamic wavefront control.

JTh2A.28
High-Q Microdisk Resonator on Aluminum Nitride Photonics Platform, Nanxi Li[1], Landobasa Y. Tobing[1], Shiyang Zhu[1], Jin Xue[1]; *[1]A*STAR Inst. of Microelectronics, Singapore.* A high-Q microdisk resonator is demonstrated on aluminum nitride (AlN) photonics platform on an 8-inch silicon wafer. Multiple modes are observed from spectrum response. A loaded Q of 1.3×10^5 is also reported.

JTh2A.29
SNAP Microresonators Created by Electric Arc Discharge, Wenxin Liu[1], Xuewen Shu[1]; *[1]Wuhan National Laboratory for Optoelectronics & School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China.* A novel approach is introduced for the fabrication of surface nanoscale axial photonics (SNAP) microresonators using arc

discharge technique. Several Gaussian SNAP microresonators are fabricated, and their angstrom-level fabrication accuracy is meticulously confirmed.

JTh2A.30

Slow Light Enhanced On-chip Stimulated Brillouin Scattering, Mingyu Xu[1], Peng Lei[1], Yunhui Bai[1], Zhangyuan Chen[1], Xiaopeng Xie[1]; *[1]Peking Univ., China.* We report slow-light enhancement of stimulated Brillouin scattering on SOI for the fisrt time. With suspended Bragg grating structure, the device achieve a 2.1-fold of Brillouin gain coeffiecient.

JTh2A.31

Sub-nanometer-confined optical field in a nanoslit waveguiding mode, Zhanke Zhou[1], Liu Yang[1], Hongliang Dang[1], Xin Guo[1], Limin Tong[1]; *[1]College of Optical Science and Engineering, Zhejiang Univ., China.* By near-field coupling between a single nanowire (SNW) and a coupled nanowire pair (CNP), we demonstrate a new method to generate a sub-nanometer-confined optical field (~0.3×3.1 nm^2) in a nanoslit waveguiding mode at 550-nm wavelength.

JTh2A.32

Investigation of Polymer Waveguide Splitters for Co-packaged Optics using External Laser Sources, MD Omar Faruk Rasel[1], Satoshi Suda[1], Akihiro Noriki[1], Fumi Nakamura[1], Takeru Amano[1]; *[1]National Inst. of Advanced Industrial Science and Technology (AIST), Japan.* We present polymer-based 1×4 Y-splitters with tapered and S-bend waveguides on the glass-epoxy substrate and characterize the optical properties of these splitters using O-band wavelengths and external laser source (ELS) with high optical power exceeding +20 dBm.

JTh2A.33

A Polarization-Insensitive a-Si Grating Coupler on the Lithium Niobate-on-Insulator Platform, Fabien Labbe[1], Alif Laila Muthali[1], Yunhong Ding[1]; *[1]DTU Electro, Denmark.* We have designed, fabricated and characterized a polarization insensitive a-Si on Lithium Niobate grating coupler for both transverse electric and magnetic light coupling to Lithium Niobate waveguide, results in the coupling efficiency of −5 dB.

JTh2A.34

Coherence-based Hybrid Simulation Model of Physical and Geometric Optics for Grating-based Lightguide in Augmented Reality Display, Chenlu Xu[1], Yuxuan Zhao[2], Lijiang Zeng[1]; *[1]Tsinghua Univ., China; [2]Beijing Greatar Tech Co., Ltd., China.* Coherence-based hybrid simulation model for grating-based lightguide used in AR is proposed. Coherence of overlapping geometric rays during ray tracing is discussed. Our simulation result is closer to experiment result than incoherence-based model.

JTh2A.35

Demonstration of Photoelectrochemical Photodetector with High Responsivity and Large Bandwidth for Optical Wireless Communication, Liuan Li[1], Shi Fang[1], Wei Chen[1], Yang Kang[1], Xin Liu[1], Yuanmin Luo[1], Muhammad Hunain Memon[1], Haiding Sun[1]; *[1]Univ. of Science and Technology of China, China.* Response speed and responsivity are crucial for photodetectors. GaN nanowires were used to construct fast-response photoelectrochemical photodetectors. Iridium-oxide decoration improved the responsivity and response speed with a demonstration of large-bandwidth optical communication.

JTh2A.36

Reprogrammable Binary and Ternary Optoelectronic Logic Gates Using GaN p-n Nanowires as Photoelectrodes, Yuanmin Luo[1], Wei Chen[1], Danhao Wang[1], Yang Kang[1], Xin Liu[1], Shi Fang[1], Muhammad Hunain Memon[1], Haiding Sun[1]; *[1]Univ of Science and Technology of China, China.* We fabricated reprogrammable optoelectronic-logic-gates (OLGs) using GaN p-n nanowires as photoelectrodes in a photoelectrochemical environment. Reprogrammable bidirectional photocurrent enabled various binary and ternary OLGs, offering a new avenue toward next-generation logic circuits for fast data-processing.

JTh2A.37

Mode-Division Multiplexing at Visible Wavelengths, Priyansh Shah[1], Elias Ben Mellouk[1], Jeremy Levine[2], Aseema Mohanty[1]; *[1]Electrical and Computer Engineering, Tufts Univ., USA; [2]Biomedical Engineering, Tufts Univ., USA.* We demonstrate mode-division multiplexing at visible wavelengths (473 nm) for the first time using adiabatic mode couplers. We measure less than -15 dB and -20 dB crosstalk for TE2 and TE3 higher-order mode couplers, respectively.

JTh2A.38

Photonic Crystal Slab Metalens on Amorphous Silicon Platform, Yudong Chen[2], Mingsen Pan[2,1], Yuze Sun[2], Weidong Zhou[1]; *[1]Semergytech, Inc., USA; [2]Univ. Texas Arlington, USA.* We report a novel metalens design based on photonic crystal slab (PCS) resonance modes. By implementing the PCS resonance on an amorphous silicon on quartz platform, we experimentally verified with a focusing metalens phase plate.

JTh2A.39

Non-Volatile Reconfigurable Transmissive Notch Filter using Wide Bandgap Phase Change Material Antimony Sulfide, Virat Tara[1], Rui Chen[1], Johannes E. Fröch[1], Zhuoran Fang[1], Jie Fang[1], Arka Majumdar[1,2]; *[1]Electrical and Computer Engineering, Univ. of Washington, USA; [2]Physics, Univ. of Washington, USA.* We experimentally demonstrate an electrically tunable notch filter. We observe a quality factor up to ~200 and demonstrate reversible tuning of a large volume (4.5 μm^3) of Sb_2S_3 with resonance wavelength shift ~4 nm.

JTh2A.40

Fast, Single Shot Readout for Whispering Gallery Mode Resonator Device, Haley A. Weinstein[1,2], Jiayuan Zhang[3], Srinivas Tadigadapa[3], Jonathan Habif[1,2]; *[1]Electrical and Computer Engineering, Univ. of Southern California, USA; [2]Information Sciences Inst., USA; [3]Electrical and Computer Engineering, Northeastern, USA.* We demonstrate a coherent detection technique for fast, sensitive readout of whispering gallery mode resonators in borosilicate glass. The results indicate resonance measurement at nanosecond time scales with sensitivities comparable to low-speed direct detection readout.

JTh2A.41

Flexible Frequency Conversion of Near-Visible Light in Linear Integrated Waveguides, Nicholas J. Jaber[1], Scott E. Madaras[1], Andrew Starbuck[1], Andrew S. Pomerene[1], Christina M. Dallo[1], Douglas C. Trotter[1], Michael Gehl[1], Nils T. Otterstrom[1]; *[1]Sandia National Laboratories, USA.* We demonstrate frequency conversion of near visible light using Bragg scattering four wave mixing in a low-loss (∼0.02 dB/cm) silicon nitride waveguide with a Kerr coefficient of ∼3 $W^{-1}m^{-1}$.

JTh2A.42

High-quality Mid-infrared Chalcogenide Ring Resonator, Bright Lu[1], Bo Xu[2], Greg Krueper[2], Mo Zohrabi[1], Juliet Gopinath[1,2], Wounjhang Park[1,3]; *[1]Department of Electrical, Computer, and Energy Engineering, Univ. of Colorado Boulder, USA; [2]Department of Physics, Univ. of Colorado Boulder, USA; [3]Materials Science and Engineering Program, Univ. of Colorado Boulder, USA.* We report $Ge_{23}Sb_{7}S_{70}$ chalcogenide ring resonators with up to 8×10^4 quality factors operating around 3.6 µm wavelengths. Their rib waveguide geometry can be engineered to support close-to-zero dispersion modes necessary for mid-infrared microcomb generation.

JTh2A.43

Multifunctional Imaging Enabled by Circularly Polarized States in Photonic Crystals, Junlong Kou[1]; *[1]Nanjing Univ., China.* We propose a multifunctional imaging system by integrating designed photonic crystal slab into a conventional 4-*f* imaging system, to realize both the edge imaging and bright-field imaging.

JTh2A.44

Propagation-variant vortex array in multimode silicon waveguide, Yunlong Li[1,2], Kaiyuan Wang[1,2], Tiange Wu[1,2], Deming Liu[1,2], Shuang Zheng[1,2], Minming Zhang[1,3]; *[1]School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China; [2]National Engineering Research Center for Next Generation Internet Access System, China; [3]Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, China.* We propose a method to generate in-plane vortex arrays with multimode silicon waveguides. By combining different modes in the silicon waveguide, space- and propagation-variant vortex arrays can be generated in a controlled manner.

JTh2A.45

Integrated Ultrafast Wavelength Division Multiplexer Based on One-Dimensional Topological Defect Cavity, Qiuchen Yan[1], Rui Ma[1], Xiaoyong Hu[1], Qihuang Gong[1]; *[1]Peking Univ., China.* We employed Su–Schrieffer–Heeger model with photonic crystal defect cavities to form transmissible topological edge states, resulting integrated ultrafast wavelength division multiplexer. This paves the way for the applications on topological photonics.

JTh2A.46

10% Component Efficiency of Fully Integrated and Oxide Embedded Photonic Crystal Cavity, M. Hussayeen Khan Anik[1], Heijun Jeong[1], Masudur Rahim[1], Yahui Xiao[1], Tingyi Gu[1]; *[1]Univ. of Delaware, USA.* We demonstrated low insertion loss fully integrated photonic crystal cavity with on-chip metalens coupling, with experimentally measured total quality factor of 10^4.

JTh2A.47

Fiber-coupled high numerical aperture microlens system: towards super-resolution microscopy via photonic nanojets, Xuesong Gao[1], Imad Agha[1,2]; *[1]Electro-Optics and Photonics, Univ. of Dayton, USA; [2]Physics, Univ. of Dayton, USA.* We demonstrate both numerically and experimentally, a path towards super-resolution focusing and imaging through the photonic nanojet technique in a microsphere-microstructure fiber platform.

JTh2A.48
Inverse design of digital nanophotonic devices using adversarial autoencoder neural networks with physically-segmented latent space, Kaiyuan Wang[1,2], Yunlong Li[1,2], Qiaomu Hu[1,2], Deming Liu[1,2], Shuang Zheng[1,2], Minming Zhang[1,3]; *[1]School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China; [2]National Engineering Research Center for Next Generation Internet Access System, China; [3]Wuhan National Laboratory for Optoelectronics, China.* We propose adversarial autoencoder neural network with physically-segmented latent space for the inverse design of digital nanophotonic power splitters with accurate arbitrary splitting ratios (relative error < 3%) and low insertion loss (< 0.5 dB).

JTh2A.49
An Intelligent Inverse Design Algorithm For Ultra-Compact Integrated Photonic Devices, Mingzhe Li[1], Tong Wang[1], Yi Zhang[1], Yulin Shen[1], Jie Yang[1], Ming Xin[1,2]; *[1]Tianjin Univ., China; [2]Tianjin Key Laboratory of Brain-Inspired Intelligence Technology, China.* A novel intelligent inverse design algorithm is proposed and used to design a low-loss 90-degree bending waveguide with a footprint of 2 μm×2 μm, and a 3.5 μm×3.5 μm high-extinction-ratio wavelength-division multiplexer.

JTh2A.50
Power-efficient Metasurface Thermal Emitter for Mid-IR Gas Sensing Application, Yuanrong Zhang[1], Prince Gupta[2], Deming Liu[1], Shuang Zheng[1], Max Yan[2], Minming Zhang[1]; *[1]School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China; [2]Applied Physics, KTH Royal Inst. of Technology, Sweden.* We propose a narrow band, power-efficient, cost-effective and on-chip mid-infrared source (at≈6.0 μm) for gas sensing applications. Combined a optimized microelectromechanical system heater with a metal-insulator-metal metasurface emitter, the source works successfully.

JTh2A.51
The Enhanced mid-IR Responsivity and The Hot Carrier Dynamics in Metal-Silicon Interface, Zih-Chun Su[1], Yao-Han Dong[1], Ching-Fuh Lin[1]; *[1]National Taiwan Univ., Taiwan.* In this work, we achieved a high-speed (< 10^{-6} s) and broad-spectrum silicon-based photodetector covering visible to mid-infrared light by enhancing the hot carrier mechanism through localized surface plasmon resonance in nano scaled metal.

JTh2A.52
Integrate-and-Fire Neural Network Based Microrings and Van Der Waals Heterostructures for Supervised Learning, Qiang Zhang[1], Ning Jiang[1], Gang Hu[1], Anran Li[1], Yiqun Zhang[1], Yongsheng Cao[1], Kun Qiu[1]; *[1]Univ of Electronic Science & Tech China, China.* We propose an integrate-and-fire neural network employing microrings and van der Waals heterostructures. The network facilitates multi-wavelength weighting operations through microrings-based arrays and incorporates nonlinear activation via non-volatile flash memory, subsequently completing supervised learning tasks.

JTh2A.53
A High-Efficiency Grating Coupler on 220-nm SOI Platform with a Minimum Feature Size of 130nm, Lihang Wang[1], Jifang Qiu[1], Yuchen Chen[1], Lan Wu[1], Hongxiang Guo[1], Jian Wu[1]; *[1]Beijing Univ. of Posts and Telecomm, China.* An inverse-designed dual-etched grating coupler optimized by the adjoint method is numerically demonstrated on a standard 220-nm

silicon-on-insulator platform with a minimum feature size of 130nm. The coupling efficiency reaches 79.7% (−0.99dB), rendering it promising for low-cost and large-scale manufacturing by deep ultraviolet lithography.

JTh2A.54
Hybrid Metasurface Color-Filter Arrays, Alex J. Thuringer[1,2], Mansoor Sultan[1], J. T. Hastings[1]; *[1]Univ. of Kentucky, USA; [2]Paul Laurence Dunbar High School, USA.* A new color filter array uses nanofabricated metasurfaces to map four focusing filters onto nine image pixels. This approach potentially offers higher stability, single-step fabrication, improved sensitivity, and high color accuracy.

JTh2A.55
Analysis of the Penetration Depth of Integrated Bragg Reflectors for Precise Microcavity Design, Farah Comis[1], Mu-Chieh Lo[1], Mykyta Shevchenko[1], Alfonso Ruocco[1]; *[1]Univ. College London, UK.* We examine the penetration depth of integrated Bragg gratings forming on-chip Fabry-Pérot cavities. We evaluate the microcavities' effective length by considering its impact on the free spectral range and compare the results with theoretical predictions.

JTh2A.56
Evaluation on Beam Trajectory Bending Functionality of Distorted Photonic Crystals, Kyoko Kitamura[2,1], Jimpei Hashizume[2], Yuki Kawamoto[2,1], Ayano Onishi[2,1]; *[1]Tohoku Univ., Japan; [2]Kyoto Inst. of Technology, Japan.* We evaluate beam trajectory bending functionality of distorted photonic crystals (DPCs) with defining standardized response index of "*softness*". We show that the shape-DPC is equivalent to the position-DPC.

JTh2A.57
Mode Splitting in Silicon Nitride Ring Resonators via Partial Sidewall Modulation, Masoud Kheyri[1,2], Shuangyou Zhang[1], Toby Bi[1,2], Arghadeep Pal[1,2], Hao Zhang[1], Yaojing Zhang[1], Abdullah Alabbadi[1,2], Eduard Butzen[1], Florentina Gannott[1], Alexander Gumann[1], Irina Harder[1], Olga Lohse[1], 'ascal Del'Haye[1,2]; *[1]Max-Planck-Inst Physik des Lichts, Germany; [2]Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany.* We investigate mode splitting in silicon nitride microresonators that is induced by modulating the resonator sidewall with different amplitudes and modulation lengths. This offers important insights for microresonator dispersion engineering for photonic integrated circuits.

JTh2A.58
Increasing the Acceptance Angle of a Resonant-Cavity Enhanced Detector Using a Confocal Microresonator, Fatemeh Hadavandmirzaee[1], Tsing-Hua Her[1]; *[1]Univ of North Carolina at Charlotte, USA.* We propose using a confocal microresonator to increase the angular bandwidth for resonant cavity-enhanced detectors. Our modeling demonstrates more than 10x increase in the acceptance angle compared to the conventional planar Fabry-Perot structure.

JTh2A.59
Plasmonic Littrow Retroreflectors, Grant W. Bidney[1,2], Igor Anisimov[2], Dennis E. Walker[2], Gamini Ariyawansa[2], Joshua M. Duran[2], Vasily N. Astratov[1,2]; *[1]Physics and Optical Science, Univ. of North Carolina at Charlotte, USA; [2]Air Force Research Laboratory, USA.* It is shown that Littrow retroreflectors show an interplay of the grating properties ("structure factor") and

plasmonic resonant properties (“form factor”) which leads to highly efficient simultaneous retroreflector performance in both polarizations of visible light.

JTh2A.60

Optical Magnetometry based on Fluidic-Solid Composite WGM Microbubble Resonator, Xingyun Zhao[1], Bing Duan[1], Chengnian Liu[1], Yongpan Gao[1], Daquan Yang[1]; *[1]Beijing Univ of Posts & Telecom, China.* We demonstrate an AC optical magnetometry based on fluid-solid composite whispering gallery mode microcavity filled with Terfenol-D particles and UV adhesive, achieving the sensitivity of 9.2 $nT \times Hz^{-1/2}$ at frequency of 2 MHz.

JTh2A.61

Scalable Two-Tier Protruding Micro-/Nano-Optoelectrode Arrays for Hybrid Photonic-Electronic Nano-Bio Interfacing, Elieser Mejia[1], Yuming Zhao[1], Wei Zhou[1]; *[1]Virginia Tech, USA.* We introduce scalable two-tier protruding micro-/nano-optoelectrode arrays, integrating biophotonic and bioelectronic functionalities with high nanoplasmonic Raman enhancement and reduced interfacial impedance, crucial for *in situ* bioelectrical and biochemical measurements in multicellular systems.

JTh2A.62

On-Chip Mid-IR Spectroscopy with Slow Light Enhanced Silicon-on-Sapphire Waveguide, Sourabh Jain[1], May Hlaing[2], Ray T. Chen[1,2], Kang-Chieh Fan[1], Jason Midkiff[1]; *[1]Univ. of Texas at Austin, USA; [2]Omega Optics Inc., USA.* An engineered slow-light enhanced 2D-PCW on the silicon-on-sapphire platform is proposed as a Mid-IR on-chip spectrometer. Theoretical calculation exhibits strong-mode confinement in the air-guided holey-slotted defect-waveguide with high-group-index of 69 around the carbon-monoxide absorption wavelength.

JTh2A.63

Experimental Demonstration of Inverse Designed All Silicon Nanowire Array Cavity, Masato Takiguchi[1,2], Peter Heidt[1], Hisashi Sumikura[1,2], Akihiko Shinya[1], Masaya Notomi[1,2]; *[1]NTT Basic Research Laboratories, Japan; [2]NTT Nanophotonics Center, Japan.* We optimized a Si nanowire array using a novel inverse design method and measured a high-Q cavity and its thermal nonlinear effect by implementing a waveguide structure.

JTh2A.64

Withdrawn

JTh2A.65

High Q-factor Nanobeams in Polycrystalline Diamond, Flavio C. Moraes[1], Pedro V. Pinho Nascimento[1], Cauê Kersul[1], Soumen Mandal[2], Oliver Willians[2], Gustavo S. Wiederhecker[1], Thiago Alegre[1]; *[1]Unicamp, Brazil; [2]Cardiff Univ., UK.* We report the fabrication of optomechanical nanobeams in polycrystalline diamond films with optical quality factor of 7.7×10^3, which is the highest achieved value for such platform

JTh2A.66

Sixteen-channel 2.5 GHz-spaced wavelength (de)multiplexer on SOI for microwave photonic applications, Chih-Hsien Chen[1], Yung-Jr Hung[1,2]; *[1]National Sung Yat-sen Univ., Taiwan; [2]College of Semiconductor and Advanced Technology Research, Taiwan.* The signatures of high channel resolution (2.5 GHz), high channel count (16), compact size (0.187 cm^2), low crosstalk (-15 dB), and simplified control (less phase shifters) make the MZI-based optical channelizer a promising solution for frequency measurement applications.

JTh2A.67
Withdrawn

JTh2A.68
Low-Loss 3D Fiber-to-Chip Couplers for Polymer Waveguides, Trisha Chakraborty[1,2], Ramesh Kudalippalliyalil[1,2], Thomas E. Murphy[1], Karen E. Grutter[2]; *[1]Univ. of Maryland at College Park, USA; [2]Laboratory for Physical Sciences, USA.* We designed and demonstrated 3D polymer coupler structures to adiabatically couple light into polymer waveguides. We measured a coupling loss of 2.1dB per coupler facet around 1550 nm.

JTh2A.69
Wavelength and 3D-Slice Multiplexing in Waveguide Meta-hologram, Rajat K. Sinha[1], Mo Mojahedi[1]; *[1]Univ. of Toronto, Canada.* A novel wavelength and 3D-slice multiplexing for waveguide meta-hologram using dislocated grating is proposed. Phase modulation is optimized to form four alphabets letters using 532nm and 650nm wavelengths at screen distances of 50µm and 100µm.

JTh2A.70
Withdrawn

JTh2A.71
Active Stabilization of Normal-Dispersion Microcombs, Angelo Manetta[1], Anamika Nair Karunakaran[1], Poul Varming[1], Patrick Montague[1]; *[1]NKTPhotonics, Denmark.* This paper presents a study of the stability over time of the properties of microcombs. An active stabilization scheme of the pump frequency is tested, with the result of decreasing the comb line frequency noise.

JTh2A.72
Chip-Integrated Interposer for Extended-Cavity Diode Lasers with Fiber-Bragg Gratings, Lisa V. Winkler[1,2], Govert Neijts[1], Albert van Rees[1], Philip Schrinner[3], Marcel Hoekman[3], Ronald Dekker[3], Adriano R. do Nascimento Jr.[4], Peter J. van der Slot[1], Christian Noelleke[2], Klaus Boller[1]; *[1]Univ. of Twente, Netherlands; [2]TOPTICA Photonics AG, Germany; [3]LioniX International BV, Netherlands; [4]PHIX BV, Netherlands.* We present a novel approach to Bragg-fiber extended diode lasers by using an integrated waveguide circuit as interposer. The interposer suppresses undesired ASE by more than 20 dB compared to previous designs.

JTh2A.73
Demonstration of Quantum Generative Adversarial Network with a Silicon Photonic Chip, Haoran Ma[1], Liao Ye[1], Fanjie Ruan[1], Maohui Li[1], Zichao Zhao[1], Yuehai Wang[1], Jianyi Yang[1]; *[1]Zhejiang Univ., China.* We demonstrated a hybrid quantum-classical generative adversarial network (GAN) with a silicon photonic chip capable of generating arbitrary 2-qubit states. The chip was successfully applied for classical distribution loading and MNIST image generation.

JTh2A.74

Monolithically Integrated Tunable Inductive Termination for Equalizing Traveling-Wave Mach-Zehnder Modulators, Junqian Liu[1], Aaron Wissing[1], Hector Andrade[1], Larry Coldren[1], James Buckwalter[1], Clint Schow[1]; *[1]UCSB, USA.* Silicon traveling-wave Mach-Zehnder modulators are monolithically integrated with tunable inductive terminations for low-power, variable equalization circuits. Equalizing subthreshold forward-biased modulators doubled EO bandwidth for 56 Gbit/s transmission below KP4-FEC thresholds while consuming 360 fJ/bit.

JTh2A.75

Integration of Novel Ferro-Electric Thin Films in Silicon Photonics for High Speed Modulators, Enes Lievens[1,3], Ewout Picavet[2,1], Muhammad Muneeb[3], Klaartje De Buysser[2], Dries Van Thourhout[3], Peter Bienstman[3], Jeroen Beeckman[1]; *[1]ELIS, Ghent Univ., Belgium; [2]Chemistry, Ghent Univ., Belgium; [3]INTEC, Ghent Univ., Belgium.* Lead zirconate titanate (PZT) exhibits a large Pockels coefficient and remnant polarization, making it a suitable candidate for integration in photonics circuits. In this work, a platform is developed to directly integrate PZT thin films on silicon-on-insulator (SOI) wafers to create electro-optic (EO) modulators.

JTh2A.76

Inverse-design based Ultra-wideband Wavelength-band De-multiplexer over 110nm Bandwidth Covering S+C+L band, Chuhang Zhou[1], Li Jianping[1], Yuwen Qin[1]; *[1]Guangdong Univ. of Technology, China.* We propose an inverse-design based ultra-wideband wavelength-band de-multiplexer with insertion loss and inter-band crosstalk lowering than 0.5 dB and -20 dB respectively over 110nm operational bandwidth in the S+C+L wavelength range.

JTh2A.77

Coupling and Splitting Structures for SiN Interposer in Quantum Photonic Integrated Circuits, Janez Krc[3], Milos Ljubotina[3], Andraz Debevc[3], Isaac Luntadila Lufungula[1,4], Jasper De Witte[1,4], Leonardo Midolo[2], Marko Topic[3], Dries Van Thourhout[1,4]; *[1]Photonics Research Group, Ghent Univ., Belgium; [2]Nield Bohr Inst., Univ. of Copenhagen, Denmark; [3]Faculty of Electrical Engineering, Univ. of Ljubljana, Slovenia; [4]imec, Belgium.* Designs of low-loss and fabrication-tolerance-resistant adiabatic optical coupler for InAs/GaAs quantum dot single-photon sources, micro-transfer-printed on a SiN interposer, and SiN multimode interferometer signal splitter are presented for application in quantum photonic integrated circuits.

JTh2A.78

Acoustic-Optic Modulation on a Silicon-Aluminum Nitride Hybrid Platform, Weixiong Huang[1], Lipeng Xia[1], Tao Wu[1], Yi Zou[1]; *[1]ShanghaiTech Univ., China.* We present a compact acoustic-optic device on a hybrid silicon-aluminum nitride (AlN) platform. The scattering efficiency is improved by incorporating a Fabry-Perot cavity with an acoustic-optic interaction length of 200 microns.

JTh2A.79

Complex Tensor Convolution in Photonic Frequency Synthetic Dimensions, Jiayuan Guo[1], Wenjia Zhang[1], Yue Jiang[1], Zuyuan He[1]; *[1]Shanghai Jiao Tong Univ., China.* We propose a complex tensor convolution accelerator in photonic frequency synthetic dimensions, which is capable of extracting coupling information from dual-frame images of size 52×42 at a rate of 4.94M frame-per-second.

JTh2A.80
Scientific Computing with Diffractive Optical Neural Networks, Ruiyang Chen[1], Yingheng Tang[1,2], Jianzhu Ma[3], Weilu Gao[1]; *[1]Univ. of Utah, USA; [2]Purdue Univ., USA; [3]Tsinghua Univ., China.* We deploy reconfigurable diffractive optical neural networks for multiple scientific computing applications, including guiding quantum material synthesis, predicting properties of materials, biomolecules, and nanophotonic devices, and dynamic stabilization of an inverted pendulum with reinforcement learning.

JTh2A.81
Time-Series Prediction Tasks with a Small-Scale Integrated Photonic Reservoir, Baoqin Ding[1], Li Pei[1], Bing Bai[1,2], Bowen Bai[3], Juan Sui[2], Jianshuai Wang[1]; *[1]Beijing Jiaotong Univ., China; [2]Photoncounts (Beijing) Technology Company Ltd., China; [3]Peking Univ., China.* The small-scale integrated photonic reservoirs excel in binary tasks but encounter challenges in broader predictions. This article achieves superior prediction performance by refining both algorithmic and input strategy perspectives, utilizing a 32-node integrated photonic reservoir.

JTh2A.82
All-Optical Orbital Angular Momentum Encoded Diffractive Networks, Kuo Zhang[1], Kun Liao[2], Hao hang Cheng[3], Shuai Feng[1], Xiaoyong Hu[2,4]; *[1]Minzu Univ. of China, China; [2]Peking Univ., China; [3]Univ. of Chinese Academy of Sciences, China; [4]Shanxi Univ., China.* We report a strategy of OAM-encoded diffractive deep neural network (OAM-encoded D^2NN) that encodes the spatial information of objects into the OAM spectrum of the diffracted light to perform all-optical classification.

JTh2A.83
Standardized Design: On-chip Diffractive Optical Logic Operation Units with Ultra-compact Structure, Run Sun[1], Yuyao Huang[1], Wencan Liu[1], Tingzhao Fu[1], Sigang Yang[1], Hongwei Chen[1]; *[1]Tsinghua Univ., China.* With an ultra-compact footprint of 9×18μm^2, on-chip diffractive optical logic operation units accomplish (N)AND, (N)OR, and X(N)OR utilizing a standardized structures with only 36 etching slots. It has outstanding integration capability and relaxed fabrication requirements.

JTh2A.84
Wafer-Scale Manufacturing of Photonic Molecule Microcombs, Marcello Girardi[1], Carmen Haide López Ortega[1], Oskar Helgason[1], Israel Rebolledo[1], Victor Torres-Company[1]; *[1]Chalmers Univ. of Technology, Sweden.* We demonstrate 98% yield of photonic molecule microcombs manufactured on a 4-inch silicon nitride wafer. Dissipative Kerr soliton microcombs with average power conversion efficiency above 50% (25th percentile of 50.3%) are achieved.

JTh2A.85
Experimental Validation of Online Learning in Deep Photonic Neural Networks, Xi Li[1], Disha Biswas[2], Peng Zhou[2], Wesley H. Brigner[2], Joseph S. Friedman[2], Qing Gu[1]; *[1]North Carolina State Univ., USA; [2]The Univ. of Texas at Dallas, USA.* We experimentally demonstrated supervised and unsupervised online learning for the “NCSUTD” letter recognition

task in a deep photonic neural network using fiber optics and proposed a chip-scale crossbar multilayer structure for unsupervised learning.

JTh2A.86
Ultra-Wideband Radiofrequency Self-Interference Canceller Using Silicon Photonics Switched Delay Lines, Samer Idres[1], Hossein Hashemi[1]; *[1]Univ. of Southern California, USA.* We experimentally demonstrate radiofrequency self-interference cancellation across an instantaneously ultra-wide bandwidth using 8-bit switched low-loss optical delay-line implemented in a commercial silicon photonics foundry. Cancellation of 14 dB is achieved for 8 GHz UWB signal.

JTh2A.87
High-Fidelity WDM-Compatible Photonic Processor for Matrix-Matrix Multiplication, Kohei Ikeda[1,2], Mitsumasa Nakajima[3], Shota Kita[1,2], Akihiko Shinya[1,2], Masaya Notomi[1,2], Toshikazu Hashimoto[3]; *[1]NTT Nanophotonics Center, Japan; [2]NTT Basic Research Laboratories, Japan; [3]NTT Device Technology Laboratories, Japan.* We experimentally demonstrate an 8 × 8 MZI-mesh photonic processor using silica-based waveguide technology. An accurate implementation of unitary matrices with high fidelity >0.96 over C-band was achieved, enabling matrix-matrix operation using wavelength multiplexing.

JTh2A.88
Hybrid InP-Si_3N_4 Tunable External Cavity Laser Achieving an Ultra-low Intrinsic Linewidth below 10 Hz, Yilin Wu[1], Shuai Shao[1], Sigang Yang[1], Hongwei Chen[1], Hui Wang[2], Minghua Chen[1]; *[1]Tsinghua Univ., China; [2]Changzhou Smartcore Optoelectronic Limited, China.* A hybrid InP-Si_3N_4 tunable external cavity laser is demonstrated. It achieves an ultra-low intrinsic linewidth below 10 Hz over the full C-band, featuring a record lowest value of 6.06 Hz.

JTh2A.89
Compact Low-Loss 20x4 Switch for ROADM Applications, Xiaotian Zhu[1], Brent Little[2], Sai CHU[1]; *[1]City Univ. of Hong Kong, Hong Kong; [2]QXP Technologies Inc., China.* We report on a compact 20x4 optical switch using HDSG platform. Fiber-to-fiber losses are below 2 dB and 3.5 dB for express and drop channels while PDL is below 0.2 dB across the C band.

JTh2A.90
Controlled Fano Lineshape in Coupled Cavity-Waveguide Structure Under Wafer-scale Manufacturing, Fujun Sun[1], Gang Yang[1], Peng Zhang[1], Jianghao Han[1], Yanpeng Hu[1], Jianfeng Gao[1], Junjie Li[1], Xiaobin He[1], Zhihua Li[1], Jun Luo[1], Wenwu Wang[1], Yan Yang[1]; *[1]Inst. of Microelectronics of CAS, China.* Experimental results of controlled Fano lineshapes in coupled nanobeam cavity-waveguide structure by tuning the defect waveguide are reported. The devices are fabricated on standard full-process CMOS passive multi-project-wafer run with 180nm technology node. This work provides potential for advanced and scalable integrated photonics applications.

JTh2A.91
Experimental Demonstration of Silicon Photonic Reservoir Computing with a Multimode Racetrack-Loop Device, Takashi Kan[1], Siim Heinsalu[2], Hideaki Tanaka[1], Hirotaka Oshima[2], Hidenori Takahashi[1], Takehiko Tsuritani[1], Katsuyuki Utaka[2], Masatoshi Suzuki[1,2]; *[1]KDDI Research, Inc., Japan; [2]Department of Electronic and Physical Systems, Waseda Univ.,*

Japan. We demonstrate a reservoir computing operation with a silicon multimode loop waveguide device. Prediction performances for the NARMA3 and NARMA5 tasks are confirmed with normalized mean square errors of 3.85×10^{-3} and 1.93×10^{-2}, respectively.

JTh2A.92
Chip Scale Bonding For Heterogeneous Integration of Lithium Niobate on Low Loss Passive Silicon Nitride, Vivian Zhou[1], Shriddha Chaitanya[1], Ipshita Datta[1], Michal Lipson[1]; *[1]Columbia Univ., USA.* We demonstrate chip-scale heterogeneous integration of lithium niobate on low loss silicon nitride microrings and measure a loss of 1.07 ± 0.05 dB/mm for the hybrid mode.

JTh2A.93
A High-Speed Automatic Polarization Controller based on the Silicon Photonics Platform, Weiqin Wang[1], Ziwen Zhou[1], Yifan Zeng[1], Wenyi Peng[1], Hao Wu[1], Yunhong Ding[2], Siqi Yan[1], Ming Tang[1]; *[1]Huazhong Univ. of Science & Technology, China; [2]Denmark Technical Univ., Denmark.* We proposed an automatic polarization controller based on a novel thermal phase tuning structure on the silicon platform, with a polarization control speed of up to 20 krad/s, which is the fastest reported silicon-based device.

JTh2A.94
Experimental demonstration of a photonic ADC with high-dynamic-range at a low oversampling ratio, Qiuyan Li[1], Jifang Qiu[1], Yuepeng Wu[1], Yijun He[1], Bowen Zhang[1], Yan Li[1], Jian Wu[1]; *[1]Beijing Univ of Posts & Telecom, China.* We propose a dual-wavelength scheme for a high-dynamic-range photonic ADC without necessitating a high oversampling rate. Utilizing a CRT-based algorithm, a 1GHz signal at an oversampling ratio of 5 was experimentally reconstructed.

JTh2A.95
Power Handling in 3D Polymer Fiber-to-Chip Couplers at Visible Wavelengths, Cormac Paterson[1], Pushkar Jha[1], Michael Turner[1], Priyansh Shah[1], Aseema Mohanty[1]; *[1]Electrical and Computer Engineering, Tufts Univ., USA.* We investigate the power handling capabilities of 3D polymer couplers for fiber-to-chip packaging at blue and red wavelengths. We show time-dependent degradation of couplers for blue that is not present at red wavelengths.

JTh2A.96
4 × 25 Gb/s on-chip WDM cascaded with MOSCAP-driven silicon microring modulators, Wei-Che Hsu[1], Alan X. Wang[2], Nabila Nujhat[1], Benjamin Kupp[1], John F. Conley[1]; *[1]Oregon State Univ., USA; [2]Baylor Univ., USA.* We present an on-chip wavelength division multiplexing cascaded by four MOSCAP silicon microring modulators integrated with high-mobility titanium-doped indium oxide. With promising 4 × 25 Gb/s data rates, it holds potential for advanced optical communication.

JTh2A.97
Wafer-Scale Photonic Parameter Extraction, Jordan N. Butt[1,2], Nathan F. Tyndall[1], Marcel W. Pruessner[1], Benjamin Miller[2], Nicholas M. Fahrenkopf[3], Alin O. Antohe[3], Todd H. Stievater[1]; *[1]US Naval Research Laboratory, USA; [2]Univ. of Rochester, USA; [3]AIM Photonics, USA.* Wafer-scale variation of waveguide dimensions and refractive index determine the fabrication yield and

design tolerances of photonic integrated circuits. We describe a technique to accurately measure the statistical properties of these parameters for dielectric waveguides.

JTh2A.98

Wide Spectral Modulation in Highly Efficient Thermally Undercut Foundry Fabricated Resonant Modulators, Yonas H. Gebregiorgis[1], Anthony Rizzo[2], Venkatesh Deenadayalan[1], Matthew v. Neikerk[1], Gerald Leake[3], Christopher Tison[2], Asher Novick[4], Daniel Coleman[3], Keren Bergman[4], Michael Fanto[2], Stefan Preble[1]; *[1]Microsystems Engineering, Rochester Inst. of Technology, USA; [2]Air Force Research Laboratory Information Directorate, USA; [3]College of Nanoscale Science and Engineering, Univ. at Albany, USA; [4]Electrical Engineering, Columbia Univ., USA.* We experimentally investigate optical modulation in thermally undercut microdisk modulators. Optical modulation is realized over a spectral range 6x wider than the resonator's linewidth due to the enhancement of optically induced thermal nonlinearity.

JTh2A.99

BEOL Post-processing of Phase Change Material in Commercial Foundry Silicon Photonics, Uthkarsh Keshav Adya[1], Dan Sturm[1], Rui Chen[1], Arka Majumdar[1], Mo Li[1], Sajjad Moazeni[1]; *[1]Electrical and Computer Engineering, Univ. of Washington, USA.* We demonstrate the first-ever electrically programmable PCM device that is monolithically integrated in a commercial foundry silicon photonics. Initial results show 0.3 dB/μm of amplitude switching contrast using a thin layer of GST.

JTh2A.100

Deep Learning Enhanced Early Detection of Pancreatic Cancer Using Integrated Photonic Chip Based Optical Neural Networks, Chun-Ju Yang[1], Hanqing Zhu[1], Shupeng Ning[1], Chenghao Feng[1], Jiaqi Gu[1], David Z. Pan[1], Ray T. Chen[1,2]; *[1]The Univ. of Texas at Austin, USA; [2]Omega Optics Inc., USA.* Employing Integrated Photonic Chip-Based ONNs for early pancreatic cancer detection, achieved an 80% Dice score, demonstrating efficient, high-speed alternatives to traditional electrical training systems for medical imaging.

JTh2A.101

Suspended Mid-infrared Guided-wave Phase Shifters in an InP-based Platform, Po-Yu Hsiao[1], Jason Midkiff[1], Patrick T. Camp[1], Ray T. Chen[1]; *[1]The Univ. of Texas at Austin, USA.* We fabricate suspended waveguide thermo-optic phase shifters on an InGaAs/InP platform for 3.6 μm to 5.2 μm wavelengths. Utilizing suspended waveguides, 2π phase tuning power ($P_{2\pi}$) drops below 100 mW via a simple fabrication process.

JTh2A.102

Design and Analysis of Novel Monolithically Integrated Bulk InAlGaAs/InP Polarization Insensitive O-band SOA for Data Center Applications, Aref Rasoulzadehzali[1], Marijn Romboutes[1], Nicola Calabretta[1]; *[1]TUe, Netherlands.* We design and propose a novel low polarization-dependent InAlGaAs bulk SOA that can be integrated with passive waveguides. Low butt-coupled reflection $< 2\times10^{-5}$, low polarization-dependent gain < 3dB is achieved with > 15 dB gain.

JTh2A.103

Bandwidth Enhancement of Silicon Thermo-Optic Phase Shifter with Electronic-Photonic Co-Design, Keyi Han[1], Liangjun Lu[1,2], Xin Li[1], Chuxin Liu[1], Xu Weihan[1], Yuyao Guo[1,2], Jianping

Chen[1,2], Linjie Zhou[1,2]; *[1]Shanghai Jiao Tong Univ., China; [2]SJTU-Pinghu Inst. of Intelligent Optoelectronics, China.* Based on a resistance-capacitance equalizer, we demonstrated a silicon thermo-optic phase shifter with a rise time of 2.3 µs and a modulation bandwidth of 250 kHz, offering 10 times enhancement over the original standalone implementation.

JTh2A.104
Experimental Demonstration of an On-Chip Coherent Beam Combiner Based on MMI, Suping Jiao[1], Jifang Qiu[1], Jingwei Song[1], Kejia Xu[1], Yijun He[1], Guangsong Yuan[1], Wenjie Guo[1], Yan Li[1], Jian Wu[1]; *[1]Beijing Univ. of Posts and Telecommunications, China.* We experimentally demonstrate an on-chip coherent combiner utilizing the COBYLA algorithm, resulting in a 3.15 dB enhancement in synthesis power. A 36-Gbit/s quadrature phase-shift-keying communication link carried by the combiner is demonstrated.

JTh2A.105
Optical Convolution Processing Using an On-Chip Thin-Film Lithium Niobate Ring Modulator, Zhaoang Deng[1], Zhenhua Li[1], Ranfeng Gan[1], Zihao Chen[1], Liu Liu[2], Jie Liu[1], Siyuan Yu[1]; *[1]Sun Yat-sen Univ., China; [2]Zhejiang Univ., China.* A novel optical accelerator scheme capable of convolution processing is proposed, utilizing a single on-chip thin-film lithium niobate ring modulator. Experimental validation of the proposed scheme is conducted through image edge extraction demonstrations.

JTh2A.106
Ultra-Compact Inverse-Designed Photonic Hadamard Transform, Arjun Khurana[1], Joel Slaby[1], Varghese A. Thomas[3], Alec M. Hammond[2], Stephen Ralph[1]; *[1]Georgia Inst. of Technology, USA; [2]Meta Platforms, Inc., USA; [3]Ciena Corporation, USA.* Ultra-compact photonic components enable massive scalability of optical networks on chip. We design, fabricate, and measure an ultra-compact (4µm x 4 µm footprint) inverse designed phase-sensitive Hadamard transform.

JTh2A.107
Mid-infrared 2D optical phased array with mirror emitters in InP, Jason Midkiff[1,2], Po-Yu Hsiao[1], Patrick T. Camp[1], Ray T. Chen[1,2]; *[1]Univ. of Texas, USA; [2]Omega Optics, Inc., USA.* A 2D beam steering optical phased array operating at a single mid-infrared wavelength is demonstrated. The device relies on an aperiodic sparse distribution of small-area mirror emitters to achieve ~1000 resolvable points.

JTh2A.108
An Electro-Photonic Unary Multiply-Accumulate (MAC) Circuit, Venkata Sai Praneeth Karempudi[1], Sairam Sri Vatsavai[1], Ishan Thakkar[1]; *[1]Univ. of Kentucky, USA.* We report a microring resonator (MRR) based electro-photonic circuit that utilizes rate-coded unary (stochastic) arithmetic with deterministic bit-position correlations to perform >10,000 multiply-accumulate (MAC) operations temporally at 36.2 pJ/MAC energy efficiency and 4% mean absolute error.

JTh2A.109
Floating-point photonic solver using Newton's method, Andrew B. Klein[1], Zheyuan Zhu[1], Guifang Li[1], Shuo S. Pang[1]; *[1]Univ. of Central Florida, CREOL, USA.* We present a method for configurable, signed, floating-point encoding and multiplication on limited precision photonic

primitives, demonstrating Newton's method with improved accuracy and expanding the dynamic range of the photonic solver by over 200×.

JTh2A.110
A Second-Order Accurate Small Signal Model for Phase Shifters in Silicon Photonics (SiPh) Modulators, Wenbo Zhao[1,2], Yingchuan Qi[1,2], Liga Bai[1,3], Shiyi Guo[1,4], Qiyu Liang[1,5], Lu Zhang[1,6], Qun Zhang[1]; *[1]Shandong Zhike Intelligence Computing Co. Ltd., China; [2]Taishan College, Shandong Univ., China; [3]Electrical Engineering, Zhejiang Univ., China; [4]Inst. of Crystal Materials, Shandong Univ., China; [5]College of Art and Science, New York Univ., USA.* A second-order accurate frequency domain segmented small signal model is proposed for phase shifters in silicon photonics modulators with traveling-wave electrodes. Its numerical efficiency in comparison to that of the first-order model is studied.

JTh2A.111
A Hybrid Time-Amplitude Analog MAC Circuit with Silicon Nitride Electro-Photonics, Venkata Sai Praneeth Karempudi[1], Ishan Thakkar[1], Justin Woods[2], J. T. Hastings[1]; *[1]Univ. of Kentucky, USA; [2]Argonne National Laboratory, USA.* We report a silicon nitride microring resonator (MRR) based electro-photonic circuit that utilizes pulse width-amplitude modulated signals to perform a temporal dot-product operation between two large vectors (up to 10,000 elements each) with >8-bit accuracy and precision.

JTh2A.112
Optical Input – Optical Output Logic Gates Using Ring Modulator and Photovoltaic Diodes, Samer Idres[1], Jonathan Habif[1], Hossein Hashemi[1]; *[1]Univ. of Southern California, USA.* We experimentally demonstrate optical input – optical output logic gates using ring modulators and bias-less stacked photodiodes operating in the photovoltaic mode. The proposed structure is implemented in a commercial silicon photonics foundry.

JTh2A.113
Photonic Extreme Learning Machine by Using Intermodulation in a Mach-Zehnder Modulator Driven by Subcarrier Signal, Hideaki Tanaka[1], Takashi Kan[1], Hidenori Takahashi[1]; *[1]KDDI Research, Japan.* We propose a simple scheme that leverages the intermodulation signals in a modulator driven by subcarriers as a neural network to increase input dimension. We experimentally achieved an MNIST classification accuracy as high as 97.29%.

JTh2A.114
Adjustment of dynamic range for integrated chip-scale optomechanical transducers compatible with CMOS technology, Talha Yerebakan[1], Jaime Gonzalo Flor Flores[1], Alexis Samoylov[1], Chee Wei Wong[1]; *[1]UCLA, USA.* We introduce a technique for adjusting the optomechanical transducer integrated CMOS heaters. This method enables the refinement of both the optical mode and the achievement of an adaptive dynamic range.

JTh2A.115
Thermal Shock Resistant Packaging of Thin Film Lithium Niobate Devices for Cryogenic Operation, Donald Witt[1], Hana K. Warner[1], Shima Rajabali[1], Marko Loncar[1]; *[1]John A. Paulson School of Engineering and Applied Sciences, Harvard Univ., USA.* We present an optically

packaged thin film lithium niobate device. We show that this packaged device is capable of cryogenic operation and is resistant to extreme thermal shock.

JTh2A.116
Generalization Performance of Thermal Crosstalk Models for Programmable Photonic Integrated Circuits, Isidora Teofilovic[1], Ali Cem[1], Metodi P. Yankov[1], Darko Zibar[1], Francesco Da Ros[1]; [1]*Technical Univ. of Denmark, Denmark.* We apply physics-based and data-driven models to predict thermal crosstalk-induced resonant wavelength shift of microring resonators. Generalization of the trained models is evaluated by transferring them to predict for different resonators on the same chip.

JTh2A.117
On-Chip Etchless Waveguide Mode Converter Based on Low-Loss Phase Change Thin Film Platform, Yin Xu[1], Yuexiang Guo[1], Shengxiong Lai[1], Hualong Bao[1]; [1]*Soochow Univ., China.* We propose an on-chip waveguide mode converter based on a new phase-change thin film platform, where the device fabrication is an etchless process. Such device has a good performance in a length of 6.8 um.

JTh2A.118
Lissajous Singularities in Young's Interference Experiment, Wenrui Miao[1], Taco Visser[2,3], Greg Gbur[1]; [1]*Univ. of North Carolina at Charlotte, USA;* [2]*Vrije Universiteit, Netherlands;* [3]*Univ. of Rochester, USA.* In Young's interference experiment, we investigate the interference of two bichromatic vector beams, focusing on the conditions for generating Lissajous-type polarization singularities on the observation screen. This marks the first demonstration of the singular behavior of polarization in a two-frequency field in Young's interference experiment.

JTh2A.119
All-optical control of ultrafast plasmon resonances in the pulse-driven extraordinary optical transmission, Hira Asif[1], Mehmet E. Tasgin[2], Ramazan Sahin[1]; [1]*Department of Physics, Akdeniz Univ. Antalya Turkey, Turkey;* [2]*Inst. of Nuclear Sciences, Hacettepe Univ., Turkey.* We proposed active control of extraordinary optical transmission (EOT) by optical tuning of surface plasmon modes. Our results show that the spectral and temporal enhancement of plasmon oscillations yields a 3-fold increase in the EOT signal.

JTh2A.120
Giant Nonlinear Faraday Rotation in
Iron Doped CdMnTe, Hernando Garcia[1]; [1]*Southern Illinois Univ Edwardsville, USA.* We report a giant intensity-dependent Faraday rotation in iron doped $Cd_{0.85}Mn_{0.15}Te$:Fe. Rotations of 12^{o} in magnetic field of 0.55T and intensities of 1.832 GW/cm^2 can be achieved. This is 60 time larger than previously reported.

JTh2A.121
Unraveling the puzzle of the super-resolution imaging by contact microspheres, Alexey V. Maslov[1], Vasily N. Astratov[2]; [1]*Univ. of Nizhny Novgorod, Russian Federation;* [2]*Univ. of North Carolina at Charlotte, USA.* Theoretical explanation of the super-resolution imaging by contact microspheres created a point of attraction during the last decade with many models proposed, but the origin of this effect remains largely elusive. Using a classical double slit, the key factors responsible for this effect are identified by ab initio simulations.

JTh2A.122
Rotationally displaced intensity distribution around square nano-plates excited by circularly polarized light, Naoki Ichiji[1], Takuya Ishida[1], Ikki morichika[1], Tetsu Tatsuma[1], Satoshi Ashihara[1]; [1]*Univ. of Tokyo, Japan.* The rotationally displaced intensity distribution of the electric fields around the nano-square plasmonic plate under circular polarization is revealed to arise from the superposition of multiple vibrational modes, not solely the fundamental mode.

JTh2A.123
Single-molecule MIR absorption detection and nanoscale image, Zhao-Dong Meng[1], En-Ming You[1,2], Jun Yi[1], Zhong-Qun Tian[1]; [1]*Xiamen Univ., China;* [2]*Jimei Univ., China.* We develop the ultra-sensitive vibration-excited fluorescence (VEF) technique for detecting MIR absorption of a single molecule. The method is calibrated with 10^8 improvement in sensitivity, compared to direct MIR detection. With SNOM, this approach exhibits high sensitivity in identifying nanoscale heterogeneity at the molecular level.

JTh2A.124
Imaging plasmon-induced hot carrier propagation on a graphene-based infrared photodetector, Manobina Karmakar[1], Tianyi Guo[1], Arindam Dasgupta[1], Aritra Biswas[1], Debashis Chanda[1]; [1]*Univ. of Central Florida, USA.* We present a real space mapping of localized surface plasmon-induced hot carrier propagation on a nano-patterned graphene-based infrared absorber.

JTh2A.125
Exploration of singularities of Tamm plasmon photonic crystal with an original phase interrogation method: sensitivity enhancement for sensor application, Lotfi Berguiga[1], Théo Girerd[1], Fabien Mandorlo[1], Cécile Jamois[1], Taha Benyattou[1], Xavier Letartre[1], Lydie Ferrier[1]; [1]*Instituts des Nanotechnologies de Lyon, France.* Tamm plasmon photonic crystals around the critical coupling is studied with an original phase interrogation method. Drastic enhancement of the sensitivity in phase is experimentally demonstrated for temperature sensor.

JTh2A.126
Bose-polarons in electron-hole systems in GaAs heterostructure, Erik A. Szwed[1], Brian Vermilyea[1], Darius J. Choksy[1], Zhiwen Zhou[1], Michael M. Fogler[1], Leonid V. Butov[1], Dmitry K. Efimkin[2], Kirk W. Baldwin[3], Loren N. Pfeiffer[3]; [1]*Univ. of California San Diego, USA;* [2]*Monash Univ., Australia;* [3]*Princeton Univ., USA.* We observed attractive and repulsive Bose-polarons in neutral electron-hole systems in separated electron and hole layers in GaAs heterostructure. The measured energy splitting between the polarons increases with density, in agreement with the theoretical calculations.

JTh2A.127
Interaction of Two-dimensional Surface Polaritons with Metallic Nano-plates, Seo-Joo Lee[1], Ji-Hun Kang[2,3]; [1]*School of Applied and Engineering Physics, Cornell Univ., USA;* [2]*Department of Optical Engineering, Kongju National Univ., Korea (the Republic of);* [3]*Kongju National Univ., Department of Future Convergence Engineering, Korea (the Republic of).* We theoretically investigate the interaction of two-dimensional surface plasmons (2DSPs) with metallic nano-plates. Our theory focuses on the reflection properties of strongly confined 2DSPs, including reflection amplitude and anomalous reflection phase shift.

JTh2A.128

Enhancement of TMD Exciton Resonances using Plasmonic Resonators, Hamza Abudayyeh[1], Zhida Liu[1], Kan Yao[1], Yuebing Zheng[1], Xiaoqin Li[1]; *[1]Univ. of Texas at Austin, USA.* Samples of monolayer, bilayer, trilayer and 4-layer WS_2 encapsulated between two layers of hBN are embedded into plasmonic patch antennas. The resulting low mode volume leads to 1000-fold enhancement of dark resonances in the material.

JTh2A.129

Anomalous Dispersion in Coupled Surface Plasmons and Excitons, Leila H. Hesami[1], Md Golam Rabbani Chowdhury[1], Mikhail A. Noginov[1]; *[1]Material science and engineering, USA.* We studied dispersion in Rhodamine laser dyes (in the Kretschmann geometry) and found multi-branch “staircase” dispersion curves, emergence of the new dispersion “fork” branch, and effect of the energy transfer on the strong coupling.

JTh2A.130

Dynamic Reciprocal Plasmonic Metasurface for the Infrared Spectral Range, Micheal J. McLamb[1], Victoria P. Stinson[1], Nuren Z. Shuchi[1], Dustin T. Louisos[1], Tino Hofmann[1]; *[1]UNCC, USA.* Reciprocal plasmonic metasurfaces exhibit perfect absorption and very high sensitivity to ambient refractive index changes. Synergizing these qualities with conformal phase-change-material layers enables dynamic infrared metasurfaces with easily tunable properties as demonstrated numerically.

JTh2A.131

Surprisingly large fluorescence enhancement via all-dielectric spherical mesoparticles, Vadim I. Zakomirnyi[1], Alexander Moroz[2], Rohit Bhargava[4,1], Ilia Rasskazov[3]; *[1]Beckman Inst. for Advanced Science, USA; [2]wavescattering@yahoo.com, Germany; [3]SunDensity Inc., USA; [4]Departments of Bioengineering, Electrical \& Computer Engineering, Mechanical Science \& Engineering, Chemical and Biomolecular Engineering and Chemistry, Cancer Center at Illinois, Beckman Inst. for Advanced Science and Technology, Univ. of Illinois at Urbana-Champaign, USA.* We performed numerical simulations to show that mesoscale homogeneous dielectric spheres have potential to support fluorescence enhancement of factors up to 10^4. This enhancement originates from multipolar resonances, which induce strong electric field enhancement within spheres.

JTh2A.132

Withdrawn

JTh2A.133

Second-harmonic generation with topological protection, Yi Tang[1], Jia-Lin Li[1], Jun-Fang Wu[1], Chao Li[1]; *[1]South China Univ. of Technology, China.* We realize efficient second-harmonic generation (SHG) with topological protection, based on the nonlinear interactions between higher-order corner states.

JTh2A.134

Second-order Nonlinear Optics of Substituted Dolmen-type Au Nanostructure, Atsushi Sugita[1], Kenshin Muroi[1], Masayoshi Kamiya[1]; *[1]Shizuoka Univ., Japan.* This paper presents LSP-enhanced SHG behavior of substituted dolmen-type Au nanostructure. By partially replacing the centro-symmetric nanorod with a noncentro-symmetric nanoprism, SHG efficiency was not only increased but giant circular dichroic SHG behavior was obtained.

JTh2A.135
A bifurcation theory for super bound states in the continuum, Nan Zhang[1]; *[1]City Univ. of Hong Kong, Hong Kong.* We show that near a super bound state in the continuum (BIC), the number of BICs may jump from 1 to 3, or stay fixed at 1, as a structural parameter is varied.

JTh2A.136
Plasmonic waveguide nearfields photodetectors in 2D materials and heterostructures, Chia-Hung Wu[2], Kuo-Ping Chen[1]; *[1]National Tsing Hua Univ., Taiwan; [2]National Yang Ming Chiao Tung Univ., Taiwan.* This study investigates plasmonic photodetection using graphene as a 2D material. It achieves non-scattering near-field detection of surface plasmon polaritons (SPPs) and reports a high photoresponsivity of 29.2 mA W−1, with polarization sensitivity.

JTh2A.137
Nanoscaled Vibrational Strong Coupling with Atomically Thin Mid-Infrared Resonances, Chi Ting Weng[1], Jia-Wun Liaw[1], Chun-Yu Yang[1], Jui-Nung Liu[1,2]; *[1]Department of Electrical Engineering and Inst. of Microelectronics, National Cheng Kung Univ., Taiwan; [2]NCKU Academy of Innovative Semiconductor and Sustainable Manufacturing, Taiwan.* We numerically and analytically demonstrate that plasmonic graphene nanoribbons (GNRs) can serve as an atomically thick open-nanocavity for vibrational strong coupling (VSC), exhibiting an extraordinary cooperativity in the nanoscale.

JTh2A.138
Enhancing Radiative Cooling in Humid Conditions: The Role of Angular Selectivity, Mohamed ElKabbash[1]; *[1]Univ. of Arizona, USA.* We introduce angular selective thermal emission through conic shields. As opposed to omnidirectional thermal emitters with only spectral selectivity, we show that subfreezing temperatures under humid conditions is possible even without vacuum pumps.

JTh2A.139
Light Emission Based on Bound States in the Continuum, Soheil Farazi[1], Srinivas Tadigadapa[1]; *[1]Department of Electrical and Computer Engineering, Northeastern Univ., USA.* This paper presents a versatile platform for mid-infrared light emission utilizing various types of bound states in the continuum, enabling chip-scale coherent light emitters crucial for applications like optical communication and sensing.

JTh2A.140
Time-Domain Optomechanics with Plasmonic Nanostructures, Farhan I. Zahin[1], Adam W. Behnke[1], Thomas J. Pollei[1], Kevin J. Webb[1]; *[1]Purdue Univ., USA.* The time-dependent pressure on a patterned gold–silicon nitride membrane is shown to depend on the optical pulse width relative to the plasmon cavity resonance. This spatiotemporal optical force density regulation enables new optomechanical device paradigms.

JTh2A.141

Low Index Metasurface Design for Active and Passive Photonic Applications, Muhammad S. Asad[1], M. Z. Alam[1]; [1]*Queen's Univ. at Kingston, Canada.* We propose reflective metasurface designs based on metal cavity filled with low index medium. We investigate the applicability of this design for various applications including biosensing and active photonics.

JTh2A.142
Fragility of edge states in topological photonic structures, Yecheng Hu[1], Alex Y. Song[1]; [1]*Univ. of Sydney, Australia.* We show that the edge states of photonic crystal-based topological insulators are intrinsically gapped due to spin mixing at the edge. Any bending of the edge leads to localization even in an ideal structure without disorder.

JTh2A.143
Deep Transfer Reinforcement Learning in Nanophotonics: A Multi-Objective Inverse Design Approach, Abdullah Bin Shams[1], A Abdur Rahman Akib[2], J Stewart Aitchison[1]; [1]*Univ. of Toronto, Canada;* [2]*Electrical and Electronic Engineering, Islamic Univ. of Technology, Bangladesh.* Two time-efficient transfer learning based multi-objective inverse design frameworks, for nanophotonics, using Deep Reinforcement Learning are proposed. The models can easily be adapted to a change of structural, material and number of input/output parameters.

JTh2A.144
Mid Infrared Mapping of Four and Five-Layer Graphene Polytypes using Near-Field Microscopy, Daniel Beitner[1,3], Shaked Amitay[3], Simon Salleh Atri[3], Andrew McEllistrim[4,5], Tom Coen[3], Vladimir I. Fal'ko[4,5], Shachar Richter[1,2], Moshe Ben Shalom[2,3], Haim Suchowski[2,3]; [1]*Materials Science and Engineering, Tel Aviv Univ., Israel;* [2]*Centre for Nanoscience and Nanotechnology, Tel Aviv Univ., Israel;* [3]*Physics and Astronomy, Tel Aviv Univ., Israel;* [4]*National Graphene Inst., Manchester Univ., UK;* [5]*Department of Physics and Astronomy, Manchester Univ., UK.* This study investigates the optical properties of 4 and 5-layer Graphene polytypes using near-field microscopy. The results show that these polytypes have diverse optical characteristics, making them suitable for a range of applications.

JTh2A.145
Snapshot 4D passive ranging and spectral imaging based on ghost imaging via sparsity constraints with multiplexing light-field modulation, Pengwei Wang[1], Li Chen[1,2], Mengyu Chen[1,2], Xiaohan Wan[1,2], Jianrong Wu[1], Zhentao Liu[1], ShenSheng Han[1,3]; [1]*Shanghai Inst of Optics and Fine Mech, China;* [2]*Center of Materials Science and Optoelectronics Engineering, Univ. of Chinese Academy of Sciences, China;* [3]*Hangzhou Inst. for Advanced Study, Univ. of Chinese Academy of Sciences, China.* A 4D passive ranging and spectral imaging based on ghost imaging via sparsity constraints is proposed. High-precision passive ranging and spectral three-dimensional images are achieved in a single exposure by multiplexing regional light-field modulating.

JTh2A.146
High-speed Classification by Optical Information Processing Based on Diffractive Deep Neural Network, Shun Miura[1], Mamoru Otake[1], Hiroyuki Kusaka[1], Masahiro Kashiwagi[1]; [1]*Fujikura, Japan.* High-speed processing of sub-millimeter-particle images by optical neural network is demonstrated. The apparatus processes light directly from samples

flowing across the laser. >98% accuracy was achieved for the classification of different sizes of particles.

JTh2A.147
A Sensitivity-enhanced Fiber Optic Gyroscope for Precision Measurements, Wenbo Wang[1], LanXin Zhu[1], Yan He[1], Yanjun Chen[1], Huimin Huang[1], Xinyu Cao[1], Fangshuo Shi[1], Zhengbin Li[1]; [1]*Peking Univ., China.* A sensitivity-enhanced fiber optic gyroscope has been verified. A self-noise level of 55 nrad/s/Hz$^{1/2}$ and an angular random walk of 1.5×10^{-4} deg/h$^{1/2}$ are achieved with an enclosed area of 25.5 m^2, demonstrating excellent sensitivity.

JTh2A.148
Synchrotron Based X-Ray Fluorescence Ghost Imaging, Mathieu Manni[1], Adi H. Ben Yehuda[2], Yishai Klein[2], Bratislav lukic[1], Andrew Kingston[3], Alexander Rack[1], Sharon Shwartz[2], Nicola Vigano[4]; [1]*ESRF, France;* [2]*bar ilan, Israel;* [3]*The Australian National Univ., Australia;* [4]*cea, France.* We successfully demonstrate X-ray fluorescence Ghost Imaging on synchrotron sources. We present a new robust protocol against drifts and positioning errors that opens the way to study previously inaccessible samples such as liquids.

JTh2A.149
Fast and Accurate Interrogation of Vernier Effect-based Optical Fiber Sensors Enabled by Machine Learning, Chen Zhu[1], Jie Huang[2]; [1]*Zhejiang Laboratory, China;* [2]*Missouri S&T, USA.* The possibility of employing a light source with a small wavelength bandwidth (35 nm) and a coarsely resolved spectrometer (~166 pm) for the interrogation of a Vernier effect-based high-sensitivity optical fiber sensor is demonstrated.

JTh2A.150
Multiparameter Optical Performance Monitoring of PAM Channels Using Asynchronous Amplitude Histogram, Siao Li[1], Jian Yang[1], Yuanpeng Liu[1], Wenqian Zhao[1], Yiwen Zhang[1], Runzhou Zhang[3], Zhongqi Pan[2], Yang Yue[4]; [1]*Nankai Univ., China;* [2]*Univ. of Louisiana at Lafayette, USA;* [3]*Univ. of Southern California, USA;* [4]*Xi'an Jiaotong Univ., China.* PAM signal performance monitoring is demonstrated using GBDT method combined with AAH, achieving a 97.54% accuracy for jointly monitoring 4 parameters, and by using moving average preprocessing, the accuracy of dispersion monitoring is above 93%.

JTh2A.151
Subsurface Spectroscopy Inside of Heterogeneous Materials Using Self-healing Optical Beams, Benjamin R. Anderson[1], Natalie Gese[1], Hergen Eilers[1]; [1]*Washington State Univ., USA.* We compare the performance of Gaussian and Self-healing (Airy and Bessel) optical beams for subsurface spectroscopy inside of heterogeneous materials. We find that self-healing beams do provide improved performance over Gaussian beams.

JTh2A.152
Three-dimensional Spatio-temporal Reconstruction of Ultrafast Events Based on a Single-shot Lensless Imaging, Youjian Yi[1,2], Fucai Ding[1,2], Dongjun Zhang[1], Ping Zhu[1], Jianqiang Zhu[1]; [1]*National Laboratory on High Power Laser and Physics, Shanghai Inst. of Optics and Fine Mechanics, Chinese Academy of Sciences, China;* [2]*Center of Materials Science and Optoelectronics Engineering, Univ. of Chinese Academy of Sciences, China.* Here, we present an ultrafast lensless imaging technique based on wavelength spatial multiplexing

technique. It can capture three-dimensional spatio-temporal information of ultrafast events in a single-shot. The feasibility of this method is verified by simulation.

JTh2A.153
Sensitivity Estimation For the Future Laser Ionization Diagnosis in Inferring Neutral Particle Density in the TCABR Tokamak, Fernando A. Albuquerque[1], Niklaus Wetter[1], José Helder F. Severo[2]; *[1]Nuclear and Energy Research Inst., Brazil; [2]Plasma Physics Laboratory, Inst. of Physics of Univ. of São Paulo, Brazil.* This study undertakes an estimation of photoionization occurrences and the ensuing reduction in hydrogen spectral line intensities via Laser-Induced Ionization. The objective is to quantify the sensitivity of the neutral particle density diagnostic.

JTh2A.154
Demultiplexing of OAM-coded signal using hybrid optical-electronic convolutional neural network, Jiachi Ye[1], Qian Cai[1], Belal Jahannia[1], Salem Altaleb[1], Haoyan Kang[2], Hao Wang[1], Chandraman Patil[1], Elham Heidari[1], Hamed Dalir[1]; *[1]Univ. of Florida, USA; [2]API Metrology, USA.* Here we propose a hybrid optical-electronic convolutional neural network based on 4f system to demultiplex OAM-coded signal under simulated atmospheric turbulence condition. Results show the classification accuracy of 70.63% under strong turbulence scenario.

JTh2A.155
Novel Time-Gated Luminescence Measurement System Based on All-Fiber Configuration, Lei Kong[1], Qisheng Deng[1], Xuewen Shu[1]; *[1]Wuhan National Laboratory for Optoelectronics & School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China.* We report a novel and low-cost time-gated luminescence measurement system based on all-fiber configuration, which uses simple and easily integrated optoelectronic devices to replace complex spatial optical systems and achieve millisecond temporal resolution.

JTh2A.156
Releasing Residual Stress in Metal-Coated Fibers Through Heat Treatment Process for Distributed High-Temperature Sensing Applications, Koustav Dey[1], Rony Kumer Saha[1], S. Narasimman[1], Bohong Zhang[1], Farhan Mumtaz[1], Ronald J. O'Malley[1], Jeffrey D. Smith[1], Rex E. Gerald II[1], Jie Huang[1]; *[1]Missouri Univ. of Sci. and Technology, USA.* The study investigates a refined heat treatment methodology tailored for commercial metal-coated optical fibers, with the objective of accurately reducing residual stress to prime them for use in distributed sensing applications at high temperatures.

JTh2A.157
Real-time Monitoring of Pedestrian Activities With Sub-meter Resolution Using Underground Telecom Cable, Jialei Zhang[1], Jianhui Sun[1], Zhenyu Ye[1], Shibo Zhang[1], Yingqing Wu[1], Yifei Qi[1], Yunjiang Rao[1], Zinan Wang[1]; *[1]Univ. Electronic Sci. & Tech. of China, China.* We present the first field trial of real-time distributed sensing of pedestrian activities with sub-meter resolution using in-service telecom cable, while the appealing details captured by DAS showcases its immense potential for smart city.

JTh2A.158
Optical AI Feature Extraction by Metasurface Encoders in Ultra-sensitive Detection, Qizhou Wang[1], Ning Li[1], Zhao He[1], Arturo Burguete Lopez[1], Maxim O. Makarenko[1], Fei Xiang[1],

Andrea Fratalocchi[1]; *[1]KAUST, Saudi Arabia.* This work introduces an optical AI sensing framework using a metasurface encoder to extract spectral features from the sensory data, reaching glucose detection sensitivity of 10^{-20} mol/L and r^2 score of 0.9718.

JTh2A.159
Nanoscale Absolute Grating Encoder with Wide Range Directional Discrimination Based on Asymmetric Code and Hybrid Positioning, Shengtong Wang[1], Linbin Luo[1], Feifan Cao[1], Xinghui Li[1,2]; *[1]Tsinghua Shenzhen International Graduate School, Tsinghua Univ., China; [2]Tsinghua-Berkeley Shenzhen Inst., Tsinghua Univ., China.* We propose an absolute positioning grating encoder with directional discrimination ability from coarse range to precision range, and the positioning accuracy can reach 10 nm for a motion range of several tens of millimeters.

JTh2A.160
Compensation of Scale Factor Error for Open-loop Fiber Optic Gyroscopes, Lanxin Zhu[1], Huimin Huang[1], Xinyu Cao[1], Yanjun Chen[1], Zhengbin Li[1]; *[1]Peking Univ., China.* Theoretical analysis of the scale factor nonlinearity (SFN) in open-loop fiber optic gyroscopes is conducted. A k-factor compensation method is introduced, effectively reducing SFN to 2.5 ppm over the range of -300 to +300 °/s.

JTh2A.161
Integrated Radiative Cooler with Solar Harvesters for Maximized Electric Power Generation Using Thermodynamic Resources, Ikhoon Jeong[1], Min Seong Kim[1], Gil Ju Lee[1]; *[1]Busan Univ., Korea (the Republic of).* This paper proposes a renewable energy generation system with parabolic mirror, radiative cooler (RC), solar absorber (SA) and solar cell. The optimization of RC and SA size is performed to achieve equalized cooling and heating power.

JTh2A.162
Birefringence in an α-hematite single-crystal in Terahertz range, Giovanni Budroni[1], Flavio C. Cruz[1], Jonathas D. Siqueira[1]; *[1]Unicamp, Brazil.* We employed terahertz time-domain spectroscopy to examine the birefringence within a single crystal of α-hematite over the frequency range of 100 to 700 GHz.

JTh2A.163
The Transmission of Moving Optical Cavities, Nazar Pyvovar[1], Lingze Duan[1]; *[1]Univ. of Alabama in Huntsville, USA.* We report a theoretical analysis of the transmission properties of an optical cavity, which moves uniformly against the observer. Velocity dependence of the amplitude and phase is examined and application prospects are discussed.

JTh2A.164
Demonstration of silicon on-chip spectrometer using a racetrack resonator and a Mach-Zehnder lattice filter, Shiqi Zhang[1,2], Tongxin Yang[1,2], Xiuli Fu[1,2], Lei Zhang[1,2]; *[1]School of Integrated Circuits, Beijing Univ. of Posts and Telecommunications, China; [2]State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ. of Posts and Telecommunications, China.* We demonstrate an integrated spectrometer on silicon-on-insulator (SOI) using a tunable racetrack resonator with an FSR of 5 nm and an 8-ch Mach-Zehnder lattice filter. The device has a resolution of 0.2 nm over C-band.

JTh2A.165

Wide-angle diffraction-limited quadratic metalens, Kuan-Pin Chen[1], Meng-Hsin Chen[2], Vin-Cent Su[2], Chao-Hsin wu[1], Bo-Wen Chen[2]; *[1]Graduate Inst. of electronics engineering, National Taiwan Univ., Taiwan; [2]Department of Electrical Engineering, National United Univ., Taiwan.* We successfully demonstrated an aberration-free wide-angle metalens with a numerical aperture of 0.24 at a wavelength of 450 nm. The metalens were verified by experiment to achieve a diffraction-limited focusing under the angle of incidence from 0 to 17.5 degrees.

JTh2A.166

Broadband and high-resolution characterization of microcombs based on coherent detection, Tomohiro Tetsumoto[1], Ayaka Shoda[2], Kentaro Furusawa[1], Kazuhiro Imai[2], Motonobu Kourogi[2], Norihiko Sekine[1]; *[1]National Inst. of Information and Co, Japan; [2]XTIA Ltd., Japan.* We report a fast characterization method based on coherent heterodyne detection to simultaneously characterize various properties of microresonator frequency combs, such as optical spectrum, comb-resonance detuning, and resonator dispersion.

JTh2A.167

A Fast Reference-less Error Correction Method for dual-comb Spectroscopy based on Free-running Fiber Lasers, Qiuying Ma[1,2], Pengpeng Zhang[1], Haoyang Yu[3], Xiaohao Wang[1,2], Xiaojun Liang[2], Kai Ni[1]; *[1]Tsinghua Univ., China; [2]Peng Cheng Laboratory, China; [3]Central South Univ., China.* A fast reference-less error correction based on truncating and zeroing and cross-correlation for suppressing noises in the dual-comb spectroscopy was proposed. The experimental results demonstrated that the coherent averaging results of the dual-reference digital error correction using 6.4 s interferograms was achieved with only 0.2 s signal.

JTh2A.168

Ultrafast pulsed laser evaluation of Single Event Transients in opto-couplers, Kavin S. Dave[1], Aditya Mukherjee[1], Shalabh Gupta[1], Deepak Jain[1], Hari Shanker Gupta[2]; *[1]IIT Bombay, India; [2]Space Application Center, ISRO, India.* We build a 1064 nm fiber laser system-based testing facility for emulating SETs in different electronics components and ICs. Using these facilities, we tested the 4N35 optocoupler to observe SETs for the first time.

JTh2A.169

Towards Entanglement Distribution Over Classical Fiber Infrastructure with Parallel Distribution of Precise Time and Optical Frequency, Josef Vojtech[1], Tomas Novak[2,1], Elisabeth Andriantsarazo[3,1], Carlos Guerra-Yanez[3], Petr Pospisil[1], Martin Slapak[1], Rudolf Vohnout[1], Michal Spacek[3,1], Ondrej Havlis[1], Jan Kundrat[1], Lada Altmannova[1], Vladimir Smotlacha[1]; *[1]CESNET, Czechia; [2]FNSPE, Czech Technical Univ., Czechia; [3]FEE, Czech Technical Univ., Czechia.* Long-distance time and frequency transfer methods in optical fiber matured in recent years, including paralllel operation with data. On other hand quantum entanglement transfer over shared fiber are really rare. Paper presents the steps of verifying the potential for sharing fiber for time and frequency with the transfer of entangled states.

JTh2A.170

Near-infrared dual-comb spectrometer based on 500 MHz ErYb:glass lasers, Jonathas D. Siqueira[1], Flavio C. Cruz[1], Antonio Saldanio Matos[1], Leandro M. Fernandes[1]; *[1]Universidade*

Estadual de Campinas, Brazil. We describe a dual-comb spectrometer in the near-infrared based on two homemade diode-pumped ErYb:glass 500 MHz femtosecond lasers.

JTh2A.171
Optical nonlinearity measurement of Cr_2Te_3: A method for estimating nonlinear refractive index with giant photothermal effect, Bo-Yi Chen[1], Kyungtaek Lee[2], In Hak Lee[3,4], Young Jun Chang[3,4], Ju Han Lee[2], Chao Kuei Lee[1]; *[1]Department of Photonics, National Sun Yat-sen Univ., Taiwan; [2]School of Electrical and Computer Engineering, Univ. of Seoul, Korea (the Republic of); [3]Department of Physics, Univ. of Seoul, Korea (the Republic of); [4]Department of Smart Cities, Univ. of Seoul, Korea (the Republic of).* A giant photothermal effect was observed within Cr_2Te_3 thin film. By removing the thermally-induced nonlinearity, the n_2 values exhibited increasing tendency from -1.667×10^{-7} cm^2/W to -1.567×10^{-8} cm^2/W as the peak intensity increased from 0.84 MW/cm^2 to 15.91 MW/cm^2.

JTh2A.172
Non-contact Burst Monitoring via Dual Fiber Fabry-Perot Interferometers, Rui-xuan Wang[1], Daniel Homa[1], Zach Dejneka[1], Logan Theis[1], Anbo Wang[1], Gary Pickrell[1]; *[1]VirginiaTech, USA.* Introducing a dual Fabry-Perot sensor system for non-contact pipe burst monitoring. With a lab-standard dual-ferrule probe, we measure absolute distance from the pipe and differentiate bursting events from absolute drifting through relative measurements.

JTh2A.173
High-Brightness Laser-Driven Light Source (LDLS®) with Manipulated Spectral Output to Facilitate UV Applications, Xiaohua Ye[1]; *[1]Energetiq Technology Inc., USA.* A high-brightness LDLS with manipulated spectral output is proposed and evaluated. Its design principle, features, radiance, and stability are presented alongside a comparison with a 30W deuterium light source.

JTh2A.174
A Geometric Phase approach to RAM control in Pound-Drever-Hall technique, Leila Mashhadi[1], Gholamreza Shayeganrad[1]; *[1]Univ. of Southampton, UK.* This study investigates the application of Geometric Phase for mitigating Residual-Amplitude-Modulation in the Pound-Drever-Hall frequency stabilization technique. It is demonstrated that Geometric Phase enhances the effectiveness of RAM cancellation via direct current voltage application.

JTh2A.175
Mitigating Misattributions in Single-Photon Detector Arrays with Row-Column Readouts, Shashwath S. Bharadwaj[1], Ruangrawee Kitichotkul[1], Akshay Agarwal[1], Vivek K. Goyal[1]; *[1]Boston Univ., USA.* A novel estimator resolves the ambiguity of spatial locations of multiphoton coincidences in single-photon detector arrays. This method mitigates misattributions introduced by multiplexed readout mechanisms that are commonly used to implement large-scale arrays.

JTh2A.176
Mutual Coupling between Multimode and Phase-Locked Loop Oscillators, Alexander Hodisan[1], Vladimir Smulakovsky[1], Moshe Horowitz[1]; *[1]Technion Israel Inst. of Technology, Israel.* We demonstrate a mutual coupling between multimode and phase-locked loop

oscillators. This coupling, which is demonstrated in an optoelecronic oscillator, is robust, and it enables suppressing spurious modes by increasing the injection ratio.

JTh2A.177

Silicon Waveguide Cross-sectional Dimension Estimation Based on Effective Refractive Index Extraction, Enge Zhang[1,2], Xiaoran Zhu[1,2], Lei Zhang[1,2]; *[1]School of Integrated Circuits, Beijing Univ of Posts & Telecom, China; [2]State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ. of Posts and Telecommunications, China.* We report a method for estimating the cross-sectional dimension of silicon waveguides. It is based on the effective refractive index data extracted from the spectra of two racetrack resonators with different perimeters.

JTh2A.178

Extraction of Group Refractive Index and its Temperature Dependence with a Ring Resonator, Xiaoran Zhu[1,2], Enge Zhang[1,2], Lei Zhang[1,2]; *[1]School of Integrated Circuits, Beijing Univ of Posts & Telecom, China; [2]State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ. of Posts and Telecommunications, China.* We report a method for the extraction of group refractive index and its temperature dependence using a single ring resonator. We verify its feasibility and determine the thermo-optic coefficient of ng to be 3×10^{-4}.

JTh2A.179

Optimizing the denoising method of DAS system based on point-backscattering-enhanced fiber, Caiyun Li[1], Hongkun Zheng[1], Lingmei Ma[1], Chen Zhu[1], Yiyang Zhuang[1], Wei Peng[1], Yunjiang Rao[2,1]; *[1]Zhejiang Lab, Hangzhou, 311100, China, China; [2]Univ. of Electronic Science and Technology of China, China.* A stable and low noise demodulation for PBSEF based DAS system is explored by theoretical and experimental analysis. The results show that, direct-average and weighted-average, for suppressing the noise level of DAS and the optimal parameters are investigated.

JTh2A.180

Super-Resolution of Optical Thickness Measurement employing Correlation-based Spectrum Estimation, Naoki Yamaguchi[1,2], Takanori Yamauchi[3], Takayuki Kitamura[3], Masaharu Imaki[3], Shinji Yamashita[2], Sze Y. Set[1]; *[1]RCAST, The Univ. of Tokyo, Japan; [2]EEIS, The Univ. of Tokyo, Japan; [3]Mitsubishi Electric Corporation, Japan.* A correlation-based spectral estimation was employed for super-resolution of optical FMCW thickness measurement. The authors successfully demonstrated that the method is feasible for FMCW range resolution enhancement surpassing the theoretical resolution.

JTh2A.181

Highly Sensitive Fiber Optic Current Sensors with Integrated λ/4 Retarder, Yuan Ke[1], Aodi Yu[1], Jundong Tian[1], Can Li[1], Li Xia[1]; *[1]Huazhong Univ. of Science and Technology, China.* We replaced the λ/4 retarder in the all-fiber current sensor with an integrated λ/4 retarder, the current sensitivity was increased from 0.235 mV/mA to 0.404 mV/mA, and the noise was suppressed.

JTh2A.182

Secure Satellite Time Synchronization Based on Chip Scale Atomic Clock Assisted GNSS Receiver, Sibo Gui[1], Junchao Wang[1], Zhaolong Li[1], Jy Zhao[1]; *[1]Peking Univ., China.* The paper introduces CSAC as a viable alternative, explores their potential in satellite time synchronization, and presents a neural network approach to classify CSAC's clock differences as unique fingerprints of GNSS receivers.

JTh2A.183
Characterization of a Remote Fiber Optic Strain Sensing System, Swapnil N. Daxini[1], Deniz Aydin[1], Arthur Giron-Santos[1], Jack Barnes[2], Xijia Gu[3], Hans-Peter Loock[1]; *[1]Univ. of Victoria, Canada; [2]Queen's Univ., Canada; [3]Toronto Metropolitan Univ., Canada.* We present a passive, all-fiber strain sensing system capable of measuring strain over 75 km using a diode laser locked to a π-shifted grating, with potential applications to develop a fiber optic hydrophone.

JTh2A.184
Vector Bending Sensor Based on Tapered Few-Mode Multi-Core Fiber Enabled by Power Monitoring, Zhuyixiao Liu[1], Zijian Jiang[1], Qixuan Wu[1], Fengming Zhang[1], Haoze Du[1], Yucheng Yao[1], Luming Zhao[1], Ming Tang[1]; *[1]HUST, China.* We proposed a vector bending sensor based on tapered few-mode multi-core fiber. The sensor could accomplish the recognition of direction and curvature through only power monitoring. The theoretical curvature sensitivity is higher than 0.14 /m^{-1} within the interval of 2.5 m^{-1} to 10 m^{-1}.

JTh2A.185
Design and Development of a Portable Raman System for Rapid Detection of Biotic Stress in Spinach, Nidhi Dhillon[1], Shilpi Agarwal[1]; *[1]Jawaharlal Nehru Univ., New Delhi, India.* A portable Raman Spectrometer has been used for the early detection of biotic stress in spinach. The significant change in the carotenoid peaks indicated the presence of bacterial infection within 48 hr.

JTh2A.186
Speed Invariant Opto-atomic Spatio-temporal Holographic Correlator for Automatic Event Recognition Using the Mellin Transform, Xi Shen[1], Julian Gamboa[1], Tabassom Hamidfar[1], Shamima A. Mitu[1], Selim M. Shahriar[1]; *[1]Northwestern Univ., USA.* We report on an opto-atomic spatio-temporal holographic event recognition system that incorporates a two-step method based on the Mellin transform to achieve invariance to temporal shifts and speed variations, allowing for more diverse recognition tasks.

JTh2A.187
Assessment on frequency stability of photonic supercontinuum based optical frequency comb, Lu Yang[1], Yongyuan Chu[1], Suwan Sun[1], Zhiming Shi[1], Hairun Guo[1]; *[1]ShangHai Univ., China.* We detected the carrier-envelope frequency and repetition rate of laser comb via the visible dispersive wave of supercontinuum generation in chip-scale silicon nitride waveguide, and assessed the frequency stability through phase-locked amplifier.

JTh2A.188
Dual-Mode, Subarray Design for Optical Phased Array With Electro-Optic Phase Shifters, Wuxiucheng Wang[1], Yongchao Liu[1], Ming Gong[1], Hui Wu[1]; *[1]Univ. of Rochester, USA.* We propose a new design optimization method for optical phased arrays with subarrays. The new design enables a low-loss mode for subarrayed OPA operation that offers better trade-offs between power consumption, optical loss, and chip area.

JTh2A.189

High Gain Squeezing in Resonators: Beyond Lorentzian Enhancement, Michael J. Sloan[1], Alice Viola[2], Marco Liscidini[2], John Sipe[1]; *[1]Department of Physics, Univ. of Toronto, Canada; [2]Dipartimento di Fisica, Universita di Pavia, Italy.* We introduce a novel method for modelling squeezed light generation in microring systems beyond the perturbative regime, without necessitating a Lorentzian resonance structure. As such, this method is applicable within broad ranges of finesse.

JTh2A.190

Inverse Designed Photonic Crystal Cavities Coupled to Colloidal Quantum Dots, Neelesh K. Vij[1], Purbita Purkayastha[1], Shaun Gallagher[2], David Ginger[2], Edo Waks[1]; *[1]Univ. of Maryland College Park, USA; [2]Univ. of Washington, USA.* We inverse design L3 photonic crystal cavity in Silicon Nitride to achieve high quality factor, low mode volume and high collection efficiencies. We fabricate our device and integrate them with colloidal perovskite quantum dots.

JTh2A.191

Sagnac ring for self-injection locking laser and microcomb generation, Bitao Shen[1], Xuguang Zhang[1], Yimeng Wang[1], Zitan Tao[1], Huajin Chang[1], Wencan Li[1], Yan Zhou[2], Zhangfeng Ge[2], Ruixuan Chen[1], Bowen Bai[1], Haowen Shu[1], Lin Chang[1], Xingjun Wang[1]; *[1]PKU, China; [2]Peking Univ. Yangtze Delta Inst. of Optoelectronics, China.* We propose the Sagnac ring with wide-band, reliable reflection for self-injection locking, achieving lasers with an intrinsic linewidth as low as 24.38 Hz and demonstrating mode-locked microcomb generation at different resonances.

JTh2A.192

High-Speed Directly Modulated Quantum Dot Lasers Utilizing Photon-Photon Resonance Effect, Zhengqing Ding[1], Minghao Cai[1], Ying Yu[1], Siyuan Yu[1]; *[1]Sun Yat-sen Univ., China.* We demonstrate a dual-section quantum dot distributed feedback (QD-DFB) laser, which achieves stable single-mode operation with >10 mW output power and a maximum modulation bandwidth of 17.31 GHz, leveraging the photon-photon resonance (PPR) effect.

JTh2A.193

Integrated Spatial-temporal Speckle Spectrometer, Jianji Dong[1], Shibo Xu[1], Jiahui Zhang[1], Junwei Cheng[1]; *[1]Wuhan National Lab for Optoelectronics, China.* We propose and demonstrate an integrated spatial-temporal speckle spectrometer. By constructing a highly uncorrelated transmission matrix, we accurately reconstructed a narrow band peak of 0.12 nm and a broadband spectrum covering the entire C-band.

JTh2A.194

Ultra-low reflection, high-power 1577nm EML+SOA laser for Combo XGPON OLT Class-D, Jack Jia-Sheng Huang[1]; *[1]Source Photonics, USA.* We present ultra-low reflection, high power 1577nm EML+SOA laser for Combo XGPON OLT Class-D. The monolithic EML+SOA shows high output power of >30mW at low bias current<160mA and clear eye opening with high mask margin>25% and high ER>9dB. Robust reliability of 5000hr aging is shown to guarantee stable operations for XGPON OLT.

JTh2A.195

Carrier Dispersion Modulation in a Silicon Strip Waveguide, Ahmed Shariful Alam[1], Hao Sun[2], Md Mahadi Masnad[2], Imtiaz Alamgir[2], José Azaña[2], J Stewart Aitchison[1]; [1]*Edward S. Rogers Sr. Department of Electrical and Computer Engineering, Univ. of Toronto, Canada;* [2]*Énergie Matériaux Télécommunications Research Centre, Institut National de la Recherche Scientifique (INRS), Canada.* We report our observation of carrier dispersion effect in a silicon strip waveguide and demonstrated a novel strip waveguide-based silicon modulator with an estimated half-wave-voltagelength product ($V_{\pi}L$) of ~9 V.cm in the telecommunication wavelength.

JTh2A.196
Semiconductor distributed-feedback (DFB) laser integrated with reflected mirror for light source in Si photonic, Yi-jen Chiu[1], Shou-Ming Chen[1], Chung-wei Hsiao[1]; [1]*National Sun Yat-Sen Univ., Taiwan.* Slanted mirror monolithically integrated with distributed-feedback laser had been demonstrated on Si photonics, enabling Si grating coupling and 3D photonic integration. Output power of 5.5mW has been observed and transferred into a Si grating coupler.

JTh2A.197
Ultrafast Spontaneous Emission in Shifted-Core Coaxial Nano-Emitter, Xi Li[1], Jiazhen Li[1], Jiyoung Moon[1], Ryan Wilmington[1], Dayang Lin[1], Mehdi Ashrafganjoie[1], Kenan Gundogdu[1], Qing Gu[1]; [1]*North Carolina State Univ., USA.* We experimentally demonstrate a Purcell-enhanced shifted-core coaxial nano-emitter at the telecommunication wavelength. Device spontaneous emission lifetimes range from 30 to 57ps, which are 31 to 59 times faster than its thin-film counterpart.

JTh2A.198
Single-microresonator-based dynamic photonic molecule switch, Zitan Tao[1], Bitao Shen[1], Wencan Li[1], Luwen Xing[1], Haoyu Wang[1], Yichen Wu[1], Yuansheng Tao[1], Yan Zhou[2], Yandong He[1], Chao Peng[1], Haowen Shu[1], Xingjun Wang[1]; [1]*PKU, China;* [2]*Peking Univ. Yangtze Delta Inst. of Optoelectronics, China.* We propose a dynamic on-chip photonic molecule switch in an ultra-compact multimode silicon microring, allowing for flexible either nonlinear control or loss reduction. This strategy leads to a record low-loss transition (Q_i ~ 10 million) under hundred-GHz FSR level.

JTh2A.199
Optimized Contact Resistance and Device Performance of AlGaN/GaN HEMTs by sub-10 nm Nano-Hole Patterns, Hsin-Jung Lee[1], Cheng-Che Lee[1], Hong-Ru Pan[1], Chieh-Hsiung Kuan[1]; [1]*National Taiwan Univ., Taiwan.* Sub-10 nm scale nano-hole patterns were designed to reduce contact resistance and improve the electrical characteristics of HEMTs by using electron beam lithography. AlGaN/GaN HEMTs with the contact resistance decreased from 1.82 Ω-mm to 0.47 Ω-mm were achieved, and the maximum drain current was enhanced from 319 mA/mm to 496 mA/mm.

JTh2A.200
A Simplified Setup for Characterizing the Beam Propagation Parameter of On-Wafer Vertical Cavity Surface Emitting Lasers, Mark Mihalik[1], Kirk A. Ingold[1], James J. Raftery[1], William North[1]; [1]*Photonics Research Center, USA Military Academy, USA.* Beam propagation measurement is typically done parallel to the optical table. We report on an improved setup that

reduces manual manipulation and accounts for device rotation for measurements taken perpendicular to the optical table.

JTh2A.201

Fabrication of ZrN nanomasks for selective epitaxy of GaN/AlGaN nanowire arrays for efficient UV light emitters, Magdalena A. Zadura[1], Marek Ekielski[1], Marek Guziewicz[1], Marta Sobanska[2], Zbigniew Zytkiewicz[2], Karol Olszewski[2], Anna Szerling[1]; *[1]Lukasiewicz-IMiF, Poland; [2]IF PAN, Poland.* In this work, we present the technology for ZrN nanostructures, which serve as masks for the selective area growth of GaN/AlGaN nanowires by plasma-assisted MBE on GaN/sapphire templates.

JTh2A.202

Compact Trident Edge Coupler on Thin Film Lithium Niobate for Octave-Spanning Nonlinear Processes, John O. Gerguis[1], Gregory Chang[1], Ruihan Chen[1], Minghao Qi[1]; *[1]Electrical and Computer Engineering, Purdue Univ., USA.* We present a trident edge coupler design for thin-film LNOI achieving <1.4 dB coupling loss at both edges of an octave-spanning spectrum (1~2 μm) with >10 dB suppression ratio of the middle wavelength (1.5 μm).

JTh2A.203

Improved Color Purity with Red-Green-Yellow Quantum Dots and Blue Resonant Cavity Micro-LEDs for High-Resolution Full Color Displays, Wei-Ta Huang[1,2], Tzu-Yi Lee[1], Wen-Chien Miao[2,3], Yu-Ying Hung[1], Yu-Heng Hong[2], Chien-Chung Lin[4], Fang-Chung Chen[1], Chia-Feng Lin[6], Shu-Wei Chang[1,5], Hao-Chung Kuo[1,2]; *[1]Photonics, National Yang Ming Chiao Tung Univ., Taiwan; [2]Semiconductor Research Center, Hon Hai Research Inst., Taiwan; [3]Electrophysics, National Yang Ming Chiao Tung Univ., Taiwan; [4]Electrical Engineering, National Taiwan Univ., Taiwan; [5]Research Center for Applied Sciences, Academia Sinica, Taiwan; [6]National Chung Hsing Univ., Taiwan.* Our research presents a 12 μm RC-μ-LED design using quantum dots for vibrant, full-color displays, overcoming InGaN RGB micro-LEDs' limitations and offering high resolution, brightness, and color accuracy for advanced digital applications.

JTh2A.204

Graphene-Inserted Metal-Slot-Added Si Waveguide Photodetector with a Large Responsivity, Jungwoo Lee[1], Jihoon Seo[1], Min-Suk Kwon[1]; *[1]Ulsan National Inst of Science & Tech, Korea (the Republic of).* We experimentally investigate a graphene-inserted metal-slot-added Si waveguide photodetector, which has feature sizes larger than 200 nm. The 15-μm-long photodetector exhibits an ultra-high responsivity of 8.09 A/W with a bias voltage of 1 V applied.

JTh2A.205

Monolithic high contrast grating integrated with metal as a transparent electrode for ICLED devices, Marek Ekielski[1], Magdalena A. Zadura[1], Karolina Bogdanowicz[1,2], Anna Szerling[1], Weronika Glowadzka[2,1], Tomasz Czyszanowski[2], Borislav Petrovic[3], Andreas Bader[3], Fabian Hartmann[3], Sven Höfling[3]; *[1]Lukasiewicz-IMIF, Poland; [2]Inst. of Physics, Lodz Univ. of Technology, Poland; [3]Technische Physik, Physikalisches Institut and Wilhelm-Conrad-Röntgen Research Center for Complex Material Systems, Universität Würzburg, Germany.* In this paper we present results of metalMHCG fabrication for GaSb-based ICLED by means of electron beam lithography, e-beam metal evaporation and plasma etching process. Configuration of metalMHCG was designed to maximize transmittance of TE polarized light in the mid-infrared wavelength region.

JTh2A.206
Compact 1650/2000 nm Si_3N_4 wavelength diplexer for multi-species gas spectroscopy of methane and carbon dioxide, Xiangeng Wang[1], Yanwei Huang[1], Chunfan Zhu[1], Jincheng Wei[1], Shuqing Lin[1], Yanfeng Zhang[1], Ruijun Wang[1], Siyuan Yu[1]; *[1]SEIT, Sun Yat-sen Univ., China.* We report a compact 1650/2000 nm silicon nitride wavelength diplexer based on a multi-mode-interferometer structure. Feasibility of using this diplexer as a wavelength beam combiner for multi-species gas spectroscopy is demonstrated.

JTh2A.207
Three-Terminal Thyristor Random Access Memory Realized on a Monolithic Silicon CMOS Photonic Platform, Ikhyeon Kwon[1], Hyangwoo Kim[2], Chang Ki Baek[2], S. J. Ben Yoo[1]; *[1]Department of Electrical and Computer Engineering, Univ. of California, Davis, USA; [2]Department of Convergence IT Engineering, Pohang Univ. of Science and Technology (POSTECH), Korea (the Republic of).* We demonstrate Three-Terminal Thyristor Random Access Memory (3T TRAM) on a monolithic silicon-CMOS-photonic platform. The gate contact plays an important role in controlling dynamic memory characteristics and optimized design can lead to non-volatile characteristics.

JTh2A.208
Coupled Mode Theory Fitting of Bragg Grating Spectra Obtained with 3D FDTD Method, Yasmin Rahimof[1], Igor.. Nechepurenko[1], M. R. Mahani[1], Andreas Wicht[1]; *[1]Ferdinand-Braun-Inst., Germany.* This study focuses on accurately fit of the main and side lobes of reflectance obtained through precise 3D FDTD simulations using coupled-mode-theory. This approach based on surrogate modeling reduces the reliance on time-consuming FDTD simulations.

JTh2A.209
Room-temperature continuous-wave lasing based on a two-dimensional erbium compound, Shipeng Yao[1,2]; *[1]Department of Electronic Engineering, Tsinghua Univ., China; [2]College of Integrated Circuits and Optoelectronic Chips, Shenzhen Technology Univ., China.* We successfully grow 2D layered ErOCl single crystals on silicon substrates. Combined with photonic crystal microcavity, continuous-wave lasing with an ultra-low threshold at room-temperature was achieved at 1.5 μm.

JTh2A.210
Tailor Bragg Grating Designs for Specific Laser Applications via Coupled-Mode-Theory Fit and Machine Learning, M. R. Mahani[1], Yasmin Rahimof[1], Igor Nechepurenko[1], Andreas Wicht[1]; *[1]Ferdinand-Braun-Inst., Germany.* Here we introduce efficient machine learning models trained on a 3D FDTD simulation-based database to predict Bragg grating characteristics from the main and the side lobes of reflectance spectra fitted by coupled mode theory.

JTh2A.211
Ultra-High Efficiency Fully-Etched Grating Coupler for Transverse Magnetic Mode with Al Mirror, Alif Laila Muthali[1], Fabien Labbe[1], Yonghe Yu[1], Jeremy C. Adcock[1], Yunhong Ding[1]; *[1]Danmarks Tekniske Universitet, Denmark.* We have designed and fabricated aluminum

mirror assisted fully-etched photonic crystal grating couplers for transverse magnetic light coupling on the 250 nm silicon-on-insulator platform, showing ultra-high coupling efficiency of −1.2 dB at different waveband couplers.

JTh2A.212
The Memory Bottleneck in Photonic Neural Network Accelerators, Russell L. Schwartz[1], Belal Jahannia[1], Nicola Peserico[1], Hamed Dalir[1], Volker Sorger[1]; [1]*Univ. of Florida, USA.* Photonic Tensor Cores are a competitive accelerator for Neural Networks, offering high throughput, but requiring large bandwidths to operate at their maximum efficiency. Here we offer an analysis of the memory bottleneck for PTC.

JTh2A.213
A Programmable Pulse Predistortion Technique for an 8×25Gb/s NRZ Microring Modulator Transmitter, Kelly M. Hunter[1], Mahdi Zabihpour[1], Eugene Zailer[1], Hossein Shakiba[2], Ali Sheikholeslami[1]; [1]*Univ. of Toronto, Canada;* [2]*Huawei Technologies Canada, Canada.* We propose a programmable predistortion technique to reduce the overshoot in the optical output power of microring modulators without sacrificing optical eye opening. We demonstrate this through an 8×25Gb/s NRZ transmitter.

JTh2A.214
Withdrawn

JTh2A.215
Excitonic Effects on the Gain in AlGaN QWs for Far-UVC Lasers, Greg Rupper[1], Gregory Garrett[1], Michael Wraback[1]; [1]*DEVCOM Army Research Laboratory, USA.* The large exciton binding energy for high Al content AlGaN QWs enables excitonic effects to increase the QW gain at room temperature by more than 2 times for moderate densities.

JTh2A.216
Spin-on Dopant Based Fabrication Methodology of Integrated Photonic Devices, Alper Sahin[1], Onur Akdeniz[1], Serdar Kocaman[1]; [1]*Middle East Technical Univ., Turkey.* Sparse schedules associated with ion implantation impede the development of active optical devices. This study presents a process based on spin-on dopants that allows in-house fabrication of active devices.

JTh2A.217
Laser driven white light generation with specially shaped phosphor, Dimitrios Kyrginas[1], Gérald Ledru[1], Laurent Canale[1], Georges Zissis[1]; [1]*LAPLACE Laboratory, France.* In this work, two types of phosphors, a flat surface and a curved surface, are simulated with LightTools software to show that the introduction of curvature on the material can help with heat accumulation and light generation in laser driven phosphor conversion applications.

JTh2A.218
Towards SiNx High Frequency Optomechanics, Nicolaas J. Schilder[1], Roberto Zurita[1], Pedro V. Pinho Nascimento[1], Cauê Kersul[1], Gustavo S. Wiederhecker[1], Thiago Alegre[1]; [1]*State Univ. of Campinas, Brazil.* SiNx is key for integrated photonic circuits [1]. Understanding its photoelasticity is crucial for optomechanical device design. We determine its photoelasticity via simulations/experiments on a 1.48 GHz mode driven by TE- and TM-polarized optical modes.

JTh2A.219

Continuous-Wave 247.5-nm UV Generation via Intracavity Frequency Doubling of Pr:BaY_2F_8 Laser, Viktor O. Smolski[1], Alex Jacobson[1], David Welford[2], Yushi Kaneda[3], Robert Waterbury[1]; *[1]Alakai Defense Systems, USA; [2]Endeavour Laser Technologies Inc., USA; [3]Wyant College of Optical Sciences, Univ. of Arizona, USA.* We report, to best of our knowledge, the first ultraviolet laser at 247.5 nm by intracavity frequency-doubling of a diode-pumped Pr^{3+}-doped BaY_2F_8 (BYF) laser. Output power of 14 mW in UV was demonstrated.

JTh2A.220

Protection of optical channels and non-classical sources using dynamic modulation, Ze-Kun Jiang[1,2]; *[1]Center for Integrated Quantum Information Technologies (IQIT), School of Physics and Astronomy and State Key Laboratory of Advanced Optical Communication Systems and Networks, Shanghai Jiao Tong Univ., China; [2]CAS Center for Excellence and Synergetic Innovation Center in Quantum Information and Quantum Physics, Univ. of Science and Technology of China, China.* A method for protecting optical channels and non-classical sources in integrated photonic systems using dynamic modulation is proposed, which provides higher design freedom and scalability than topological protection with the need for auxiliary waveguides.

JTh2A.221

Selective Emitter Metasurface for Waste Heat Energy Reclamation, Zachary Kranefeld[1], Kareena Guness[1], T. Pan Menasuta[1], Md. Sifat Hossain[1], Kevin Grossklaus[1], Thomas Vandervelde[1]; *[1]Tufts Univ., USA.* Mid-wave infrared (MWIR) thermophotovoltaic (TPV) cells can convert waste heat from manufacturing processes into electricity but struggle with efficiency outside a narrow bandwidth. A robust selective emitter metasurface was designed and fabricated from iridium to increase efficiency of MWIR TPV cells operating in high-temperature environments.

JTh2A.222

Compact Circuit Models for Nanoantenna-Based Petahertz Electronics, Adina R. Bechhofer[1], Shruti Nirantar[2], Luca Daniel[1], Karl K. Berggren[1], Phillip D. Keathley[1]; *[1]Massachusetts Inst. of Technology, USA; [2]School of Engineering, RMIT, Australia.* We developed a circuit model for petahertz electronic nanoantenna networks. This approach enables fast and scalable simulations of the the attosecond to femtosecond charge dynamics within the nanoantenna networks. We use the model to explore designs for a memory cell and shift register.

JTh2A.223

High Density, Broadband Vertical Optical Interconnects for Passive Assembly, Drew M. Weninger[1], Luigi Ranno[1], Samuel F. Serna Otálvaro[2], Lionel Kimerling[1], Anuradha Agarwal[1]; *[1]Massachusetts Inst. of Technology, USA; [2]Bridgewater State Univ., USA.* A chip-to-interposer coupler between silicon nitride and silicon was experimentally demonstrated between 1480-1640 nm with a coupling loss upper limit of -2.3 ± 1 dB and a 1 dB alignment tolerance of 1.12 ± 0.23 μm.

JTh2A.224

Analysis of Uniform Waveguide Bragg Gratings in a Silicon Nitride Platform, Mauricio Tosi[1,2], Marvin Bustillos[1,2], Saket Kaushal[1], Pablo A. Costanzo-Caso[2], José Azaña[1]; *[1]Centre*

Énergie Matériaux Télécommunications, Institut National de la Recherche Scientifique, Canada; [2]Instituto Balseiro, Argentina. We study the implementation of photonic filters based on waveguide Bragg gratings using a silicon nitride platform. Excellent agreement in the measured coupling coefficient with theoretical predictions is observed.

JTh2A.225

Radiation Hardened Compact Solid-State Laser, Bhabana Pati[1], Mason Varuso[2], Emma Potter[2], Barrett G. Potter[3], Kelly Potter[2]; *[1]Physical Sciences Inc., USA; [2]Optical Sciences and Material Science and Engineering, Univ. of Arizona, USA; [3]Materials Science and Engineering, Univ. of Arizona, USA.* Using radiation hardened components a compact solid-state laser was developed which can produce 6mJ of energy in a < 5ns pulse at < 50Hz repetition rate. Radiation induced changes are reported for the optics.

13:00 -- 15:00
Room: W201AB
ATh3A • Environmental and Biometric Sensing
Presider: To be Announced

ATh3A.1 • 13:00

Sapphire Fiber Scattering Array Interferometer for Multiplexable High-Temperature Sensing, Guannan Shi[1], Joseph Thomas[1], Gary Pickrell[1], Anbo Wang[1], Yizheng Zhu[1]; *[1]Virginia Tech, USA.* An intrinsic sapphire fiber scattering array interferometer (SAI) is presented. SAI generates robust interferometric signal with a ~20 dB signal-to-noise ratio and is immune to blackbody radiation-induced noise. Multiplexable high-temperature sensing to ~1500°C is demonstrated.

ATh3A.2 • 13:15

High Precision Temperature Sensor Based on π-Phase-Shifted FBG and OFDR System, Zhengqi Sun[1], Yuejuan Lv[1], Meng Zou[1], Zhengxuan Shi[1], Wangyang Xu[1], Qizhen Sun[1,2], Zhijun Yan[1,2]; *[1]School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China; [2]Wuxi Research Inst., Huazhong Univ. of Science and Technology, China.* We proposed a high precision temperature sensing system which is based on phase-shifted fiber grating interrogated by an OFDR system. The temperature sensing system showed 0.1°C temperature precision with ±0.029°C measurement uncertainty.

ATh3A.3 • 13:30

A Dual DFB Laser Based Temperature Sensor, Mehmet Ziya Keskin[1], Abdulkadir Yentur[1], Faruk Uyar[2], Ibrahim Ozdur[1]; *[1]Electrical and Electronics Engineering, TOBB Univ. of Economics and Technology, Turkey; [2]NANOTAM-Nanotechnology Research Center, Bilkent Univ., Turkey.* In this manuscript, we present a temperature sensing method that utilizes a dual fiber laser system based on two adjacent pi-phase shift fiber Bragg gratings with a slight difference in wavelength.

ATh3A.4 • 13:45

Wearable Microfiber-Based Senor Chip with Active Adaptive Pressure Unit for Cardiovascular Assessment, Yunfei Liu[1], Liangye Li[1], Heyi Cai[1], Shunfeng Sheng[1], Wangyang Xu[1], Zhijun Yan[1], Qizhen Sun[1]; *[1]Huazhong Univ of Science and Technology,*

China. We presented an accurate and wearable microfiber-based sensor chip with an active pressure adaptation unit for cardiovascular assessment, exhibiting an accuracy of 93.75% for arteriosclerosis assessment and errors of 0.0254 ± 6.1977ms for inter-beat interval.

ATh3A.5 • 14:00
Miniaturized and Flexible $MAPbBr_3$ Quantum Dot-doped Polymer Optical Fiber for Wearable Temperature Sensing, Wangyang Xu[1], Liangye Li[1], Shunfeng Sheng[1], Yunfei Liu[1], Qizhen Sun[1]; *[1]Huazhong Univ of Science and Technology, China.* We present a polymer optical fiber sensor doped with $MAPbBr_3$ quantum dots for wearable temperature sensing. This sensor exhibits miniaturization, flexibility, and stretchability, with a temperature sensitivity of 1.74%°C^{-1} within 25-40°C.

ATh3A.6 • 14:30 (Invited)
Vital Sign Detection with Broadband Photonic Radar, Benjamin J. Eggleton[1]; *[1]Univ. of Sydney, Australia.* Photonic radar can achieve millimetre-level range resolution based on synthesized radar signals with a bandwidth of up to 30 GHz. The high resolution of the radar system enables accurate respiratory detection from breathing simulators and a cane toad as a human proxy.

13:00 -- 15:00
Room: W201CD
ATh3B • Optical Coherence Tomography and Bio-Optical Sensing
Presider: David Nolte; Purdue Univ., USA

ATh3B.1 • 13:00
Affordable Smartphone-Based Point-of-Care Device for INR Screening with Foldable Design, Weiming Xu[1], Majed Althumayri[1], Amin Mohammad[2], Hatice Ceylan Koydemir[1]; *[1]Texas A&M Univ., USA; [2]Baylor Scott & White Medical Center, USA.* We have innovated a foldable and cost-effective 3D-printed platform, featuring a tailored cartridge designed for point-of-care blood coagulation testing. The coagulation time is assessed by measuring the flow stopping time of the blood-coagulation reagent mixture.

ATh3B.2 • 13:15
***In Situ* Lipid Profiling at Submicron Resolution by Hyperspectral Stimulated Raman Imaging,** Yihui Zhou[1,2], Xiangjie Huang[1], Hyeon Jeong Lee[1]; *[1]Zhejiang Univ., China; [2]Key Laboratory for Biomedical Engineering of Ministry of Education, China.* Achieving high spatial resolution in lipid profiling for life science and biomedical applications has been challenging. Here, we developed a hyperspectral stimulated Raman scattering imaging and analysis method for *in situ* lipid profiling in single cells and tissues by identifying spectroscopic signatures of chain length and unsaturation levels.

ATh3B.3 • 13:30 (Invited)
Lensfree Nanoscopic Imaging and Sensing, Euan McLeod[1]; *[1]Univ. of Arizona, USA.* Lensfree holographic microscopy provides an ultra-large field of view with submicron resolution using compact and cost-effective components. We discuss recent applications to time-gated fluorescence, air quality monitoring, and protein biosensing, including COVID-19 sensors.

ATh3B.4 • 14:00
Doppler Spectroscopy of Intracellular Dynamics Detects Pathogenic Infection and Antibiotic Resistance, Dawith Lim[1], Zhen Hua[1], John Turek[1], David D. Nolte[1]; *[1]Purdue Univ., USA.* Doppler spectroscopy detects signatures of bacterial infection of *in vitro* tissue and can monitor their suppression upon antibiotic use. Such early detection may allow quick diagnosis and selection of effective therapy for patients.

ATh3B.5 • 14:15
Optimized photonic integrated circuit components for optical coherence tomography at 1060 nm, Senyue Hao[1], Aaron J. Adkins[1], Yitian Zhang[1], Chao Zhou[1]; *[1]Washington Univ. in St. Louis, USA.* To implement optical coherence tomography on photonic chips, we developed optimized and experimentally validated silicon nitride-based components for photonic integrated circuits in order to achieve high sensitivity and axial resolution for OCT at 1060 nm.

ATh3B.6 • 14:30
Cardiac Substrate Classification of Human Venoatrial Junction OCT Images, Aidan M. Therien[1], Arielle Joasil[1], Christine Hendon[1]; *[1]Columbia Univ., USA.* Radiofrequency ablation adresses atrial fibrilation by creating lesions within the left atrium; correctly targeting the cardiac substrate is critical. We investigate optical coherence tomography as real-time guidance by classifying patches from images of the venoatrial junction.

ATh3B.7 • 14:45
Silicon Photonic Swept-Source Optical Coherence Tomography Resampling, Chia-Yu Wu[1], Ying-Kai Chen[1], Shih-Hsiang Hsu[1]; *[1]National Taiwan Univ of Science & Tech, Taiwan.* The dispersion-related optical-clock resampling of a swept-source optical coherence tomography in a silicon platform is demonstrated on the main interferometer through Hilbert-transform for the axial resolution of 21.78 μm, which is limited by grating couplers.

13:00 -- 15:00
Room: W204AB
STh3C • Fiber and Chip-Scale Sources
Presider: Niklaus Wetter; Centro de Lasers e Aplicações - IPEN/SP, Brazil

STh3C.1 • 13:00
Single Frequency Low Quantum Defect Fiber Laser at 980nm, Khawlah Al Yahyaei[1], Xiushan Zhu[1], Lizhu Li[1], Jie Zong[2], Maohe Li[2], Junqin Wang[2], Jason Mayer[2], Arturo Chavez-Pirson[2], Robert A. Norwood[1], Nasser Peyghambarian[1]; *[1]Univ. of Arizona, USA; [2]NP Photonics, Inc., USA.* An ultra-low quantum defect (< 0.6%) linearly polarized single frequency fiber laser was demonstrated. To mitigate thermal effects, pump wavelength optimization has been performed in order to study the effect of quantum defects on laser performance.

STh3C.2 • 13:15
Long-Wave Infrared Dual-Comb Fiber Laser from 6.0 to 10.0 μm, Yoshiaki Nakajima[1], Kousuke Kubota[1], Ryusei Uchiyama[1], Takumi Yumoto[1], Naoki Takeshi[1], Peter G. Shunemann[2], Kokuyama Wataru[3]; *[1]Toho Univ., Japan; [2]BAE systems, USA; [3]NMIJ/AIST, Japan.* A high-coherence ultra-broadband bidirectional dual-comb fiber laser incorporating an orientation-

patterned gallium phosphide crystal was developed for practical dual-comb spectroscopy in the long-wave infrared range. This system successfully demonstrated frequency comb generation spanning 6.0–10.0 µm.

STh3C.3 • 13:45
C+L band tunable ultra-narrow linewidth fiber laser, Laiyang Dang[1], Zhiyao Su[1], Dongmei Huang[1], Yujia Li[1], P. K. A. Wai[2]; *[1]Hong Kong Polytechnic Univ., Hong Kong; [2]Hong Kong Baptist Univ., Hong Kong.* We propose a C+L band tunable ultra-narrow linewidth fiber laser using a sub-ring and saturable absorber. The measured optical signal-to-noise ratio reaches 80.6 dB and the linewidth is several hundred Hertz in each wavelength channel.

STh3C.4 • 14:00
A 6 mm^2 Wideband Modulation-free Laser Stabilization Chip in a Commercial SiN Process, Mohamad Hossein Idjadi[1], Farshid Ashtiani[1], Kwangwoong Kim[1]; *[1]Nokia Bell Labs, USA.* We demonstrate a wideband integrated modulation-free laser stabilization system using a commercial low-loss SiN process. The photonic chip achieves more than 40 dB frequency noise suppression while occupying a 6 mm^2 area.

STh3C.5 • 14:15
Withdrawn

STh3C.6 • 14:30 (Invited)
Revolutionizing High-Power Lasers: Unleashing Industrial-Grade Robustness with All-Fiber Femtosecond Oscillators, Dariusz T. Swierad[1], Michal Nejbauer[1], Yuriy Stepanenko[1]; *[1]Fluence Technology, Poland.* The robustness of high-power femtosecond lasers hinges on the seed laser's quality. Experience the advantages offered by the all-fiber oscillator, revolutionizing the most demanding industrial and spectroscopic applications.

13:00 -- 15:00
Room: W205AB
STh3D • Non-Hermitian and Nonlinear System
Presider: Matthias Heinrich; Univ. of Rostock, Germany

STh3D.1 • 13:00
Nonlinearity-controlled Non-Hermitian Topological Phase Transitions, Tianxiang Dai[1], Yutian Ao[1], Jun Mao[1], Yan Yang[2], Yun Zheng[1], Chonghao Zhai[1], Yandong Li[1], Jingze Yuan[1], Bo Tang[2], Zhihua Li[2], Jun Luo[2], Wenwu Wang[2], Xiaoyong Hu[1], Qihuang Gong[1], Jianwei Wang[1]; *[1]Peking Univ., China; [2]Chinese Academy of Sciences, China.* We observe nonlinearity-driven fast NH phase transitions in a photonic Floquet topological insulator on a silicon chip. Light that was in a forbidden bandgap can now be transported along a topological gain-loss junction at which a nonlinearity-controlled NH phase transition occurs.

STh3D.2 • 13:15
A Simple Optomechanical Platform with Ultra-Wide Phonon-Frequency Tunability, Arjun Iyer[1], Wendao Xu[1], Michael Pomerantz[1], William H. Renninger[1]; *[1]Univ. of Rochester, USA.* Phonon-frequency-tunable optomechanical interactions are demonstrated in shaped bulk

acoustic resonators. Non-collinear all-optical coupling enables access to phonons with novel mode-selection rules, high quality factors (>10^7), and frequency tunability over 10 GHz.

STh3D.3 • 13:30

Pseudospin Localization of Light in Nonlinear Optics, Shani Izhak[1], Aviv Karnieli[1], Ofir Yesharim[1], Shai Tsesses[2], Ady Arie[1]; *[1]Tel Aviv Univ., Israel; [2]Technion, Israel.* We predict a new universal pseudospin localization phenomenon and demonstrate it experimentally in an optical analogue of a spin-glass material – a disordered sum-frequency generation process in a nonlinear photonic crystal.

STh3D.4 • 13:45

Non-Hermitian swallowtail degeneracy in the two-mode squeezing of light, Polina Blinova[1,2], Evgeny Moiseev[1], Kai Wang[1]; *[1]Department of Physics, McGill Univ., Canada; [2]School of Applied and Engineering Physics, Cornell Univ., USA.* We show that swallowtail catastrophe consisting of various-order non-Hermitian degeneracies naturally exists in the dynamics of two-mode quadrature squeezing systems with asymmetric losses that break pseudo-Hermiciticy and propose a practical experimental setup.

STh3D.5 • 14:00

Quantum decay in non-Hermitian subsystems induced by artificial environments, Mahmoud A. Selim[2], Max Ehrhardt[3], Yuqiang Ding[1], Armando Perez Leija[1], Qi Zhong[1], Georgios Pyrialakos[1], Matthias Heinrich[3], Alexander Szameit[3], Demetrios Christodoulides[2], Mercedeh Khajavikhan[2]; *[1]Univ. of Central Florida, CREOL, USA; [2]Ming Hsieh Department of Electrical and Computer Engineering, Univ. of Southern California, USA; [3]Institut für Physik, Universität Rostock, Germany.* We propose a systematic methodology for realizing quantum parity-time symmetric subsystems in a fully Hermitian photonic environment. We show that these artificial systems behave in a similar manner to their non-Hermitian counterparts

STh3D.6 • 14:15

Single-photon optical modulation at room temperature enabled by an electron avalanche in a photodiode, Demid Sychev[1], Peigang Chen[1], Morris Yang[1], Colton Fruhling[1], Alexei S. Lagoutchev[1], Alexander Kildishev[1], Alexandra Boltasseva[1], Vladimir M. Shalaev[1]; *[1]ECE, Purdue Univ., USA.* We show all-optical modulation of a 1550-nm wavelength beam with a power of around 10mW controlled by a single-photon intensity signal in an avalanche photodiode

STh3D.7 • 14:30

Withdrawn

STh3D.8 • 14:45

Generation of circularly polarized ultra-broadband MIR pulses through the laser-induced filament of atmosphere, Wei-Hong Huang[1], Yi-Ruei Sie[1], Chih Wei Luo[1]; *[1]National Yang Ming Chiao Tung Univ., Taiwan.* Circularly polarized MIR pulses were generated by polarization-twisting optical dual pulses via a modified Michelson interferometer with the turnability of frequency, helicity, and time interval between two pulses.

13:00 -- 15:00
Room: W205CD
ATh3E • Development for Atmospheric Sensing
Presider: Anthony Yu; NASA Goddard Space Flight Center, USA

ATh3E.1 • 13:00
Rapid Characterization of Single Aerosol Particles by Differential Circular Polarization, Yongle Pan[1], Aimable Kalume[1], Joshua Santarpia[2]; *[1]DEVCOM Army Research Laboratory, USA; [2]Global Center for Health Security, Univ. of Nebraska Medical Center, USA.* A innovative method was developed to record the phase functions of circular intensity differential scattering from individual single flowing through micron size particles, it has the ability to rapidly detect and characterize bioaerosol particles.

ATh3E.2 • 13:15
Real-Time Airborne Particle Density Detection with High Spatial Resolution Using OFDR LiDAR, Qirui Wang[1], Guangyin Zhang[1], Kehao Zhao[1], Jieru Zhao[1], Shuda Zhong[1], Kevin Chen[1]; *[1]Univ. of Pittsburgh, USA.* This article demonstrates that a cost-effective OFDR LiDAR interrogator with a 1-nm wavelength sweep range can effectively measure the spatial distribution of smoke-generated particles and enable real-time detection and alert in free space.

ATh3E.3 • 13:30
Unsupervised Source Separation Technique for Multi-speciation Using a Single Laser: Quantifying Hydrocarbons without their Reference Spectra, Mohamed Sy[1], Emad Alibrahim[1], Ali Elkhazraji[1], Aamir Farooq[1]; *[1]KAUST, Saudi Arabia.* We present an autoencoder that can infer molar fractions and reference spectra based solely on mixture spectra. The model is demonstrated to work for C1-C3 hydrocarbon gas mixtures measured using an interband cascade laser. This method can ease the dependence of spectroscopic sensing on reference spectra.

ATh3E.4 • 13:45
Cavity-enhanced Photoacoustic Dual-comb Spectrometer for Sensitive and Broadband Gas Spectroscopy, Qinxue Nie[1], Zhen Wang[1], Haojia Sun[1], Simone Borri[2], Paolo De Natale[2], Wei Ren[1]; *[1]The Chinese Univ. of Hong Kong, Hong Kong; [2]Istituto Nazionale di Ottica CNR and LENS, Italy.* We present a cavity-enhanced photoacoustic dual-comb spectrometer for highly sensitive and broadband gas spectroscopy using a flute-type acoustic resonator and an optical cavity.

ATh3E.5 • 14:00
Ultra-Sensitive Mid-IR Gas Sensing: Engineering High Group Index Air-Core Modes in Vertical Photonic Crystal Waveguide Arrays, Kang-Chieh Fan[1], Jason Midkiff[1], Sourabh Jain[1], May Hlaing[1], Ray T. Chen[1]; *[1]The Univ. of Texas at Austin, USA.* An air-core mode with an even mode and high group index in the VPCW structure has been confirmed. Optimizing the selection of the appropriate air-core mode improves the Mid-IR detection capabilities of the targeted analytes.

ATh3E.6 • 14:15
Simultaneous Open-path Optical Communication and Gas Sensing in the MIR, Ali Elkhazraji[1], Mohammed A. Sait[2], Aamir Farooq[1]; *[1]KAUST, Saudi Arabia; [2]Upstream Research*

Center, EXPEC ARC, Aramco, Saudi Arabia. Simultaneous open-path optical communication and H2S emission sensing is proven feasible, for the first time, utilizing the same optical link using an 8-μm quantum cascade laser. This work illustrates the dynamic interplay between communication and sensing.

13:00 -- 15:00
Room: W206A
STh3F • Lithium Niobate Photonics
Presider: Zaijun Chen; Univ. of Southern California, USA

STh3F.1 • 13:00 (Invited)
Developing Quantum and Classical Nonlinear Photonic Devices using Thin-Film Lithium Niobate, Amir Safavi-Naeini[1]; *[1]Stanford Univ., USA.* Abstract not available.

STh3F.2 • 13:30
Observation of Fundamental Charge Noise in Electro-optic Photonic Integrated Circuits, Junyin Zhang[1], Zihan Li[1], Johann Riemensberger[1], Grigory Lihachev[1], Guanhao Huang[1], Tobias J. Kippenberg[1]; *[1]Ecole Polytechnique Federale de Lausanne, Switzerland.* We observed a novel 1/f-type frequency noise in Lithium Niobate and Lithium Tantalate microresonators, distinct from thermorefractive noise and originating from thermodynamic charge fluctuations. Our results establish electrical Johnson-Nyquist noise as the fundamental refractive noise limit for Pockels integrated photonics.

STh3F.3 • 13:45
Arbitrary engineering of resonant frequencies in lithium niobate photonic crystal ring resonators, Ke Zhang[1], Yikun Chen[1], Wenzhao Sun[1], Zhaoxi C. Chen[1], Hanke Feng[1], Cheng Wang[1]; *[1]City Univ. of Hong Kong, Hong Kong.* We realize arbitrary engineering of resonant frequencies by mode splitting in both isotropic z-cut LN and anisotropic x-cut LN photonic crystal ring resonators. Spectral engineering in x-cut LN is realized by a gradient design that precisely compensates for variations in both refractive index and perturbation strength.

STh3F.4 • 14:00
Second-harmonic generation with a 440,000%/W conversion efficiency in a lithium niobate microcavity without periodic poling, Xiao Wu[1], Zhenzhong Hao[1], li zhang[1], Di Jia[1], Rui Ma[1], Fang Bo[1], Feng gao[1], Guoquan zhang[1], Jingjun Xu[1]; *[1]Nankai Univ., China.* We designed and fabricated racetrack microcavities on reverse-poling double-layer X-cut thin-film lithium niobate, based on which second-harmonic generation with a normalized conversion efficiency of 440,000%/W, comparable to periodically poled lithium niobate devices, was realized.

STh3F.5 • 14:15
Deterministic Phase-Matching of Micro-Transfer-Printed Periodically-Poled Lithium Niobate Waveguides, Tom Vandekerckhove[1,2], Tom Vanackere[1,2], Jasper De Witte[1], Gunther Roelkens[1], Stephane Clemmen[1,2], Bart Kuyken[1]; *[1]Ghent Univ. - imec, Belgium; [2]Universite Libre de Bruxelles, Belgium.* State-of-the-art periodically-poled lithium niobate waveguides struggle with extreme fabrication sensitivity, resulting in unpredictable phase-matching wavelengths. We

developed a micro-transfer-printed periodically-poled lithium niobate waveguide that enables deterministic phase-matching at a predefined wavelength through optical feedback.

STh3F.6 • 14:30
Highly-Selective Etching of Micro-Transfer-Printed Thin-Film Lithium Niobate for Low Coupling Losses, Tom Vandekerckhove[1,2], Ruben Van Assche[1], Ivo Tanghe[1], Margot Niels[1], Stijn Poelman[1], Tom Vanackere[1,2], Maximilien Billet[1], Stephane Clemmen[1,2], Bart Kuyken[1]; *[1]Ghent Univ. - imec, Belgium; [2]Universite Libre de Bruxelles, Belgium.* Efficient low-loss coupling to micro-transfer-printed lithium niobate remains a challenge. We developed a highly-selective lithium niobate etch that enables selective etching of tapered coupling structures into the lithium niobate thin film after micro-transfer printing.

STh3F.7 • 14:45
High quality lithium niobate Euler racetrack resonators, Shuting Kang[1], Di Jia[1], Xuanyi Yu[1], Feng Gao[1], Fang Bo[1], Guoquan Zhang[1], Jingjun Xu[1]; *[1]Nankai Univ., China.* We demonstrated Euler racetrack resonators on X-cut thin film lithium niobate with intrinsic quality factors up to 5.53 million and free spectrum range standard deviation 33 times lower than the circular racetrack microcavity.

13:00 -- 15:00
Room: W206B
ATh3G • Integration and Trapped Quantum Systems
Presider: Susannah Dickerson; Charles Stark Draper Laboratory, USA

ATh3G.1 • 13:00 (Invited)
Development of Chip-scale Atomic Beam Clocks, William R. McGehee[1], Gabriela Martinez[1,2], Alexander Staron[1,2], Paul Slayback[1,2], Travis Autry[3], John Kitching[1]; *[1]NIST, USA; [2]Physics, CU Boulder, USA; [3]HRL Laboratories, USA.* We report on the development of chip-scale atomic beam clocks as low SWAP and potentially low drift microwave frequency standards. Clock performance, leading systematics, and progress in miniaturization are discussed.

ATh3G.2 • 13:30
Electronic Design Automation (EDA) for Industrializing Atomic Technologies, Douglas Bopp[1], Steven E. Bopp[1]; *[1]Vapor Cell Tech., USA.* A modified variant of semiconductor electronic design automation (EDA) software has been developed which has been successfully proven to bring new materials, processes, and architectures to bear on transitioning atomic technologies to mass-producible commodities.

ATh3G.3 • 13:45
Differential Homodyne Detection Using an Integrated Photonics Chip, Christian Carver[1], Benjamin J. Fisher[1], Jared Marchant[1], Shiuh-Hua Wood Chiang[1], Ryan M. Camacho[1]; *[1]Brigham Young Univ., USA.* We present a homodyne detection system that uses a novel differential amplification scheme with potential applications for quantum key distribution (QKD), quantum random number generation (QRNG) or quantum state tomography.

ATh3G.4 • 14:00 (Invited)
Integrated Technologies for Miniaturized Trapped-Ion Quantum Sensors, Robert McConnell[1]; *[1]Massachusetts Inst of Tech Lincoln Lab, USA.* Trapped ions hold promise for compact high-performance optical clocks. Reducing experimental overhead due to free-space optics is essential for miniaturization and environmental robustness. I will discuss chip-integrated photonics and detectors enabling next-generation trapped-ion precision sensors.

ATh3G.5 • 14:30
Scalable Passive Optical Masks That Enable One- and Two-Species Atom-Trap Arrays, Chengyu Fang[2], Preston Huft[1], Sam A. Norrell[1], Sanket Deshpande[2], Mark Saffman[1], Mikhail A. Kats[2]; *[1]Department of Physics, Univ. of Wisconsin - Madison, USA; [2]Department of Electrical and Computer Engineering, Univ. of Wisconsin - Madison, USA.* We report a passive approach for trapping arrays of neutral atoms of one or two species, using a single laser. Compared to active setups, e.g., spatial light modulators, our approach is simple, compact, and robust.

ATh3G.6 • 14:45
Laser phase lock for trapped ion quantum computing, Matthew J. Bohn[1]; *[1]Quantinuum, USA.* An effiicient laser phase lock at a heterodyne frequency of 12.643 GHz is described and it's performance measured as a two qubit gate laser for Quantinuum's trapped ion quantum computer.

13:00 -- 15:00
Room: W207A
ATh3H • A&T Topical Review on Shaping the Future of Laser-Plasma Applications with Structured Light Fields II
Presider: Matthew Edwards; Stanford Univ., USA

ATh3H.1 • 13:00 (Invited)
First Electrons from Axiparabola-Based LWFA, Aaron Liberman[1], Slava Smartsev[2,1], Sheroy Tata[1], Anton Golovanov[1], Salome Benracassa[1], Igor Andriyash[2], Ronan Lahaye[2], Eitan Levine[1], Eyal Kroupp[1], Cedric Thaury[2], Victor Malka[1]; *[1]Weizmann Inst. of Science, Israel; [2]LOA, France.* We present the first acceleration of electrons by an axiparabola-focused wakefield. This proof-of-concept experiment strengthens the argument for an axiparabola-based solution for dephasingless LWFA. We also show numerical simulations confirming the experimental results

ATh3H.2 • 13:30 (Invited)
Laser Plasma Acceleration with Structured Light Fields, Ronan Lahaye[1], Igor Andriyash[1], Kosta Oubrerie[2,1], Lena Kolonenko[1], Slava Smartsev[1,3], Cedric Thaury[1]; *[1]Laboratoire d'Optique Appliquée, France; [2]LIDYL, CEA, France; [3]Department of Physics of Complex Systems, Weizmann Inst. of Science, Israel.* Laser plasma accelerators are a promising alternative to conventional accelerators due to the high amplitude of the generated fields. We present two techniques to increase the energy gain, both based on the use of an axiparabola and the control of the spatio-temporal couplings of the light field.

ATh3H.3 • 14:00 (Invited)

Laser Driven Ion Acceleration Using Ultra-intense, High Order Orbital Angular Momentum Laser Pulses, Mihail Cernaianu[1]; *[1]ELI-NP, Romania.* We report a novel method for generation of high order orbital angular momentum laser pulses, suitable for multi PW laser beams. The results of using helical light to accelerate ion beams will be also shown.

ATh3H.4 • 14:30 (Invited)

Dephasingless Laser Wakefield Acceleration in the Bubble Regime, Kyle G. Miller[1], Jacob R. Pierce[2], Manfred V. Ambat[1], Jessica L. Shaw[1], Kale Weichman[1], Warren B. Mori[2,3], Dustin Froula[1], John Palastro[1]; *[1]Laboratory for Laser Energetics, Univ. of Rochester, USA; [2]Physics and Astronomy, Univ. of California, Los Angeles, USA; [3]Electrical and Computer Engineering, Univ. of California, Los Angeles, USA.* An ultrashort flying-focus pulse created by an axiparabola and radial echelon drives a dephasingless laser wakefield accelerator in the bubble regime. Simulations show that 25 pC of ionization-injected electrons gain 2.1 GeV over 20 dephasing lengths (1.3 cm), with projected energy gains of 125 GeV over <1 m.

13:00 -- 15:00
Room: W206BC
STh3I • Optical Parametric Oscillators
Presider: Nathaniel Kinsey; Virginia Commonwealth Univ., USA

STh3I.1 • 13:00

Purely Quadratic Cavity Solitons in a Nanophotonic Parametric Oscillator, Nicolas Englebert[2,1], Robert M. Gray[2], Ryoto Sekine[2], Thomas Zacharias[2], Luis Ledezma[2], Selina Zhou[2], Carlos Mas Arabi[3,1], Simon-Pierre Gorza[1], François Leo[1], Alireza Marandi[2]; *[1]Universite Libre de Bruxelles, Belgium; [2]California Inst. of Technology, USA; [3]Universitat Politècnica de València, Spain.* We experimentally observe signatures of 475-fs-long sech-squared-shaped solitons in a ps-pumped phase-mismatched parametric oscillator in the normal dispersion regime, purely due to cascaded quadratic nonlinearities. The results are in good agreement with our theoretical predictions.

STh3I.2 • 13:15

Frequency-Modulated Optical Parametric Oscillator in Thin Film Lithium Niobate, Hubert S. Stokowski[1], Devin J. Dean[1], Alexander Y. Hwang[1], Taewon Park[1,3], Oguz Tolga Celik[1,3], Timothy McKenna[1,2], Marc Jankowski[1,2], Carsten Langrock[1], Vahid Ansari[1], Martin M. Fejer[1], Amir Safavi-Naeini[1]; *[1]Department of Applied Physics and Ginzton Laboratory, Stanford Univ., USA; [2]Physics & Informatics Laboratories, NTT Research, Inc., USA; [3]Department of Electrical Engineering, Stanford Univ., USA.* We present a theory and realization of an integrated frequency-modulated optical parametric oscillator. We generate ~200 comb lines using second-order nonlinearity and electro-optic effect in thin film lithium niobate with low optical and RF power.

STh3I.3 • 13:30

Narrow-linewidth and tunable parametric oscillator, Fuchuan Lei[2,1], Yi Sun[2], Oskar Helgason[2], Zhichao Ye[2], Yan Gao[2], Magnus Karlsson[2], Peter Andrekson[2], Victor Torres-Company[2]; *[1]School of Physics, Northeast Normal Univ., China; [2]Department of Microtechnology and Nanoscience, Chalmers Univ. of Technology, Sweden.* We present a tunable coherent oscillator based on parametric gain. It is realized through self-injection locking one comb line of a Kerr microcomb. Sub-Hertz intrinsic linewidth and 20nm tuning range are achieved.

STh3I.4 • 13:45
Hybrid AM/FM Mode-Locking of OPOs, Ryan Hamerly[1,2], Evan Laksono[3], Marc Jankowski[2,3], Edwin Ng[2,3], Noah Flemens[3], Myoung-Gyun Suh[2,4], Hideo Mabuchi[3]; *[1]Massachusetts Inst. of Technology, USA; [2]PHI Laboratories, NTT Research, USA; [3]Ginzton Laboratory, Stanford Univ., USA; [4]Electrical Engineering, Caltech, USA.* We investigate a novel AM/FM hybrid mode-locking mechanism for OPO frequency combs. Numerical simulations reveal stable, efficient (>30%), broadband (>100nm), tunable, turnkey comb formation in singly-resonant OPOs in close agreement with an analytic FMCW model.

STh3I.5 • 14:00
Noise Limits in Kerr Microresonator Optical Parametric Oscillators, Jordan R. Stone[1], Xiyuan Lu[1], Gregory Moille[1], Kartik Srinivasan[1]; *[1]Joint Quantum Inst., USA.* We explore frequency noise associated with Kerr optical parametric oscillation (OPO), identifying a spectral translation regime as well as fundamental decoherence due to thermorefractive noise. We demonstrate OPO linewidth reduction via active feedback.

STh3I.6 • 14:15
Noncritical, Narrowband, Intracavity Pumped CdSe OPO, Li Wang[1,2], Weidong Chen[1], Youbao Ni[2], Zhenyou Wang[2], Valdas Pasiskevicius[3], Ivan Divliansky[4], Kjell Moelster[3], Oussama Mhibik[4], Haixin Wu[2], Haihe Jiang[2], Andrius Zukauskas[3], Leonid Glebov[4], Valentin Petrov[1]; *[1]Max Born Inst., Germany; [2]CAS, China; [3]KTH, Sweden; [4]CREOL, USA.* We report on a noncritically phase-matched cascade CdSe optical parametric oscillator with an output energy of 0.54 mJ at 100 Hz, temperature tuning within 9274-9314 nm, and narrow spectrum achieved by a Volume Bragg Grating.

STh3I.7 • 14:30 (Invited)
Advances in Sub-µm PPKTP: Applications and Prospects of Counterpropagating Photons Interactions, Carlota Canalias[1]; *[1]Kungliga Tekniska Hogskolan, Sweden.* In this talk, we will present recent advances in fabrication of PPKTP crystals with sub-µm periods. We will review their key properties as counterpropagating photons generators and discuss their prospects.

13:00 -- 15:00
Room: W207D
STh3J • Optical Computing and Theoretical Methods
Presider: Logan Wright; Yale Univ., USA

STh3J.1 • 13:00
Fiber Optic Reservoir Computer Using Distributed Feedback, Nicholas Cox[1], Joseph B. Murray[1], Joseph Hart[1], Brandon Redding[1]; *[1]U.S. Naval Research Laboratory, USA.* We demonstrate a photonic reservoir computer (RC) using Rayleigh backscattering in single mode optical fiber to perform passive random convolutions. The RC examines select variables of a multidimensional chaotic system and cross-predicts missing elements.

STh3J.2 • 13:15 (Invited)
Scalable and Programmable Optical Computing with Fibers and Complex Media, Ugur Tegin[1,2], Ilker Oguz[2], Bora Carpinlioglu[1], Bahrem Serhat Danis[1], Leo Hsieh Jih-liang[2], Ulas Dinc[2], Mustafa Yildirim[2], Christophe Moser[2], Demetri Psaltis[2]; *[1]Koc Universitesi, Turkey; [2]Ecole Polytechnique Federal de Lausanne, Switzerland.* Novel scalable and programmable optical computing frameworks are presented by harnessing spatiotemporal nonlinear effects of multimode fibers and the linear effect of complex media for machine learning. For both platforms, brain-inspired computation engines are experimentally realized.

STh3J.3 • 13:45
Deep Learning for Modeling Dynamic Gain and Nonlinearities in Ultrafast Fiber Amplifiers, Siyun Chen[1], Dan Wang[1], Qiang Du[1], Mahek Logantha[1], Fanting Kong[1], Lauren Cooper[2], Almantas Galvanauskas[2], Andy Liu[3], Qing Ji[1], Jeroen van Tilborg[1], Carl Schroeder[1], Eric Esarey[1], Russell Wilcox[1], Tong Zhou[1], Cameron Geddes[1]; *[1]Lawrence Berkeley National Laboratory, USA; [2]Univ. of Michigan, USA; [3]Univ. of California San Diego, USA.* We introduce a deep-learning method for modeling dynamic gain and nonlinearities in ultrafast fiber amplifiers, overcoming limitations of physics-based models. Trained and tested with experiments, the algorithm can predict accurately, adaptable to varying amplifier conditions.

STh3J.4 • 14:00
Fast and Generalizable Light Field Propagation Modelling in Optical Fiber by Physics-Informed Neural Operator, Xiao Luo[1], min zhang[1], Yuchen Song[1], Xiaotian Jiang[1], Danshi Wang[1]; *[1]Beijing Univ. of Posts and Telecomu, China.* An unsupervised physics-informed neural operator is proposed for fast light field propagation modelling in optical fiber of different configurations. The learned PHE-operator obtains accuracy results and shows generalizable performance with lower complexity and running time.

STh3J.5 • 14:15
Fast and Efficient Solver for Raman Amplifier Equations Employing Neural Networks, Li Zhang[1], Erwan Pincemin[3], Naveena Genay[2], Darko Zibar[1]; *[1]Technical Univ. of Denmark, Denmark; [3]Orange Labs, France.* The proposed solver enables significant improvements in terms of computational time compared to standard Runge-Kutta approach, and enables ultra-fast gain predictions.

STh3J.6 • 14:30
Efficient Modeling of Photonic Lanterns: A Taper Reference Frame Approach, Konrad Tschernig[1], Swati Bhargava[1], Daniel Cruz-Delgado[1], Stephen Eikenberry[1], Sergio Leon-Saval[2], Rodrigo Amezcua Correa[1], Miguel A. Bandres[1]; *[1]Univ. of Central Florida, CREOL, USA; [2]Inst. of Photonics and Optical Science, Univ. of Sydney, Austria.* We develop a method to efficiently model light propagation in photonic lanterns. By working in the taper reference frame, our model avoids resizing the tapered potential and preserves resolution in the region of interest.

STh3J.7 • 14:45
Analytic Expressions for Mode Effective Indices in Step-Index Fibers Near and Beyond Cutoff, Aku Antikainen[1], Robert W. Boyd[1,2]; *[1]U of Rochester, The Inst. of Optics, USA; [2]Department of Physics, Univ. of Ottawa, Canada.* We derive a formula to determine approximate modal effective indices in step-index fibers near and beyond mode cutoff. This

allows for mode behavior trends to be determined analytically and can speed up effective index computations.

13:00 -- 15:00
Room: W208
JTh3K • Symposium: 3-D Horizons in Photonics: Unraveling the Next Frontier of Integrated Circuits I
Presider: Yasha Yi; Univ. of Michigan, USA

JTh3K.1 • 13:00 (Invited)
3D Electronic Photonic Integrated Circuits (3D EPICs): Co-Design and Co-Integration for Optimal Performance at Scale, S. J. Ben Yoo[1]; *[1]Univ. of California Davis, USA.* 3D integration of nanoscale electronics and photonics brings agility, parallelism, bandwidth, and scalability on a compact platform. We will discuss co-design and co-integration methods towards optimal performance for given workloads including AI and neuromorphic computing.

JTh3K.2 • 13:30 (Invited)
Wafer-scale Heterogeneous Integration for Integrated Photonics, Martijn J. Heck[1]; *[1]Eindhoven Hendrik Casimir Inst., Eindhoven Univ. of Technology, Netherlands.* Photonic integrated circuits ideally combine InP-based actives on a silicon substrate. I will discuss the techniques to achieve this heterogeneously on a wafer scale, using wafer bonding or micro-transfer printing.

JTh3K.3 • 14:00 (Invited)
Frontiers of the American Integrated Photonics Ecosystem: Sensors, PDKs, and Workforce Development, Sean Nelan[1]; *[1]Spark Photonics, USA.* A glimpse into the state of the American integrated photonics ecosystem through the lens of specific areas with which the presenters are directly involved: photonic sensors, process design kits (PDKs), and the next generation of workforce to drive these technologies.

13:00 -- 15:00
Room: W209A
FTh3L • Applied Nano-Optics and Plasmonics
Presider: Ruwen Peng; Nanjing Univ., China

FTh3L.1 • 13:00 (Invited)
There's Plenty of Interaction at the Bottom, Yohannes Abate[1]; *[1]Univ. of Georgia, USA.* The formulation of quantum mechanics in the late 1920s forever changed physics. More recently, quantum materials have emerged, offering fascinating opportunities. I will present recent results of high-resolution probing of physical phenomena and interactions in quantum materials.

FTh3L.2 • 13:30
Electrical Control of Cavity Exciton-Polaritons, Zhi Wang[1], Li He[1], Bumho Kim[1], Bo Zhen[1]; *[1]Univ. of Pennsylvania, USA.* We demonstrate the electrical control of cavity exciton-polaritons by strongly coupling a transition metal dichalcogenides (TMD) heterostructure to a photonic crystal nanocavity and adjusting the doping level of the TMD monolayer.

FTh3L.3 • 13:45

Current-biased Weyl and Dirac Semimetals as Tunable Nonreciprocal Plasmonic Platforms, Morgan Blevins[1,2], Svetlana Boriskina[1]; *[1]Massachusetts Inst. of Technology, USA; [2]Draper Labs, USA.* We present the first comprehensive theory of the optical response of Weyl and Dirac semimetals under a current bias and show that they offer a new competitive material platform for nonreciprocal optics, such as isolators.

FTh3L.4 • 14:00

Deterministic vortices evolving from partially coherent fields, Wenrui Miao[2], Yongtao Zhang[1], Greg Gbur[2]; *[1]College of Physics and Information Engineering, Minnan Normal Univ., China; [2]Department of Physics and Optical Science, Univ. of North Carolina at Charlotte, USA.* It has long been believed that there is an intrinsic conflict between vortices and partial coherence. However, we demonstrate that a partially coherent beam can be designed, through the use of fractional Fourier transforms (FracFTs), to manifest a deterministic vortex at any range and for any degree of spatial coherence in the source plane.

FTh3L.5 • 14:15

Experimental demonstration of nanocavity tuning on photonic crystal by sub-micron-square Ge2Sb2Te5 patterns, Takahiro Uemura[1,2], Hisashi Chiba[1,2], Yoshito Horiguchi[1,2], Taiki Yoda[1,2], Yuto Moritake[1], Yusuke Tanaka[2], Masaaki Ono[2,3], Eiichi Kuramochi[2,3], Masaya Notomi[1,2]; *[1]Department of Physics, Tokyo Inst. of Technology, Japan; [2]NTT Basic Research Laboratories, NTT Corporation, Japan; [3]Nanophotonics Center, NTT Corporation, Japan.* Our study showcases the successful tuning of wavelength-scale photonic crystal nanocavities through phase change of precise aligned sub-micron-scale $Ge_2Sb_2Te_5$ patterns, which is the first achievement in any nanocavities.

FTh3L.6 • 14:30

A Single-Celled Design Approach for Tri-Channel Metalenses, Xudong Guo[1], Kenneth Kin-Yip Wong[1,2]; *[1]The Univ. of Hong Kong, Hong Kong; [2]Advanced Biomedical Instrumentation Centre, Hong Kong Science Park, Hong Kong.* We present a non-interleaved single-celled design approach for tri-channel metalenses. We encode each meta-atom with three independent phase responses to generate three different spin-selective metalenses, which enables multi-functional meta-device.

FTh3L.7 • 14:45

Voltage-Modulated Nanoplasmonic Metal Luminescence in Electrochemical Surface-Enhanced Raman Spectroscopy, Yuming Zhao[1], Wei Zhou[1]; *[1]Virginia Tech, USA.* This study explores dynamic voltage-modulated nanoplasmonic metal luminescence at the electrode-electrolyte interface using nanolaminate nano-optoelectrode arrays. We demonstrate a negative voltage modulation slope in nanoplasmonic metal luminescence during electrochemical surface-enhanced Raman spectroscopy measurements.

13:00 -- 14:45
Room: W209B
STh3M • Laser and Light Source Integration I
Presider: Toshimasa Umezawa; National Inst of Information & Comm Tech, Japan

STh3M.1 • 13:00 (Invited)
Epitaxial Quantum Dots and Their Photonic Integration, Klaus Jöns[1]; *[1]PhoQS Inst., Paderborn Univ., Germany.* To unleash the full potential of photonic quantum technologies we are urged to miniaturize our systems. I will discuss routes to photonic integration of epitaxial quantum dots as quantum light sources and their applications.

STh3M.2 • 13:30
Narrow-Ridge Red-Wavelength InP Quantum Dot Lasers Grown Heteroepitaxially Within Patterned Si-Based PIC, Christopher Heidelberger[1], Jason J. Plant[1], Yiteng Wang[2], Dave Kharas[1], Minjoo L. Lee[2], Cheryl Sorace-Agaskar[1], Paul Juodawlkis[1]; *[1]MIT Lincoln Laboratory, USA; [2]Holonyak Micro and Nanotechnology Laboratory, Univ. of Illinois, Urbana-Champaign, USA.* We demonstrate CW narrow-ridge visible-wavelength (752 nm) lasers grown within a patterned Si-based photonic integrated circuit exhibiting output powers as high as 10 mW/facet and wall-plug efficiencies up to 1.7%.

STh3M.3 • 13:45
Integrated Photonic Platform for Low Noise Microwave Generation, Igor Kudelin[2,1], William Groman[2,1], Qingxin Ji[3], Joel Guo[4], Megan L. Kelleher[1,2], Dahyeon Lee[1,2], Takuma Nakamura[2,1], Charles McLemore[2,1], Pedram Shirmohammadi[5], Samin Hanifi[5], Haotian Cheng[6], Naijun Jin[6], Lue Wu[3], Samuel Halladay[6], Yizhi Luo[6], Zhaowei Dai[6], Warren Jin[4], Junwu Bai[4], Yifan Liu[2,1], Wei Zhang[7], Chao Xiang[4], Lin Chang[4], Vladimit Iltchenko[7], Owen Miller[6], Andrey Matsko[7], Steven Bowers[5], Peter Rakich[6], Joe Campbell[5], John Bowers[4], Kerry Vahala[3], Franklyn Quinlan[2,1], Scott Diddams[1,2]; *[1]Univ. of Colorado at Boulder, USA; [2]Time and Frequency Division, National Inst. of Standards and Technology, USA; [3]California Inst. of Technology, USA; [4]Univ. of California Santa Barbara, USA; [5]Univ. of Virginia, USA; [6]Yale Univ., USA; [7]Jet Propulsion Laboratory, California Inst. of Technology, USA.* Using integrated photonic chip components for '2-point' optical frequency division, we generate a 20 GHz microwave signal with phase noise of -135 dBc/Hz at 10 kHz offset.

STh3M.4 • 14:00
Sub-kHz linewidth integrated Pockels laser, Shixin Xue[1], Mingxiao Li[2], Jingwei Ling[1], Zhengdong Gao[1], Qili Hu[1], Raymond L. Rios[1], Jeremy Staffa[1], Chao Xiang[2], Heming Wang[2], John Bowers[2], Qiang Lin[1]; *[1]Univ. of Rochester, USA; [2]Univ. of California, Santa Barbara, USA.* We demonstrate a sub-kHz linewidth Pockels cell integrated laser with a linear mode-hop-free frequency modulation range of 15 GHz, and an on-chip power of 5.4 mW.

STh3M.5 • 14:15
Low-threshold single ternary GaAsSb nanowire lasers emitting at silicon transparent wavelengths, Cem Doganlar[1], Paul Schmiedeke[1], Hyowon W. Jeong[1], Markus Döblinger[2], Jonathan Finley[1], Gregor Koblmüller[1]; *[1]Technische Universität Munchen, Germany; [2]LMU Munich, Germany.* We report lasing from single ternary GaAsSb nanowire lasers under optical pumping at silicon transparent wavelengths (~1.1-1.2 µm). These breakthroughs are enabled by

high-quality, phase-pure GaAsSb nanowires passivated by lattice-matched InAlGaAs layers. Lasing at thresholds of ~ 3 µJ/cm^2 and up to 250 K is verified.

STh3M.6 • 14:30
Microresonator-based Optical Frequency Division for Ultralow-noise Microwave Synthesis, Xing Jin[1], Zhenyu Xie[1], Hanfei Hou[1], Fangxing Zhang[2], Xuanyi Zhang[1], Qihuang Gong[1], Qi-fan Yang[1]; *[1]Peking Univ., China; [2]Peking Univ. Yangtze Delta Inst. of Optoelectronics, China.* Utilizing a MgF_2 microresonator as optical reference and a Si_3N_4 microresonator as comb generator, we synthesize ultralow-noise 25-GHz rate microwave with -141 dBc/Hz phase noise at 10 kHz offset frequency via optical frequency division.

13:00 -- 15:00
Room: W209C
JTh3N • Symposium: Photonics Meets Free-Electron Science II
Presider: Aviv Karnieli; Tel Aviv Univ., Israel

JTh3N.1 • 13:00 (Invited)
Quantum Interactions between Free Electrons and Photonic Nanostructures, Javier García de Abajo[1,2]; *[1]ICFO -Institut de Ciencies Fotoniques, Spain; [2]ICREA, Spain.* We capitalize on recent advances in electron microscopy and free-electron interactions with nanostructured optical modes to boldly push the limits of space-time-energy resolution in spectromicroscopy while enabling the exploration of previously inaccessible quantum optical phenomena.

JTh3N.2 • 13:30 (Invited)
Classical vs. Quantum Effects in the Coupling of Photons with Free Electrons, Ofer Kfir[1]; *[1]Tel Aviv Univ., Israel.* We discuss selected e^--photon coupling phenomena through the prism of their quantumness, point to the parameters at which a system behaviour transits from quantum to classical, and discuss the implications of quantum effects

JTh3N.3 • 14:00 (Invited)
Dielectric Laser Accelerators: Photonic Control, Electron Compression, and Quantum Sensing, Zhexin Zhao[2,1], Dylan Black[1], Xiaoqi Sun[1], Tyler Hughes[1], Kenneth J. Leedle[1], Si Tan[1], Joel England[3], Olav Solgaard[1], Robert Byer[1], Shanhui Fan[1], Peter Hommelhoff[2]; *[1]Stanford Univ., USA; [2]Physics, FAU, Germany; [3]SLAC, USA. We discuss how photonic control addresses key challenges of dielectric laser accelerators (DLAs) and propose applications using DLAs, i.e., electron pulse compression and quantum sensing of two-level systems.*

JTh3N.4 • 14:30 (Invited)
Leveraging Free Electrons for Quantum Information Processing: Generation, Control, and Quantum Error Correction of Quantum Light, Gefen Baranes[1]; *[1]Massachusetts Inst. of Technology, USA.* We show how the coherent shaping of free-electron wavefunctions enables quantum information processing. We present a scheme to create Schrödinger cat and GKP states and enable universal quantum computation and error correction with GKP qubits.

13:00 -- 15:00
Room: W209DE
ATh3O • Advanced Semiconductor Lasers
Presider: Carl Liebig; US AFRL Wright Patterson, USA

ATh3O.1 • 13:00 (Invited)
Distributed Micron-size III-V Epitaxy on SOI for Integrated Active Devices, Kei May Lau[1]; *[1]Hong Kong Univ of Science & Technology, Hong Kong.* We developed and demonstrated localized III-V epitaxy on SOI platform for photonic integration. Active quantum well laser structures and high-speed photodetectors have been grown laterally from the patterned silicon layer of commercial SOI wafers.

ATh3O.2 • 13:30
Achieving InAs Quantum Dot Laser Operation at and Beyond 150 ˚C, Pawan Mishra[1], Lydia Jarvis[1], Chris Hodges[1], Sara Gillgrass[1], Richard Forrest[1], Dagmar Butkovicova[1], Craig Allford[1], Mingchu Tang[2], Huiyun Liu[2], Samuel Shutts[1], Peter Smowton[1]; *[1]School of Physics and Astronomy, Cardiff Univ., UK; [2]Department of Electrical Engineering, Univ. College London, UK.* We achieved InAs quantum dot-based laser operation up to 170 °C by adopting a codoped active region, including p-modulation doping and direct n-type doping in the InAs quantum dots, without resorting to high-reflectivity facet-coatings.

ATh3O.3 • 13:45
Narrow linewidth VECSEL for photoionization of Ba for trapped ion computing, Kostiantyn Nechay[1], Luukas Kuusela[1], Andreas Schramm[1], Soile Talmila[1], Pekko Sipilä[1], Kalle Palomäki[1], Petteri Uusimaa[1]; *[1]Modulight Corporation, Finland.* Trapped-ion-based quantum computing is a forerunning approach which ultimately relies on single-frequency lasers. We present narrow linewidth intracavity frequency doubled semiconductor laser platform, here emitting around 553 nm for the efficient Ba atom two-step photoionization.

ATh3O.4 • 14:00
Flexible Mode-locking in a Semiconductor Laser, Emmanuel Bourgon[1], Alexandre Shen[1], Pierre fanneau de la horie-clavier[4], Arnaud Wilk[1], Nicolas Vaissiere[1], Delphine Néel[1], Dalila Make[1], Karim Hassan[2], Stephane Malhouitre[2], Sylvain Combrié[3], Alfredo de Rossi[3]; *[1]III-V Lab, France; [2]CEA-Leti, France; [3]Thales Research and Technology, France; [4]Nokia, USA.* We present a new concept of integrated semiconductor laser providing broad, continuous and potentially fast tunable mode-locked frequency.

ATh3O.5 • 14:15
Characterization of Three-Section AlGaInAs Multiple Quantum-Well Mode-locked Lasers for Space Applications, Di Huang[1]; *[1]Univ. of Central Florida, CREOL, USA.* We report a quantum-well-intermixing-free three-section mode-locked laser diode at 1580nm, featuring 1.70 psec pulse width. The fixed-point frequency analysis shows four different laser parameters conducive for compensating repetition rate and carrier frequency variations in space environment.

ATh3O.6 • 14:30
A Highly Reliable Color Conversion Layer Based on Colloidal Quantum Dots with High Resolution of 3628 Pixel-Per-Inch, Ting-Jhih Kuo[1], Han-Yu Chao[1], Fang-Chung Chen[2], Hao-

Chung Kuo[2], Chien-Chung Lin[1]; *[1]Graduate Inst. of Photonics and Optoelectronics, National Taiwan Univ., Taiwan; [2]Department of Photonics, National Yang Ming Chiao Tung Univ., Taiwan.* A 3628-PPI color conversion layer based on colloidal quantum dots is demonstrated with high resolution and good reliability. The sub-pixel size is 2 microns and the color conversion efficiency is as high as 22%.

ATh3O.7 • 14:45
Integration of metasurface and PCSEL in real-time depth-sensing micro-system for facial recognition, Wen-Cheng Hsu[1,2], Chia-Hsun Chang[1], Yu-Heng Hong[2], Hao-Chung Kuo[1,2], Yao-Wei Huang[1]; *[1]National Yang Ming Chiao Tung Univ., Taiwan; [2]Semiconductor Research Center, Hon Hai Research Inst., Taiwan.* We demonstrate a novel dot projector architecture for depth-sensing perception facial recognition applying metasurfaces and photonic crystal surface-emitting lasers (PCSELs), which has area 55 times smaller and power-consumption 5~10 times lower than commercial dot projector.

13:00 -- 15:00
Room: W209F
STh3P • Nonlinear Metasurfaces and Nanophotonics
Presider: Haim Suchowski; Tel Aviv University, Israel

STh3P.1 • 13:00
Blue and Ultraviolet Light Beams with Nonlinear TiO_2 Metasurfaces, Hooman Barati Sedeh[1], Yuruo Zheng[1], Jiannan Gao[1], Fangxing Lai[2], Hao Li[2], Shumin Xiao[2], Natalia M. Litchinitser[1]; *[1]Duke Univ., USA; [2]Harbin Inst. of Technology, China.* We design and experimentally demonstrate the generation of blue and ultraviolet third-harmonic generation from a TiO_2 metasurface supporting quasi-bound state in the continuum with 0.2% conversion efficiency.

STh3P.2 • 13:15
Broadband Infrared Imaging via Silicon Metasurfaces, Ze Zheng[1], Gabriel Sanderson[1], Cuifeng Ying[1], Demosthenes Koutsogeorgis[1], Zixi Liu[2], Rupert Oulton[3], Lujun Huang[4], Arman Yousefi[1], Daria Smirnova[5], Andrey E. Miroshnichenko[6], Dragomir Neshev[5], Mary O'Neill[1], Mohsen Rahmani[1], Lei Xu[1]; *[1]School of Science & Technology, Nottingham Trent Univ., UK; [2]Nankai Univ., China; [3]Department of Physics, Imperial College London, UK; [4]Extreme Optoelectromechanics Laboratory (XXL), East China Normal Univ., China; [5]Research School of Physics, The Australian National Univ., Australia; [6]School of Engineering & IT, Univ. of New South Wales, Australia.* We demonstrate an innovative platform with nonlinear metasurfaces to convert images from broadband mid-infrared (2200-4000 nm) to visible via four-wave mixing. We minimise high-power signal requirements by tailoring the resonant metasurface at the pump wavelength.

STh3P.3 • 13:30
Nonlinear Metamaterial for Efficient Terahertz Second-Harmonic Generation from Anharmonic Oscillation of 2DEG, Kaixin Yu[1], Chen Wang[1], Yongzheng Wen[1], Yong Tan[1,2], Shiqiang Zhao[1], Jingbo Sun[1], Ji Zhou[1]; *[1]Tsinghua Univ., China; [2]Research Center for Metamaterials, Wuzhen Laboratory, China.* We experimentally demonstrate an efficient terahertz second harmonic generation by a metamaterial-based artificial nonlinearity. By driving

carriers in the two-dimensional electron gas, the large second-order nonlinear susceptibility of 136.1 nm/V is achieved.

STh3P.4 • 13:45
Phase-Matched Second-Harmonic Generation from Metasurfaces Inside Multipass Cells, Madona Mekhael[1], Timo Stolt[1], Anna Vesala[1], Heikki Rekola[2], Tommi Hakala[2], Robert Fickler[1], Mikko J. Huttunen[1]; *[1]Tampere Univ., Finland; [2]Univ. of Eastern Finland, Finland.* We demonstrate scalable enhancement of second-harmonic generation (SHG) of metasurfaces through multipass cells. We achieve phase matching with superlinear dependence on the number of passes, promising applications in diverse nonlinear optics.

STh3P.5 • 14:00 (Invited)
The All-Optical Stern-Gerlach Effect in Space and in Time, Ady Arie[1]; *[1]Dept of Physical Electronics, Tel Aviv Univ., Israel.* Lightwaves can be split into two beams or two pulses, each comprising a frequency-bin superposition, in the presence of a nonlinear coupling gradient, representing the nonlinear optics analog of the celebrated Stern-Gerlach effect for atoms.

STh3P.6 • 14:30
Quasi phase matching from periodically poled 3R-stacked transition metal dichalcogenides, Chiara Trovatello[1], Carino Ferrante[2], Birui Yang[1], Cory Dean[1], Andrea Marini[2], Giulio Cerullo[3], P. James Schuck[1]; *[1]Columbia Univ., USA; [2]CNR-SPIN, Italy; [3]Politecnico di Milano, Italy.* Here we demonstrate broadband quasi phase matching in a periodically poled van der Waals semiconductor (3R-MoS_2). This work opens up the new and unexplored field of phase-matched nonlinear optics with microscopic van der Waals crystals.

STh3P.7 • 14:45
Anisotropic Temperature and Polarization Dependence of Third Harmonic Generation in van der Waals Layered Material $AgScP_2S_6$, Mohamed Yaseen Noor[1], Ryan P. Siebenaller[1], Micheal Susner[2], Enam Chowdhury[1]; *[1]Materials Science and Engineering, The Ohio State Univ., USA; [2]Materials and Manufacturing Directorate, Air Force Reseach Laboratory, USA.* We investigate temperature and polarization dependent third harmonic generation in several microns thick $AgScP_2S_6$ crystal using 77fs 1030nm driver laser pulses. The THG efficiency is orders of magnitude higher than that of many 2D materials.

13:00 -- 15:00
Room: W210
STh3Q • Neural Networks and Secure Communications
Presider: Vincent Chan; Massachusetts Inst. of Technology, USA

STh3Q.1 • 13:00
High-Speed Quantum Noise Stream Cipher System Enabled by Optical Fiber-based Encryption and Low-Complexity Digital Decryption, Ryosuke Matsumoto[1], Takahiro Kodama[2]; *[1]National Inst. of Advanced Industria, Japan; [2]Kagawa Univ., Japan.* We propose secure digital-coherent system utilizing high-speed encryption/decryption through fiber and simplified digital back propagation (DBP). Negligible penalty is observed by detecting 64-Gbaud 2^{16}-level PSK-like chipper signals through a 5-stage DBP with precise fiber parameters.

STh3Q.2 • 13:15

Impact of AES-CTR Mode Modified QAM Symbol Block Cipher on Nonlinear Fiber-Optic Channels, Hodaka Amano[1], Keiji Shimada[1], Reika Suketomo[1], Ryosuke Matsumoto[2], Takahiro Kodama[1]; *[1]Kagawa Univ., Japan; [2]National Inst. of Advanced Industrial Science and Technology (AIST), Japan.* In a 7-ch WDM transmission experiment spanning 2240 km with fiber nonlinearity effects, we employed AES-CTR mode corrected symbol block cipher for dual-polarized-QAM, showcasing penalty-free performance irrespective of encryption presence and rendering eavesdropper decryption challenging.

STh3Q.3 • 13:30 (Invited)

Silicon Photonics Neural Networks for Optical Communications, Chaoran Huang[1]; *[1]Chinese Univ. of Hong Kong, Hong Kong.* Abstract not available.

STh3Q.4 • 14:00

9.06-Gb/s, 100-km Physical-layer Key Distribution Based on Unclonable Random Fiber Grating and Channel Reciprocity, Taihang Qiu[1,2], Xiangpeng Xiao[1,2], Qiang Lu[1,2], Zhijun Yan[1,2], Lei Deng[1,2], Qi Yang[1,2], Xiaoxiao Dai[1,2], Deming Liu[1,2], Mengfan Cheng[1,2]; *[1]National Engineering Research Center for Next Generation Internet Access System, School of Optical and Electronic Information, Huazhong Univ. of Sci and Tech, China; [2]Jinyinhu Laboratory, China.* We experimentally demonstrate a physical-layer key distribution scheme based on unclonable random fiber gratings and optical link channel reciprocity. The distribution distance is 100km and the distribution rate reaches 9.06 Gb/s.

STh3Q.5 • 14:15

10 Gb/s Entanglement Assisted Communication over Free-Space Optical Link with Phase Conjugation on
Idler Photons and Improvements from Adaptive Optics, Vijay Nafria[1], Ivan B. Djordjevic[1]; *[1]Univ. of Arizona, USA.* We demonstrate record 10 Gb/s entanglement assisted communication over 1.5 km long turbulent free-space optical link in which optical phase-conjugation is performed on bright idler photons. To further improve the system performance adaptive optics is used.

13:00 -- 15:00
Room: W211
FTh3R • Single and Entangled Photon Sources and Their Measurement
Presider: Valeria Cimini; Univ degli Studi di Roma La Sapienza, Italy

FTh3R.1 • 13:00

Noise-free Topological Features of Entangled States, Pedro Ornelas[1], Isaac Nape[1], Robert De Mello Koch[2,3], Andrew Forbes[1]; *[1]Univ. of the Witwatersrand, South Africa; [2]School of Science, Huzhou Univ., China; [3]Mandelstam Inst. for Theoretical Physics, School of Physics, Univ. of the Witwatersrand, South Africa.* Entangled states are a promising resource for many quantum technologies, however they are highly susceptible to noise. Here we identify non-local topological features of entangled states which are robust to noise.

FTh3R.2 • 13:15

Real Time Generation and Measurement of 60-GHz Optical Entangled States, Akito Kawasaki[1], Hector Brunel[1,2], Ryuhoh Ide[1], Takumi Suzuki[1], Takahiro Kashiwazaki[3], Asuka Inoue[3], Takeshi Umeki[3], Taichi Yamashima[1], Atsushi Sakaguchi[4], Kan Takase[1,4], Mamoru Endo[1,4], Warit Asavanant[1,4], Akira Furusawa[1,4]; *[1]The Univ. of Tokyo, Japan; [2]l'Ecole normale supérieure, France; [3]NTT Corporation, Japan; [4]RIKEN Center for Quantum Computing, Japan.* We generate and perform real-time measurement of optical entangled states with 60-GHz bandwidth using waveguide optical parametric amplifiers and homodyne measurement with phase sensitive amplification, foreseeing quantum information processing with ultrafast clock frequency.

FTh3R.3 • 13:30

Chip-based Multidimensional Entanglement Network with Hybrid Multiplexing, Chonghao Zhai[1], Yun Zheng[1], Dajian Liu[2], Daoxin Dai[2], Jianwei Wang[1]; *[1]Peking Univ., China; [2]Zhejiang Univ., China.* We demonstrate a chip-based multidimensional entanglement network with hybrid multiplexing technology and develop a technique that can efficiently retrieve multidimensional entanglement in complex-medium quantum channels, which is important for practical uses.

FTh3R.4 • 13:45

Integrated High-dimensional Orbital Angular Momentum Entangled Photon Source, Jieshan Huang[1], Xudong Li[1], Jun Mao[1], Jingze Yuan[1], Jianwei Wang[1]; *[1]Peking Univ., China.* We experimentally demonstrate the generation of arbitrary entangled 2-photon 5-dimensional orbit angular momentum(OAM) states on a programmable silicon photonic chip. High-dimensional witness and tomography are used to verify the genuine entanglement.

FTh3R.5 • 14:00

Polarization Entanglement from a Crystalline Whispering Gallery Resonator, Sheng-Hsuan Huang[2,1], Thomas Dirmeier[2,1], Golnoush Shafiee[2,1], Kaisa Laiho[3], Dmitry Strekalov[2], Gerd Leuchs[2,1], Christoph Marquardt[1,2]; *[1]Department of Physics, Friedrich-Alexander-Universitaet Erlangen-Nuernberg, Germany; [2]Max Planck Inst. for the Science of Light, Germany; [3]German Aerospace Center (DLR e.V.), Inst. of Quantum Technologies, Germany.* Polarization entanglement has not yet been shown in crystalline whispering gallery resonators. Here, we generate polarization entanglement by using an interferometric scheme. The S value of the Clauser-Horne-Shimony-Holt's inequality in the system is 2.54 ± 0.06, in clear violation of the local realism.

FTh3R.6 • 14:15

Boosted Linear-Optical Bell-State Measurements and their Applications, Matthias Bayerbach[1], Simone E. DAurelio[1], Stefanie Barz[1], Peter van Loock[2]; *[1]Universität Stuttgart, Germany; [2]Johannes-Gutenberg Univ. of Mainz, Germany.* We present the realization of a linear optical Bell-state measurement scheme, surpassing the 50% bound success by utilising ancillary states in a linear-optical circuit and discuss possible applications.

FTh3R.7 • 14:30

Entanglement between a telecom photon and a room-temperature atomic-vapor quantum memory, Yang Wang[1], Alexander Craddock[1], Jaeda Mendoza[1], Rourke Sekelsky[1], Mael Flament[1], Mehdi Namazi[1]; *[1]Qunnect Inc., USA.* We report experimental results of entangling a telecom photon and a long-lived atomic quantum memory, a key step in building a quantum repeater for long-distance quantum communications.

FTh3R.8 • 14:45
Network-ready Source of Indistinguishable Single Photons, Nijil Lal[1], Ivan A. Burenkov[1,2], Ya-Shian Li-Baboud[1], Jabir M. V.[1], Paulina S. Kuo[1], Thomas Gerrits[1], Oliver Slattery[1], Sergey Polyakov[1,3]; *[1]National Inst. of Standards and Technology, USA; [2]Joint Quantum Inst. & Univ. of Maryland, USA; [3]Department of Physics, Univ. of Maryland, USA.* We demonstrate a source of transform-limited indistinguishable photons in telecom band synchronized to the external clock. We observe near-perfect indistinguishability and sub-picosecond synchronization timing jitter. This network-compatible source enables large-scale, multi-node practical quantum networks.

15:30 -- 17:30
Room: W201AB
ATh4A • Novel Light Sources for Hyperspectral Imaging and Tomography
Presider: To be Announced

ATh4A.1 • 15:30 (Invited)
Withdrawn

ATh4A.2 • 16:00
High-Resolution Computed Tomography with Scattered X-ray Radiation and a Single Pixel Detector, Adi H. Ben Yehuda[1], Or Sefi[1], Yishay Klein[1], Hila Schwartz[1], Hen Shukrun[1,2], Eliahu Cohen[1], Sharon Shwartz[1]; *[1]Bar Ilan Univ., Israel; [2]Radiation Safety Department, Soreq Nuclear Research Center, Israel.* We experimentally demonstrate a technique for high-resolution computed tomography (CT) that measures the scattered x-ray radiation by utilizing a ghost imaging approach. Our research can improve image contrast while minimizing radiation exposure for patients.

ATh4A.3 • 16:15
Mid-Infrared Optical Coherence Tomography with an OP-GaP Optical Parametric Oscillator, Jake M. Charsley[1], Marius Rutkauskas[1], Peter G. Schunemann[2], Yoann Altmann[1], Derryck T. Reid[1]; *[1]Heriot-Watt Univ., UK; [2]BAE Systems, USA.* We demonstrate mid-infrared time-domain OCT with an OP-GaP optical parametric oscillator. Broadband spectra tunable from 5–11 µm provide reduced scattering for OCT applications. Volumetric imaging inside a plastic bank card is demonstrated at 5.1 µm.

ATh4A.4 • 16:30
Significant Improvements to Terahertz Hyperspectral Image Analysis by Using Full-Field and Time-Domain Data, Margaret E. Granger[1], Abby Hassler[1], Jeremy A. Johnson[1]; *[1]Brigham Young Univ., USA.* We demonstrate improvements in terahertz (THz) hyperspectral image analysis by incorporating full-field THz data. We also show for the first time that THz hyperspectral analysis can be performed in the time-domain.

ATh4A.5 • 16:45
Visible and NIR Spectrum-Simulation Light Source Facilitates Hyperspectral Imaging Applications, Xiaohua Ye[1]; *[1]Energetiq Technology Inc., USA.* A spectrum-simulating light

source covering 380 nm to 1100 nm, powered by a Laser-Driven Light Source, is proposed to facilitate HSI applications. Key parameters examined include spectral resolution, out-of-band suppression, and spectral manipulation flexibility.

ATh4A.6 • 17:00
Withdrawn

ATh4A.7 • 17:15
Spectral Broadening of Femtosecond Cr:ZnS MOPA Oscillation in InP, Rem Danilin[1], Vladimir V. Fedorov[1], Dmitry V. Martyshkin[1], Sergey B. Mirov[1]; *[1]Univ. of Alabama at Birmingham, USA.* We present a Cr:ZnS Kerr-lens mode-locked master oscillator-single-pass amplifier scheme for supercontinuum generation in nonlinear materials. The amplified output radiation was broadened in bulk InP over the 1800–3000 spectral range at a -30 dB level.

15:30 -- 17:30
Room: W201CD
ATh4B • Silicon Photonics for Healthcare
Presider: Judith Su; Univ of Arizona, Coll of Opt Sciences, USA

ATh4B.1 • 15:30 (Invited)
Scalable Approaches to Photonic Sensing for Diagnostics and Drug Development, Benjamin Miller[1]; *[1]Univ. of Rochester, USA.* This talk will discuss two applications of photonic sensors we have developed on the AIM Photonics manufacturing platform: first, a “disposable photonics” sensor platform for diagnostics, and second, sensor integration with tissue chips.

ATh4B.2 • 16:00
Plasmonic Crystal Cavity in Metal-Insulator-Metal for Fiber-Tip Label-Free Biosensing, Chenjia He[1], Xiaqing Sun[1], Hao Zhong[1], Qingwei Liu[1], Shengfu Chen[2], Tian Yang[1]; *[1]State Key Laboratory of Advanced Optical Communication Systems and Networks, Key Laboratory for Thin Film and Microfabrication of the Ministry of Education, School of Electronic Information and Electrical Engineering, Shanghai Jiao Tong Univ., China; [2]Key Laboratory of Biomass Chemical Engineering, College of Chemical and Biological Engineering, Zhejiang Univ., China.* To achieve a flat and uniform sensing surface for fiber-tip surface plasmon resonance devices, we have developed a plasmonic crystal cavity in metal-insulator-metal structure. Biotinylated protein binding has been detected at down to 30 fM.

ATh4B.3 • 16:15
Ring Resonator Based Ultrasound Detection in a Zero-Change 45nm CMOS-SOI Process, Sarika R. Madhvapathy[1], Panagiotis Zarkos[2], Danielius Kramnik[1], Vladimir Stojanović[1]; *[1]Electrical Engineering and Computer Sciences, Univ. of California, Berkeley, USA; [2]Lawrence Berkeley National Laboratory, USA.* We present an ultra-dense row of silicon microring resonators used as optical ultrasound sensors in a high-volume monolithic electronics-photonics CMOS platform, achieving an average (maximum) intrinsic sensitivity of 34.25fm/kPa (38.22fm/kPa) at 5MHz.

ATh4B.4 • 16:30 (Invited)

Photonic Integrated Circuits at MWIR and Green Wavelengths for Biomedical Applications, Sk Shafaat Saud Nikor[1], Md Saiful Islam Sumon[1], Imad I. Faruque[2], Sarvagya Dwivedi[3], Shamsul Arafin[1]; *[1]ECE, Ohio State Univ., USA; [2]Univ. of Bristol, UK; [3]Texas Instruments, USA.* Light at mid-wave infrared- as well as visible-wavelengths are widely used in biophotonic applications with the promise of much improved healthcare. This talk will review on recent progress made at OSU towards developing photonic integrated circuit technologies at these wavelengths.

ATh4B.5 • 17:00

Silicon NEMS Optomechanic Modulator for Multiplexed Recording of Electrophysiological Neural Signals, Harshvardhan Gupta[1], Andrew Cochran[1], Zabir Ahmed[1], Maysamreza Chamanzar[1], Gianluca Piazza[1]; *[1]Carnegie Mellon Univ., USA.* We present a novel NEMS Optomechanic modulator on a silicon photonics platform capable of resolving sub-millivolt analog signals, making it suitable for the recording and multiplexing of electrophysiological neural signals.

ATh4B.6 • 17:15

Low back-reflection 2x2 MMI developed for Silicon-Nitride platform, Amir Abbas Kashi[1], Ruud Oldenbeuving[1]; *[1]IMEC, Netherlands.* In this paper, a novel design of a low-reflection Silicon Nitride (SiN) 2x2 MMI on the IMEC's iSiPP200 platform is proposed. The simulation results predict that reflections are -71 dB and -70 dB for in-phase and out-of-phase inputs, respectively.

15:30 -- 17:30
Room: W204AB
STh4C • Photonics and Brillouin Optomechanics
Presider: Avik Dutt, Univ. of Maryland, USA

STh4C.1 • 15:30

Enhanced stimulated Brillouin scattering in tellurite covered silicon nitride waveguides via geometric and cladding engineering, Yvan Klaver[1], Randy te Morsche[1], Batoul Hashemi[2], Bruno Segat Frare[2], Pooya Torab Ahmadi[2], Niloofar Majidian Taleghani[2], Evan Jonker[2], Roel Botter[1], Kaixuan Ye[1], Akhileshwar Mishra[1], Redlef Braamhaar[1], Jonathan Bradley[2], David Marpaung[1]; *[1]Univ. of Twente, Netherlands; [2]McMaster Univ., Canada.* We measure Brillouin-scattering in geometrically and cladding engineered tellurite covered silicon nitride waveguide in which we report gain values of 80.9 $m^{-1}W^{-1}$ and 76.3 $m^{-1}W^{-1}$, a 150 times improvement over previous silicon nitride based waveguides.

STh4C.2 • 15:45

On-Chip Backward Stimulated Brillouin Scattering in Lithium Niobate Waveguides, Caíque C. Rodrigues[1,2], Roberto Zurita[1], Nicolaas J. Schilder[1], Leticia Magalhães[2], Amirhassan Shams-Ansari[2], Thiago Alegre[1], Marko Loncar[2], Gustavo S. Wiederhecker[1]; *[1]UNICAMP, Brazil; [2]SEAS, Harvard Univ., USA.* We present the first experimental demonstration of backward stimulated Brillouin scattering in lithium niobate on insulator waveguides. We observed both intra- and intermodal scattering, showcasing gains up to G_B=10/m/W.

STh4C.3 • 16:00

An Optically Broadband Piezo-Optomechanical Magnetometer, Zachary A. Castillo[1,2], Brandon Smith[2], Alex Will-Cole[2], Mark Dong[3], Konrad Bussmann[4], Peter Finkel[4], Matt Eichenfield[5]; *[1]Physics, Univ. of New Mexico, USA; [2]Sandia National Labs, USA; [3]The MITRE Corporation, USA; [4]US Naval Research Laboratory, USA; [5]Wyant College of Optical Sciences, Univ. of Arizona, USA.* We demonstrate optically broadband piezo-optomechanical magnetometry, integrating a Mach-Zehnder interferometer with magnetostrictive material for magnetic responsivity and piezoelectric material for actuation/control, with broadband sensitivity ~1nT/√Hz up to ~500kHz and ~10pT/√Hz at mechanical resonance.

STh4C.4 • 16:15

Integrated Microelectromechanical-System Optical Probes for Diagnosing Phase Errors of Programmable Photonic Integrated Circuits, Thuy Trinh[1], Ming-Chang Lee[2]; *[1]National Tsing Hua Univ., Inst. of Photonics Technologies, Taiwan; [2]National Tsing Hua Univ., Inst. of Photonic Technologies, Taiwan.* We present using microelectromechanical-system optical probes in combination with an image analysis method to dynamically monitor the waveguide power of Mach-Zehnder interferometers for phase error diagnosis in programmable photonic integrated circuits.

STh4C.5 • 16:30

Plasmonic Enhancement of Surface Acoustic Wave – Photonic Integrated Devices in Silicon-on-Insulator, Leroy Dokhanian[1], Saawan Kumar Bag[1], Mirit Hen[1], Avi Zadok[1]; *[1]Bar-Ilan Univ., Israel.* Thermoelastic stimulation of surface acoustic waves in standard silicon photonic circuits is enhanced through the absorption of pump light in surface plasmon resonant unit cells. Transmission losses are reduced by 20 dB.

STh4C.6 • 16:45

Stimulated Brillouin scattering in a 3 µm thick non-suspended silicon platform, Kaixuan Ye[1], Yisbel Marin[2], Matteo Cherchi[2], Timo Aalto[2], David Marpaung[1]; *[1]Univ. of Twente, Netherlands; [2]VTT, Finland.* We report the first stimulated Brillouin scattering signal from the 3 µm thick low-loss silicon-on-insulator waveguide platform. The Brillouin gain coefficient is 2.5 $m^{-1}W^{-1}$ and 1.9 $m^{-1}W^{-1}$ at 37.6 GHz for the rib and strip waveguides, respectively.

STh4C.7 • 17:00

Suppression of Spontaneous Phonon Processes in Single Defect Centers in Diamond using Phononic Crystals, Kazuhiro Kuruma[2,1], Benjamin Pingault[2,3], Cleaven Chia[2], Michael Haas[2], Graham Joe[2], Daniel R. Assumpcao[2], SophieWeiyi Ding[2], Chang Jin[2], CJ Xin[2], Matthew Yeh[2], Neil Sinclair[2], Marko Loncar[2]; *[1]Univ. of Tokyo, Japan; [2]Harvard Univ., USA; [3]Delft Univ. of Technology, Netherlands.* We engineer the interaction between phonons and single silicon-vacancy centers using phononic crystals with a complete bandgap spanning 50-70 GHz. We observe a 18-fold extension of single color center's orbital lifetime in the phononic bandgap.

15:30 -- 17:30
Room: W205AB
FTh4D • Non-hermiticity and Synthetic Dimensions
Presider: Mohammad-Ali Miri; City Univ. of New York

FTh4D.1 • 15:30

Creating Non-Abelian Gauge fields In Non-Hermitian Systems Via Photonic Synthetic Dimensions, Zehai Pang[1], Bengy Tsz Tsun Wong[1], Jinbing Hu[2], Yi Yang[1]; *[1]The Univ. of Hong Kong, China; [2]Univ. of Shanghai for Science and Technology, China.* We introduce synthetic non-Abelian gauge fields to non-Hermitian systems and study their topological consequences via a non-Abelian Hatano--Nelson model, its photonic realization via a polarization-multiplexed fiber ring resonator, and broken gauge invariance of the non-Abelian Wilson loop.

FTh4D.2 • 15:45

Robust symmetry-free zero modes in non-Hermitian systems, Jose H. Rivero[1,2], Courtney Fleming[1,2], Bingkun qi[1,2], Liang Feng[3], Li Ge[1,2]; *[1]College of Staten Island, CUNY, USA; [2]CUNY Graduate Center, USA; [3]Univ. of Pennsylvania, USA.* We present an approach to achieve zero modes in lattice models that do not rely on any symmetry or topology of the bulk, which are robust against disorder in the bulk Hamiltonian of *any* kind.

FTh4D.3 • 16:00

Non-Hermitian topology in a programmable silicon photonics lattice, Amin Hashemi[1], Elizabeth Pereira[2], Hongwe Li[3], Jose Lado[2], Andrea Blanco-Redondo[1]; *[1]CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA; [2]Department of Applied Physics, Aalto Univ., Finland; [3]Nokia Bell Labs, UK.* We report the experimental realization of non-Hermitian topology purely based on loss modulation in a programmable silicon photonics platform. Our results show the robustness of the topological mode to perturbations in the loss.

FTh4D.4 • 16:30

Controlled Power Distribution in Microresonator Chains via Concurrent Symmetry Breakings, Alekhya Ghosh[1,2], Arghadeep Pal[1,2], Lewis J. Hill[1], Pascal Del'Haye[1,2]; *[1]Max-Planck-Inst Physik des Lichts, Germany; [2]Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany.* We show the control of optical power patterns in coupled resonators optical waveguides (CROW) via the Kerr effect. This has applications in photonic integrated circuits, especially for light steering, sensors, and optical computing.

FTh4D.5 • 16:45

Mode-Locking in active PT-symmetric dimers, Jesús Yelo Sarrión[1], François Leo[1], Simon-Pierre Gorza[1]; *[1]Universite Libre de Bruxelles, Belgium.* We experimentally demonstrate mode-locking in a parity-time symmetric laser made of two coupled ring resonators, one experiencing loss and the other gain. This versatile concept opens the way to new laser architectures for pulse generation.

FTh4D.6 • 17:00

Band Structure Measurements in Multi-Dimensional Synthetic Frequency Lattices, Dali Cheng[1], Eran Lustig[1], Kai Wang[1,2], Shanhui Fan[1]; *[1]Stanford Univ., USA; [2]McGill Univ., Canada.* We experimentally demonstrate a method to fully measure multi-dimensional band structures in synthetic frequency dimensions by introducing a gauge potential into the lattice Hamiltonian. We use this method to study non-Hermitian topology in high dimensions.

15:30 -- 17:30
Room: W205CD
ATh4E • Remote Sensing for Terrestrial and Space Applications
Presider: Molly Fahey; NASA-GSFC, USA

ATh4E.1 • 15:30
Reduction of Littrow Recombination Ghosts in Astronomic Spectrograph 1st -Order Transmission Gratings, Uma Subash[1], Hanshin Lee[2], Menelaos Poutous[1]; *[1]Optical Science and Engineering, Univ. of North Carolina Charlotte, USA; [2]McDonald Observatory, Univ. of Texas – Austin, USA.* We designed and fabricated a high-efficiency, first-order transmission spectrographic grating and measured the angular directional scatter at near-Littrow incidence, mapping the positions and suppression of Littrow recombination ghosts.

ATh4E.2 • 15:45
Laser Development for the Sodium Lidar for the TOMEX-Plus Rocket Experiment, Michael A. Gachich[1], Michael A. Rizk[1], Alexander Pietros[1], Coggan Banerian[3], James Clemmons[2], Gary R. Swenson[1], Peter D. Dragic[1]; *[1]Electrical and Computer Engineering, Univ. of Illinois Urbana-Champaign, USA; [2]Physics & Astronomy, Univ. of New Hampshire, USA; [3]Department of Mechanical Science & Engineering, Univ. of Illinois Urbana-Champaign, USA.* Progress towards the development of a 589 nm laser for a sodium lidar for the TOMEX-Plus rocket campaign is presented. The laser is a Raman amplified (1178 nm) and frequency doubled MOPA configuration.

ATh4E.3 • 16:00 (Invited)
From Starlight to Seafloor: Space-Tech's Leap in Rapid Environmental Sensing for Net-Zero, Pablo Sobron[1]; *[1]BEAM, USA.* For years, space exploration has spearheaded transformative technologies. Today, these innovations, forged through space challenges, are crucial in tackling climate change. This shift represents a strategic realignment, leveraging space-derived advancements for Earth's sustainability.

ATh4E.4 • 16:30
Material-sensitive LiDAR – a technique for multidimensional chemical mapping, Bibek R. Samanta[1]; *[1]Nokia Bell Labs, USA.* A range-resolved standoff chemical sensing technique for simultaneous ranging and material characterization is demonstrated with various polymers. The technique is used to selectively identify polymer compositions and sensitively map trace concentrations in 3D.

ATh4E.5 • 16:45
A Synchronized LiDAR-OWC Integrated System for Multi-user Indoor Scenario Using A Shared Light Path, Ziming Ye[1], Lihang Liu[1], Yi Hao[1], Yaqi Han[1], Lican Wu[1], Qingyang Zhu[1], Annan Xia[1], H. Y. Fu[1]; *[1]SIGS, China.* We present an integrated LiDAR and OWC system for indoor IoT applications. Experimental results on different channels show Gbps-level communication performance while maintaining a millimeter-scale sensing capability simultaneously.

ATh4E.6 • 17:00
4D FMCW LiDAR System with Compact Spectral-Scanning Structure and High Angular Resolution, Qingyang Zhu[1], Yi Hao[1], Lican Wu[1], Yaqi Han[1], Ziming Ye[1], Annan Xia[1], H. Y.

Fu[1]; [1]*Tsinghua Univ., China.* We develop a spectral-scanning FMCW LiDAR system achieving simultaneous 3D imaging and velocity measurement using a grating-rotator set. A FoV of 16.2°×4.73° and an angular resolution of 0.10°×0.059° are demonstrated.

ATh4E.7 • 17:15

Diffuse Imaging using Foveated FMCW LiDAR, Muralidhar Madabhushi Balaji[1], Danyal Ahsanullah[1], Prasanna Rangarajan[1]; [1]*Southern Methodist Univ., USA.* The proposed work combines ideas from foveated sensing and FMCW LiDAR to monitor scattering or absorption variations inside a diffusely scattering medium. Dense spatial maps of inhomogeneities embedded inside 8cm thick scattering medium are recovered

15:30 -- 17:30
Room: W206A
FTh4F • Solitons and Frequency Combs
Presider: Andrea Blanco-Redondo; Univ. of Central Florida

FTh4F.1 • 15:30

Genetic Algorithm-Enabled Microcomb Tailoring in Microring Resonators, Celine Mazoukh[1], Luigi Di Lauro[1], Imtiaz Alamgir[1], Nicolas Perron[1], Bennet Fischer[2], Aadhi Rahim[1], Armaghan Eshaghi[3], Brent Little[4], Sai CHU[5], David Moss[6], Roberto Morandotti[1]; [1]*INRS-EMT, Canada;* [2]*Leibniz Inst. of Photonic Technology (IPHT), Germany;* [3]*Huawei Technologies Canada, Canada;* [4]*QXP Technology Inc., China;* [5]*City Univ. of Hong Kong, Hong Kong;* [6]*Optical Sciences Centre, Swinburne Univ. of Technology, Australia.* We present a novel approach to robustly tailor microcomb states in microring resonators pumped with a continuous-wave laser source, employing genetic algorithms to optimize the parameters required for coherent state generation.

FTh4F.2 • 15:45

Stable Modelocking of Coupled Resonator Normal-GVD Kerr-Combs, Swarnava S. Sanyal[1], Yoshitomo Okawachi[1], Yun Zhao[1], Bok Y. Kim[1], Karl J. McNulty[1], Michal Lipson[1], Alexander L. Gaeta[1]; [1]*Columbia Univ., USA.* We theoretically and experimentally investigate the stability of single and multi-pulse normal group-velocity dispersion Kerr-combs in coupled-resonators. We show implementation of a drop-port is critical for suppressing parasitic modulation instability and accessing stable modelocked states.

FTh4F.3 • 16:00

High brightness coherently driven active fiber cavity soliton crystals by optical gain clamping, Corentin J. Simon[1], Nicolas Englebert[1], François Leo[1], Simon-Pierre Gorza[1]; [1]*Universite Libre de Bruxelles, Belgium.* Active cavity solitons suffer from gain saturation preventing high average cavity power. We overcome this limitation by optical gain clamping and demonstrate the generation of numerous solitons, opening the way to high power soliton crystals.

FTh4F.4 • 16:15

Counter-propagating Solitons in Coupled Ring Microresonators, Yan Yu[1], Jinhao Ge[1], Maodong Gao[1], Zhiquan Yuan[1], Warren Jin[2,3], Joel Guo[2], Hao-Jing Chen[1], Qingxin Ji[1], Avi Feshali[3], Mario Paniccia[3], John Bowers[2], Kerry Vahala[1]; [1]*California Inst. of Technology,* *USA; [2]Univ. of California, Santa Barbara, USA; [3]Anello Photonics, USA.* Counter-propagating solitons are generated in CMOS-ready coupled microresonators featuring normal dispersion. In each direction, the soliton mode locks and compensates the dispersion through the formation of a pulse pair. Both the spectra and the radiofrequency beatnotes of counter-propagating solitons are observed.

FTh4F.5 • 16:30 (Invited)
Experimental simulations of Post-Newtonian Schrodinger dynamics with nonlocal nonlinearities, Rivka Bekenstein[1], Omer Paz[1], Yonatan Ben Haim[1], Shay Rakia[1]; *[1]Physics, Hebrew Univ., Israel.* We simulate experimentally the post-Newtonian Schrodinger equation in a nonlocal nonlinear medium. We derive a novel equation by considering additional non-Newtonian terms and demonstrate new soliton solutions that are unique in their waveforms and energies.

FTh4F.6 • 17:00
Observation of New Class of Bright Solitons: Tower and Volcano Solitons, Michal Kwasny[2], Urszula Laudyn[2], Miroslaw Karpierz[2], Marek Trippenbach[4], David Hagan[1], Demetrios Christodoulides[3], Wieslaw Krolikowski[5], Pawel Jung[1,2]; *[1]CREOL, College of Optics and Photonics Univ. of Central Florida, USA; [2]Faculty of Physics, Warsaw Univ. of Technology, Poland; [3]Ming Hsieh Department of Electrical and Computer Engineering, Univ. of Southern California, USA; [4]Faculty of Physics, Univ. of Warsaw, Poland; [5]Laser Physics Centre, Research School of Physics, Australian National Univ., Australia.* We report the first experimental observation of a novel fundamental soliton class, termed Tower and Volcano solitons, in soft-matter systems characterized by nonlinear responses driven by competing nonlocal interactions.

FTh4F.7 • 17:15
Enhanced Frequency Combs via Self-Crystallizing Cavity Solitons, Graeme Campbell[2,1], Lewis J. Hill[1], Pascal Del'Haye[1,3], Gian-Luca Oppo[2]; *[1]Max Planck Inst. for the Science of Light, Germany; [2]Department of Physics, Univ. of Strathclyde, UK; [3]Department of Physics, Friedrich Alexander Univ. Erlangen-Nuremberg, Germany.* A “self-crystallization” phenomenon of dark vectorial temporal cavity solitons can occur in Fabry-Pérot resonators, with major applications in frequency comb generation. This phenomenon arises from the long-range interactions between symmetry-broken light fields with orthogonal polarizations.

15:30 -- 17:30
Room: W206B
ATh4G • Qubits and Quantum Sources
Presider: Garrett Cole; Thorlabs Inc., USA

ATh4G.1 • 15:30 (Invited)
NIST on a Chip – Embeddable Metrology for Advanced Technologies, Barbara Goldstein[1]; *[1]NIST, USA.* This talk provides an overview of the NIST on a Chip program, which leverages advances in photonics and quantum sensing to create a suite of embeddable, deployable devices that deliver precision metrology at point-of-use.

ATh4G.2 • 16:00

Coherent Optical Driving of a Superconducting Qubit with an Electro-Optic Transducer, Hana K. Warner[1], Jeffrey Holzgrafe[1,2], Beatriz Yankelevich[3], David Barton[1], Stefano Poletto[3], CJ Xin[1], Neil Sinclair[1], Di Zhu[1], Eyob Sette[3], Brandon Langley[3], Emma Batson[4], Marco Colangelo[4], Amirhassan Shams-Ansari[1], Graham Joe[1], Karl K. Berggren[4], Liang Jiang[5], Matthew Reagor[3], Marko Loncar[1]; *[1]Harvard Univ., USA; [2]Hyperlight Corporation, USA; [3]Rigetti Computing, USA; [4]Research Laboratory for Electronics, Massachusetts Inst. of Technology, USA; [5]Pritzker School of Molecular Engineering, Univ. of Chicago, USA.* We describe coherent optical control of a superconducting qubit with an electro-optic transducer as a step towards enabling optical interconnects between superconducting processor nodes.

ATh4G.3 • 16:15
Fabrication of All-to-All Transmon Superconducting Qubits for Scalable Quantum Information Processing, Haw-Tyng Huang[2], Yu-Huan Huang[1], Wei-Chen Lin[1,2], Sheng-Jie Kuo[1], Ching-Yeh Chen[1], Kai-Min Hsieh[1], Ming-Hsuan Ho[1,2], Yen-Hsiang Lin[1], Po-Chun Yeh[2], Chih-Ming Lai[2], Shyh-Shyuan Sheu[2]; *[1]Department of Physics, National Tsing Hua Univ., Taiwan; [2]Electronic and Optoelectronic System Research Laboratories, Industrial Technology Research Inst., Taiwan.* Wafer-scale fabrication of superconducting qubits with all-to-all connections has been demonstrated on 4-inch Si wafer. The wafer process results in the construction of four Transmon qubits, interconnected through transmission line terminated by a capacitive mirror.

ATh4G.4 • 16:30
Classical Gaussian Boson Samplers, Ned B. Goodman[1], Alexander Dellios[1], Peter Drummond[1]; *[1]Swinburne Univ. of Technology, Australia.* We use phase space simulations to find an accurate ground-truth describing Gaussian Boson Sampling experiments and to compare these experiments and classical samplers against that ground-truth. In addition, we introduce a novel competitive classical sampler.

ATh4G.5 • 16:45
Parallel Triggering of Quantum Emitters using Adiabatic Rapid Passage, Grant R. Wilbur[1], Ajan Ramachandran[1], Reuble Matthew[1], Jasleen Kaur Jagde[1], Palwinder Signh[1], Sabine O'neal[2], Dennis Deppe[2], Kimberley Hall[1]; *[1]Dalhousie Univ., Canada; [2]The College of Optics and Photonics, Univ. of Central FLorida, USA.* By the application of chirped laser pulses to ensembles of quantum dots, we demonstrate the simultaneous triggering of >10 quantum dots using adiabatic rapid passage.

ATh4G.6 • 17:00
Pulsed 780nm Diode-Pump Fiber-Based Entangled Photon Source, Andi Shahaj[1], Alexander Greenwood[1], Jackson Russett[1], Chiangjia Chen[1], Alexei Gladyshev[3], Peter Kazansky[2], Li Qian[1]; *[1]Univ. of Toronto, Canada; [2]Univ. of Southampton, UK; [3]Prokhorov General Physics Inst. of the Russian Academy of Sciences, Russian Federation.* We demonstrate a low-cost, fiber-based, pulsed entanglement source, using periodically-poled silica fiber and a pulsed 780nm diode laser, which generates ~1ns pulses of polarization-entangled photon pairs at up to 60MHz, 0.15 pairs/pulse

ATh4G.7 • 17:15
A Gigahertz-rate Source of Polarization-Entangled Photons using Type-0 PPLN Waveguides, Bienvenu Ndagano[1,2], Ruaridh Smith[1], Lewis Wright[3], Krish Pandiyan[3], Sarah

McCarthy[1], Ali Anwar[1], Corin Gawith[3,4], Loyd J. McKnight[1]; [1]*Fraunhofer Centre for Applied Photonics, UK;* [2]*Institut national de la recherche scientifique, Canada;* [3]*Covesion Ltd., UK;* [4]*Univ. of Southampton, UK.* We demonstrate a source of polarization-entangled photons based on periodically-poled lithium niobate waveguides that produces pairs of entangled photons at a rate of 1.25 gigahertz and a CHSH entanglement parameter of 2.73.

15:30 -- 17:30
Room: W207A
ATh4H • A&T Topical Review on Shaping the Future of Laser-Plasma Applications with Structured Light Fields III
Presider: Kyle Miller; Univ. of Rochester, USA

ATh4H.1 • 15:30 (Invited)
Spatiotemporal Optical Vortices (STOVs) and Laser-matter Interactions, Scott W. Hancock[1], Sina Zahedpour[1], Andrew T. Goffin[1], Howard M. Milchberg[1]; [1]*Univ. of Maryland at College Park, USA.* Light with orbital angular momentum orthogonal to propagation can exist in free space and as emergent structures integral to self-focused propagation. I will review our first observations, recent results on STOV-matter interactions, and possible applications.

ATh4H.2 • 16:00 (Invited)
The Ultrafast Flying-focus, Jeremy Pigeon[1], Philip Franke[2], Mervin Lim Pac Chong[1], Joseph Katz[1], Robert Boni[1], Christophe Dorrer[1], John Palastro[1,2], Dustin Froula[1,2]; [1]*Univ. of Rochester Laboratory for L, USA;* [2]*Univ. of Rochester, USA.* We present a femtosecond-class flying-focus laser pulse produced using an axiparabola-echelon pair. Spectral interferometric measurements and Fresnel integral simulations of the focal trajectory and pulse duration are presented. Next steps in flying-focus experiments are discussed.

ATh4H.3 • 16:30 (Invited)
Probing Strong Field Effects with Flying Focus Pulses, Martin Formanek[1], John Palastro[2], Dillon Ramsey[2], Antonino Di Piazza[3,2]; [1]*ELI Beamlines, The Extreme Light Infrastructure ERIC, Czechia;* [2]*Laboratory for Laser Energetics, USA;* [3]*Univ. of Rochester, USA.* We capitalize on the properties of “Flying Focus” (FF) pulses to accumulate signatures of strong field effects in laser-particle interactions, allowing experimental access at orders of magnitude lower laser powers and intensities.

ATh4H.4 • 17:00 (Invited)
Withdrawn

15:30 -- 17:30
Room: W206BC
STh4I • Approaches for Broadband Light Generation
Presider: Giedre Archipovaite; Novanta, UK

STh4I.1 • 15:30
Dual-Wavelength CW and CW mode-locked Cr:Colquirrite Lasers, Zekican Erturk[1], Muharrem Kilinc[2], Serdar Okuyucu[1], Yusuf Ozturk[1], Mikhail Pergament[2], Franz Kärtner[2], Umit

Demirbas[3]; [1]*Antalya Bilim Univ., Turkey;* [2]*Deutsches Elektronen-Synchrotron DESY, Germany;* [3]*Paul Scherrer Inst., Switzerland.* We show the versatile dual-wavelength operation of Cr:LiCAF and Cr:LiSAF lasers around 790 and 850 nm using diving optical-axis birefringent filters. In mode-locked regime, tunable synchronous two-color picosecond pulses with THz beating frequency are realized.

STh4I.2 • 15:45

Free Beam Propagation Multipass Cells for Post-Compression of High-Energy Laser Pulses, Vladimir Savichev[1], Takil Tarkan[1], Yong Wang[1], Jorge Rocca[1], Vladimir Chvykov[1]; [1]*SCU, USA.* Post-compression of high energy laser pulses by folded free propagation MPC in atmospheric air is presented. Proof-of-principle experiments demonstrate the ability of this scheme to compress the 0.1J-level energy pulses up to 10 times scalable.

STh4I.3 • 16:00

Fast, High-Resolution Image-Based Spatial Mapping of Phase-Matching Conditions in Nonlinear Crystals, Rhett Wampler[1], Christophe Dorrer[1]; [1]*Laboratory for Laser Energetics, USA.* Phase-matching conditions for second-harmonic generation in nonlinear crystals are spatially mapped by imaging the output of a scanned beam, producing results with higher resolution than an integrated-power, point-measurement approach while also improving scan time.

STh4I.4 • 16:15

Prediction of Laser Beam Spatial Profiles in a Multipass, High-Energy Laser Facility Using Deep Learning, Mark J. Guardalben[1], Jingtian Wang[2], Aradhya Mathur[2], Richa Yadav[2], Lakshmi N. Goduguluri[2]; [1]*Laboratory for Laser Energetics, Univ. of Rochester, USA;* [2]*Goergen Inst. for Data Science, Univ. of Rochester, USA.* A deep-learning model based on the U-Net architecture has been characterized for accuracy and speed to support real-time laser performance prediction in multipass, high-energy laser facilities, providing a prediction time of 1.3 ms.

STh4I.5 • 16:30

Robust Monolithic Meta-Optics for High-Power Laser Beam Shaping from Near-UV to Near-IR, Maria Beatriz Silva Oliveira[1], Pablo San Miguel Claveria[1], Patricia Estrela[1], Pedro Araujo[1], Marta Fajardo[1], Marco Piccardo[1]; [1]*Técnico Lisboa, Portugal.* We demonstrate monolithic fused silica metasurfaces enabling high-power laser beam shaping, offering robustness and unprecedented control at the single nanopillar level. They withstand extreme power densities, promising advancements in high-power *structured* laser-matter interactions.

STh4I.6 • 16:45

Ultra-high damage threshold optics for high energy and high average power lasers, Yurina Michine[1], Hitoki Yoneda[1]; [1]*Univ. of Electro-Communications, Japan.* By using new gas optics, high laser flux can be controlled with small UV laser energy. The damage threshold for 355nm is kept high so that 10kJ-3ω laser will be focused by only 3x3cm optics.

STh4I.7 • 17:00

Quantitative evaluation of the impact of individual optics in the PW laser stretcher on the contrast pedestal, Yunxin Tang[1], Dave Egan[2], Oleg Chekhlov[1], Steve Hawkes[1], Cristina Hernandez-Gomez[1], John Collier[1], Rajeev Pattathil[1]; [1]*STFC Rutherford Appleton Laboratory,* *UK; [2]The Orion Laser facility, AWE plc, UK.* We demonstrate the contrast pedestal enhancement by deploying a transmission grating. We report a method to quantitatively evaluate the impact of individual large optics in the stretcher on the contrast pedestal of high power lasers.

STh4I.8 • 17:15
Power Scaling Potential of Diode-Pumped Cr:LiCAF Slab Lasers to >10 W Level in Continuous-Wave Operation, Zekican Erturk[1], Muharrem Kilinc[2], Serdar Okuyucu[1], Yusuf Ozturk[1], Umit Demirbas[3]; *[1]Electrical and Electronics Engineering, Antalya Bilim Univ., Turkey; [2]Center for Free-Electron Laser Science CFEL, Deutsches Elektronen-Synchrotron DESY, Germany; [3]Paul Scherrer Inst., Switzerland.* We have experimentally and numerically investigated the power scaling capacity of diode edge-pumped Cr:LiCAF slab lasers employing low chromium doped samples and showed their potential to exceed 10 W output power level in continuous-wave operation.

15:30 -- 17:30
Room: W207D
STh4J • Fiber Fabrication and Characterization Techniques
Presider: To be Announced

STh4J.1 • 15:30 (Tutorial)
Optical Fiber Fabrication: Emerging Methods Such as 3D Glass Printing and Future Perspectives, Heike Ebendorff-Heidepriem[1]; *[1]Univ. of Adelaide, Australia.* This tutorial presents an overview and future perspectives of established and emerging technologies to fabricate fibre preforms from silica and soft glass, with focus on direct and indirect methods of 3D glass printing.

STh4J.2 • 16:30
Correlation of quantum efficiency to ion concentrations in Er:BaF_2 nanoparticle optical fiber, Jennifer Campbell[1], Mary Ann Cahoon[2], Michael A. Gachich[1], Michael Norlander[1], Alexander Pietros[1], Thomas W. Hawkins[2], John Ballato[2], Peter D. Dragic[1]; *[1]UIUC, USA; [2]Materials Science and Engineering, Clemson Univ., USA.* Highly Er concentrated Er:BaF_2 nanoparticle doped silica fibers exhibit subdued quenching effects and possess relatively high quantum efficiency (QE) (976 nm pumping). Investigations herein probe the change in QE with increasing Er concentration.

STh4J.3 • 16:45
Efficient diffraction-limited cladding-pumped ytterbium fiber laser at ~994nm, Monica T. Kalichevsky-Dong[1], Samuel Bingham[1], Thomas W. Hawkins[1], Peter D. Dragic[2], John Ballato[1], Liang Dong[1]; *[1]Clemson Univ., USA; [2]ECE, Univ. of Illinois at Urbana-Champaign, USA.* We demonstrate for the first time a diffraction-limited cladding-pumped ytterbium fiber laser at ~994nm with 41W output power, ~55% optical efficiency, and 1.8% quantum defect, opening new wavelengths of operation for cladding-pumped ytterbium fiber lasers.

15:30 -- 17:30
Room: W208
JTh4K • Symposium: 3-D Horizons in Photonics: Unraveling the Next Frontier of Integrated Circuits II
Presider: Yasha Yi; Univ. of Michigan, USA

JTh4K.1 • 15:30 (Invited)
Electronic-Photonic Interposers for 3D Integration, Colin McDonough[2,1]; [1]*SUNY Polytechnic Inst., USA;* [2]*AIM Photonics, USA.* The American Inst. for Manufacturing Integrated Photonics (AIM Photonics) has developed an electronic-photonic interposer platform to enable 3D co-integration of PICs and EICs. The benefits, challenges, and future of this platform will be discussed.

JTh4K.2 • 16:00 (Invited)
3D Ultralow-noise Laser Integration in Silicon Photonics, Chao Xiang[1]; [1]*The Univ. of Hong Kong, Hong Kong.* In this talk I'll showcase the recent discoveries in 3D integrated lasers with ultra-low-loss silicon nitride platform. Such structure, while maintaining the high performance of both active and passive elements, enables ultralow-noise and isolator-free lasers.

JTh4K.3 • 16:30 (Invited)
Designing Heterogeneously and Hybridly Integrated Photonic ICs, Pieter Dumon[1], Martin Fiers[1]; [1]*Luceda Photonics, Belgium.* We review challenges and solutions for the design of photonic ICs that use hybrid and heterogenous integration to combine subsystems and components in different materials. An integrated design flow allows for end-to-end PIC design.

15:30 -- 17:30
Room: W209A
FTh4L • Topological and Applied Nanophotonics
Presider: Yue Zhou; Yale Univ., USA

FTh4L.1 • 15:30
Hyperbolic Polariton Lenses For Sub-Diffractive Imaging, Enrico Maria Renzi[1,2], Simon Yves[1], Diana Strickland[1], Sveinung Erland[3], Eitan Bachmat[4], Andrea Alù[1,2]; [1]*Photonics Initiative, Advanced Science Research Center, City Univ. of New York, USA;* [2]*Physics Program, The Graduate Center, City Univ. of New York, USA;* [3]*Department of Maritime Studies, Western Norway Univ. of Applied Sciences, Norway;* [4]*Department of Computer Science, Ben-Gurion Univ. of the Negev, Israel.* We introduce the design of lenses for hyperbolic surface phonon polaritons operated in the mid-infrared range. Based on Minkowski space considerations, these lenses offer unbounded numerical aperture and can largely overcome the diffraction limit on resolution imaging.

FTh4L.2 • 15:45
Geometric Similarities and Topological Phases in Surface Magnon Polaritons, Chen Qian[1], Jicheng Jin[1], Thomas Christensen[2], Li He[1], Anthony Sigillito[1], Eugene John Mele[1], Bo Zhen[1]; [1]*Univ. of Pennsylvania, USA;* [2]*Department of Photonics and Electrical Engineering, Technical Univ. of Denmark, Denmark.* We investigate the properties of surface-magnon polaritons. Our theory predicts ways to strongly localize and enhance magnetic fields in the

microwave range and to develop compact and lossless connectors interconnecting waveguides with different effective impedances.

FTh4L.3 • 16:00
Plasmonics-engineered dispersive-dissipative modal couplings, Xiaoxiu Zhu[1], Xiao Xiong[1], Qi-Tao Cao[1], Zhendong Zhu[1], Wenjing Liu[1], Qihuang Gong[1], Yun-Feng Xiao[1]; *[1]Peking Univ., China.* We establish the phase diagram for the plasmonics-engineered couplings between whispering gallery modes, and experimentally demonstrate exotic phenomena with an integrated hybrid microresonator, including the engineered dissipative-dispersive couplings, and modal splitting at tens of gigahertz.

FTh4L.4 • 16:15
Schottky photodetectors for photonic integrated circuits with transparent conductive oxides, Jacek Gosciniak[1]; *[1]ENSEMBLE3, Poland.* Silicon photonics has many attractive features but faces a major issue: inefficient photodetection in the telecom range. The Schottky photodetectors address this problem, but their efficiency remains low. We suggest that by creating a junction between silicon and a transparent oxide a detection efficiency could increase by more than tenfold.

FTh4L.5 • 16:30
On-chip Terahertz Plasmonic Reflector, Shima Rajabali[1,2], Josefine Enkner[1], Erika Cortese[3], Mattias Beck[1], Simone De Liberato[3], Jerome Faist[1], Giacomo Scalari[1]; *[1]Physics, ETH Zurich, Switzerland; [2]School of Engineering and Applied Sciences, Harvard Univ., USA; [3]Physics and Astronomy, Univ. of Southampton, UK.* When resonators with deep subwavelength gaps couple to two-dimensional electron gases, propagating magnetoplasma waves cause energy leakage, hindering polaritonic resonances. This study introduces plasmonic reflectors, establishing an artificial energy stopband that confines terahertz-range magnetoplasmons, and restoring polaritonic resonances.

FTh4L.6 • 16:45
Ultralight Non-Toxic Plasmonic Paint, Mahdi Soudi[1], Pablo Cencillo-Abad[1], Debashis Chanda[1]; *[1]Univ. of Central Florida, USA.* Traditional pigment-based colors suffer from instability and toxicity. Introducing a self-assembled subwavelength plasmonic cavity, we offer a scalable and environmentally friendly platform for vivid structural colors, providing stand-alone paints that are the lightest in the world.

FTh4L.7 • 17:00 (Invited)
Nonlinear Topological Photonics, Bo Zhen[1]; *[1]Univ. of Pennsylvania, USA.* I will discuss the recent progress in the study of Floquet topological phases in driven nonlinear optical systems, covering both theoretical and experimental aspects.

15:30 -- 17:30
Room: W209B
STh4M • Laser and Light Source Integration II
Presider: Aseema Mohanty; Tufts Univ., USA

STh4M.1 • 15:30

Exceptional-Surface-Tailored Robust Microlaser, Kun Liao[1], Yangguang Zhong[2], Zhuochen Du[1], Guodong Liu[1], Chentong Li[1], Xianxin Wu[2], Chunhua Deng[3], Cuicui Lu[4], Xingyuan Wang[5], Che Ting Chan[6], Qinghai Song[3], Shufeng Wang[1], Xinfeng Liu[2], Xiaoyong Hu[1], Qihuang Gong[1]; *[1]Peking Univ., China; [2]National Center for Nanoscience and Technology, China; [3]Harbin Inst. of Technology Shenzhen, China; [4]Beijing Inst. of Technology, China; [5]Beijing Univ. of Chemical Technology, China; [6]The Hong Kong Univ. of Science and Technology, China.* We report a scalable strategy to realize a robust on-chip integrated microlaser source with simultaneous in-plane emission, linewidth compression, and pump energy utilization improvement based on different orders of exceptional surfaces (ESs).

STh4M.2 • 15:45
Sub-kHz-Linewidth and Wide-Tuning External Cavity Laser Based on Low-Loss Lithium Niobate Photonics, Renyou Ge[2], Bigeng Chen[2], Shaoliang Yu[2], Yannong luo[3], Shengqian Gao[1]; *[1]Sun Yat-Sen Univ., China; [2]Zhejiang Lab, China; [3]Guangxi Medical Univ., China.* We demonstrate a sub-kHz-linewidth laser on LNOI platform utilizing long delay and narrowband filtering. Lasing with high side mode suppression ratio above 60dB, wide tuning range of 80nm, and narrow linewidth of 270Hz are achieved.

STh4M.3 • 16:00
Self-Injection Locking to Mitigate the Impact of Chip-Scale Reflections in Hybrid-Integrated Quantum-Well Lasers, Omid Esmaeeli[1], Shangxuan Yu[1], Matthew Mitchell[2], Lukas Chrostowski[1,2], Sudip Shekhar[1]; *[1]Electrical and Computer Engineering, The Univ. of British Columbia, Canada; [2]Stewart Blusson Quantum Matter Inst., The Univ. of British Columbia, Canada.* We investigate the dynamics of quantum-well DFB lasers when they are hybrid-integrated via a photonic wire bond to a silicon photonic integrated circuit (PIC). By controlling the phase and amplitude of self-injection, the PIC stabilizes the laser.

STh4M.4 • 16:15
Low-noise Microwave Signal Generation by Heterodyning Two Narrow-linewidth Self-injection Locked Lasers, Yihao Fan[1], Siyu E[1], Yuyao Guo[1,2], Xinhang Li[1], Liangjun Lu[1,2], Shuxiao Wang[3,4], Yan Cai[3,4], Jianping Chen[1,2], Linjie Zhou[1,2]; *[1]Shanghai Jiao Tong Univ., China; [2]SJTU-Pinghu Inst. of Intelligent Optoelectronics, China; [3]Shanghai Inst. of Microsystem and Information Technology, China; [4]Shanghai Industrial μTechnology Research Inst., China.* We realize a hybrid integrated self-injection locking laser (SIL) with an ultra-narrow intrinsic linewidth of 5 Hz. With heterodyne synthesis using a pair of SILs, a microwave signal with a 4-kHz linewidth is achieved.

STh4M.5 • 16:30
Monolithic 50 GHz tunable microwave signal generation based on erbium-doped lithium niobate dual lasers, Minglu Cai[1], Xujia Zhang[1], Tianyi Li[1], Hao Shi[1], Tieying Li[1], Xianyi Cao[1], Zekun Cui[1], Jianping Chen[1], Kan Wu[1]; *[1]Shanghai Jiao Tong Univ., China.* The monolithic erbium-doped lithium niobate lasers can achieve a tunable wavelength range of 56.25 GHz and generate a 50 GHz microwave signal with a side-mode suppression ratio of 35 dB by dual lasers.

STh4M.6 • 16:45
Automated Tuning of an Integrated InP Laser Comprising an 8-arm Intra-Cavity Filter, Thomas Booij[1], Stefano Tondini[1], Tasfia Kabir[1], Marco Fattori[1], Eugenio Cantatore[1], Martijn J.

Heck[1]; [1]*Electrical Engineering, Eindhoven Univ. of Technology, Netherlands.* We demonstrate a tuning method for an InP integrated tunable laser based on stochastic optimization. A tuning range of 40 nm is attained when applied to a laser design comprising an 8-arm intra-cavity Mach-Zehnder Interferometer.

STh4M.7 • 17:00 (Invited)
Photonic Integrated Titanium Sapphire Laser, Yubo Wang[1], Yu Guo[1], Jorge Holguin-Lerma[1], Mattia Vezzoli[1], Hong Tang[1]; [1]*Yale Univ., USA.* We present a photonic integrated Ti:Sa laser on silicon-nitride-on-sapphire waveguide platform. Broadband Ti-Sa lasing is demonstrated in a single microring resonator with high modal confinement, reducing the lasing threshold by orders of magnitude.

15:30 -- 17:30
Room: W209C
JTh4N • Symposium: Photonics Meets Free-Electron Science III
Presider: Ido Kaminer

JTh4N.1 • 15:30 (Invited)
Accelerating Quantum Materials Development with Advances in Transmission Electron Microscopy, Jennifer Dionne[1]; [1]*Stanford Univ., USA.* Abstract not available.

JTh4N.2 • 16:00 (Invited)
Ultrafast Dephasing of Single Quantum Emitters in Hexagonal Boron Nitride Probed with Electron beams, Nahid Talebi[1]; [1]*Kiel Univ., Germany.* Defect centers in hexagonal boron nitride appear as room-temperature single-photon emitters. We unravel the phonon-mediated dephasing of the emitters, being at the order of 200 fs, using cathodoluminescence spectroscopy combined with electron-driven photon sources.

JTh4N.3 • 16:30 (Invited)
High Q photonic cavities probed by EEGS and EELS, Mathieu Kociak[1], Malo Bézard[1], Yves Auad[1], Jean-Denis Blazit[1], Paul Baroux[2], Eduardo Dias[3], Luiz Zagonel[4], Luiggi Ruggiero[1], Imène Mohand[2], Arthur Leroux[2], Luiz Tizei[1], Javier García de Abajo[3], Xavier Checoury[2], Odile Stéphan[2]; [1]*CNRS, France;* [2]*Université Paris Saclay, France;* [3]*ICFO, Spain;* [4]*Unicamp, Brazil.* We will present new tools, methods, theories and samples to measure high Q photonic cavities with free electrons

JTh4N.4 • 17:00 (Invited)
Coupling Free Electrons and Cavity Photons in a Transmission Electron Microscope, Germaine Arend[2,1], Armin Feist[2,1], Guanhao Huang[3,4], Yujia Yang[3,4], Jan-Wilke Henke[2,1], Arslan S. Raja[3,4], F. Jasmin Kappert[2,1], Rui N. Wang[3,4], Hugo Lourenco-Martins[2,1], Zheru Qiu[3,4], Junqiu Liu[3,4], Ofer Kfir[2,1], Tobias J. Kippenberg[3,4], Claus Ropers[2,1]; [1]*Georg-August Univ. Göttingen, Germany;* [2]*Max Planck Inst. for Multidisciplinary Sciences, Germany;* [3]*Swiss Federal Inst. of Technology Lausanne (EPFL), Switzerland;* [4]*Center for Quantum Science and Engineering, EPFL, Switzerland.* We couple free electrons to the optical modes of a photonic microring resonator. Inelastic electron scattering leads to the generation of cavity photons, correlated to the electrons in time and energy loss

15:30 -- 17:30
Room: W209DE
STh4O • Highly Coherent Semiconductor Lasers
Presider: Stephan Reitzenstein; Technische Universität Berlin, Germany

STh4O.1 • 15:30
Linewidth Compression of a Widely Tunable Hybrid Laser Through High-Q Resonance Feedback, Siyu E[1], Xinhang Li[1], Yuyao Guo[1,2], Yihao Fan[1], Minhui Jin[1,2], Yu Li[1,2], Anton Stroganov[3], Liangjun Lu[1,2], Jianping Chen[1,2], Linjie Zhou[1,2]; *[1]Shanghai Jiao Tong Univ., China; [2]SJTU-Pinghu Inst. of Intelligent Optoelectronics, China; [3]LIGENTEC SA, Switzerland.* We present a III-V/Si3N4 widely tunable hybrid laser with an intrinsic linewidth of 50 Hz by using a resonance feedback from a high-Q ring resonator. The linewidth is reduced by approximately 24 fold.

STh4O.2 • 15:45
High-power photonic-crystal surface-emitting lasers with 1-kHz-class intrinsic linewidths, Ryohei Morita[1], Takuya Inoue[1], Masahiro Yoshida[1], Menaka D. Zoysa[1], Kenji Ishizaki[1], Susumu Noda[1]; *[1]Kyoto Univ., Japan.* We report theoretical and experimental results on intrinsic spectral linewidths of 1-mm-diameter PCSELs under continuous-wave operation, and we demonstrate 1-kHz-class intrinsic spectral linewidths with 5-W-class output power.

STh4O.3 • 16:00
104 Hz Linewidth, Self-Injection Locked, Chip Scale NIR Laser, Scott Madaras[1], Andrew Starbuck[1], Douglas C. Trotter[1], Andrew S. Pomerene[1], Thomas A. Friedmann[1], Matthew S. Boady[1], William M. Martinez[1], Nils T. Otterstrom[1], Weng W. Chow[1], Erik J. Skogen[1], Michael Gehl[1]; *[1]Sandia National Laboratories, USA.* Self-injection locking is induced via low-loss Si_3N_4 ring coupled to a III/V DBR laser, achieving intrinsic linewidths of 103.8Hz. The injection locked laser shows 3 orders of magnitude improvement in linewidth versus the free running state.

STh4O.4 • 16:15
Integrated Brillouin laser in 4-meter-coil resonator realizing 40 mW output power and 31 mHz fundamental linewidth, Kaikai Liu[1], Daniel J. Blumenthal[1]; *[1]UC Santa Barbara, USA.* We report a Brillouin laser in a photonic integrated ultra-high-Q 4-meter-coil waveguide resonator realizing 40 mW output power and 31 mHz fundamental linewidth.

STh4O.5 • 16:30
Narrow linewidth Chip-Scale InP-PIC Mode-locked Laser enabled by Filtering and Self-injection locking with a Fabry-Perot Etalon, Srinivas Varma Pericherla[1], Lawrence Trask[1], Chinmay Shirpurkar[1], Peter Delfyett[1]; *[1]Univ. of Central Florida, USA.* We report an InP-PIC based mode-locked laser self-injection locked to a Fabry-Perot Etalon, demonstrating an optical linewidth enhancement from 600 MHz to 6 MHz, 50x RF linewidth reduction and an Allan-Deviation of 4.5x10−11 at 1s.

STh4O.6 • 16:45
Thermally Shunted Heterogeneously Integrated DFB Laser Arrays Spanning O- and C-band Wavelengths, Ashok Kodigala[1], Courtney L. Sovinec[1], William M. Martinez[1], Nathan

Henry[1], Christina M. Dallo[1], Erica Calman[1], Patrick Finnegan[1], Shawn C. Arterburn[1], Thomas A. Friedmann[1], Andrew S. Pomerene[1], Andrew Starbuck[1], Douglas C. Trotter[1], Anthony L. Lentine[1]; [1]*Sandia National Laboratories, USA.* We demonstrate continuous-wave thermally-shunted heterogeneously integrated (HI) single-mode distributed feedback (DFB) laser arrays on IIIV-on-Si platform at O- and C-band wavelengths presenting 4X improvement in thermal impedance and realized with first-order quarter-wave shifted Bragg gratings.

STh4O.7 • 17:00 (Invited)
Highly Coherent Diode Lasers for Quantum Technologies, Christian Noelleke[1]; [1]*TOPTICA Photonics AG, Germany.* High-coherent lasers are key components for the control of quantum systems such as ion-based quantum computers. We will discuss the next generation of diode lasers that will enable the shift of laboratory demonstrators towards real-world applications.

15:30 -- 17:30
Room: W209F
STh4P • Photonic Crystals
Presider: Shota Kita; NTT Basic Research Laboratories, Japan

STh4P.1 • 15:30 (Tutorial)
Topological Photonics in Semiconductor Photonic Crystal Platforms: Potential and Challenges, Satoshi Iwamoto[1]; [1]*Univ. of Tokyo, Japan.* Various photonic crystal devices exploiting topologically-defined modes have been intensively studied. We overview the recent progress on topological photonic crystal devices, particularly topological waveguides, and discuss the potential applications and future challenges.

STh4P.2 • 16:30
Subwavelength-engineered Antislot Photonic Crystals in a Silicon Photonics Foundry for On-chip Communications, Kellen P. Arnold[1], Joshua Allen[1], Sami Halimi[2], Landen Ryder[3,2], Francis Afzal[4], Yusheng Bian[4], Abdelsalam Aboketaf[4], Takako Hirokawa[4], Kevin Dezfulian[4], Michal Rakowski[4], Rod Augur[4], Karen Nummy[4], Sharon Weiss[2,1]; [1]*Interdisciplinary Materials Science, Vanderbilt Univ., USA;* [2]*Electrical and Computer Engineering, Vanderbilt Univ., USA;* [3]*Code 561, NASA Goddard Space Flight Center, USA;* [4]*GlobalFoundries, USA.* We report scalable foundry fabrication and characterization of photonic crystal nanobeam waveguides incorporating subwavelength-scale dielectric antislot unit cells. This work enables enhanced light-matter interaction and three-fold improvement in $V_{\pi}L$ when incorporated in Mach-Zehnder modulators.

STh4P.3 • 16:45
Constraint immune design of ultrahigh-*Q* silicon photonic crystal nanocavities, Eiichi Kuramochi[1], Shota Kita[1], Akihiko Shinya[1], Masaya Notomi[1,2]; [1]*NTT Corporation, Japan;* [2]*Physics, Tokyo Inst. of Technology, Japan.* We reveal that to setting *r/a* to ~0.2 makes L3 nanocavity easier more easily to haveing a higher theoretical *Q* factor and experimentally immune to fabrication errors such as sidewall roughness.

STh4P.4 • 17:00
Robust Low-loss Topological Photonic Crystal Waveguides, Masudur Rahim[1], Heijun Jeong[1], Yahui Xiao[1], Tingyi Gu[1]; [1]*Univ. of Delaware, USA.* We observe ultra-low propagation

and coupling loss (<2dB) in topological photonic crystal waveguide with integrated metalens coupling.

STh4P.5 • 17:15

All-Optical Switching Based on Silicon Nanocavities Boosted by Two-Dimensional Semiconductors, Daiki Yamashita[1,2], Nan Fang[1], Shun Fujii[1,3], Yuichiro K. Kato[1]; *[1]RIKEN, Japan; [2]National Inst. of Advanced Industrial Science and Technology (AIST), Japan; [3]Keio Univ., Japan.* We propose and demonstrate hybrid all-optical switching devices that combine silicon nanocavities and two-dimensional semiconductor materials, successfully overcoming the intrinsic switching speed limitation of silicon while maintaining low switching energy.

15:30 -- 17:30
Room: W210
STh4Q • Microwave Photonics Systems and Subsystems
Presider: Jason McKinney; Purdue Univ., USA

STh4Q.1 • 15:30

Feedback control in RF photonic transversal filter systems based on optical microcombs, Yang Li[1], Jiayang Wu[1], Yang Sun[1], Guanghui Ren[2], Mengxi Tan[3,2], Xingyuan Xu[4], Bill Corcoran[5], Sai CHU[6], Brent Little[7], Roberto Morandotti[8], Arnan Mitchell[2], David Moss[1]; *[1]Swinburne Univ. of Technology, Australia; [2]RMIT Univ., Australia; [3]Beihang Univ., China; [4]Beijing Univ. of Posts and Telecommunications, China; [5]Monash Univ., Australia; [6]City Univ. of Hong Kong, Hong Kong; [7]QXP Technology Inc., China; [8]INRS, Canada.* We propose and experimentally demonstrate four different feedback control methods employed in microcomb-based RF photonic transversal filter systems to enhance their accuracy and stability. Detailed characterizations are carried out to compare the performance of different methods.

STh4Q.2 • 15:45

Maximizing the accuracy of microcomb-based microwave photonic transversal signal processors, Yang Sun[1], Jiayang Wu[1], Yang Li[1], Guanghui Ren[2], Mengxi Tan[8,2], Xingyuan Xu[3], Bill Corcoran[4], Sai CHU[5], Brent Little[6], Roberto Morandotti[7], Arnan Mitchell[2], David Moss[1]; *[1]Swinburne Univ. of Technology, Australia; [2]RMIT Univ., Australia; [3]Beijing Univ. of Posts and Telecommunications, China; [4]Monash Univ., Australia; [5]City Univ. of Hong Kong, Hong Kong; [6]QXP Technology Inc., China; [7]INRS, Canada; [8]Beihang Univ., China.* We experimentally implement microcomb-based microwave photonic transversal signal processors and test their accuracy for differentiation, integration, and Hilbert transform. A global picture quantifying the impact of different error sources on the overall performance is provided.

STh4Q.3 • 16:00

Demonstration of Reconfigurable Microring-Based Silicon Optical Switch for Optical Fronthaul, Bohao Sun[1], Tongyun Li[1], Huiyu Huang[1], Qixiang Cheng[1], Richard Penty[1]; *[1]Univ. of Cambridge, UK.* We demonstrate an 8×8 optical fronthaul switching system that combines real-time data and control functions. It attains >40dB RF and >10dB optical dynamic range, facilitating both switching and multicasting within a single silicon switch fabric.

STh4Q.4 • 16:15

Stable Unidirectional Two-way Radio Frequency Transfer over 185 km Outdoor Optical Cable Based on Dual-PLL, Jiahui Cheng[1], Hao Gao[1], Yaojun Qiao[1], Zhuoze Zhao[1], Jiameng Dong[1], Bin Luo[1], Song Yu[1]; [1]*Beijing Univ of Posts & Telecom, China.* We design a novel phase-locked loop and demonstrate stable unidirectional two-way radio frequency transfer over 185 km outdoor optical cable based on dual-PLL. The fractional frequency stability of the received signal approaches 1.18×10^{-14}@1 s and 1.63×10^{-15}@10000 s.

STh4Q.5 • 16:30

Measuring and processing partially coherent light with self-configuring optics, Charles Roques-Carmes[1], Shanhui Fan[1], David Miller[1]; [1]*Stanford Univ., USA.* We show that self-configuring optical networks can analyze partially incoherent light. We consider the case of N spatial input channels and present a power-optimization method to measure their coherency matrix.

15:30 -- 17:30
Room: W211
STh4R • Photonic Integrated Solid State Systems
Presider: To be Announced

STh4R.1 • 15:30 (Invited)

Investigation of Quantum Emitters for Spin Control and Machine Learning, Valeria Saggio[1], Dirk Englund[1]; [1]*Massachusetts Inst. of Technology, USA.* I will discuss the properties of quantum emitters with a focus on spin control. I will also show applications of machine learning algorithms exploiting the spin properties of such systems.

STh4R.2 • 16:00

Heterogeneous Integration of Solid-state Quantum Systems with Silicon Foundry Microelectronics, Hao-Cheng Weng[1], Sofiia Komrakova[1], Jonathan C. Matthews[1], John G. Rarity[1], Krishna C. Balram[1], Joe A. Smith[1]; [1]*Quantum Engineering Technology Labs, H. H. Wills Physics Laboratory and Department of Electrical and Electronic Engineering, Univ. of Bristol, UK.* Site-defined electron spin control is demonstrated by heterogeneous integrating NV centres in nanodiamond with silicon foundry microelectronics. Rabi oscillations indicates fifty times lower power consumption compared to addressing with an external microwave antenna.

STh4R.3 • 16:15

Sawfish photonic crystal cavities with resonances at NV and SnV transition frequencies, Marco E. Stucki[1,2], Tommaso Pregnolato[1,2], Julian M. Bopp[2,1], Maarten H. v. d. Hoeven[2], Alok Gokhale[2], Olaf Krüger[1], Tim Schroder[2,1]; [1]*Ferdinand-Braun-Institut gGmbH, Germany;* [2]*Department of Physics, Humboldt-Universität zu Berlin, Germany.* We present the fabrication and characterization of “Sawfish” cavities in diamond, a new design of resonant photonic nanostructures to increase the emission rate of color centers into the zero-phonon-line, a requirement for efficient quantum communication.

STh4R.4 • 16:30

An on-chip platform for multi-degree-of-freedom control of two-dimensional quantum and nonlinear materials, Haoning Tang[1], Yiting Wang[1], Xueqi Ni[1], Kenji Watanabe[2], Takashi Taniguchi[2], Shanhui Fan[3], Eric Mazur[1], Amir Yacoby[1], Yuan Cao[4]; [1]*Harvard Univ.,*

USA; [2]National Inst. for Materials Science, Japan; [3]Stanford, USA; [4]Univ. of California, Berkeley, USA. We introduce the first on-chip, microelectromechanical system for the in situ tuning of twisted 2D materials, enabling tunable interfacial properties, synthetic topological singularities, and adjustable-polarization light sources for advanced quantum material manipulation in 2D-3D devices.

Friday, 10 May

08:00 -- 10:00
Room: W201AB
SF1A • Sensing with Novel Materials
Presider: Nathan Tyndall, USA

SF1A.1 • 08:00
Integrated Magnetic Field Camera Based on Infrared Absorption ODMR Mediated by Diamond NV Centers, Julian M. Bopp[1,2], Hauke Conradi[3], Felipe Perona[2], Anil Palaci[1], Jonas Wollenberg[1], Thomas Flisgen[2], Armin Liero[2], Heike Christopher[2], Norbert Keil[3], Wolfgang Knolle[4], Andrea Knigge[2], Wolfgang Heinrich[2], Moritz Kleinert[3], Tim Schroder[1,2]; *[1]Department of Physics, Humboldt-Universität zu Berlin, Germany; [2]Ferdinand-Braun-Institut gGmbH, Leibniz-Institut für Höchstfrequenztechnik, Germany; [3]Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, Germany; [4]Leibniz-Institut für Oberflächenmodifizierung e.V., Germany.* Life sciences demand for chip-integrated, fiber-packaged magnetic field cameras to image pulses propagating along nerves. For the first time, we propose and demonstrate such a magnetic field camera employing diamond NV infrared absorption ODMR.

SF1A.2 • 08:15
Fabry-Perot Cavity Assembled on Terfenol-D Slab for High-Resolution Magnetic Field Measurement, Yucheng Yao[1], Zhiyong Zhao[1], Jun-bo Han[1], Jing Liu[1], Shuyan Chen[1], Zhuyixao Liu[1], Ming Tang[1]; *[1]Huazhong Univ. of Science and Technology, China.* By utilizing a microwave photonics-interrogated Fabry-Perot interferometer fabricated on a Terfenol-D slab, an ultra-high resolution magnetic field sensor is achieved with a maximum sensitivity of 4.6 MHz/mT, and a resolution of 54 μT.

SF1A.3 • 08:30
Tactile Sensing at Cryogenic Temperatures Using MichTac Sensors Based on GaN Nanopillar LEDs, Nathan A. Dvorak[1], Pei-Cheng Ku[1]; *[1]Univ. of Michigan, USA.* Experiments successfully established the feasibility of a nanopillar-LED-based tactile sensor showing tactile perception at extremely cold temperatures.

SF1A.4 • 08:45
Using Colorimetric Compounds in Integrated Optical Refractive Index Sensors, Marc de Cea Falco[1], Jaehwan Kim[1], Rajeev J. Ram[1]; *[1]Massachusetts Inst. of Technology, USA.* We show that the use of colorimetric compounds in integrated optical refractometric sensors can enhance the response to the presence of analytes of interest by virtue of the Kramers-Konig relations.

SF1A.5 • 09:00
Lensless microimaging via a multimode fiber probe based on compression sampled speckles, Lele Wang[1], Yiwei Zhang[1], Dan Li[1], Ping Yan[1], Qirong Xiao[1]; *[1]Tsinghua Univ., China.* The all-fiber lensless microimaging scheme was experimentally demonstrated for the first time. Natural scenes reconstruction and distance detection are implemented with dual networks and partially diffuse speckles. Highly integrated structure is suitable for implantable micro-endoscopes.

SF1A.6 • 09:15
Spatiotemporally Resolved Dual-band Hyperchromatic Structural Color with a Mesoporous Metamaterial, Nithesh Kumar[1], Estevao Marques Dos Santos[1], Tahmid Talukdar[1], Judson R. Ryckman[1]; [1]*Clemson Univ., USA.* We present an approach to achieve highly responsive structural color utilizing dual-band porous silicon rugate filter metamaterials combined with dichromatic laser illumination. Spatiotemporally resolved sensing experiments are reported.

SF1A.7 • 09:30
Single-arm Interferometric Plasmonic Sensor integrated on a cladded polymeric photonic platform, Konstantinos Fotiadis[1], Lamprini Damakoudi[1], Stelios Simos[1], Evangelia Chatzianagnostou[1], Dimosthenis Spasopoulos[1], Dimitris Bellas[2], Omkar Bhalerao[3,4], Stephan Suckow[4], Max Lemme[3,4], Elefterios Lidorikis[2], Nikos Pleros[1]; [1]*Computer Science Department, Aristotle Univ. of Thessaloniki, Greece;* [2]*Univ. of Ioannina, Greece;* [3]*Aachen Univ., Germany;* [4]*AMO GmbH, Germany.* We demonstrate a high-sensitivity single-arm interferometric plasmo-photonic refractive index sensor co-integrated for the first time on a cladded SU-8 polymer waveguide platform, reporting a low-complexity and low-cost sensor with an experimental sensitivity of 6069 nm/RIU.

SF1A.8 • 09:45
Active Optical Chiral Nanocavity through MEMS-integrated Twisted Bilayer Photonic Crystals, Fan Du[2], Guangqi Gao[2], Mingjie Zhang[2], Beicheng Lou[1], Xueqi Ni[2], Yuan Liu[2], Shanhui Fan[1], Yuan Cao[3], Eric Mazur[2], Haoning Tang[2]; [1]*Stanford Univ., USA;* [2]*Harvard Univ., USA;* [3]*Univ. of California, Berkeley, USA.* We experimentally demonstrate MEMS-integrated bilayer photonic crystals with tunable intrinsic chirality. By controlling the interlayer gap and twist angle between the two photonic crystal layers, the circular dichroism varies from 0 to 0.85.

08:00 -- 10:00
Room: W201CD
AF1B • Machine Learning and Numerical Simulations for Biophotonics
Presider: David Nolte; Purdue Univ., USA

AF1B.1 • 08:00
Accurate identification of bacteria in a minimally prepared environment using Raman spectroscopy assisted by machine learning, Benjamin L. Thomsen[1], Jesper B. Christensen[1], Thomas Emil Andersen[2], Mikael Lassen[1]; [1]*Danish Fundamental Metrology, Denmark;* [2]*Department of Clinical Research, Univ. of Southern Denmark, Denmark.* Raman spectroscopy is a promising tool for bacterial identification. However, to take full advantage of Raman machine learning is a necessary tool. We present a novel and more accurate machine learning algorithm for bacteria identification.

AF1B.2 • 08:15
Enhanced Light Control in Transmission and Reflection through a Dynamically Deformed Multimode Fiber with Deep Learning, Pengfei Fan[1,3], Yufei Wang[1], Michael Ruddlesden[1], Chao Zuo[2], Lei Su[1]; [1]*Queen Mary Univ. of London, UK;* [2]*Nanjing Univ. of Science and Technology, China;* [3]*Xi'an Jiaotong-Liverpool Univ., China.* We present a continual deep-learning framework for characterizing a dynamically deformed multimode fiber (MMF). It enables

real-time self-adaptive focus control using transmission and reflection synchronously, addressing challenges like imaging system drift and fiber distal access.

AF1B.3 • 08:30
Neural network uncertainty quantification in inverse imaging problems using cycle consistency, Luzhe Huang[1], Jianing Li[1], Xiaofu Ding[1], Yijie Zhang[1], Hanlong Chen[1], Aydogan Ozcan[1]; *[1]Univ. of California, Los Angeles, USA.* We present an uncertainty quantification method for neural networks solving inverse imaging problems. We leverage the physical forward model to establish forward-backward cycles to quantify inference uncertainty and detect out-of-distribution data in computational imaging tasks.

AF1B.4 • 08:45
Virtual histological staining of label-free autopsy tissue sections via deep learning, Yuzhu Li[1], Nir Pillar[1], Jingxi Li[1], Tairan Liu[1], Di Wu[1], Songyu Sun[1], Guangdong Ma[1], Kevin de Haan[1], Luzhe Huang[1], Yijie Zhang[1], Sepehr Hamidi[1], Anatoly Urisman[2], Tal K. Haran[3], William D. Wallace[4], Jonathan E. Zuckerman[1], Aydogan Ozcan[1]; *[1]UCLA, USA; [2]UCSF, USA; [3]Hadassah Hebrew Univ. Medical Center, Israel; [4]USC, USA.* We present deep learning-based virtual staining of label-free autopsy tissue sections, eliminating severe autolysis-induced artifacts caused by delayed fixation inherent in traditional histochemical H&E staining.

AF1B.5 • 09:00
Virtual staining-based diagnosis of organ transplant rejection, Yuzhu Li[1], Nir Pillar[1], Tairan Liu[1], Guangdong Ma[1], Kevin de Haan[1], Yijie Zhang[1], Adrian J. Correa[2], Yulun Wu[1], Bijie Bai[1], Xilin Yang[1], Yuxuan Qi[1], William D. Wallace[2], Aydogan Ozcan[1]; *[1]UCLA, USA; [2]USC, USA.* We present deep learning-based virtual staining of unlabeled lung and heart tissue sections to diagnose organ transplant rejection, achieving comparable diagnostic accuracy to histochemical staining methods, while significantly reducing staining-related time, cost and labor.

AF1B.6 • 09:15
An innovative deep learning-empowered paradigm for precise biological sample quantification, Yuanyuan Wei[1], Wu Yuan[1], Ho-Pui Ho[1]; *[1]The Chinese Univ. of Hong Kong, Hong Kong.* We present an innovative deep learning-aided paradigm that enables real-time and automated detection and classification of GFP (Green fluorescence protein)-labeled microreactor, overcoming the limitations of conventional methods.

AF1B.7 • 09:30
Streamlined lightsheet deconvolution for ultra-wide diagonally-scanned samples, Tom Vettenburg[1], Laurynas Valantinas[1]; *[1]Univ. of Dundee, UK.* The large bandwidth of lightsheet microscopy acquisition is a challenge for digital image processing. Off-line processing breaks the experimental feedback loop. We demonstrate an efficient, streamlined, deconvolution algorithm for translation-variant lightsheet, capable of on-the-fly deconvolution.

AF1B.8 • 09:45
The impact of the spatial heterogeneity of pigmented tissues on the multiphoton microscopy imaging performance, Nitin Y. Dubey[1], Chris Xu[1]; *[1]Cornell Univ., USA.* We study the effect of randomly distributed absorbing tissue on the surface of the sample in multiphoton microscopy. Through numerical simulation, the signal-to-background ratio and point spread function of the system are investigated.

08:00 -- 10:00
Room: W204AB
FF1C • Ultrafast Spectroscopy of Charge Dynamics in Oxides and Nanostructures
Presider: Daniel Suarez Forero; Univ. of Maryland, USA

FF1C.1 • 08:00 (Invited)
Manipulating magnetization and polarization by resonant excitations, Wanzheng Hu [1]; *[1]Boston Univ., USA.* I will present two cases in which we use nonlinear phononic rectification and resonant optical excitations to manipulate magnetization and ferroelectric polarization, and to create novel quantum phases beyond what may be possible in equilibrium.

FF1C.2 • 08:30
Withdrawn

FF1C.3 • 08:45
Ultrafast Charge Carrier Separation in InGaN Photocatalytic Nanostructures, Yifan Shen[1], Josey Hanish[1], Ishtiaque A. Navid[1], Yuyang Pan[1], Zetian Mi[1], Theodore Norris[1]; *[1]Univ. of Michigan, USA.* A combination of time-resolved photoluminescence and differential reflection spectroscopy reveals highly efficient nanoscale separation of photoinjected electrons and holes in different types of InGaN nanostructures, enabling high-efficiency photocatalysis.

FF1C.4 • 09:00
Non-equilibrium Inter-site Dynamics of Photoexcited Kitaev α-Li_2IrO_3, Hui-Yuan Chen[1]; *[1]EPFL, Switzerland.* The inter-site transition dynamics in a 2D honeycomb lattice of the Mott-insulator Li2irO3 were investigated via broadband time-resolved spectroscopy. Through two excitation regimes, distinct inter-site transition dynamics were revealed and attributed to the distinct photoexcited quasiparticles, i.e., doublon and holon, in the 2D honeycomb lattice.

FF1C.5 • 09:15
Generation of Superfluorescence from Multiexcitons Confined in Semiconductor Quantum Dots, Gen Fujioka[1], Yuki Otani[1], Xi YU[1], Kensuke Miyajima[1]; *[1]Tokyo Univ. of Science, Japan.* Superfluorescences from triexcitons and biexcitons confined in semiconductor quantum dots were observed by time-resolved photoluminescence measurements. Superfluorescence of the triexcitons shows a shorter pulse width and a broader spectral width than that of the biexcitons.

FF1C.6 • 09:30
Spectral splitting and enhanced emission rate in X-ray-driven scintillation from perovskite quantum dots, Shaul Katznelson[1], Shai Levy[1], Alexey Gorlach[1], Offek Tziperman[1], Roman Schütz[1], Rotem Strassberg[1], Georgy Dosovitsky[1], Yehonadav Bekenstein[1], Charles Roques-Carmes[2], Ido Kaminer[1]; *[1]Technion - Israel Inst. of technolog, Israel; [2]Stanford, USA.* We observe record-fast X-ray-induced light emission (scintillation) from perovskite quantum dots, a long-sought characteristic in time-of-flight radiation detectors. This fast emission is correlated with spectral.

FF1C.7 • 09:45
Interferometry Among Strongly Driven Quasiparticles with Distinct Dynamical and Geometrical Phases, James D. O'Hara[2,1], Joseph Costello[1], Qi Tian[2], Qile Wu[2], Kenneth

West[3], Loren N. Pfeiffer[3], Mark Sherwin[2], Liang Wu[2]; [1]*Department of Physics, UCSB, USA; [2]Physics, Univ. of Pennsylvania, USA; [3]Electrical and Computer Engineering, Princeton, USA.* We present polarization data of sidebands emitted from strongly driven quasiparticles, demonstrate the dependence of these data on various parameters of the external driving field, and describe the data using an analytical expression.

08:00 -- 10:00
Room: W205AB
AF1D • Optical Metrology and Wavefront Sensing
Presider: To be Announced

AF1D.1 • 08:00
Highly accurate measurements of electro-optic coefficients based on transmission Teng and Man ellipsometric method, Yasufumi Enami[1]; [1]*Nagasaki Univ., Japan.* We measure highly accurate electro-optic (EO) coefficient for EO polymers using a transmission method, overcoming the limitations of the Teng and Man reflection ellipsometric method and enhancing reliability and accuracy in EO research.

AF1D.2 • 08:15
Withdrawn

AF1D.3 • 08:30
Measuring the Spherical Curvature Radius Based on Optical Fractional Fourier Transform, Wen-Xiu Dong[1,2], Hong-Tao Wei[1,2], Ming-Feng Lu[1,2], Jin Hu[1,2], Yan Zhang[3], Yi-Xiao Yang[1,2], Jin-Min Wu[1,2], Feng Zhang[1,2], Ran Tao[1,2]; [1]*School of Information and Electronics, Beijing Inst. of Technology, China; [2]Beijing Key Laboratory of Fractional Signals and Systems, China; [3]Department of Physics, Capital Normal Univ., China.* The optical measurement of the spherical curvature radius can be converted to the detection of the chirpiness of a chirp signal, thus can be realized by the optical fractional Fourier transform with chirp-basis.

AF1D.4 • 08:45
High-Accuracy Simultaneous Measurement of Spectrum and Full-Stokes Polarization Based on Speckle Pattern, Qianyu Zhou[1], Yangyang Wan[1], Xinyu Fan[1], Zuyuan He[1]; [1]*State Key Laboratory of Advanced Optical Communication Systems and Networks, Shanghai Jiao Tong Univ., China.* The computational spectropolarimeter is demonstrated for the first time using speckle patterns obtained from a multi-mode fiber, with 100-pm spectral resolution, 30-nm bandwidth and a polarization measurement error of 5.3×10^{-5}.

AF1D.5 • 09:00
Rapid M^2 Estimates Using a Reverse HOBBIT System, Vincent W. Holsenback[1], Matthew Reid[1], J. Keith Miller[1], Eric G. Johnson[1]; [1]*Clemson Univ., USA.* A reverse Higher-Order Bessel Beam Integrated in Time (HOBBIT) system is used to estimate single-mode, 10 μm multimode, and 50 μm multimode fibers' output beam's M^2 factor in under 10 microseconds each.

AF1D.6 • 09:15
Simple Few-Shot Method for Spectrally Resolving the Wavefront of an Ultrashort Laser Pulse, Slava Smartsev[1], Aaron Liberman[2], Igor Andriyash[1], Antoine Cavagna[1], Alessandro

Flacco[1], Camilla Giaccaglia[1], Jaismeen Kaur[1], Josephine Monzac[1], Sheroy Tata[2], Aline Vernier[1], Victor Malka[2], Rodrigo Lopez-Martens[1], Jerome Faure[1]; *[1]Laboratoire d'Optique Appliquée, France; [2]Weizmann Inst. of Science, Israel.* We introduce a novel method for spatio-spectral characterization of ultrashort pulses. Our custom iterative algorithm, capable of color separation, retrieves phase information from speckles generated through a specialized pinhole mask.

AF1D.7 • 09:30
Stable Radio Frequency Transfer Based on Phase Modulation with Michelson Interferometer Demodulation, Qingwei Liu[1], Zhaohui Wang[1], Jiameng Dong[1], Hao Gao[1], Song Yu[1], Bin Luo[1]; *[1]State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ. of Posts and Telecommunications, China.* We experimentally demonstrate stable radio frequency transfer based on phase modulation and single port detection. Michelson interferometer is utilized for demodulation. Compared to the conventional intensity modulation scheme, the superior performance is obtained.

AF1D.8 • 09:45
Wideband RF Analysis with Rayleigh Backscattering, Matthew Murray[1], Joseph B. Murray[1], Ross Schermer[1], Jason D. McKinney[2], Brandon Redding[1]; *[1]U.S. Naval Research Laboratory, USA; [2]Elmore Family School of Electrical and Computer Engineering, Purdue Univ., USA.* We present an RF spectrum analyzer capable of monitoring a 15GHz band with MHz-level resolution and 385kHz update rate. We use Rayleigh-backscattering in single-mode fiber to produce frequency-dependent speckle patterns to recover the RF spectrum.

08:00 -- 10:00
Room: W205CD
AF1E • Integrated Photonics and Process Control
Presider: To be Announced

AF1E.1 • 08:00
Calibration-Free Thickness and Temperature Measurement of Oil Films Wetting a Spin Coater Using Absorption Spectroscopy, Matthias Bonarens[1], Gabriele Goet[1], Ariane Auernhammer[1], Clemens Hansemann[1], Steven Wagner[1]; *[1]Mechanical Engineering, Technical Univ. of Darmstadt, Germany.* The lack of measurement techniques for the investigation of oil films impedes the improvement of cooling strategies for electric drives. In this paper, broadband absorption spectroscopy is shown to enable calibration-free thickness and temperature measurements.

AF1E.2 • 08:15
Nonlinear Ultrafast Imaging for Defect Inspection in Silicon Carbide Wafers, Torben L. Purz[1], Steven T. Cundiff[2,1], Eric W. Martin[1]; *[1]MONSTR Sense Technologies, USA; [2]Physics, Univ. of Michigan, USA.* We demonstrate wafer-scale detection of defects in silicon carbide epitaxial layers and substrates using nonlinear imaging. Defects that alter the band structure appear in the nonlinear images; some are distinguishable by their ultrafast decay time.

AF1E.3 • 08:30

Overcoming Nanofabrication Variance in Photonic Crystal Cavities by Transfer Print Integration, Sean P. Bommer[1], Christopher Panuski[2], Benoit Guilhabert[1], Zhongyi Xia[1], Martin D. Dawson[1], Dirk Englund[2], Michael J. Strain[1]; *[1]Inst. of Photonics, Univ. of St, UK; [2]Massachusetts Inst. of Technology, USA.* Two-dimensional silicon photonic crystal cavities were transfer printed as individual pixels from their native substrate. In-situ spectral measurement during printing facilitated spatial ordering of 119 devices, with sub-linewidth deviations observed during printing.

AF1E.4 • 08:45
Extraction of Reflection Coefficient in Silicon Waveguides using Multiple Reflection Signals in OFDR, Tsuyoshi Horikawa[1], Atsushi Kitamura[2], Masanori Yatani[2], Nobuhiko Nishiyama[1,3]; *[1]Tokyo Inst. of Technology, Japan; [2]Santec LIS Corporation, Japan; [3]Photonics Electronics Technology Research Association, Japan.* We, for the first time, formulated the behavior of multiple reflections in waveguides with distributed reflections and demonstrated the precise extraction of reflection coefficients in silicon waveguides from OFDR reflection-distance profiles.

AF1E.5 • 09:00 (Invited)
Optical Gas Sensing in the Mid-IR using Integrated Silicon Photonic Circuits, Pen-Sheng Lin[1], Arne Quellmalz[1], Po-Han Huang[1], Shayan Parhizkar[2,3], Nour Negm[2,3], Stephan Suckow[2], Floria Ottonello-Briano[4], Max Lemme[2,3], Frank Niklaus[1], Kristinn B. Gylfason[1]; *[1]Kungliga Tekniska Hogskolan, Sweden; [2]AMO GmbH, Germany; [3]RWTH, Germany; [4]Senseair AB, Sweden. The mid-infrared region is crucial for the analysis of gas compositions, due to the high specificity of optical spectroscopy. We demonstrate a platform based on mid-IR silicon waveguides and show sensing of carbon dioxide and methane.*

AF1E.6 • 09:30
Snapshot Multi Angle Mueller matrix metrology using multiple self-interference, Garam Choi[1], Jinseob Kim[1], Jinyong Kim[1], Young-Uk Jin[1], Soonhong Hwang[1], Wookrae Kim[1], Myungjun Lee[1]; *[1]Samsung, Korea (the Republic of).* We proposed the massive acquisition of Mueller matrix across an entire range of angles, offering fully comprehensive structural analysis. Our method could be a novel solution to recent metrological challenges limitations in advanced semiconductor metrology.

AF1E.7 • 09:45
Dynamic range augmentation on chip-scale optomechanical accelerometers with frequency readout, Jaime Gonzalo Flor Flores[1], Talha Yerebakan[1], Alexis Samoylov[1], Andrey Matsko[2], Chee Wei Wong[1]; *[1]Univ. of California, Los Angeles, USA; [2]NASA JPL, USA.* Here we present a novel technique to augment the dynamic range of an optomechanical accelerometer based on the optomechanical spring effect and frequency readout, without sacrificing resolution, through operational point calibration.

08:00 -- 10:00
Room: W206A
AF1F • Time and Robust Precision Clocks
Presider: Garrett Cole; Thorlabs Inc., USA

AF1F.1 • 08:00 (Invited)
Withdrawn

AF1F.2 • 08:30
An Acetylene-based Optical Clock With < $3x10^{-13}/\sqrt{\tau}$ Fractional Frequency Instability, Stefan Droste[1], Andrew Attar[1], Henry Timmers[1], Nate Phillips[1], Cole Smith[1], Jan Hald[2], Michael Kjaer[2], Bennett M. Sodergren[1], Kurt Vogel[1], Kevin Knabe[1]; *[1]Vescent Technologies, Inc., USA; [2]Danish National Metrology Inst., Denmark.* We demonstrate an acetylene-based optical clock that achieves <$3x10^{-13}/\sqrt{\tau}$ fractional frequency instability and a flicker floor below 10^{-14} after 1,000s. The clock is made entirely from commercially available components, offering a simple setup and environmental robustness.

AF1F.3 • 08:45
2nd Generation Rack-Mount Iodine Optical Clocks with Stability Below $3\times10^{-14}/\sqrt{\tau}$, Micah Ledbetter[1], Jonathan Roslund[1], Arman Cingoz[1], Abijith Kowligy[1], Dan Sheredy[1], Guthrie Partridge[1], Will Lunden[1], Frank Roller[1], joe song[1], Evan Atchison[1], Omar Husain[1], Paul Carney[1], Gunnar Skulason[1], Mary-Kate Pasha[1], Akash Rakholia[1], Andy Dowd[1], Jamil Abo-Shaeer[1], Martin Boyd[1]; *[1]Vector Atomic, USA.* Vector Atomic has recently developed and fielded portable rack-mount optical clocks based on iodine vapor cells. We present our 2nd generation device featuring improved system integration and short-term performance.

AF1F.4 • 09:00
Low Size, Weight, and Power Frequency Comb Modules for Deployed Optical Clocks and Quantum Applications, Henry Timmers[1], Andrew Attar[1], Bennett M. Sodergren[1], Star Fassler[1], Cole Smith[1], Evan Barnes[1], Alina Spiess[1], Stefan Droste[1], Kurt Vogel[1], Kevin Knabe[1]; *[1]Vescent Technologies, USA.* Performance levels, increased levels of system integration, and examples of fielded demonstrations of low size, weight, and power optical frequency combs will be discussed for potential next-generation optical clocks and quantum applications.

AF1F.5 • 09:15
Field-Proven Laser Systems for Quantum Technologies, Vincent Menoret[1,2], Aurélien Eloy[1], Cédric Majek[1], Bruno Desruelle[1]; *[1]Quantum Systems, Exail, France; [2]Laboratoire photonique, numérique et nanosciences (LP2N), France.* Exail has developed vertically integrated turnkey fibered laser system for quantum technologies. They have been extensively used in research laboratories, in field conditions in quantum gravimeters and are in the process of being space qualified.

AF1F.6 • 09:30 (Invited)
Withdrawn

08:00 -- 10:00
Room: W206B
SF1G • Towards Mid-IR and THz Generation

Presider: Niklaus Wetter; Centro de Lasers e Aplicações - IPEN/SP, Brazil

SF1G.1 • 08:00

Efficient Continuous-Wave Tm,Ho:$GdScO_3$ Laser at 2.1 µm, Kirill Eremeev[2], Pavel Loiko[2], Shanming Li[3], Chengchun Zhao[3], Ying Hang[3], Weidong Chen[4,1], Ghassen Elabedine[5], Xavier Mateos[5], Patrice Camy[2], Alain Braud[2], Uwe Griebner[1], Valentin Petrov[1]; *[1]Max Born Inst., Germany; [2]Universite de Caen, France; [3]Shanghai Inst. of Optics and Fine Mechanics, China; [4]FJIRSM, China; [5]Universitat Rovira i Virgili, Spain.* We report on the growth, polarized spectroscopy and first laser operation of orthorhombic Tm,Ho:$GdScO_3$ perovskite-type crystal featuring broadband emission properties. The Tm,Ho:$GdScO_3$ laser generated 521 mW near 2.1 µm with a slope efficiency of 30%.

SF1G.2 • 08:15

Demonstration of a Joule-Level, Sub-Picosecond, Diode-Pumped Tm:YLF Chirped Pulse Amplification System, Zbynek Hubka[1], Issa Tamer[1], Leily Kiani[1], Jason Owens[1], Andrew Church[1], Frantisek Batysta[1], Thomas Galvin[1], Drew Willard[1], Andrew Yandow[1], Justin Galbraith[1], David Alessi[1], Colin Harthcock[1], Brad Hickman[1], Candis Jackson[1], James Nissen[1], Sean Tardif[1], Hoang Nguyen[1], Emily Sistrunk[1], Thomas M. Spinka[1], Brendan A. Reagan[1]; *[1]Lawrence Livermore National Laboratory, USA.* We report the demonstration of a diode-pumped, chirped pulse amplification Tm:YLF laser that produces broadband pulses up to 1.3 J pulse energy. Amplified pulses at the 100 mJ-level were compressed using gratings to sub-400 fs duration.

SF1G.3 • 08:45

Watt-Level Diode-Pumped Tm:CALGO Laser at 2.31 µm, Xiaoxu Yu[2], Zhongben Pan[2], Kirill Eremeev[3], Pavel Loiko[3], Hongwei Chu[2], Han Pan[2], Alain Braud[3], Patrice Camy[3], Luidgi Giordano[4], Bruno Viana[4], Uwe Griebner[1], Valentin Petrov[1], Dechun Li[2]; *[1]Max Born Inst., Germany; [2]Shandong Univ., China; [3]Universite de Caen, France; [4]PSL Univ., France.* A diode-pumped continuous-wave 1.5 at.% Tm:CALGO laser operating on the $^3H_4 \rightarrow {}^3H_5$ transition generated 1.44 W at 2284-2348 nm with a linear laser polarization (σ). The relevant spectroscopic properties of this material were also determined.

SF1G.4 • 09:00 (Invited)

Strong, Mid-IR Driven THz Generation for Nonlinear Spectroscopy, Claudia Gollner[1], Rokas Jutas[2], Dominik Kreil[3], Dmitry N. Dirin[4,5], Simon C. Boehme[4,5], Maksym V. Kovalenko[4,5], Andrius Baltuška[2,6], Anastasios D. Koulouklidis[7], Vladimir Y. Fedorov[8,9], Mostafa Shalaby[10,11], Stelios Tzortzakis[7,8], Audrius Pugzlys[2,6]; *[1]Stanford Univ./SLAC, USA; [2]Photonics Inst., TU Wien, Austria; [3]Inst. for Theoretical Physics, Johannes Kepler Univ., Austria; [4]Inst. of Inorganic Chemistry, ETH Zurich, Switzerland; [5]Empa-Swiss Federal Laboratories for Materials Science and Technology, Switzerland; [6]Center for Physical Sciences & Technology, Lithuania; [7]Inst. of Electronic Structure and Laser (IESL), Foundation for Research and Technology - Hellas (FORTH), Greece; [8]Texas A&M Univ. at Qatar, Qatar; [9]P.N. Lebedev Physical Inst. of the Russian Academy of Sciences, Russian Federation; [10]Swiss Terahertz Research-Zurich, Switzerland; [11]Key Laboratory of Terahertz Optoelectronics, Beijing Advnaced Innovation Center of Imaging Technology CNU, China.* We report on strong-field THz sources from optical rectification in organic crystals or two-color plasma filaments, driven by intense mid-IR pulses. Non-linear perturbation of semiconductor materials is demonstrated by the applied THz transients.

SF1G.5 • 09:30

50-fs pulse generation from a SESAM mode-locked Tm,Ho:CALYGO laser, Heng Ding[2], Jian Liu[2], Yinyin Wang[2], Ning Zhang[2], Zhanxin Wang[2], Yongguang Zhao[2], Xiaodong Xu[2], Yanyan Xue[3], Jun Xu[3], Uwe Griebner[1], Valentin Petrov[1]; *[1]Max Born Inst., Germany; [2]Jiangsu Normal Univ., China; [3]Tongji Univ., China.* Mode-locking of a novel Tm,Ho:CALYGO crystal, exhibiting both structural and compositional disorder, is demonstrated generating 50-fs long pulses at 2078 nm with an average output power of 60 mW at 79.3 MHz.

SF1G.6 • 09:45

44.6 fs Pulse Generation in An Er:Fiber Laser at 540 MHz Repetition Rate, Chen Zhendong[1], Ruoao Yang[1], Yangpeng Tang[2], duo pan[1], ya wang[3], Jinpeng Cao[1], Jianjun Wu[1], Zhigang Zhang[1], Jingbiao Chen[1]; *[1]Peking Univ., China; [2]Zhongshan InitiaLase Technologies Inc., China; [3]Beijing Univ. of Posts and Telecommunications, China.* We demonstrate a mode-locked ring-cavity Er:fiber laser at a repetition rate of 540 MHz. The pulse duration is 44.6 fs with a spectral bandwidth of 82 nm. The maximum output power is 280 mW.

08:00 -- 10:00
Room: W207A
FF1H • Optical Continuous Variable Quantum Information
Presider: Linran Fan; Univ of Arizona, Coll of Opt Sciences, USA

FF1H.1 • 08:00

Continuous Variables Cluster States in Photonic Time-Crystals, Mark Lyubarov[1], Michael Birk[1], Ohad Segal[1], Aliaksei Horlach[1], Liat Nemirovsky Levy[1], Yonatan Plotnik[1], Mordechai Segev[1]; *[1]Technion, Israel.* We show that Photonic Time-Crystals (PTCs) produce two-mode squeezing for pairs of photonic modes. We propose an algorithm for generating a cluster state in PTC for a measurement-based quantum computing in a simple three-step process.

FF1H.2 • 08:15

Towards All-optical Cavity-based Memory for Non-Gaussian Quantum State Engineering, Fumiya Hanamura[1], Kan Takase[1,2], Kazuki Hirota[1], Rajveer Nehra[1,3], Florian Lang[1,4], Shigehito Miki[5,6], Hirotaka Terai[5], Masahiro Yabuno[5], Fumihiro China[5], Takahiro Kashiwazaki[7], Asuka Inoue[7], Takeshi Umeki[7], Warit Asavanant[1,2], Mamoru Endo[1,2], Jun-ichi Yoshikawa[2], Akira Furusawa[1,2]; *[1]The Univ. of Tokyo, Japan; [2]RIKEN, Japan; [3]Univ. of Massachusetts-Amherst, USA; [4]ETH Zurich, Switzerland; [5]National Inst. of Information and Communications Technology, Japan; [6]Kobe Univ., Japan; [7]NTT Corporation, Japan.* We present our experimental results on all-optical memory to store and manipulate quantum states, and propose resource-efficient time-domain-multiplexed state engineering using the memory. This paves a path to scalable quantum information processors.

FF1H.3 • 08:30

Universal Control of Symmetric States Using Spin Squeezing, Nir Gutman[1], Aliaksei Horlach[1], Offek Tziperman[1], Ron A. Ruimy[1], Ido Kaminer[1]; *[1]Technion, Israel.* We present protocols relying on coherent rotations and squeezing for creation of arbitrary symmetric states. The obtained symmetric states can be further transferred to traveling photonic states via spontaneous emission, enabling engineered quantum light states.

FF1H.4 • 08:45
Generating foliated quantum error-correcting codes with quantum optics, Leandre Brunel[1], Miller Eaton[2], Hussain Zaidi[2], Olivier R. Pfister[1]; *[1]Univ. of Virginia, USA; [2]QC82, Inc., USA.* We present a graph generation algorithm, using quantum optical circuits, for general continuous-variable cluster states of arbitrary dimension. We describe its application to the large-scale generation of the foliated toric code for quantum error correction.

FF1H.5 • 09:00
All-photonic GKP-qubit repeater using analog-information-assisted multiplexed entanglement ranking, Filip Rozpedek[1,2], Kaushik P. Seshadreesan[3,5], Paul Polakos[4], Liang Jiang[2], Saikat Guha[5]; *[1]Univ. of Massachusetts Amherst, USA; [2]Univ. of Chicago, USA; [3]Univ. of Pittsburgh, USA; [4]Cisco Systems, USA; [5]Univ. of Arizona, USA.* We propose a novel strategy of using the bosonic Gottesman-Kitaev-Preskill (GKP) code in a repeater architecture with multiplexing. We also quantify the number of GKP qubits needed for the implementation of our scheme.

FF1H.6 • 09:15
Machine learning for efficient generation of universal hybrid quantum computing resources, Amanuel Anteneh[1], Leandre Brunel[1], Olivier R. Pfister[1]; *[1]Univ. of Virginia, USA.* We present numerical simulations of deep reinforcement learning on a measurement-based quantum processor-a time-multiplexed optical circuit sampled by photon-number-resolving detection-and find it generates squeezed cat states with an average success rate of 98%, outperforming all other similar proposals.

FF1H.7 • 09:30
Adaptive generation of flying logical qubits, Kan Takase[1,2], Fumiya Hanamura[1], Hironari Nagayoshi[1], Akito Kawasaki[1], Warit Asavanant[1,2], Mamoru Endo[1,2], Akira Furusawa[1,2]; *[1]the Univ. of Tokyo, Japan; [2]RIKEN Center for Quantum Computing, Japan.* We formulate a method to efficiently extract the non-classicality of photon number measurements into optical traveling wave and show that practical logical qubits can be generated over 10% probability in a realistic system.

08:00 -- 10:00
Room: W206BC
SF1I • Laser Micro- and Nano-patterning
Presider: Richard Averitt; Univ. of California San Diego, USA

SF1I.1 • 08:00 (Invited)
Ultrafast Laser Induced Fabrication of 3D Functional Micro/nanostructures, Wei Xiong[1]; *[1]Wuhan National Lab for Optoelectronics, China.* Abstract not available.

SF1I.2 • 08:30

Polarization Effects in Laser-Written Directional Couplers, Zhi Kai Pong[1], Bangshan Sun[1], Patrick S. Salter[1], Martin J. Booth[1]; *[1]Univ. of Oxford, UK.* This work characterizes the splitting ratio for output light in laser written directional couplers dependent on the input polarization state. The theoretical analysis presented is supported by experimental results.

SF1I.3 • 08:45
Ultrafast Laser Stress Generation and Morphology in Fused Silica, Kevin A. Laverty[1], Caroline Humphreys[1], Francisco A. Calixtro[1], Ian J. Arnold[1], Brandon D. Chalifoux[1]; *[1]Univ. of Arizona, USA.* Ultrafast laser generated structural modification morphology depends on pulse energy and repetition rate. We present integrated stress measurements and cross-section micrographs showing the peak stress correlates to a transition between nanograting formation and melting.

SF1I.4 • 09:00
Broadband Directional Control of Radiative Heat Flows Through Micropatterning, Yung Chak Anson Tsang[1], Mathis DeGeorges[2,1], Jyotirmoy Mandal[1,3]; *[1]Civil and Environmental Engineering, Princeton Univ., USA; [2]Institut National des Sciences Appliqué es de Lyon, France; [3]Princeton Materials Inst., Princeton Univ., USA.* A spheroidal microlens array is patterned on infrared transparent substrates to control the polar transmission and reflection of broadband thermal radiation. Geometric parameters and materials can be altered to tune the angular transmittance. Our design is promising for controlling thermal emissions for radiative cooling applications.

SF1I.5 • 09:15
Ultrafast Laser Processing: "Green" Nanocomposites with Controlled Chemical Composition for Mild Hyperthermia, Yury Ryabchikov[1]; *[1]Scientific Laser Application, HiLASE Centre, Inst. of Physics ASCR, Czechia.* Ultrafast laser processing was applied for the synthesis of semiconductor nanostructures with finely tunable chemical composition and plasmonic properties that were further employed for laser-induced hyperthermia with variable heating efficiency.

SF1I.6 • 09:30
Cavitation-based Laser Micromachining with Nonstandard Immersion Liquids, Brian K. Canfield[1], John N. Allman[1], Lino Costa[1], Alexander Y. Terekhov[1], Trevor M. Moeller[1]; *[1]Univ. of Tennessee Space Inst., USA.* We continue our investigation into the effects of ultrafast laser cavitation-based micromachining using various immersion liquids beyond simple water. Physical properties beyond vapor pressure are considered to contribute to enhancing or suppressing material removal.

08:00 -- 10:00
Room: W207D
FF1J • Control of Absorption & Emission of Radiation
Presider: Alex Song; Univ. of Sydney, Australia

FF1J.1 • 08:00
Compressed Meta-Optical Encoder for Image Classification, Anna Wirth-Singh[1], Jinlin Xiang[1], Minho Choi[1], Johannes E. Fröch[1], Luocheng Huang[1], Eli Shlizerman[1], Arka

Majumdar[1]; *[1]Univ. of Washington, USA.* For MNIST image classification, we compress a CNN to a single convolutional layer and linear electronic backend. We implement the convolution optically via engineering the PSF of meta-optics and demonstrate classification accuracy exceeding 93%.

FF1J.2 • 08:15

Curved light sheets for 3D holography and volumetric displays, Vinicius S. de Angelis[1,2], Ahmed Dorrah[1], Jhonas O. de Sarro[2], Leonardo A. Ambrosio[2], Michel Z. Rached[3], Federico Capasso[1]; *[1]Harvard Univ., USA; [2]Univ. of São Paulo, Brazil; [3]Univ. of Campinas, Brazil.* We demonstrate the holographic projection of target scenes onto arbitrarily curved surfaces in 3D. Our holograms are composed of non-diffracting light threads oriented perpendicular to the display's plane, enabling high axial resolution and accurate reconstruction.

FF1J.3 • 08:30

A Ceramic Radiative Cooler with Near-Ideal Solar Reflectance and Intrinsic Selective Emittance, Nithin J. Varghese[1], Jyotirmoy Mandal[1,2]; *[1]Civil and Environmental Engineering, Princeton Univ., USA; [2]Princeton Materials Inst., Princeton Univ., USA.* A ceramic bi-layer, owing to its porosity, long wavelength infrared (LWIR) Christiansen effect, and Reststrahlen band behavior, exhibit a near-ideal solar reflectance and a high selective LWIR emittance without the use of any metal backings.

FF1J.4 • 08:45

Unitary Control of Absorption and Emission, Cheng Guo[1], Shanhui Fan[1]; *[1]Stanford Univ., USA.* Unitary control changes absorption and emission by transforming external modes. We answer two basic questions: What absorptivity, emissivity, and their difference are attainable via unitary control? How to obtain given absorptivity, emissivity, and their difference?

FF1J.5 • 09:00

Self-driving lab discovers high-efficiency directional incoherent emission from reconfigurable semiconductor metasurfaces, Saaketh Desai[1], Sadhvikas Addamane[1], Remi Dingreville[1], Igal Brener[1], Prasad Iyer[1]; *[1]Sandia National Laboratories, USA.* We discover high efficiency (77%) steering of incoherent emission from reconfigurable semiconductor metasurfaces by engineering the spatial refractive index profile of the metasurface resonators using autonomous experiments driven by generative models and active learning

FF1J.6 • 09:30

Inhibited Spontaneous Emission Using Synthetic Dimensions, Noa Konforty[1], Eran Lustig[2,1], Mordechai Segev[1]; *[1]Technion, Israel; [2]Stanford, USA.* We show how a synthetic SSH lattice structure can inhibit the spontaneous emission of photons by a quantum emitter. Opening doors to optical approach to switching spontaneous emission on and off.

FF1J.7 • 09:45

Optimal Photonic Crystal Laser Designs via Superpotentials, Koorosh Sadri[1], Jonas Karcher[1], Maria G. Barsukova[1], Zeyu Zhang[1], Mikael C. Rechtsman[1]; *[1]The Pennsylvania State Univ., USA.* Typical photonic crystal lasers exhibit either localized defect modes or extended Bloch modes. Here we theoretically propose the concept of photonic crystal super potentials and show that they can achieve optimal performance in the trade-off between power versus spatial and spectral purity.

08:00 -- 10:00
Room: W208
FF1K • Nonlinear Phenomena in Classical and Quantum System
Presider: Liang Jie Wong; Nanyang Technological Univ., Singapore

FF1K.1 • 08:00
Counter-Directional Generation of Photon-Pairs in Periodically Poled $Rb\text{-}KTiOPO_4$, Marcin Swillo[1], Patrick Mutter[1], Albert P. Amores[1], Andrius Zukauskas[1], Valdas Pasiskevicius[1]; [1]*Kungliga Tekniska Hogskolan, Sweden.* For the first time, we show spectral and polarization indistinguishability of photon pairs generated in counter-propagating degenerate spontaneous parametric downconversion in the telecommunications band using first-order quasi-phase-matching in periodically poled $Rb\text{-}KTiOPO_4$.

FF1K.2 • 08:15
Quantum squeezing of edge-states in a nonlinear resonator, Eran Lustig[1], Melissa Guidry[1], Daniil M. Lukin[1], Shanhui Fan[1], Jelena Vuckovic[1]; [1]*Stanford, USA.* In this work we study quadrature-squeezed multi-frequency edge states. We show how edge-states and band-topology shape the squeezing spectrum by pumping a $c^{(3)}$ nonlinear integrated micro-ring resonator with CW light.

FF1K.3 • 08:30
Quantum image distillation with undetected light, Jorge Fuenzalida[1], Marta Gilaberte Basset[2], Sebastian Töpfer[1], Juan P. Torres[3,4], Markus Gräfe[1,2]; [1]*Inst. of Applied Physics, Technical Univ. of Darmstadt, Germany;* [2]*Fraunhofer Institute for Applied Optics and Precision Engineering IOF Jena, Germany;* [3]*ICFO-Institut de Ciencies Fotoniques, The Barcelona Inst. of Science and Technology, Spain;* [4]*Department of Signal Theory and Communications, Universitat Politecnica de Catalunya, Spain.* The distillation of genuine object data from noise when recoding an image is of immense value in modern microscopy. We demonstrate, an approach in the realm of quantum imaging without the need of measuring correlations.

FF1K.4 • 09:00
Driven-dissipative phases and dynamics in non-Markovian nonlinear photonics, Jamison M. Sloan[1], Nicholas Rivera[2,1], Marin Soljačić[1]; [1]*Massachusetts Inst. of Technology, USA;* [2]*Harvard, USA.* We introduce a novel class of driven-dissipative nonlinear optical systems with non-Markovian cavity coupling, which can enable low-threshold nonlinear effects, self-pulsing at THz frequencies, and highly squeezed stable cavity states including high-order Fock states.

FF1K.5 • 09:15
Self-suppressed Quantum Diffusion and Fundamental Noise Limit of Soliton Microcombs, Xing Jin[1], Zhe Lv[1], Qihuang Gong[1], Qi-fan Yang[1]; [1]*Peking Univ., China.* We theoretically and numerically investigate the quantum diffusion of dissipative Kerr solitons in multi-mode microresonators. Our results indicate that dispersive-wave radiation changes effective viscosity, reducing the diffusion rate by up to 20 dB.

FF1K.6 • 09:30

Controlling Steady-State Statistics of a Bistable Driven-Dissipative System with Quantum Bias, Alex S. Gu[1], Jamison Sloan[1], Charles Roques-Carmes[2,1], Seou Choi[1], Michael Horodynski[1], Yannick Salamin[1], Marin Soljačić[1,3]; *[1]Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA; [2]E. L. Ginzton Laboratory, Stanford Univ., USA; [3]Department of Physics, Massachusetts Inst. of Technology, USA.* We investigate the dynamics of optical parametric oscillators biased with quantum states of light and present a method for single-quadrature reconstruction of their Husimi Q-function. Perfect reconstruction fidelity is predicted at specific threshold values.

FF1K.7 • 09:45
Self-focusing in nonlinear Hatano-Nelson lattices, Ioannis Komis[1,2], Ananya Ghatak[1], Ziad H. Musslimani[3], Konstantinos Makris[1,4]; *[1]Inst. of Electronic Structure and Laser (IESL) – FORTH, Greece; [2]Humboldt-Universität zu Berlin, Institut für Physik, AG Theoretische Optik & Photonik, Germany; [3]Department of Mathematics, Florida State Univ., USA; [4]Univ. of Crete, Greece.* We probe the interplay between Kerr nonlinearity and non-Hermiticity of a Hatano-Nelson lattice in the context of non-Hermitian photonics. In particular, we examine the relation between self-focusing and the skin effect under single-channel excitation.

08:00 -- 10:00
Room: W209A
SF1L • Space and Mode Division Multiplexing
Presider: Deepa Venkitesh; Indian Inst. of Technology Madras, India

SF1L.1 • 08:00 (Invited)
Transmission in a Field-Deployed Multimode Fiber Cable, Lauren Dallachiesa[1], Roland Ryf[1], Mikael Mazur[1], Nicolas Fontaine[1], Pierre Sillard[2], Cristian Antonelli[3]; *[1]Nokia Bell Labs, USA; [2]Prysmian Group, France; [3]Univ. of L'Aquila, Italy.* In this invited paper, we review our recent results for mode-division-multiplexed transmission over subsets of spatial modes in a field-deployed 15-mode fiber cable, and analysis of impulse responses from individual fiber strands in the cable.

SF1L.2 • 08:30
Laser Nutation Alignment with Multicore Fiber for Common Optical Path FSOC System, Qirun Fan[1], Xueyuan Ao[1], Haoze Du[1], Qirui Xu[1], Jingzhe Zhong[1], Li Luo[1], Xiaoxiao Dai[1], Qi Yang[1], Ming Tang[1], Chen Liu[1], Tianjin Mei[1]; *[1]Huazhong Univ. of Science and Tech, China.* We utilize multicore fiber with a stepped structure to nutate the laser terminals within large range and construct a common optical path for the free space optical communication terminal without splitting the incident light beam.

SF1L.3 • 08:45
Distributed vibration sensing and simultaneous self-homodyne coherent transmission of single-carrier net 5.36 Tbps signal using 7-core fiber, Yaguang Hao[1], Bing Yue[1], Bang Yang[2], Jianwei Tang[1], Chen Cheng[2], Linsheng Fan[2], Jiali Li[1], Yanfu Yang[2], Weisheng Hu[1], Xueyang Li[1]; *[1]Peng Cheng Laboratory, China; [2]Harbin Inst. of Technology (Shenzhen), China.* We demonstrate a self-homodyne coherent transmission system with integrated laser interferometry based on a weakly-coupled 7-core fiber. We achieve multi-parameter vibration sensing and simultaneous transmission of single-carrier net 5.36 Tbps signals over 41.4 km.

SF1L.4 • 09:00
Performance Analysis of an UWB/SDM Optical Network Node with PIC-based Flexible WaveBand-Selective Switches, Charalampos Papapavlou[1], Konstantinos Paximadis[1], Braulio Gomez[2], Dan M. Marom[3], Tomkos Ioannis[1]; *[1]Electrical & Computer Engineering, Univ. of Patras, Greece; [2]VPI Photonics, Greece; [3]Inst. of Applied Physics, Hebrew Univ. of Jerusalem, Israel.* We analyze a hierarchical optical node architecture supporting flexible band switching using WBSSs across a variety of spatial/spectral granularities from a wavelength channel to full-fiber switching, offering high-performance along with significant size/cost-savings.

SF1L.5 • 09:15
Demonstration of Mitigation of Both Turbulence and Misalignment in a 50-Gbit/s/channel Free-Space Mode-Division-Multiplexed Optical Link Using Complex Beamforming, Muralekrishnan Ramakrishnan[1], Huibin Zhou[1], Zile Jiang[1], Xinzhou Su[1], Yuxiang Duan[1], Abdulrahman Alhaddad[1], Moshe Tur[2], Alan Willner[1]; *[1]Univ. of Southern California, USA; [2]Tel Aviv Univ., Israel.* We experimentally demonstrate a beamforming technique for mitigating channel crosstalk effects due to both misalignment and turbulence in a two-mode-multiplexed free-space-optical communication link, achieving a crosstalk reduction by ~15 dB in a 50-Gbits/s/channel link.

08:00 -- 10:00
Room: W209B
SF1M • Large-scale Photonic Integrated Circuits
Presider: Kazuhiro Kuruma; Univ. of Tokyo, Japan

SF1M.1 • 08:00 (Invited)
Large-scale Silicon-photonic Circuits for Quantum Computing and Networking, Jianwei Wang[1]; *[1]Peking Univ., China.* Integrated photonic circuits enable the generation, control, storage, and detection of quantum states of light. We will discuss recent advancements in large-scale integrated silicon-photonic devices, specifically interferometers and microresonators, for quantum information science and technologies.

SF1M.2 • 08:30
Foundry-fabricated Visible-Wavelength Polarization Splitter and Rotator on a Silicon Nitride-on-Insulator Platform, Vijay Soorya Shunmuga Sundaram[1], Venkatesh Deenadayalan[1], Thomas Palone[1], Michael Fanto[2], Gregory A. Howland[1], Stefan Preble[1]; *[1]Rochester Inst. of Technology, USA; [2]Air Force Research Laboratory, USA.* We present the first foundry-fabricated polarization rotator in the visible-wavelength-regime of 647-657nm on a silicon nitride-on-insulator platform. Polarization-Extinction-Ratio (PER) of >18dB and insertion loss (IL) <1dB are experimentally shown.

SF1M.3 • 08:45
Manufacturing High-*Q* Silicon Nitride Photonic Chips via Silicon Hardmask Etching, Shuai Liu[1], Yuheng Zhang[1], Zheshen Zhang[1]; *[1]Electrical Engineering and Computer Science, Univ. of Michigan, USA.* We present a robust process for fabricating high-*Q*, dispersion-engineered Si_3N_4 photonic chips using amorphous silicon hardmask etching with PECVD SiO_2 cladding, achieving an intrinsic quality factor up to ~ 17.5×10^6.

SF1M.4 • 09:00

CMOS analog electronics for on-chip monitoring and control of Silicon Photonics circuits, Francesco Zanetto[1], Monica Crico[1], Andres I. Martinez[1], Seyedmohammad Seyedinnavadeh[1], Francesco Morichetti[1], Andrea Melloni[1], Giorgio Ferrari[1], Marco Sampietro[1]; [1]*Politecnico di Milano, Italy.* We report on the monolithic cointegration of CMOS analog electronic circuits in a commercial Silicon Photonics technology, providing the essential building blocks for on-chip amplification and processing of electrical signals.

SF1M.5 • 09:15
Large-scale photonic chip based pulse interleaver for low-noise microwave generation, Zheru Qiu[1,3], Neetesh Singh[2], Yang Liu[1,3], Xinru Ji[1,3], Wang R. Ning[1,3], Franz Kärtner[2], Tobias J. Kippenberg[1,3]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland;* [2]*Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron, Germany;* [3]*Center for Quantum Science and Engineering, EPFL, Switzerland.* We demonstrate a 64-times multiplication of a mode-locked laser's 217 MHz pulse repetition rate using an integrated Si3N4 interleaver with a compact 8.5 mm×1.7 mm footprint, for the generation of a low-noise 14 GHz microwave signal.

SF1M.6 • 09:30
Alumina Based Piezo-Optomechanical Blue and Ultraviolet Photonic Integrated Circuits in a VLSI Architecture, Roman Shugayev[1], Daniel Dominguez[1], Andrew Leenheer[1], Bethany Little[1], Matthew Chow[1], Yuan-Yu Jau[1], Matt Eichenfield[1]; [1]*Sandia National Laboratories, USA.* We demonstrate VLSI-fabricated piezo-optomechanical photonic integrated circuits operating in the blue (420 nm) and UV (320 nm) spectral ranges. We characterize their performance and discuss their application to important problems in quantum information processing.

SF1M.7 • 09:45
Withdrawn

08:00 -- 10:00
Room: W209C
FF1N • New Concepts in Metamaterials and Complex Media
Presider: Alex Song; Univ. of Sydney, Australia

FF1N.1 • 08:00
Experimental demonstration of photonic Landau levels, Maria G. Barsukova[1], Fabien Grisé[2], Zeyu Zhang[1], Sachin Vaidya[1,3], Jonathan Guglielmon[1], Michael Weinstein[4], Li He[5], Bo Zhen[5], Randall McEntaffer[2], Mikael C. Rechtsman[1]; [1]*Department of Physics, The Pennsylvania State Univ., USA;* [2]*Department of Astronomy & Astrophysics, The Pennsylvania State Univ., USA;* [3]*Department of Physics, Massachusetts Inst. of Technology, USA;* [4]*Department of Applied Physics and Applied Mathematics & Department of Mathematics, Columbia Univ., USA;* [5]*Department of Physics and Astronomy, Univ. of Pennsylvania, USA.* We experimentally observe dispersive Landau levels resulting from a strain-induced pseudomagnetic fields in a photonic crystal slab. An additional strain corresponding to a pseudoelectric field flattens the bands.

FF1N.2 • 08:30

Optical Nonreciprocal Magnetoelectric Metamaterials Based on Spontaneous Magnetization, Shadi Safaei Jazi[1], Ihar Faniayeu[2], Rafael Cichelero[2], Dimitrios Tzarouchis[3,4], Alexandre Dmitriev[2], Shanhui Fan[5], Viktar S. Asadchy[1,5]; *[1]Department of Electronics and Nanoengineering, Aalto Univ., Finland; [2]Department of Physics, Univ. of Gothenburg, Sweden; [3]Department of Electrical and Systems Engineering, Univ. of Pennsylvania, USA; [4]Meta Materials Europe, Greece; [5]Ginzton Laboratory and Department of Electrical Engineering, Stanford Univ., USA.* We propose the first isotropic three-dimensional metamaterials with nonreciprocal magnetoelectric resonant responses at visible and mid-infrared frequencies. The proposed metamaterials do not require external magnetic bias.

FF1N.3 • 09:00
Three Dimensional Reconfigurable Optical Singularities in Bilayer Photonic Crystals, Xueqi Ni[1], Yuan Liu[1], Beicheng Lou[2], Mingjie Zhang[1], Evelyn Hu[1], Shanhui Fan[2], Eric Mazur[1], Haoning Tang[1]; *[1]Harvard Univ., USA; [2]Stanford Univ., USA.* This paper explores tunable bilayer photonic crystals (BPhCs) for dynamic control of optical singularities, demonstrating bidirectional/unidirectional polarization, and spatiotemporal phase singularities. This study enables multidimensional control in ultrafast and quantum optics.

FF1N.4 • 09:15
Light-induced Magnetostatic Field with Subwavelength Confinement via Metamaterials, Shiqiang Zhao[1], Yongzheng Wen[1], Chen Wang[1], Jingbo Sun[1], Ji Zhou[1]; *[1]Tsinghua Univ., China.* We theoretically demonstrate a metamaterial-based route for light-induced magnetostatic field generation through artificial magneto-electric coupling. The numerical simulations show a magnetostatic field at sub-Tesla level, and its spatial confinement reaches deep-subwavelength.

FF1N.5 • 09:30
Nano-electromechanically Tunable Dielectric Metasurfaces for Reconfigurable Beam Steering, Ayse B. Baspinar[1], Tianzhe Zheng[1], Hyounghan Kwon[1,2], Andrei Faraon[1]; *[1]California Inst. of Technology, USA; [2]Korea Inst. of Science and Technology, Korea (the Republic of).* We present a reconfigurable nanoelectromechanical metasurface design based on slot modes at telecom wavelength that can achieve 80% amplitude and 250 degrees phase modulation, and therefore beam steering reaching 60% efficiency with ~10V actuation.

FF1N.6 • 09:45
Engineering Form Birefringence in All-Glass Metasurfaces: A Geometric Perspective on Phase-Space Filling, Maria Beatriz Silva Oliveira[1], Marco Piccardo[1]; *[1]Técnico Lisboa, Portugal.* We demonstrate all-glass metasurfaces for high-power lasers, detailing design criteria for complete 2D phase-space coverage through geometric reasoning. This enables full wavefront manipulation in monolithic devices paving the road to intense *vectorial* laser-matter interactions.

08:00 -- 09:45
Room: W209DE
SF1O • Photonic Multiplexer
Presider: Kyoko Kitamura; Tohoku Univ., Japan

SF1O.1 • 08:00 (Invited)

Compact Spatial Division Multiplexing with Dielectric Metasurfaces, Paulo C. Dainese, Jr.[1], Jaewon Oh[2], Jun Yang[1], Louis Marra[1], Ahmed Dorrah[2], Alfonso Palmieri[2], Federico Capasso[2]; *[1]Corning Research & Development Corp, USA; [2]John A. Paulson School of Engineering and Applied Sciences, Harvard Univ., USA.* Compact, integrated, and scalable devices are critical for future high-density optical communication applications. Here, we review our recent results demonstrating dielectric metasurfaces devices for mode-division multiplexing in few-mode fibers and freespace coupling into multi-core fibers.

SF1O.2 • 08:30

Inversely designed photonic integrated vector dot-product core with mode-division multiplexing, Zheyuan Zhu[1], Raktim Sarma[2], Seth Smith-Dryden[1], Guifang Li[1], Shuo S. Pang[1]; *[1]Univ. of Central Florida, CREOL, USA; [2]Sandia National Laboratories, USA.* We present an inversely designed integrated photonic dot-product core based on mode-division multiplexing. The core features a 5µm×3µm footprint for scalability and can perform general-purpose vector dot-products with easily reconfigurable inputs for various computing applications.

SF1O.3 • 08:45

Multi-bit Optical Digital Multiplier for High-speed Computing, Haojun Zhou[1], Wenkai Zhang[1], Jianji Dong[1], Hailong Zhou[1]; *[1]Wuhan National Lab for Optoelectronics, China.* We propose a multi-bit optical digital multiplier using time-space multiplexed architecture. An 8-bit optical digital multiplier is experimentally executed to demonstrate its extensibility and functionality.

SF1O.4 • 09:00

Wavelength-division-multiplexed Transmission and Dispersion Compensation Enabled by Soliton Microcombs and Cascaded Microrings, Yuanbin Liu[1], Hongyi Zhang[1], Jiacheng Liu[1], Liangjun Lu[1,2], Jiangbing Du[1], Yu Li[1,2], Zuyuan He[1], Jianping Chen[1,2], Linjie Zhou[1,2], Andrew W. Poon[3]; *[1]Shanghai Jiao Tong Univ., China; [2]SJTU-Pinghu Inst. of Intelligent Optoelectronics, China; [3]Hong Kong Univ. of Science and Technology, Hong Kong.* We demonstrate wavelength-division-multiplexed data transmission and dispersion compensation of 25 Gb/s × 9 on-off-keying signals over a 20-km singlemode fiber using an integrated single-soliton microcomb and a cascaded microring resonator-based reconfigurable dispersion compensator.

SF1O.5 • 09:15

Silicon Photonic Integration of DWDM and Mode-Division Multiplexing for Advancing Multi-Dimensional Data Transmission, Robert Parsons[1], Xiang Meng[1], James T. Robinson[1], Maarten Hattink[1,3], Asher Novick[1,3], Anthony Rizzo[1,2], Utsav D. Dave[1], Michal Lipson[1], Keren Bergman[1]; *[1]Columbia Univ., USA; [2]Air Force Research Laboratory, USA; [3]Xscape Photonics, USA.* We demonstrate an innovative integration of DWDM and Mode-Division Multiplexing, enabling multi-dimensional transmission with 8 wavelengths and 4 modes. The packaged photonic chip demonstrates a remarkable 512 Gbps aggregate bandwidth with a BER < 1e-9.

SF1O.6 • 09:30

Hyper-multiplexed, Ultralow-Energy Optical Neural Networks on Thin-Film Lithium Niobate, Shaoyuan Ou[1], Alexander Sludds[3], Ryan Hamerly[3,4], Eric Zhong[1], Ke Zhang[2,1], Hanke

Feng[2], Cheng Wang[2], Dirk Englund[3], Mengjie Yu[1], Zaijun Chen[1]; *[1]Univ. of Southern California, USA; [2]City Univ. of Hong Kong, Hong Kong; [3]Massachusetts Inst. of Technology, USA; [4]PHI Laboratories, NTT Research Inc., USA.* We demonstrate a large-scale wavelength-time-space-multiplexed optical neural network using high-bandwidth (>40 GHz) electro-optic modulators at CMOS-compatible voltages ($V\pi$=1.3 V). Parallel computing with 7 wavelengths (over 1-THz) achieves 6-bit precision for accurate image classification.

08:00 -- 10:00
Room: W209F
SF1P • Mircoresonators and Applications
Presider: Oliver Heckl; Universitat Wien, Austria

SF1P.1 • 08:00 (Invited)
Laser Conversion Beyond an Octave using Nanophotonic Oscillators, Jennifer A. Black[1]; *[1]NIST Boulder, USA.* Integrated Kerr microresonators incorporating nanostructures provide a novel approach to phase-matching for flexible and efficient laser wavelength conversion based on optical-parametric oscillation. I will discuss the development of these nanophotonic oscillators for laser wavelength conversion spanning beyond an octave.

SF1P.2 • 08:30
Unifying Optical Frequency Metrology with Free-Electron Spectroscopy, Yujia Yang[1], Paolo Cattaneo[1], Arslan S. Raja[1], Bruce Weaver[1], Rui N. Wang[1], Alexey Sapozhnik[1], Fabrizio Carbone[1], Thomas LaGrange[1], Tobias J. Kippenberg[1]; *[1]École Polytechnique Fédérale de Lausanne, Switzerland.* We establish a frequency link across the microwave, optical, and free-electron domains by a photonic chip-based electron phase modulator driven by a continuous-wave laser locked to a fully stabilized optical frequency comb.

SF1P.3 • 08:45
Design and Realization of Octave-spanning, Low f_{ceo} Microcombs at Sub-telecom Wavelengths in Silicon Nitride, Gabriel M. Colacion[1], Lala Rukh[1], Tristan Melton[2], Alwaleed Aldhafeeri[2], Hsiao-Hsuan Chin[2], Chee Wei Wong[2], Tara E. Drake[1,3]; *[1]Optical Science and Engineering, Univ. of New Mexico, USA; [2]Mesoscopic Optics and Quantum Electronics Laboratory, Univ. of California Los Angeles, USA; [3]Department of Physics and Astronomy, Univ. of New Mexico, USA.* We present design and experimental characterization of microcombs with octave bandwidth, harmonic dispersive waves, and low carrier-envelope-offset frequency (f_{ceo}) for f-2f self-referencing. The method of tuning f_{ceo} is independent of changes in the spectral envelope.

SF1P.4 • 09:00
Ultrasensitive Thermometry Using Coupled Modes in an Optical Microresonator, Wenle Weng[1], Andre Luiten[1]; *[1]Univ. of Adelaide, Australia.* We present a self-referenced thermometry scheme based on a lithium niobate microresonator. Leveraging coupling between orthogonally polarized modes, dual-resonant state is obtained with a single pumping laser, enabling temperature sensing with a record-setting few-nanokelvin resolution.

SF1P.5 • 09:15

Multi-comb Interferometry Using Photonic Molecule Microcombs, Israel Rebolledo[1,2], Marcello Girardi[1], Oskar Helgason[1], Martin Zelan[2], Victor Torres-Company[1]; *[1]Microtechnology and nanoscience, Chalmers Tekniska Högskola, Sweden; [2]Measurement Science and Technology, RISE Research Insts. of Sweden, Sweden.* Microcomb-based phase-sensitive interferometry is demonstrated over a broad bandwidth using power-efficient solitons. This work highlights the possibilities of spatial multi-sensing using chip-scale frequency combs enabled by wafer-scale manufacturing with a high yield.

SF1P.6 • 09:30
Vernier Microcombs towards RF-to-Optical links, Saleha Fatema[1], Nathan P. O'Malley[1], Kaiyi WU[1], Cong Wang[1], Marcello Girardi[2], Daniel E. Leaird[1], Victor Torres-Company[2], Andrew M. Weiner[1]; *[1]Purdue Univ., USA; [2]Chalmers Univ. of Technology, Sweden.* We use the Vernier dual-comb method to separately detect and stabilize the ~ THz rep rate and ~100 GHz carrier envelope offset frequency of an octave spanning Kerr comb - both outside the bandwidth of conventional electronics.

SF1P.7 • 09:45
Frequency Division of a Brillouin laser for robust ultralow-noise signal generation, William Loh[1], Dodd Gray[1], Reed Irion[1], Owen May[1], Connor Belanger[1], Jason J. Plant[1], Sivasubramaniam Yegnanarayanan[1]; *[1]Massachusetts Inst of Tech Lincoln Lab, USA.* We divide a Brillouin laser to 10 GHz frequency to reach ultralow levels of phase noise of -95 dBc/Hz and -110 dBc/Hz at 10 Hz and 100 Hz offset frequencies.

08:00 -- 10:00
Room: W210
SF1Q • Optical Frequency Combs in Fiber Lasers and Resonators
Presider: Richard Zeltner; Menlo Systems GmbH, Germany

SF1Q.1 • 08:00
Optical fiber bending-induced parabolic microresonator with ±0.01 pm-precise tunable and pm-small free spectrum range, Manuel Crespo Ballesteros[1], Misha Sumetsky[1]; *[1]Aston Univ., UK.* By bending an optical fiber, we introduce a parabolic microresonator having more than 45 equally spaced eigenwavelengths, whose free spectral range is continuously tuned between 1.09 and 1.73 pm with better than ±0.01 pm precision.

SF1Q.2 • 08:15
Vernier Microcombs for Optical Frequency Division, Kaiyi WU[1], Nathan P. O'Malley[1], Saleha Fatema[1], Cong Wang[1], Marcello Girardi[2], Mohammed S. Alshaykh[3], Daniel E. Leaird[1], Minghao Qi[1], Victor Torres-Company[2], Andrew M. Weiner[1]; *[1]Purdue Univ., USA; [2]Chalmers Univ. of Technology, Sweden; [3]King Saud Univ., Saudi Arabia.* We demonstrate microcomb-based frequency division from a narrow-linewidth 871nm laser to a radio-frequency clock output. We introduce a noise suppression scheme to mitigate the fiber interferometric noise experienced by the system.

SF1Q.3 • 08:30
Unexpected phase-locked Brillouin Kerr Frequency comb in fiber Fabry-Perot resonators, Thomas Bunel[1], Matteo Conforti[1], Zoheir Ziani[1], Julien Lumeau[2], Antonin Moreau[2],

Arnaud Fernandez[3], Olivier Llopis[3], Germain Bourcier[3,4], Arnaud Mussot[1]; *[1]Univ. of Lille, CNRS, UMR 8523-PhLAM, France; [2]Aix Marseille Univ., CNRS, Centrale Marseille, Institut Fresnel, France; [3]LAAS-CNRS, Universite de Toulouse, CNRS, 7 avenue de Colonel Roche, France; [4]CNES, 18 Avenue Edouard Belin, France.* We report the observation of a stable and broadband optical frequency comb in a high-Q fiber Fabry-Perot resonator. We evidence it arises from an unexpected mode-locking phenomena triggered by the Brillouin effect.

SF1Q.4 • 08:45 (Invited)
Temporal Solitons in Ring Resonators, François Leo[1]; *[1]Universite Libre de Bruxelles, Belgium.* In this talk I will present our recent results about soliton generation in fiber and integrated resonators. I will discuss active solitons, parametrically driven solitons as well as electro-optic solitons

SF1Q.5 • 09:15
Kerr frequency comb generation in normal dispersion fiber Fabry-Perot resonators via switching waves excitation, Thomas Bunel[1], Matteo Conforti[1], Zoheir Ziani[1], Julien Lumeau[2], Antonin Moreau[2], Arnaud Fernandez[3], Olivier Llopis[3], Germain Bourcier[3,4], Arnaud Mussot[1]; *[1]Univ. of Lille, CNRS, UMR 8523-PhLAM, Lille, France, France; [2]Aix Marseille Univ., CNRS, Centrale Marseille, Institut Fresnel, Marseille, France, France; [3]LAAS-CNRS, Universite de Toulouse, CNRS, 7 avenue de Colonel Roche, 31031 Toulouse, France, France; [4]CNES, 18 Avenue Edouard Belin, F-31401 Toulouse, Franc, France.* We generate optical frequency combs in normal dispersion fiber Fabry-Perot resonators. The influence of dispersion is thoroughly discussed, revealing the potential to create a frequency comb spanning a 15 THz bandwidth via switching waves excitation.

SF1Q.6 • 09:30
Demonstration of Viability for Dual Comb Spectroscopy Using an Erbium Dual Comb Fiber Laser Based on Polarization Multiplexing, P. E. Collin Aldia[1,2], Lukas W. Perner[1,2], Jonas K. Ballentin[1], Zbigniew Laszczych[3], Monika Bahl[1], Oliver H. Heckl[1]; *[1]Christian Doppler Laboratory for Mid-IR Spectroscopy and Semiconductor Optics, Faculty Center for Nano Structure Research, Faculty of Physics, Univ. of Vienna, Boltzmanngasse 5, 1090 Vienna, Austria, Univ. of Vienna, Austria; [2]Vienna Doctoral School in Physics, Univ. of Vienna, Boltzmanngasse 5, 1090 Vienna, Austria, Univ. of Vienna, Austria; [3]Laser & Fiber Electronics Group, Faculty of Electronics, Photonics and Microsystems, Wybrzeze Wyspianskiego 27, 50-370, Wroclaw Univ. of Science and Technology, Poland.* We demonstrate for the first time the viability of dual-comb spectroscopy using a free-running polarization-multiplexed erbium dual-comb laser. For the current laser parameters, we achieve an optical resolution of 4.152 GHz.

SF1Q.7 • 09:45
Polarization-Multiplexed Dual-Comb Generation with Tunable Repetition Rates, Bowen Liu[1], Maolin Dai[1], Takuma Shirahata[1], Shinji Yamashita[1], Sze Y. Set[1]; *[1]Univ. of Tokyo, Japan.* We demonstrate a bidirectional polarization-multiplexed fiber laser and explore its potentials towards self-referenced dual-comb generation with tunable repetition rates. Regardless of ambient temperature fluctuations, the absolute deviation of dual-comb frequencies' difference is within 0.52 Hz.

08:00 -- 10:00
Room: W211
SF1R • Photonics of Low Dimensional Materials I
*Presider: Xiaodong Shi; IMRE, A*STAR, Singapore*

SF1R.1 • 08:00 (Invited)
Topological Exciton Polaritons: Interweaving Light and Matters, Wenjing Liu[1]; *[1]Peking Univ., China.* Abstract not available.
SF1R.2 • 08:30
Visible-Light Fiber Amplifier Based on Halide Perovskite Quantum Dots, Yue Wang[1], Chun Hong Kang[1], Kuang-Hui Li[1], Tien Khee Ng[1], Boon S. Ooi[1]; *[1]KAUST, Saudi Arabia.* We report, for the first time, on a high optical gain visible-light amplifier of up to 22 dB using a facile dip-coating method of $CsPbBr_3$ quantum dots on a fiber facet.

SF1R.3 • 08:45
Perovskite Quantum Wires and Their Applications in the Field of Display and Lighting, Qianpeng Zhang[1], Daquan Zhang[2], Bryan Cao[2], Hualiang Lv[1], Xiaoliang Mo[1], Zhiyong Fan[2]; *[1]Fudan Univ., China; [2]The Hong Kong Univ. of Science & Technology, Hong Kong.* The quantum wire is a unique category in one-dimensional perovskite materials. Here, we summarize our previous work on perovskite quantum wires and their successful applications in displays and lighting.

SF1R.4 • 09:00
Using Colloidal Quantum Shells as a Novel Gain Medium for Integrated Visible Lasers, Ivo Tanghe[1], Amelia Waters[2], Jiamin Huang[2], Korneel Molkens[1], Tom Vandekerckhove[1], Dries Van Thourhout[1], Mikhail Zamkov[2], Pieter Geiregat[1]; *[1]Univ. Ghent - Imec, Belgium; [2]Bowling Green State Univ., USA.* Colloidal Quantum Shells (QSs) are a class of novel solution-processible nanocrystals. In this work, their potential for optical gain is investigated and lasing with optical excitation is demonstrated.

SF1R.5 • 09:15
Optimizing Optical and Scintillation Properties through the Replacement of Organic Chains, Ion Doping, and Anions in Two-Dimensional Perovskite Crystals, Muhammad D. Birowosuto[1], Dominik Kowal[1], Md. Abdul Kuddus Sheikh[1], Somnath Mahato[1], Michal Makowski[1], Francesco Maddalena[2], Cuong Dang[2], Arramel Arramel[3], Marcin E. Witkowski[4], Winicjusz Drozdowski[4]; *[1]Lukasiewicz PORT, Poland; [2]Nanyang Technological Univ., Singapore; [3]Nano Center Indonesia, Indonesia; [4]Nicolaus Copernicus Univ. in Torun, Poland.* Enhancing two-dimensional perovskite crystals, low-temperature-solution-grown scintillators exhibit >10 photons/keV light yield and <10 ns decay time. Optical and scintillation properties are tuned by replacing ions and adding ion doping for timing and spectral applications.

SF1R.6 • 09:30
An Ultra-high Concentration of Colloidal Quantum Dots for Efficient Light Generation in A Packaged LED, Tzu Chia Huang[1], Ching Chang[1], Chung-Ping Huang[2], Hao-Chung Kuo[3], Chien-Chung Lin[1]; *[1]Graduate Inst. of Photonics and Optoelectronics, National Taiwan Univ., Taiwan; [2]College of Photonics, National Yang Ming Chiao Tung Univ., Taiwan; [3]Department of Photonics, Inst. of Electro-Optical Engineering, National Yang Ming Chiao Tung Univ., Taiwan.* In this study, we increase the amount of colloidal quantum dots in a packaged LED.

With help of microcarrier and novel package method, a 63.5% improvement of color conversion efficiency is reported.

SF1R.7 • 09:45
Selective Area Growth of Ga- and N-Polar InGaN/GaN Nanowires - A Comparative Study, Arnob Ghosh[1], Kamruzzaman Khan[2], Shrivatch Sankar[1], Elaheh Ahmadi[2], Shamsul Arafin[1]; *[1]The Ohio State Univ., USA; [2]Univ. of Michigan, USA.* InGaN quantum disks in GaN nanowires are grown on both Ga- and N-polar GaN templates. Comparative analysis indicates superior geometric control in N-polar GaN with higher vertical, reduced lateral growth rates, flat tops, and increased indium incorporation compared to Ga-polar.

10:30 -- 12:30
Room: W201AB
SF2A • Advanced Sensing Methods
Presider: Nathan Dvorak; Univ. of Michigan, USA

SF2A.1 • 10:30
Imaging-free, few-shot, three-dimensional focusing on point-like emitters in confocal microscopy, Swetapadma Sahoo[1,2], Junyue Jiang[3], Jaden Li[1,4], Kieran Loehr[4,5], Chad E. Germany[4,5], Jincheng Zhou[3], Bryan K. Clark[4,5], Simeon Bogdanov[1,2]; *[1]Department of Electrical and Computer Engineering, Univ. of Illinois at Urbana-Champaign, USA; [2]Nick Holonyak, Jr. Micro and Nanotechnology Laboratory, Univ. of Illinois at Urbana-Champaign, USA; [3]Zhejiang Univ.-Univ. of Illinois at Urbana-Champaign Inst., China; [4]Department of Physics, Univ. of Illinois at Urbana-Champaign, USA; [5]Illinois Quantum Information Science and Technology Center, Univ. of Illinois at Urbana-Champaign, USA.* We introduce a rapid, noise-robust, three-dimensional focusing framework for as-is confocal microscopes. We show automated real-time focusing on nanoscale emitters for SNR down to 1, and position tracking with a precision below 10 nm.

SF2A.2 • 10:45
Visible-Wavelength Chip-Scale Polarization-Sensitive Spectrometer Using GaN Photodiodes, Juhyeon Kim[1], Nathan A. Dvorak[1], Pei-Cheng Ku[1]; *[1]Univ. of Michigan, USA.* A chip-scale spectrometer is proposed to resolve linear polarization information in the visible-wavelength range. The design was supported with preliminary experimental data based on elliptical cross-section nanopillar-shaped GaN photodetectors.

SF2A.3 • 11:00 (Invited)
Microscopic Lasers as Exquisite Sensors for Biomedical Research, Malte C. Gather[2,1]; *[1]Univ. of St Andrews, UK; [2]Humboldt Centre for Nano- and Biophotonics, Univ. of Cologne, Germany.* Joining the photophysics of (organic) light-emitting materials with the sensitivity of optical resonances to geometry and refractive index enables a plethora of new opportunities in biophotonics, e.g. via the integration of microlasers into live cells.

SF2A.4 • 11:30
Beyond Labels: Advancing Single Molecule Sensitivity with Hot Fabry-Perot Micro Cavities, Carlos Saavedra[1], Daniel Sole-Barber[1], Julia Rasch[1], Lisa-Maria Needham[1], Randall Goldsmith[1]; *[1]Univ. of Wisconsin-Madison, USA.* Fiber-Fabry-Perot microcavities are tools that

enhance light-matter interactions. A new detection scheme exploiting photo-thermal effects and Pound-Drever-Hall locking technique enabled label-free detection of solution-phase single biomolecules hundred times smaller than the wavelength in solution phase.

SF2A.5 • 11:45
Sensing beyond the exceptional point for high detectivity, Zhichao Li[1,2], Ciril S. Prasad[1,2], Xielin Wang[1,2], Ding Zhang[3], Gururaj V. Naik[2]; *[1]Applied Physics Program, Rice Univ., USA; [2]Department of Electrical and Computer Engineering, Rice Univ., USA; [3]Department of Physics and Astronomy, Rice Univ., USA.* Exceptional point (EP)-based optical sensors exhibit exceptional sensitivity but poor detectivity. Slightly off EP operation boosts detectivity without much loss in sensitivity. We experimentally demonstrate a high-detectivity-off-EP plasmonic-photonic hybrid sensor for anti-mouse IgG protein.

SF2A.6 • 12:00
Phase-change-material integrated, phase-error corrected, resolution-enhanced Michelson Interferometer Fourier Transform Spectrometer, Jianhao Shen[1], Daniel Donnelly[1], Asela Perera[1], Swapnajit Chakravarty[1]; *[1]Univ. of Dayton, USA.* We experimentally demonstrate a hybrid silicon waveguide integrated with phase change materials to enable active phase error correction for spectral decomposition in compact on-chip Fourier Transform spectrometer based on spatially heterodyned array of Michelson interferometers.

SF2A.7 • 12:15
Multi-layer Optical Convolutional Neural Network with Nonlinear Activation, Zheng Huang[1,2], Conghe Wang[2], Wanxin Shi[1,2], Shukai Wu[1,2], Sigang Yang[1,2], Hongwei Chen[1,2]; *[1]Tsinghua Univ., China; [2]Beijing National Research Center for Information Science and Technology, China.* We present a compact multi-layer optical convolutional neural network for pre-sensor computing with nonlinear activation by masks and an image intensifier. This can off-load 83.1% computation to optics and achieve competitive accuracies for classification tasks.

10:30 -- 12:30
Room: W201CD
SF2B • Multiphoton Microscopy
Presider: Catherine Saladrigas; Univ. of Colorado Boulder, USA

SF2B.1 • 10:30 (Invited)
Fast Axial Scanning with Remote Focusing for Multiphoton Microscopy of Acute Rabbit Ventricular Slices to Follow Action Potentials Transmurally, Giedre Astrauskaite[1], Lewis Williamson[1], Sharika Mohanan[1], Steven M. Moreno[1], Ryo Kinegawa[1], Erin Bowland[1], Eline Huethorst[1], Godfrey Smith[1], Marie-Caroline Muellenbroich[1]; *[1]Univ. of Glasgow, UK.* Remote focusing on a multiphoton microscope allows for fast axial scanning to track action potentials transmurally in slices of rabbit hearts. Here we present benchmark results for cardiac structure and function. 2023 The Authors.

SF2B.2 • 11:00
All-optical Photoacoustic Microscopy Based on Superheterodyne Interferometry, Ningbo Chen[1], Xudong Guo[1], Huajun Tang[1], Ji-Xiang Chen[1], Najia Sharmin[1], Yitian Tong[1], Kenneth Kin-Yip Wong[1]; *[1]The Univ. of Hong Kong, Hong Kong.* We present an all-optical photoacoustic

microscopy with a custom-built superheterodyne interferometer, achieving a 20 MHz demodulation bandwidth and 18 dB signal-to-noise ratio in tungsten wires phantom imaging.

SF2B.3 • 11:15
New HOPE for Lipid Imaging: New Hybrid Optical Parametrically-oscillating Emitter at 1.7 µm for Lipid-based Photoacoustic Microscopy, Najia Sharmin[2], Jixiang Chen[2], Huajun Tang[2], Nikki Pui Yue Lee[1], Yitian Tong[2], Kenneth Kin-Yip Wong[2,3]; *[1]Department of Surgery, Univ. of Hong Kong, Hong Kong; [2]Department of Electrical and Electronic Engineering, Univ. of Hong Kong, Hong Kong; [3]Advanced Biomedical Instrumentation Centre, Hong Kong Science Park, Hong Kong.* A new-type hybrid optical parametrically-oscillating emitter (HOPE) is proposed at 1725 nm, attaining less than 0.1 ns pulse width jitter. It is applied for lipid-based photoacoustic microscopy, differentiating fatty and healthy human liver specimens.

SF2B.4 • 11:30
Pulse-to-Pulse Wavelength Switching Near-infrared Fiber Laser for Multi-contrast PA Imaging, Ji-Xiang Chen[1], Huajun Tang[1], Najia Sharmin[1], Ningbo Chen[1], Xiaoxiao Wen[1], Yitian Tong[1], Kenneth Kin-Yip Wong[1]; *[1]The Univ, of Hong Kong, Hong Kong.* We demonstrate an all-fiber laser with 100 kHz pulse-to-pulse wavelength switching speed between 1725 nm and 1920 nm using parametric amplification. Multi-contrast photoacoustic imaging for water and lipids is demonstrated with the proposed laser.

SF2B.5 • 11:45
Sub-Diffraction-Limited Multi-Color Multiphoton Imaging with a Single Laser Source and Single Photon Avalanche Detector Array, Aart Verhoef[1], Anton Classen[1], Girish S. Agarwal[1], Stan Vitha[1], Mia Pacheco[1], Dylan McCreedy[1], Alexei Sokolov[1], Alma Fernandez[1]; *[1]Texas A&M Univ., USA.* We demonstrate sub-diffraction-limited simultaneous two- and three-photon imaging, using a high-power ultrafast fiber laser and single-photon avalanche detector array. Despite the 3-times longer excitation wavelength, our demonstration outperforms standard confocal microscopy of the same samples.

SF2B.6 • 12:00 (Invited)
Pushing the Limits of Multiphoton Imaging in Living Systems, Chris Xu[1]; *[1]Cornell Univ., USA.* We will review state-of-the-art multiphoton microscopes for in vivo imaging of living tissues. We will discuss the limits of the imaging depth, volume and speed, and possible directions for pushing the boundaries of multiphoton imaging.

10:30 -- 12:30
Room: W204AB
FF2C • Ultrafast Studies of Chiral Phenomena and Phonon Dynamics
Presider: Zhuquan Zhang; Massachusetts Inst. of Technology, USA

FF2C.1 • 10:30
Coherent Excitation of Chiral Phonons Using THz Light, Megan Biggs[1], Enoch (Sin Hang) Ho[1], Aldair Alejandro[1], Matthew Lutz[1], Clayton Moss[1], Abby Hassler[1], Jeremy A. Johnson[1]; *[1]Brigham Young Univ., USA.* A circular polarized THz pulse is used to excite coherent chiral phonon motion in non-magnetic $LiNbO_3$ and β-BaB_2O_4, which in turn induces a transient magnetic moment that we probe via the ultrafast Faraday effect.

FF2C.2 • 10:45

Chiral optical nanocavity with atomically thin mirrors, Daniel G. Suarez Forero[1], Ruihao Ni[2], Supratik Sarkar[1], Mahmoud Jalali Mehrabad[1], Mohammad Hafezi[1], You Zhou[2]; *[1]Joint Quantum Inst., Univ. of Maryland, USA; [2]Department of Materials Science and Engineering, Univ. of Maryland, USA.* We demonstrate the design and fabrication of a 2D optical cavity composed of two atomically thin mirrors made of transition metal dichalcogenide (TMD) monolayers. Under a magnetic field, the cavity acquires a chiral behavior due to the active nature of the TMD mirrors.

FF2C.3 • 11:00

Chiral phonon-induced magnetization in cerium fluorides, Jiaming Luo[1], Tong Lin[1], Junjie Zhang[1], Xiaotong Chen[1], Elizabeth Blackert[1], Rui Xu[1], Boris Yakobson[1], Hanyu Zhu[1]; *[1]Rice Univ., USA.* We report that circularly polarized terahertz light pulses can drive chiral phonons, which then induce an effective quasi-static magnetic field on the order of 1 tesla to polarize the paramagnetic cerium fluoride.

FF2C.4 • 11:30

Effects of Magnetic Ordering on *A*-mode Peaks using Raman Spectroscopy in Magnetic Topological Material $EuCd_2As_2$, Jin ho Kang[1], Ioannis Petrides[1], Subhajit Roychowdhury[2], Chandra Shekhar[2], Claudia Felser[2], Prineha Narang[1], Chee Wei Wong[1]; *[1]UCLA, USA; [2]Chemical Physics of Solids, Max Plank, Germany.* Magneto-Raman spectroscopy reveals magnetic ordering dependent helical phonon vibration modes in FM- and AFM-$EuCd_2As_2$ samples below their critical temperatures. While AFM-sample has the same spectra in co-circular polarizations, FM-sample has different degree of circular polarization.

FF2C.5 • 11:45

Ultrafast Dynamics in Iron-Based Superconductors and Innovation of High Pressure Ultrafast Spectroscopy, Jimin Zhao[1,2]; *[1]Inst. of Physics, Chin. Acad. of Sci., China; [2]School of Physical Sciences, Univ. of Chinese Academy of Sciences, China.* First, we have discovered the superconducting T_c in all iron-based superconductors is positively correlated with their electron-phonon coupling strength λ. Second, we have successfully innovated high pressure ultrafast spectroscopy, creating a new area of research.

FF2C.6 • 12:00

Coherent Acoustic Phonons in Bi_2Se_3 Ultrathin Films Probed by Femtosecond, Optical Pump-Probe Spectroscopy, Jing Cheng[1], Kiryl A. Niherysh,[2], Peter Francis[1], Debamitra Chakraborty[1], Floriana Lombardi[3], Donats Erts[2], Serghej L. Prischepa[4], Adam Laszcz[5], Ivan Komissarov[1], Roman Sobolewski[1]; *[1]Univeristy of Rochester, USA; [2]Univ. of Latvia, Latvia; [3]Chalmers Univ. of Technology, Sweden; [4]Università degli Studi di Salerno, Italy; [5]Inst. of Microelectronics and Photonics, Poland.* The dynamics of coherent acoustic phonons in the Bi_2Se_3 layered crystal system are investigated. The findings reveal that the frequency evolution of breathing modes with the number of the material quintuple layers and the dispersion relation both can be explained by a modified chain model with a nonuniform coupling force.

FF2C.7 • 12:15

Observation of Ultrafast Coherent Acoustic Vibrations in 2D Antimonene/MoS2 and Quantification of the Weak Van der Waals Coupling, Zih-Sian Yang[1], Che-Jia Chang[1], Peng-Jui Wang[1], Shih-Yen Lin[2], Chi-Kuang Sun[1]; *[1]National Taiwan Univ., Taiwan; [2]Academia Sinica, Taiwan.* Here we report the observation of ultrafast coherent acoustic vibrations in antimonene/MoS_2 2D van der Waals (vdW) heterostructures. The vdW coupling between antimonene/MoS_2 layers was successfully quantified through analyzing the observed thickness dependent vibrational frequencies.

10:30 -- 12:30
Room: W205AB
AF2D • Optical Neural Networks and Applications of Machine Learning
Presider: To be Announced

AF2D.1 • 10:30
All-Optical Phase Conjugation Using a Diffractive Visual Processor, Che-Yung Shen[1], Jingxi Li[1], Tianyi Gan[1], Mona Jarrahi[1], Aydogan Ozcan[1]; *[1]UCLA, USA.* We present a diffractive visual processor that can approximate optical phase conjugation operation by linear optical processing without any digital computing or external power sources, which can be used for turbidity suppression and aberration correction.

AF2D.2 • 10:45
Sub-micron Ultracold Neutron Position Resolution using Chip Based Optical Neural Network, Shanny Lin[2,1], Hanqing Zhu[1], S. Clayton[2], C. L. Morris[2], Z. Tang[2], Zhehui Wang[2], Ray T. Chen[1]; *[1]Univ. of Texas at Austin, USA; [2]Los Alamos National Laboratory, USA.* High spatial resolution of ultracold neutron (UCN) measurements of 1 µm or less is highly desired for many UCN experiments. Optical neural networks are potential radiation-hard hardware platforms for real-time, energy-efficient analysis of UCN hits.

AF2D.3 • 11:00
Scalable Optical Neural Network Based on Parametric Process, Xin Dong[1], Yi Zhou[1], Xiaoxiao Wen[1], Kenneth Kin-Yip Wong[1,2]; *[1]the Univ. of Hong Kong, Hong Kong; [2]Advanced Biomedical Instrumentation Centre, Hong Kong.* An optical neural network based on parametric process is demonstrated, and DFT is applied to realize a computation frame rate of up to 40MHz. The MNIST-digit dataset classification accuracy is improved to 87.7%.

AF2D.4 • 11:15
Enhancing Underwater Imaging for Robot through Embedded Polarization Neural Network, Yuanzheng Ma[1], Shu Pan[2], Peter Marsh[1], Xun Guan[1]; *[1]Tsinghua Univ., China; [2]Harbin Inst. of Technology (Shenzhen), China.* Transforming underwater imaging, our integrated neural network and polarization camera enhance PSNR by 40.61%, enabling the robot to effectively discern weak signals in highly scattering environments and facilitating swift imaging and detection.

AF2D.5 • 11:30
Inch-scale achromatic planar flat lens doublet reshaping near-eye display, Dajun Lin[1], Tina M. Hayward[1], Apratim Majumder[1], Rajesh Memon[1]; *[1]Univ. of Utah, USA.* We demonstrate an inch-scale planar multi-level diffractive lens (MDL) doublet for near-eye display, delivering 90° field-of-view (FOV), diffraction-limited focusing, while maintaining extremely low weight (~ 6 grams)

AF2D.6 • 11:45

Achromatic Imaging Systems with Flat Lenses Enabled by Deep Learning, Roy Maman[1], Eitan Mualem[1], Noa Mazurski[1], Jacob Engelberg[1], Uriel Levy[1]; *[1]The Hebrew Univ. of Jerusalem, Israel.* We experimentally demonstrate an achromatic imaging system by the fusion of chromatically aberrated flat lenses with deep learning. We obtained high-quality images captured with a large field-of-view under normal outdoor light illumination conditions.

AF2D.7 • 12:00
POFNet: Enlarging the Dynamic Range of Phase Demodulation by Signal Fusion, Zechao Liu[1], Hongkun Zheng[1], Chen Zhu[1], Lingmei Ma[1]; *[1]Research Center for Optical Fiber Sensing, Zhejiang Lab., China.* To break the π-phase criterion in phase demodulation, POFNet is proposed to fuse the OPD and the phase signal to estimate the unwrapping errors and recover larger phase. The results showcase its superiority performance.

10:30 -- 12:30
Room: W205CD
AF2E • Optical Ranging and Spectroscopy
Presider: To be Announced

AF2E.1 • 10:30
Towards Spatially Resolved, Single-Ended Tunable Diode Laser Absorption Spectroscopy in Particle-Laden Flows, Clemens Hansemann[1], Matthias Bonarens[1,2], Kyle Daun[2], Johannes Emmert[1], Steven Wagner[1]; *[1]Mechanical Engineering, Technical Univ. of Darmstadt, Germany; [2]Mechanical and Mechatronics Engineering, Univ. of Waterloo, Canada.* This study introduces a novel technique for single-ended measurements of the properties of inhomogeneous particle-laden gases by combining tunable-diode laser absorption spectroscopy with optical ranging. The technique and evaluation strategy are demonstrated with a numerical study.

AF2E.2 • 10:45
Neural Network Analysis of flame emission spectra for mineralogical analysis, Adam Bernicky[2], Boyd Davis[3], Hans-Peter Loock[1]; *[1]Univ. of Victoria - Chemistry, Canada; [2]Chemistry, Queen's Univ., Canada; [3]Kingston Process Metallurgy, Canada.* We present a real-time, online, all-optical analysis of the feedstock minerals used in an industrial copper smelter based on the emission spectra generated in an acetylene-nitrous oxide flame and artificial neural network analysis.

AF2E.3 • 11:00 (Invited)
THz Absorption Spectroscopy of Atoms in Plasmas, Jente R. Wubs[1], Uwe Macherius[1], Andy s. Nave[1], Laurent Invernizzi[2], Kristaq Gazeli[2], Guillaume Lombardi[2], Xiang Lü[3], Lutz Schrottke[3], Klaus-Dieter Weltmann[1], Jean-Pierre H. van Helden[1]; *[1]Leibniz Inst. for Plasma Science and Technology (INP), Germany; [2]Laboratoire des Sciences des Procédés et des Matériaux (LSPM), CNRS, Université Sorbonne Paris Nord, France; [3]Paul-Drude-Institut für Festkörperelektronik, Leibniz-Institut im Forschungsverbund Berlin e. V., Germany.* Terahertz absorption spectroscopy with quantum cascade lasers has recently been developed as a new diagnostic technique for investigating ground state atomic oxygen densities in plasmas. We compare the results with well-known diagnostics TALIF and CRDS.

AF2E.4 • 11:30

Extended Ambiguity Range in Photonic Stepped-Frequency Radar Systems, Ziqian Zhang[1,2], Yang Liu[3], Eric Magi[1,2], Benjamin J. Eggleton[1,2]; *[1]Inst. of Photonics and Optical Science (IPOS), School of Physics, The Univ. of Sydney, Australia; [2]The Univ. of Sydney Nano Inst. (Sydney Nano), The Univ. of Sydney, Australia; [3]Inst. of Physics, Swiss Federal Inst. of Technology Lausanne, Switzerland.* The unambiguity range of photonic stepped frequency radar is inversely determined by the frequency-shifting modulation step, thereby typically being at metre level. Here, we demonstrate a 10-fold unambiguity range extension to 15 metres.

AF2E.5 • 11:45
Optical Ranging Using Coherent Kerr Soliton Dual microcombs with Extended Ambiguity Distance, Yang Shen[1], Yuechen Yang[1], Kailu Zhou[1], Yuanzhuo Ding[1], Tinghao Jiang[1], Guangqiang He[1]; *[1]Shanghai Jiao Tong Univ., China.* We propose a dual-comb ranging method using coherent dual microcombs generated by single pump and thermo-optic tuning of resonances. This scheme provides the compatibility of low-bandwidth detectors and potential of real-time processing.

AF2E.6 • 12:00
Integrated lithium niobate electro-optic comb-based precise absolute distance measurement with 25-MHz acquisition rate, Yifan Qi[1], Xingyu Jia[1], Jingyi Wang[2], Weiwei Yang[1], Yihan Miao[1], Kunpeng Chen[1], Gongcheng Yue[1], Xinlun Cai[2], Guanhao Wu[1], Yang Li[1]; *[1]Tsinghua Univ., China; [2]Sun Yat-sen Univ., China.* Based on a folded integrated lithium niobate electro-optic phase modulator frequency comb, we demonstrate an absolute distance measurement method and system with 25-MHz acquisition rate and 13.77-μm Allan deviation.

AF2E.7 • 12:15
Optical Ranging – The Amorphous Silicon Intrinsic Photomixing Detector, Maurice Müller[1], Andreas Bablich[1], Rainer Bornemann[1], Nils Marrenbach[1], Paul Kienitz[1], Peter Haring Bolívar[1]; *[1]Univ. of Siegen, Germany.* The Intrinsic Photomixing Detector, a device enabling Time-of-Flight optical ranging up to ~70m and mean depth resolution of ~41.6mm, is presented. It may enhance pixel density and readout performance due to the utilized intrinsic mixing.

10:30 -- 12:30
Room: W206A
SF2F • Frequency Comb Spectroscopy and Ranging
Presider: Megan Kelleher; HRL Laboratories, LLC, USA

SF2F.1 • 10:30 (Invited)
Chemical Kinetics Study with a GHz Mid-infrared Dual-comb Spectrometer, Nazanin Hoghooghi[1,2], Peter Chang[2], Scott Egbert[2], Matt Burch[3], Rizwan Shaik[3], Patrick Lynch[3], Scott A. Diddams[2,1], Gregory B. Rieker[2]; *[1]NIST, USA; [2]Univ. of Colorado Boulder, USA; [3]Univ. of Illinois Chicago, USA.* We study abundance and temperature of species in reactant to product breakdown of 1,3,5-trioxane inside a shock-tube using a 1 GHz repetition rate mid-infrared dual-comb spectrometer with optical bandwidth > 30 THz.

SF2F.2 • 11:00
High-resolution and High-rate Dual-comb FMCW Lidar with Coherent Comb Stitching, Xianyi Cao[1], Long Wang[1], Tianyi Li[1], Minglu Cai[1], Guiling Wu[1], Jianping Chen[1], Kan

Wu[1]; [1]*Shanghai Jiao Tong Univ., China.* A dual-comb FMCW Lidar with coherent comb stitching (CCS) technique is firstly demonstrated. CCS can simultaneously achieve 65 GHz high frequency sweeping range, millimeter-level ranging resolution and 100 kHz high voxel acquisition rate.

SF2F.3 • 11:15
Mode-Resolved Direct Frequency Comb Cavity Ring-Down Spectroscopy using an Interband Cascade Laser, Chen Tzu-Ling[2,1], Charles Markus[2,3], Douglas Ober[2], Lukasz A. Sterczewski[3,4], Yi-Jan Huang[1], Chadwick Canedy[5], Igor Vurgaftman[5], Clifford Frez[3], Jerry Meyer[5], Maghmood Bagheri[3], Mitchio Okumura[2]; [1]*Department of photonics, National Yang Ming Chiao Tung Univ., Taiwan;* [2]*Division of Chemistry and Chemical Engineering, California Inst. of Technology, USA;* [3]*Jet Propulsion Laboratory, USA;* [4]*Wroclaw Univ. of Science and Technology, Poland;* [5]*Optical Sciences Division, Naval Research Laboratory, USA.* We demonstrate a mid-infrared mode-resolved direct frequency comb CRDS with a 3.27 µm interband cascade laser. Absorption for each comb line is extracted during cavity scanning in the Vernier configuration. The compact design achieves a 1.7 km equivalent pathlength, showcasing sensitivity surpassing 4×10^{-7} cm^{-1}.

SF2F.4 • 11:30
Microcomb-Based Digital Holography, Stephan Amann[1], Edoardo Vicentini[2], Bingxin Xu[1], Yang He[3], Theodor W. Hänsch[1], Qiang Lin[3], Kerry Vahala[4], Nathalie Picqué[1,5]; [1]*Max-Planck Inst. of Quantum Optics, Germany;* [2]*CIC nanoGUNE BRTA, Spain;* [3]*Department of Electrical and Computer Engineering, Univ. of Rochester, USA;* [4]*T.J. Watson Laboratory of Applied Physics, California Inst. of Technology, USA;* [5]*Max-Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany.* Lensless three-dimensional hyperspectral imaging is performed with a Kerr comb of 100 GHz line spacing. Broad microcombs will enable an unprecedented combination of long axial range, high precision and fast acquisition rate.

SF2F.5 • 11:45
Dual-Comb Spectroscopy with 200,000 Resolved Comb Teeth Across Mid-IR to THz at Video (69 Hz) Rate, Dmitrii D. Konnov[1], Andrey Muraviev[1], Sergey Vasilyev[2], Konstantin L. Vodopyanov[1]; [1]*CREOL, College of Optics and Photonics, Univ. of Central Florida, USA;* [2]*IPG Photonics Corporation, USA.* Using electro-optically sampled dual-comb spectroscopy we performed high-resolution spectroscopic measurements across an unprecedented 1.5–45 THz (6.6–200µm) spectral range with simultaneous acquisition of octave-wide spectra (200,000 comb lines) at 69-Hz rate.

SF2F.6 • 12:00 (Invited)
Precision Frequency Comb Spectroscopy of Reactive Molecular Plasmas, Ibrahim Sadiek[1], Norbert Lang[1], Adam J. Fleisher[2], Jean-Pierre H. van Helden[1]; [1]*Leibniz Inst. for Plasma Science and Technology (INP), Germany;* [2]*National Inst. of Standards and Technology, USA.* Using precision frequency comb spectroscopy, we study low-pressure molecular plasmas containing nitrogen, hydrogen, and a carbon source. We obtain precise quantum-state-resolved knowledge of plasma-generated molecules, providing insights into the non-thermal nature of plasma chemical processes.

10:30 -- 12:30
Room: W206B
SF2G • Yb Lasers
Presider: Giedre Archipovaite; Novanta Inc

SF2G.1 • 10:30 (Invited)
Light Conversion for Ultrafast Spectroscopy, Greta Bucyte[1]; *[1]Light Conversion, Ltd., Lithuania.* Femtosecond lasers and wavelength-tunable sources combined with time-resolved spectroscopy systems allows researchers to uncover the dynamic properties of molecules and materials across a broad range of time scales, aiding our understanding of fundamental processes in chemistry and physics. Let's delve into the evolution of these spectroscopy systems, unraveling how they have become more compact and comprehensive for intricate experiments.

SF2G.2 • 11:00
High Frequency Ytterbium Regenerative Amplifier Based on Yb:CALYO with sub-135 fs Pulses, Lyuben Petrov[1], Kaloyan Georgiev[1], Dimitar Velkov[1], Anton Trifonov[2], Xiaodong Xu[3], Mikhail Grishin[4], Ivan Buchvarov[1,5]; *[1]Sofia Univ. St. Kliment Ohridski, Bulgaria; [2]IBPhotonics Ltd., Bulgaria; [3]Jiangsu Normal Univ., China; [4]EKSPLA, Lithuania; [5]John Atanasoff Center for Bio and Nano Photonics (JAC BNP), Bulgaria.* We present enhanced functionalities of Yb-regenerative amplifier based on a single disordered Yb:$CaYAlO_4$ crystal, providing a sub-135 fs and high repetition rates of 0.5–1 MHz ultrafast pulses of 6.3 Watts at 1043 nm

SF2G.3 • 11:15
Optimization of Depolarization Compensation by a Spatially Variable Wave Plate in a High Power and High Energy End Pumped Yb:YAG Amplifier System, Aivaras Kazakevicius[2,1], Rokas Danilevičius[1], Andrejus Michailovas[2,1]; *[1]EKSPLA, Lithuania; [2]Center for Physical Sciences and Technology, Lithuania.* We present experimental data and theoretical simulation of depolarization compensation by a spatially variable wave plate in high average power end-pumped Yb:YAG amplifiers and analyze thermally induced output beam distortions and depolarization losses.

SF2G.4 • 11:30
Dual-Wavelength Emission From An Yb:YAG Thin-Disk Laser, Ayoub Boubekraoui[1], Thomas Graf[1], Marwan Abdou Ahmed[1]; *[1]Institut für Strahlwerkzeuge, Germany.* We experimentally demonstrate a dual-wavelength emission with adjustable wavelength separation from 0 nm to 27 nm from an Yb:YAG thin-disk laser by using a pair of high diffraction efficiency grating waveguide structures inside the resonator.

SF2G.5 • 11:45
A Nanosecond Pulsed DPSSL Demonstrating Long-Term, Stable Operation at 10 J, 100 Hz, Gary Quinn[1,2], Mariastefania De Vido[1], Danielle L. Clarke[1,2], Luke McHugh[1], Paul Mason[1], Jacob Spear[1], Jodie Smith[1], Martin Divoky[3], Jan Pilar[3], Ondre Denk[3], Thomas Butcher[1], Chris Edwards[1], Tomas Mocek[3], John Collier[1]; *[1]STFC Rutherford Appleton Laboratory, UK; [2]Inst. of Photonics and Quantum Sciences, Heriot-Watt Univ., UK; [3]HiLASE Centre, Inst. of Physics of the Czech Academy of Sciences, Czechia.* We report on the successful commissioning of DiPOLE-100Hz, a nanosecond diode-pumped solid-state laser (DPSSL) operating at 10 J, 100

Hz. This system has demonstrated long-term, stable operation with an energy stability of 1% rms.

SF2G.6 • 12:00
Characterisation of Stress-induced Depolarisation in a 10 J, 100 Hz Nanosecond Diode-pumped Solid-state Laser, Danielle L. Clarke[1,2], Mariastefania De Vido[1], Gary Quinn[1,2], Luke McHugh[1], Paul Mason[1], Jacob Spear[1], Jodie Smith[1], Martin Divoky[3], Jan Pilar[3], Ondre Denk[3], Thomas Butcher[1], Chris Edwards[1], Tomas Mocek[3], John Collier[1]; *[1]STFC Rutherford Appleton Laboratory, UK; [2]Heriot-Watt Univ., UK; [3]Hilase Centre, Czechia.* We characterise stress-induced depolarisation in a high-average power, diode-pumped, Yb:YAG laser, producing 10 J pulses at a 100 Hz repetition-rate. Depolarisation was measured at 6.6% after 7 passes without any compensation.

SF2G.7 • 12:15
High-power pulses generated by the spatiotemporal mode locking from the figure-9 fiber laser, Zhiwei Zhu[1], Wei Liu[1,2], Shih-Chi Chen[1,2]; *[1]Department of Mechanical and Automation Engineering, Chinese Univ. of Hong Kong, China; [2]Centre for Perceptual and Interactive Intelligence (CPII) Ltd., Hong Kong Science Park, China.* We present the generation of high-power pulses from a spatiotemporal mode-locked figure-9 fiber laser with graded-index multimode fibers. The maximal average power of the pulses is up to 1.05 W with an 18.86-MHz repetition rate.

10:30 -- 12:30
Room: W207A
FF2H • Progress in Squeezed Light Generation
Presider: Frédéric Grillot, France

FF2H.1 • 10:30
Boosting generation rate of squeezed single photon states by generalized photon subtraction, Hiroko Tomoda[1], Akihiro Machinaga[1], Kan Takase[1,2], Jun Harada[1], Takahiro Kashiwazaki[3], Takeshi Umeki[3], Shigehito Miki[4,5], Hirotaka Terai[4], Masahiro Yabuno[4], Fumihiro China[4], Daichi Okuno[1], Shuntaro Takeda[1]; *[1]The Univ. of Tokyo, Japan; [2]RIKEN Center for Quantum Computing, Japan; [3]NTT Device Technology Labs, Japan; [4]National Inst. of Information and Communications Technology, Japan; [5]Kobe Univ., Japan.* We theoretically and experimentally proved that the generation rate of squeezed single photon states can be increased by generalized photon subtraction method. Our work will encourage universal and fault-tolerant continuous-variable quantum information processing.

FF2H.2 • 10:45
Pulsed Homodyne Measurement of Multi-Mode Squeezed Vacua for Large Scale Quantum Computation, Nomura Takefumi[1], Mamoru Endo[1,2], Takahiro Kashiwazaki[3], Takeshi Umeki[3], Rajveer Nehra[4], Kan Takase[1], Warit Asavanant[1], Akira Furusawa[1]; *[1]Univ. of Tokyo, Japan; [2]RIKEN Center for Quantum Computing, Japan; [3]NTT Corporation, Japan; [4]Univ. of Massachusetts, USA.* Optical quantum computers require a large number of squeezed vacua. In this research, 36 squeezed spectral modes were produced with type-0 lithium niobate waveguide, thus demonstrating its scalability as a resource for multi-partite entanglement.

FF2H.3 • 11:00

Multimode Squeezed Vacuum of Kerr Primary Combs in Optical Microresonators, Melissa Guidry[1], Eran Lustig[1], Daniil Lukin[1], Shanhui Fan[1], Jelena Vuckovic[1]; [1]*Stanford Univ., USA.* We measure the squeezing structure of the below-threshold modes of a primary comb in an optical Kerr microresonator. Through two-photon autocorrelation measurements and balanced homodyne detection, we observe bichromatic gain and a multimode structure.

FF2H.4 • 11:15

Programmable Multimode Squeezed Light At Visible Wavelengths With >400 Modes, Federico Presutti[2], Logan Wright[2,1], Shi-Yuan Ma[2], Tianyu Wang[2], Benjamin Malia[2,3], Tatsuhiro Onodera[2,1], Peter L. McMahon[2,4]; [1]*NTT Physics and Informatics Laboratories, NTT Research, Inc., USA;* [2]*School of Applied and Engineering Physics, Cornell Univ., USA;* [3]*Intelligence Community Postdoctoral Research Fellowship Program, USA;* [4]*Kavli Inst. at Cornell for Nanoscale Science, Cornell Univ., USA.* We demonstrate a source of highly multimode, high gain vacuum squeezed light, and demonstrate how ultra-broadband frequency conversion enables the use of visible-light detector arrays and programmable frequency-domain unitary transformations.

FF2H.5 • 11:30

Photon statistics of squeezed light from a silicon nitride microresonator without photon number resolving detectors, Massimo Borghi[1], Emanuele Brusaschi[1], Marcello Bacchi[1], Marco Liscidini[1], Matteo Galli[1], Daniele Bajoni[1]; [1]*Univ. of Pavia, Italy.* We measure the photon number statistics of squeezed light from a silicon nitride resonator using on-off detectors. The distribution is well described by that of the product of a two-mode squeezer and two uncorrelated single-mode thermal states.

FF2H.6 • 11:45

Generation of Squeezed Light in Silicon Nitride Photonic Integrated Chips, Shuai Liu[1], Abdulkarim Hariri[1], Bo-Han Wu[2], Yuheng Zhang[1], Zheshen Zhang[1]; [1]*Univ. of Michigan, USA;* [2]*Massachusetts Inst. of Technology, USA.* We develop a scalable Si_3N_4 photonics platform with high-*Q* microring resonators and efficient couplers to genenerate squeezed light.

FF2H.7 • 12:00

Generation of Squeezed Quantum Microcomb in an Integrated Silicon Nitride Microresonator, Mandana Jahanbozorgi[1], Zijiao Yang[1], Haoran Chen[1], Beichen Wang[1], Shuman Sun[1], Xu Yi[1]; [1]*Univ. of Virginia, USA.* We report a squeezed quantum microcomb generated from a silicon nitride microresonator. 70 quantum modes, in the form of 35 two-mode-squeezed comb pairs, are observed. A maximum raw squeezing of 1.1 dB is attained.

FF2H.8 • 12:15

Frequency Tuning of a Squeezed Vacuum State Using Interferometric Enhanced Bragg Diffraction Effect, Qiqi Deng[1], Xiaoying Li[1], Xueshi Guo[1], Wenqi Li[1]; [1]*Tianjin Univ., China.* We demonstrate a frequency tuning of a squeezed state with efficiency of 91%. The tuning frequency is 80 MHz, which is orders of magnitude larger than the line-width of the laser used for state generation.

10:30 -- 12:30
Room: W206BC
SF2I • Laser Ablation and Surface Processing
Presider: Euan McLeod, USA

SF2I.1 • 10:30 (Invited)
Influence of Polymer Film Properties on Laser Induced Periodic Surface Structures Formation and Control of Surface Functionality, Patricia Martínez-García[2], Javier Prada-Rodrigo[3], René I Rodríguez-Beltrán[4], Aurora Nogales[5], Pablo Moreno[6], Tiberio A Ezquerra[5], Esther Rebollar[1]; *[1]Instituto de Química Física Blas Cabrera, CSIC, Spain; [2]Universidad Nacional de Educación a Distancia (UNED), Spain; [3]Laboratoire Hubert Curien, France; [4]CONACYT-Centro de Investigación Científica y de Educación Superior de Ensenada, Unidad Foránea Monterrey, Mexico; [5]Instituto de Estructura de la Materia, CSIC, Spain; [6]Grupo de Aplicaciones del Láser y Fotónica (ALF-USAL), Universidad de Salamanca, Spain.* Laser Induced Periodic Surface Structures (LIPSS) formation on the surface of polymer materials is studied as a function of polymer properties and irradiation conditions, and effects on surface chemistry and properties like wettability, surface energy and adhesion are assessed.

SF2I.2 • 11:00
Measurement and Thermal Description of Laser Ablation Threshold in Ultra-wide Pulse Durations, Tsubasa Endo[1], Shuntaro Tani[1], Haruyuki Sakurai[1], Yohei Kobayashi[1]; *[1]The Inst. for Solid State Physics, The Univ. of Tokyo, Japan.* We measured laser ablation thresholds for copper at pulse durations from 300 fs to 1 µs. We found a thermal description of the threshold to be valid for >5 ps.

SF2I.3 • 11:15
Mechanisms of femtosecond laser ablation of monolayer hBN and its application to nanopatterning, Sabeeh Irfan Ahmad[1], Arpit Dave[1], Emmanuel Sarpong[1], Hsin-Yu Yao[2], Joel M. Solomon[1], Jing-Kai Jiang[3], Chih-Wei Luo[3], Wen-Hao Chang[3], Tsing-Hua Her[1]; *[1]Physics and Optical Science, Univ of North Carolina at Charlotte, USA; [2]Physics, National Chung Cheng Univ., Taiwan; [3]Department of Electrophysics, National Yang Ming Chiao Tung Univ., Taiwan.* We observe a reduced ablation threshold of monolayer hBN in comparison to bulk materials with similar bandgap energy. The ablation mechanism is established to be intrinsic and impressive nanopatterning resolution is demonstrated.

SF2I.4 • 11:30
Withdrawn

SF2I.5 • 11:45
The Role of Plasmas in Self-organized Micro/nanoscale Structure Formation in Femtosecond Laser Surface Processing, Andrew R. Reicks[1], Craig A. Zuhlke[1]; *[1]Univ. of Nebraska- Lincoln, USA.* Spectroscopic techniques are used to study the plasma generated during femtosecond laser surface processing as a function of fluence to better understand the effect of laser plasmas on resulting surface morphology.

SF2I.6 • 12:00
Femtosecond Laser Damage Comparison between Silica/Hafnia Nanolaminates vs. Mixed Material Coatings for High Power Laser Optics, Emma DeAngelis[1], Mohamed Yaseen Noor[1],

Maxwell Weiss[2], Carmen Menoni[2,3], Enam Chowdhury[1]; *[1]Materials Science and Engineering, The Ohio State Univ., USA; [2]Electrical and Computer Engineering, Colorado State Univ., USA; [3]XUV Lasers Inc., USA.* Two layer anti-reflection coatings (Air/SiO_2/HfSiO/substrate. Vs Air/SiO_2/Hf-SiO_2 nanolaminates/substrate) were tested with p-polarized 77fs 1030nm laser pulses. Damage threshold fluence of the sample with nanolaminate was 2/3 of the damage fluence of the mixed layer sample.

10:30 -- 12:30
Room: W207D
SF2J • Sensing and Imaging on Chip
Presider: Linbo Shao; Virginia Tech, USA

SF2J.1 • 10:30
Ultrawide Field-of-View, Large Depth-of-Field Imaging Using Metalenses, Louis Martin-Monier[1], Zhaoyi Li[1], Tian Gu[1], Juejun Hu[1]; *[1]Department of Materials Science and Engineering, MIT, USA.* Herein, we present a bi-layer metasurface with a 172° field-of-view, a depth-of-field extending from 1 mm to 300 mm, a resolution down to 50 lp/mm, and thicknesses down to 0.2 mm.

SF2J.2 • 10:45
Silicon Photonic Integrated Circuits for Heterodyne Interferometric Imaging of Incoherent Light Source, Humphry Z. Chen[1], Mingye Fu[1], Lawrence Shing[2], Gopal Vasudevan[2], Tony Kowalczyk[2], Neal Hurlburt[2], S. J. Ben Yoo[1]; *[1]UC Davis, USA; [2]Lockheed Martin, USA.* We demonstrate a photonic-integrated-circuit heterodyne imaging system with polarization-diverse gratings, heterodyne mixing, and associated photonic components on-chip. Proof-of-principle experiments demonstrate spectrum recovery using two apertures

SF2J.3 • 11:00
Nanosecond wavelength measurements with a silicon photonic wavemeter, Brian Stern[1], Bob Farah[1], Kwangwoong Kim[1], Robert Borkowski[1], Kovendhan Vijayan[1], David Bitauld[2]; *[1]Nokia Bell Labs, USA; [2]Nokia Bell Labs, France.* We demonstrate a silicon photonic wavemeter with nanosecond-scale measurement speed. We show tracking of the frequency excursions of a laser during bursts and steps, with wavemeter response times of 3 ns.

SF2J.4 • 11:15
Photo-Thermal Plasmonic Sensors for Technology-independent Control and Stabilization of PICs, Alessandro di Tria[1], Andres I. Martinez[1], Sergio Bongiorno[1], Vittorio Grimaldi[1], Manuel Kohli[2], Dimitrios Chatzitheocharis[3], Ueli Koch[2], Juerg Leuthold[2], Deepak Sharma[4], Alexandre Bouhelier[4], Andrea Melloni[1], Francesco Morichetti[1], Francesco Zanetto[1], Giorgio Ferrari[1], Marco Sampietro[1]; *[1]Politecnico di Milano, Italy; [2]ETH Zürich, Switzerland; [3]Aristotle Univ. of Thessaloniki, Greece; [4]CNRS UMR 6303 Université de Bourgogne, France.* This paper presents photo-thermal plasmonic sensors enabling closed-loop stabilization of photonic integrated circuits. Micrometric dimensions and simple fabrication make them suitable for any technological platform, providing sensitivity and control to technologies not featuring active optoelectronics.

SF2J.5 • 11:30

Enhanced photoresponse beyond the bandgap spectral limit of a normal-incidence silicon photodetector by helium-ion implantation, Zhao Wang[1], Xiaolei Wen[2], Kai Zou[1], Yun Meng[1], Jinwei Zeng[3], Jian Wang[3], Huan Hu[4], Xiaolong Hu[1]; *[1]Tianjin Univ., China; [2]Univ. of Science and Technology of China, China; [3]Huazhong Univ. of Science and Technology, China; [4]Zhejiang Univ., China.* We enhance the photoresponse beyond the bandgap spectral limit of a normal-incidence silicon photodetector by helium-ion implantation. The minimal detectable optical power is improved from -33.2 dBm to -63.1 dBm at 1550-nm wavelength.

SF2J.6 • 11:45
1D Line-scan Metalens Integrated with MEMS Actuator for Depth Sensing Applications, Yuan Hsing Fu[1], Roberto Carminati[2], Huanhuan Wang[1], Leh Woon Lim[1], Narak Choi[1], Keng Heng Lai[1], Charmaine Shuyan Goh[1], Yat Fung Tsang[1], Navab Singh[1], Qingxin Zhang[1]; *[1]Inst. of Microelectronics (IME), Agency for Science Technology and Research (A*STAR), Singapore; [2]STMicroelectronics, Italy.* A 1D line-scan metalens integrated MEMS actuator with a field-of-view 80° × 60° has been demonstrated as proof-of-concept. This metalens integrated MEMS actuator shows promise as a compact optical module for depth sensing applications.

SF2J.7 • 12:00
High Sensitivity FSR-Free Sidewall Grating Slot Waveguide Microring Resonator Biochemical Sensors, Weiqing Cheng[1], Xiao Sun[1], Shengwei Ye[1], Bocheng Yuan[1], John Marsh[1], Lianping Hou[1]; *[1]Univ. of Glasgow, UK.* A compact sidewall grating slot microring resonator is demonstrated with a high sensitivity of 620 nm/RIU and a limit of detection of 1.4×10 -4 RIU, offering an unbounded detection range.

SF2J.8 • 12:15
Subwavelength Grating Cascaded Microring Resonator Biochemical Sensors with Record-High Sensitivity, Weiqing Cheng[1], Xiao Sun[1], Shengwei Ye[1], Bocheng Yuan[1], John Marsh[1], Lianping Hou[1]; *[1]Univ. of Glasgow, UK.* A compact SOI-based subwavelength grating cascaded microring resonator is demonstrated with a record-high sensitivity of 810 nm/RIU and a limit of detection of 2.04×10 -5 RIU. The measured concentration sensitivity is 1430 pm/%.

10:30 -- 12:30
Room: W208
FF2K • Nonlinear Quantum Photonics
Presider: Matthew Grein; Massachusetts Inst of Tech Lincoln Lab, USA

FF2K.1 • 10:30
Polarization-Entangled Photon-Pair Sources Based on 3R-MoS_2, Maximilian A. Weissflog[1], Anna Fedotova[1,2], Yilin Tang[3], Elkin A. Santos[1], Benjamin Laudert[1], Saniya Shinde[1], Fatemeh Abtahi[1], Mina Afsharnia[1], Inmaculada Pérez Pérez[1], Sebastian Ritter[1], Hao Qin[3], Jiri Janousek[3], Sai Shradha[1,4], Isabelle Staude[1,2], Sina Saravi[1], Thomas Pertsch[1,5], Frank Setzpfandt[1,5], Yuerui Lu[3], Falk Eilenberger[1,5]; *[1]Inst. of Applied Physics, Abbe Center of Photonics, Friedrich Schiller Univ. Jena, Germany; [2]Inst. of Solid State Physics, Friedrich Schiller Univ. Jena, Germany; [3]School of Engineering, College of Science and Computer Scienc, The Australian National Univ., Australia; [4]Inst. for Condensed Matter Physics, Technical Univ. of Darmstadt, Germany; [5]Fraunhofer Inst. for Applied Optics and Precision Engineering IOF, Germany.* We demonstrate for the first time generation of polarization-entangled photon pairs in a transition

metal dichalcogenide. Using 3R-phase molybdenum disulfide, we experimentally show tunable, high-fidelity generation of different polarization Bell states.

FF2K.2 • 10:45
High-Dimensional Biphoton Emission in the OAM Basis, Daniel Shahar[1], Jeffrey Demas[1], Aaron G. Peterson-Greenberg[1], Siddharth Ramachandran[1]; [1]*Boston Univ., USA.* We demonstrate a 7-dimensional, fiber-based, single-apertured source of spectrally overlapping biphotons distinguished by orbital angular momentum enabled by the large modal density of a ring core fiber.

FF2K.3 • 11:00
High-Efficiency Nanophotonic Entangled Pair Production at Visible and Near-IR Wavelengths, Nathan A. Harper[1], Emily Hwang[4], Ryoto Sekine[2], Luis Ledezma[2], Christian Perez[3], Alireza Marandi[2,4], Scott K. Cushing[1]; [1]*Department of Chemistry and Chemical Engineering, California Inst. of Technology, USA;* [2]*Department of Electrical Engineering, California Inst. of Technology, USA;* [3]*California State Univ., USA;* [4]*Department of Applied Physics and Material Science, California Inst. of Technology, USA.* We demonstrate nanophotonic visible and near-IR entangled photon pair production via periodically poled thin-film lithium niobate waveguides. Pairs spanning 720-900 nm are generated from 405-406.4 nm pump wavelengths with per-photon efficiencies approaching 10^{-4}.

FF2K.4 • 11:15
Hyperentangled photon pairs emitted from an integrated source delivering more than 1 Gpair/s, Linda Gianini[1,2], Andrea Barone[1], Marcello Bacchi[3], Jonathan Faugier-Tovar[2], Sara Congia[3,2], Massimo Borghi[3], Noemi Tagliavacche[3], Luca Zatti[1], Quintin Wilmart[2], Ségolène Olivier[2], Marco Liscidini[3], Matteo Galli[3], Daniele Bajoni[1]; [1]*Dipartimento di Ingegneria Industriale e dell'Informazione, Università degli Studi di Pavia, Italy;* [2]*CEA-Leti, France;* [3]*Dipartimento di Fisica, Universita degli Studi di Pavia, Italy.* We demonstrate a high-rate source of hyperentangled photons based on a silicon racetrack resonator. Hyperentanglement is verified by violating Bell's inequality in both time and frequency domains, and obtaining a high-purity state using frequency-bin encoding.

FF2K.5 • 11:30
Integrated Silicon Nitride Photon-Pair Source Based on Nonlinear Interferometers, Zhaorong Fu[1], Xiaojiong Chen[1], Xinyu Jia[1], Jun Mao[1], Xianghao Wu[1], Tianxiang Dai[1], Qihuang Gong[1], Jianwei Wang[1]; [1]*Peking Univ., China.* We demonstrate an optimized silicon nitride chip-based parametric photon-pair source via spontaneous four-wave mixing process. Nonlinear interference and dispersion engineering yield high spectral purity without compromising heralding efficiency, offering a solution for integrated photon-pair sources with uniformity and wavelength flexibility.

FF2K.6 • 11:45 (Invited)
Emergence of Spontaneous Order in Driven and Undriven Arrays of Atoms, Silvia Cardenas-Lopez[1]; [1]*Columbia Univ., USA.* In a waveguide QED system, collective dissipation induces emergent order in photon emission. Transient decay breaks mirror symmetry, causing photon avalanches. Steady-state conditions yield coherent light with a narrow spectrum akin to superradiant laser light.

FF2K.7 • 12:15

Domain-engineered Thin-film Lithium Niobate for Frequency-multiplexed Photon-pair Generation, Jiayu Yang[1], CJ Xin[1], Amirhassan Shams-Ansari[1], Shengyuan Lu[1], Neil Sinclair[1], Marko Loncar[1]; *[1]Harvard Univ., USA.* The ferroelectric domains of thin-film lithium niobate are structured for multi-wavelength nonlinear optical frequency conversion. We target frequency-multiplexed photon-pair generation, in which we show conditions for five pair sources (fidelity >90%) in a single waveguide.

10:30 -- 12:30
Room: W209A
SF2L • Novel Transmitters and Receivers
Presider: Wang Ting; Inst. of Physics CAS, China

SF2L.1 • 10:30

An Improved Upsampling-free Kramers-Kronig Receiver for Low Carrier-to-Signal Power Ratio, Shiwei Luo[1], Li Jianping[1], Xinkuo Yu[1], Yuwen Qin[1], Meng Xiang[1], Songnian Fu[1]; *[1]Guangdong Univ. of Technology, China.* An improved upsampling-free Kramers-Kronig receiver has been proposed in which 0.8dB CSPR reduction can be realized for the 40Gbaud 16-QAM signal after 80km transmission with a comparison of the typical KK receiver without digital upsampling.

SF2L.2 • 10:45

FPGA-Programmable 512 Gbps 2.5D DWDM Photonic Network Interface Card, James T. Robinson[1], Maarten Hattink[1], Liang Yuan Dai[1], Max Haimowitz[1], Mao Li[1], Daniel Jang[1], Padraic Morrissey[2], Arun K. Malik[2], Peter O'Brien[2], Seth Robertson[3], Mingoo Seok[1], Keren Bergman[1]; *[1]Columbia Univ., USA; [2]Photonics Packaging and System Integration Group, Tyndall National Inst., Ireland; [3]Peraton Labs, USA.* We present a 2.5D integrated, FPGA-programmable silicon photonic network interface card implementing a bidirectional 512Gbps dense wavelength-division multiplexed link. We demonstrate sixteen transmitter and eight of sixteen receiver channels operating error-free at 16 Gbps each.

SF2L.3 • 11:00

Nonlinear Distortion Resilient Nyquist Sampling Receiver, Younus N. Mandalawi[1], Abhinand Venugopalan[1], Janosch Meier[1], Karanveer Singh[1], Mohamed I. Hosni[1], Thomas Schneider[1], Deepanshu Yadav[1]; *[1]Technische Universität Braunschweig, Germany.* We experimentally studied the effect of nonlinear distortion on a Nyquist sampling receiver, that enables high-bandwidth signal detection with low-bandwidth devices. Our findings confirm resilience to MZM nonlinearities, reducing stringent parameters on the modulator design.

SF2L.4 • 11:15

High Speed Optical Wireless Receiver with Wide Coverage, Rui Chen[1], Wajahat Ali[1], Yi Liu[1], Michael Crisp[1], Richard Penty[1]; *[1]Univ. of Cambridge, UK.* An optical wireless receiver at 850 nm is realized, providing 8.6 Gbps maximum data rate and >7 Gbps data rate across a 9.5 cm lateral coverage at 3 m range with a BER of <$2x10^{-3}$

SF2L.5 • 11:30 (Invited)

Power-Efficient Transceivers for Scalable High-performance Free-space Optical Communications, David O. Caplan[1]; [1]*MIT Lincoln Lab, USA.* Power-efficiency, flexibility, and performance are important technical drivers for scalable long-distance free-space optical communication networks. Candidate agile WDM-scalable transmitter technologies and compatible receivers that support many modulation options and rates with exceptional sensitivities are presented.

SF2L.6 • 12:00

Polarization Fading Suppression Based on Passive Metasurface for Self-homodyne Coherent Detection, Zhi Cheng[1], Yue Wang[1], Jing Zhou[1], Zhuo Wang[1], Jiaqi Qu[1], Li Wang[1], Changyuan Yu[1,2]; [1]*Hong Kong Polytechnic Univ., Hong Kong;* [2]*Hong Kong Polytechnic Univ. Shenzhen Research Inst., China.* Passive metasurface using supercell design achieves non-uniformly mapping of SOPs on Poincaré sphere to suppress polarization fading. Applied in a 60-Gbaud DP-16QAM self-homodyne optical network, it reduces the probability of burst error by over 40%.

SF2L.7 • 12:15

200-Gb/s/λ Linewidth-Tolerant Transmission Using Phase Retrieval Field Recovery, Hanzi Huang[1,2], Haoshuo Chen[1], Yetian Huang[1,2], Cheng Guo[1], Qi Gao[2], Nicolas Fontaine[1], Mikael Mazur[1], Lauren Dallachiesa[1], Roland Ryf[1], Zhengxuan Li[2], Yingxiong Song[2]; [1]*Nokia Bell Labs, USA;* [2]*Shanghai Univ., China.* Utilizing a phase retrieval receiver, we experimentally demonstrate 50-Gbaud probabilistically shaped 64-QAM transmission over 40-km SSMF using a MHz-level uncooled DFB laser, achieving a net date rate exceeding 200 Gb/s.

10:30 -- 12:30
Room: W209B
SF2M • Photonics for Machine Learning
Presider: Chaoran Huang; Chinese Univ. of Hong Kong, Hong Kong

SF2M.1 • 10:30

A Fully Programmable On-Chip Planar Waveguide for Machine Learning, Martin M. Stein[1], Tatsuhiro Onodera[1,2], Benjamin A. Ash[1], Mandar M. Sohoni[1], Melissa Bosch[1], Ryotatsu Yanagimoto[1,2], Marc Jankowski[2,3], Timothy McKenna[2,3], Tianyu Wang[1], Gennady Shvets[1], Maxim R. Shcherbakov[1,6], Logan Wright[1,4], Peter L. McMahon[1,5]; [1]*School of Applied and Engineering Physics, Cornell Univ., USA;* [2]*NTT Physics and Informatics Laboratories, NTT Research, Inc., USA;* [3]*E. L. Ginzton Laboratory, Stanford Univ., USA;* [4]*Department of Applied Physics, Yale Univ., USA;* [5]*Kavli Inst. at Cornell for Nanoscale Science, Cornell Univ., USA;* [6]*Department of Electrical Engineering and Computer Science, UC Irvine, USA.* We introduce a device containing a planar waveguide whose spatial refractive index profile n(x,z) can be programmed in real time. We demonstrate use this device as an optical neural network.

SF2M.2 • 10:45

Electrically Programmable Non-Volatile Silicon Photonic Content Addressable Memory (CAM) Cell, Chuanyu Lian[4,5], Hongyi Sun[4,5], Yi-Siou Huang[4,5], Steven Vitale[1], Juejun Hu[2], Ichiro Takeuchi[4], Nathan Youngblood[3], Christos Vagionas[6], Carlos A. Rios Ocampo[4,5]; [1]*Advanced Materials and Microsystems Group, MIT Lincoln Laboratory, USA;* [2]*Materials Science & Engineering, Massachusetts Inst. of Technology, USA;* [3]*Electrical & Computer Engineering, Univ. of Pittsburgh, USA;* [4]*Materials Science & Engineering, Univ. of Maryland, USA;* [5]*Inst. for*

Research in Electronics and Applied Physics, Univ. of Maryland, USA; [6]Department of Informatics, Aristotle Univ. of Thessaloniki, Greece. We experimentally demonstrate the first electrically programmable, non-volatile silicon photonic content addressable memory cell using Sb_2Se_3 phase change material on microring resonators, opening the path for light-based search operations in zero-power look-up tables.

SF2M.3 • 11:00
Self-Induced Optical Nonlinear-Nonlocal Effect and Short-Term Memory for Chip-Scale Reservoir Computing, Chengkuan Gao[1], Prabhav Gaur[1], Shimon Rubin[1], Yeshaiahu Fainman[1]; *[1]ECE, Univ. of California, San Diego, USA.* We demonstrate nonlinear and nonlocal optical phase change effects due to thermocapillary deformation of thin liquid film interacting with photonic mode in silicon photonic waveguide. The interaction allows storing information in the liquid film, achieving short term memory, and implementing compact chip-scale Reservoir Computing (RC)

SF2M.4 • 11:15
A Single-Wavelength Non-Coherent Photonic Matrix Multiplication Circuit For Optical Neural Networks, Rui Tang[1], Makoto Okano[2], Kasidit Toprasertpong[1], Shinichi Takagi[1], Mitsuru Takenaka[1]; *[1]The Univ. of Tokyo, Japan; [2]National Inst. of Advanced Industrial Science and Technology, Japan.* We demonstrate a single-wavelength, non-coherent silicon photonic 4×4 matrix multiplication circuit for optical neural networks. An accuracy of 91.7% is obtained using this circuit in a simple neural network for classifying Iris flowers.

SF2M.5 • 11:30
Non-volatile Reconfigurable Digital Optical Diffractive Neural Network Based on Phase Change Material, Qiaomu Hu[1,2], Chu Wu[1,2], Jingyu Zhao[1,2], Yuanrong Zhang[1,2], Rui Zeng[1,2], Shuang Zheng[1,2], Minming Zhang[1,3]; *[1]School of Optical and Electronic Information, Huazhong Univ of Science and Technology, China; [2]National Engineering Research Center for Next Generation Internet Access System, China; [3]Wuhan National Laboratory for Optoelectronics, China.* We propose a non-volatile reconfigurable digital all-optical diffractive neural network based on Sb_2Se_3 phase-change material. With three optical diffraction layers and a correcting layer, our model achieves 94.46% accuracy for handwritten digit recognition.

SF2M.6 • 11:45
Withdrawn

SF2M.7 • 12:00
Compact and Power-efficient Thermo-optic Phase Shifter using Strongly Over-coupled Resonators in Tandem, Gaolei Hu[1], Hon K. Tsang[1]; *[1]Department of Electronic Engineering, The Chinese Univ. of Hong Kong, China.* We propose and experimentally demonstrate a compact 395ynchro-optic phase shifter using strongly over-coupled resonators in tandem. The device consumes 2.2 mW for 2π phase shift with a modulation dependent loss of 0.5 dB.

SF2M.8 • 12:15
Experimental Verification of Non-Volatile and Reversible Phase Shift in Silicon Nitride Waveguide, Yuriko Maegami[1], Guangwei Cong[1], Rai Kou[1], Noritsugu Yamamoto[1], Toshihiro Narushima[1], Tai Tsuchizawa[1], Hitoshi Kawashima[1], Koji Yamada[1]; *[1]Natl Inst of Adv Industrial Sci & Tech, Japan.* We demonstrate a reversible and non-volatile optical phase shift in a silicon-

nitride waveguide by a process of thermal annealing and ultraviolet irradiation, and investigate a correlation between phase shifts and charge state of dangling bonds.

10:30 -- 12:30
Room: W209C
FF2N • Sub-wavelength Systems and 2D Materials
Presider: Luca Razzari; INRS-Energie Materiaux et Telecom, Canada

FF2N.1 • 10:30
Topological Nonlinear Optics in Twisted h-BN Interface, Xueqi Ni[1], Mingjie Zhang[1], Beicheng Lou[2], Shanhui Fan[2], Eric Mazur[1], Yuan Cao[3], Haoning Tang[1]; *[1]Harvard Univ., USA; [2]Stanford Univ., USA; [3]Univ. of California, Berkeley, USA.* Our research demonstrates tunable second harmonic generation in quantum material heterostructures, revealing nontrivial topological properties in their nonlinear optical responses with potential applications in quantum optics and condensed matter physics.

FF2N.2 • 11:00
Microcavity Platform for Widely Tunable Optical Double Resonance, Sigurd Flågan[2,1], Patrick Maletinsky[2], Richard J. Warburton[2], Daniel Riedel[3,2]; *[1]Univ. of Calgary, Canada; [2]Department of Physics, Univ. of Basel, Switzerland; [3]AWS Center for Quantum Networking, USA.* We present *in situ* tuning of both the absolute and relative frequency spacing of the modes in an optical microcavity by incorporating a wedged diamond membrane. We demonstrate THz continuous tuning of doubly-resonant Raman scattering.

FF2N.3 • 11:15
Nonlinear Optics of Molecular Nanomaterials and Devices: Multi-Scale Simulations, Marjan Krstic[1], Benedikt Zerulla[1], Alejandro Luna Díaz[1], Christof Holzer[1], Dominik Dominik[1], Ivan Fernandez-Corbaton[1], Carsten Rockstuhl[1]; *[1]Karlsruhe Inst. of Technology, Germany.* A novel computational framework couples quantum chemical and full-wave optical simulations to study bulk and surface contributions to the second harmonic signal from molecular materials. Photonic cavities can tremendously enhance the nonlinear response.

FF2N.4 • 11:30
Near Infrared Photoswitching of Avalanching Nanoparticles, Changhwan Lee[1], Emma Xu[1], Kevin Kwock[2], Benedikt Ursprung[1], Natalie Fardian-Melamed[1], Ayelet Teitelboim[3], Hye Sun Park[4], Jongwoo Kim[6], Sang Hwan Nam[6], Yung Doug Suh[5], Bruce Cohen[3], Emory Chan[3], P. James Schuck[1]; *[1]Mechanical engineering, Columbia Univ., USA; [2]Electrical engineering, Columbia Univ., USA; [3]The molecular foundry, Lawrence Berkeley National Laborabory, USA; [4]Research Center for Bioconvergence Analysis, Korea Basic Science Inst., Korea (the Republic of); [5]Department of Chemistry, Ulsan National Inst. of Science and Technology, Korea (the Republic of); [6]Laboratory for Advanced Molecular Probing, Korea Research Inst. of Chemical Technology, Korea (the Republic of).* We demonstrate indefinite and bidirectional photoswitching of avalanching nanoparticles (ANPs) using NIR excitations. This enables the 2-D and 3-D optical patterning on ANP films as well as super-resolution imaging of single ANPs with sub-Angstrom localization accuracy.

FF2N.5 • 11:45

Photoinduced Modification of Second Harmonic Generation in Diamond Cavities, Sigurd Flågan[1], Joe Itoi[1], Prasoon K. Shandilya[1], Elham Zohari[1,2], Vinaya K. Kavatamane[1], Joseph E. Losby[1], Paul E. Barclay[1]; *[1]Univ. of Calgary, Canada; [2]Department of Physics, Univ. of Alberta, Canada.* We demonstrate cavity-enhanced second-harmonic generation from a diamond microdisk. By performing multicolor illumination, we show that optical manipulation of nitrogen-vacancy centers strongly affects the second-harmonic signal, indicating a difference in χ(2) between two possible electronic configurations.

FF2N.6 • 12:00

Silicon Nitride Nanobeam Cavity Enhanced Second-Harmonic Generation of Monolayer Wse2, Hannah D. Rarick[1], Abhinav Kala[1], Sinabu Pumulo[1], Arnab Manna[1], David Sharp[1], Chris Munley[1], Arka Majumdar[1]; *[1]Univ. of Washington, USA.* Integration of transition metal dichalcogenides onto photonic platforms enables on-chip nonlinear optical effects, like second-harmonic generation (SHG). In this paper, we demonstrate cavity enhanced SHG by integrating monolayer Wse2 onto a silicon nitride nanobeam.

FF2N.7 • 12:15

Non-Geodesic Propagation in Integrated Curved Nanophotonic Structures, Michal C. Roth[1], Uri Israeli[1], Rivka Bekenstein[1]; *[1]Hebrew Univ. of Jerusalem, Israel.* We present an experimental observation of electromagnetic wavepackets propagating on non-geodesic trajectories in curved space by shaping them via integrated nanophotonic grating and confining them to a nanophotonic structure emulating two-dimensional curved space.

10:30 -- 12:30
Room: W209DE
SF2O • Brillouin Scattering and Spectral Broadening
Presider: Ady Arie, Israel

SF2O.1 • 10:30

Deep recurrent neural networks operations based on stimulated Brillouin scattering, Steven D. Becker[1,2], Jesús H. Marines Cabello[1], Dirk Englund[3], Birgit Stiller[1,2]; *[1]Max Planck Inst. for the Science of Light, Germany; [2]Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany; [3]Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA.* We experimentally demonstrate eight layers of a recurrent operator for photonic neural networks using stimulated Brillouin scattering. The programmable optoacoustic building block captures and processes coherently and frequency-selectively information without relying on artificial reservoirs.

SF2O.2 • 10:45

Brillouin dynamic gratings in silicon nitride waveguides, Roel Botter[1], Jasper van den Hoogen[1], Akhileshwar Mishra[1], Kaixuan Ye[1], Albert van Rees[1], Marcel Hoekman[2], Klaus Boller[1], David Marpaung[1]; *[1]Univ. of Twente, Netherlands; [2]LioniX International, Netherlands.* We demonstrate the first observation of a Brillouin dynamic grating signal in the double-stripe silicon nitride waveguides.

SF2O.3 • 11:00

Soliton Frequency Combs via Cascaded Brillouin Scattering, Hao Zhang[2,1], Shuangyou Zhang[2], Toby Bi[2,3], George Ghalanos[2], Yaojing Zhang[2], Haochen Yan[2,3], Arghadeep Pal[2,3], Jijun He[1], Shilong Pan[1], Pascal Del'Haye[2,3]; [1]*National Key Laboratory of Microwave Photonics, Nanjing Univ Aeronautics & Astronautics, China;* [2]*Max Planck Inst. for the Science of Light, Germany;* [3]*Department of Physics, Friedrich Alexander Univ. Erlangen-Nuremberg, Germany.* We present Kerr soliton generation via a forward propagating second order Brillouin scattering process in a microresonator. The solitons repetition rates are independent from the Brillouin gain frequency shift (~10 GHz in fused silica).

SF2O.4 • 11:15
Maniputing Brillouin Scattering on Chip Using Suspended Anti-resonant Acoustic Waveguides, Peng Lei[1], Mingyu Xu[1], Yunhui Bai[1], Zhangyuan Chen[1], Xiaopeng Xie[1]; [1]*Peking Univ., China.* Inspired by the anti-resonant properties of hollow-core fibers, we introduce suspended anti-resonant acoustic waveguides for on-chip phonon confinement and selection. It enables record-breaking achievements in forward and backward Brillouin scattering on a chip-scale.

SF2O.5 • 11:30
Low-threshold Brillouin lasing in a chalcogenide planar integrated resonator, Jingcui Song[1], Yuhang Wei[1], Chunxu Wang[1,2], Yan Li[1], Shuixian Yang[1], Tianhua Feng[3], Xiaojie Guo[4], Zhaohui Li[1,5]; [1]*Guangdong Provincial Key Laboratory of Optoelectronic Information Processing Chips and Systems and School of Electronics and Information Technology, Sun Yat-sen Univ., China;* [2]*Peng Cheng Laboratory, China;* [3]*Department of Electronic Engineering, College of Information Science and Technology, Jinan Univ., China;* [4]*Guangdong Provincial Key Laboratory of Optical Fiber Sensing and Communications, Inst. of Photonics Technology, Jinan Univ., China;* [5]*Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai), China.* We report Brillouin lasing with a threshold of 24.8 mW in a compact $Ge_{25}Sb_{10}S_{65}$ chalcogenide planar integrated resonator with a high *Q*-factor of 1.01×10^6. The slope efficiency of the Brillouin laser is 8.3%.

SF2O.6 • 11:45
Spectrometer based on Brillouin lasing and spectral compression, Joseph B. Murray[1], Matthew Murray[1], Brandon Redding[1]; [1]*US Naval Research Laboratory, USA.* We introduce a spectrometer that uses Brillouin lasing to perform scan-free measurements of a 4 THz optical band (1535-1570 nm) with 28 MHz (0.2 pm) resolution and an update rate of 5 ms.

SF2O.7 • 12:00
50fs, VIS and NIR Tunable Femtosecond Pulses via Hollow Core Fibre spectral broadening of sub-ps Yb lasers, Pedram Abdolghader[1], Maksym Ivanov[1,2], Étienne Doiron[1], Marco Scaglia[1], Young-Gyun Jeong[2], Alexis Labranche[1], Gabriel Tempea[1], Luca Razzari[2], Giulio Vampa[3,4], Bruno E. Schmidt[1]; [1]*Research and development, few-cycle Inc., Canada;* [2]*Institut national de la recherche scientifique, Canada;* [3]*National Research Council of Canada, Canada;* [4]*NRC-uOttawa Joint Centre for Extreme Photonics, Canada.* Starting from a 330fs Yb laser, we generate 50fs femtosecond VIS pulses (340-580 nm) and in the NIR (1600-2500 nm) via frequency mixing of spectral side lobes out of a hollow core fibre continuum.

SF2O.8 • 12:15

Polarization-Based Contrast Enhancement during Spectral Broadening in a Multi-Pass Cell, Esmerando Escoto[1], Federico Pressacco[1], Ingmar Hartl[1], Christoph M. Heyl[1,2], Marcus Seidel[1,2], Henrik Tünnermann[1,3]; *[1]Deutsches Elektronen-Synchrotron DESY, Germany; [2]Helmholtz Inst. Jena, Germany; [3]HIR^3X: Helmholtz International Laboratory on Reliability, Repetition, Results at the most Advanced X-Ray Sources, Germany.* We optimize the combination of nonlinear polarization ellipse rotation and post-compression in a multi-pass cell, to minimize temporal contrast degradation at large compression factors even in close temporal proximity to the compressed pulse.

10:30 -- 12:30
Room: W209F
SF2P • Laser Spectroscopy
Presider: Sida Xing; SIOM, China

SF2P.1 • 10:30 (Tutorial)
New Trends in Trace Gas Sensing by Mid-IR Absorption Laser Spectroscopy, Lukas Emmenegger[1]; *[1]EMPA, Switzerland.* Recent instrumental developments based on QCLs create tantalizing options for highly sensitive detection of clumped isotopes, multi-species and VOCs analysis, and open up new opportunities for mobile applications. Selected applications will highlight the performance and enabling technologies.

SF2P.2 • 11:30
Dual-Comb Spectroscopy in the Deep Ultraviolet, John J. McCauley[1], Yu Zhang[1], Reagan R. Weeks[2], Sivanandan Harilal[3], Mark C. Phillips[1], R. J. Jones[1]; *[1]Univ. of Arizona, USA; [2]Air Force Research Laboratory, USA; [3]Pacific Northwest National Laboratory, USA.* Time-resolved dual-comb spectroscopy was performed at the shortest wavelengths to date in the deep ultraviolet. Measurements on laser-produced plasmas provide both atomic and ion number densities while spectral analysis yields temperature and electron density evolution.

SF2P.3 • 11:45
Hz-level Broadband Spectroscopy with a Dual-Modulated Tunable Diode Laser, Shuangyou zhang[1], Toby Bi[1,2], Pascal Del'Haye[1,2]; *[1]Max-Planck-Inst Physik des Lichts, Germany; [2]Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany.* We demonstrate Hz-level broadband spectroscopy using a dual radio frequency modulated diode laser referenced to a fiber cavity. This approach offers great simplicity, robustness and low costs, making it well-suited for out-of-the-lab applications.

SF2P.4 • 12:00
Dual-comb Fiber Laser-based Practical Mid-infrared Dual-comb Spectroscopy via Real-time and Long-term Coherent Averaging, Akifumi Asahara[1], Gakuto Fukawa[1], Takayuki Shimizu[1], Takashi Kato[1], Kaoru Minoshima[1]; *[1]Univ. of Electro-Communications, Japan.* We demonstrate practical mid-infrared dual-comb spectroscopy based on a bidirectional dual-comb fiber laser. By implementing real-time and long-term coherent averaging, greenhouse gas spectroscopy with absolute wavelength around 3.9 μm is achieved without complex tight-locking system.

SF2P.5 • 12:15

Vis-NIR Broadband Dual-Comb Spectroscopy towards Highly-Functional Measurements with a High-Power, High-Coherence Fiber Comb System, Ruichen Zhu[1], Haochen Tian[1], Runmin Li[1], Sida Xing[2], Thomas R. Schibli[3], Takashi Kato[1], Akifumi Asahara[1], Kaoru Minoshima[1]; *[1]The Univ. of Electro-Communications, Japan; [2]Shanghai Inst. of Optics and Fine Mechanics, China; [3]Univ. of Colorado, USA.* We present the generation of a broadband high-power dual-comb source covering the Visible-NIR range based on nonlinear broadening and wavelength conversion of Er fiber comb. Preliminary dual-comb measurement successfully retrieved the broad visible spectrum.

10:30 -- 12:30
Room: W210
SF2Q • Four-wave Mixing and Nonlinear Dynamics in Fiber Systems
Presider: François Leo; Universite Libre de Bruxelles, Belgium

SF2Q.1 • 10:30
Fiber Source of Spectrally Uncorrelated Photon Pairs Based on Intermodal Four-Wave Mixing, Kasper H. Alexander[1], Rodrigo Silva[1], Jacob G. Koefoed[1], Lars Rishøj[1], Karsten Rottwitt[1]; *[1]Danmarks Tekniske Universitet, Denmark.* Using intermodal four-wave mixing (FWM) in an optical step-index fiber, we demonstrate a process capable of generating photon pairs with low spectral correlations without the need for optical filtering in the FWM sideband.

SF2Q.2 • 10:45
Wavelength and Supermode Conversion based on Four-Wave Mixing in Coupled Multicore Fibres, Kunhao Ji[1], Muhammad I. Abdul Khudus[1,2], Ian Davidson[1], Lin Xu[1], Massimiliano Guasoni[1]; *[1]Univ. of Southampton, UK; [2]Universiti Malaya, Malaysia.* We investigate the four-wave mixing between supermodes in coupled multicore fibres. First-time experimental observation of selective supermode and wavelength conversion based on four-wave mixing is reported by controlling pump modes in a dual core fibre.

SF2Q.3 • 11:00
Broadband and Tunable Frequency Conversion using Intermodal Bragg Scattering, Thjalfe Ulvenberg[1], Denis Bolotov[1], Lars Rishøj[1], Michael Galili[1], Karsten Rottwitt[1]; *[1]Technical Univ. of Denmark, Denmark.* We demonstrate frequency conversion between waves spanning over 600 nm using intermodal Bragg scattering driven by two high-power pumps separated by up to 49 nm while achieving above -10 dB conversion efficiency.

SF2Q.4 • 11:15
Supermode-dependent Modulation Instability in Dual-Core Fiber Cavities, Negar Shaaani Shishavan[1], Minji Shi[1], Arnaud Mussot[2], Matteo Conforti[2], Auro M. Perego[1]; *[1]Aston Univ., UK; [2]Univ. Lille, France.* This work explores nonlinear dynamics in dual-core fiber resonators by means of two coupled Lugiato-Lefever equations uncovering peculiar bistability features and supermode dependent modulation instability gain.

SF2Q.5 • 11:30
Control of nonlinear recurrences in optical fibers by fine tuning of gain, Guillaume Vanderhaegen Vanderhaegen[2], Pascal Szriftgiser[2], Alexandre Kudlinski[2], Andrea Armaroli[2,1], Matteo Conforti[2], Arnaud Mussot[2], Stefano Trillo[1]; *[1]Universita degli Studi di Ferrara,*

Italy; [2]PhLAM, Univ. Lille, France. We demonstrate experimentally the influence of forcing on the nonlinear stage of modulational instability in standard optical fibers. Weak linear amplification via Raman gain is tuned to characterize the separatrix crossing behavior between successive recurrences.

SF2Q.6 • 11:45
Synchronisation of Breather Molecular Complexes in a Laser Cavity, Xiuqi Wu[2], Junsong Peng[2], Sonia Boscolo[1], Christophe Finot[3], Heping Zeng[2]; *[1]Aston Inst. of Photonic Technologies, Aston Univ., UK; [2]State Key Laboratory of Precision Spectroscopy, East China Normal Univ., China; [3]LICB, Universite' de Bourgogne Franche-Comte', France.* We report on the experimental and numerical observations of subharmonic 401ynchronized401ti and 401ynchronized401tion of breather molecular complexes in an ultrafast fibre laser. We also unveil an intermediate regime featuring self-modulation of the 401ynchronized state.

SF2Q.7 • 12:00
Soliton Self-Frequency Shift of µJ-Level Pulse at MHz Repetition Rates for Tunable and Broadband THz Generation Using an Organic Crystal, Markus Lippl[1], Nicolas Couture[2], Martin Butryn[1], Jean-Michel Menard[2], Nicolas Joly[3], Francesco Tani[1]; *[1]MPI for the science of light, Germany; [2]Univ. of Ottawa, Canada; [3]Friedrich Alexander Univ. Erlangen-Nuremberg, Germany.* We present a tunable light source based on soliton self-frequency shift in hydrogen filled hollow-core fibers with record breaking pulse energy and use it to pump a DSTMS crystal for efficient and broadband terahertz generation

SF2Q.8 • 12:15
Fiber-Interferometric Second Harmonic Generator for Dual-Color Standard Quantum-limited Noise Suppression, Marvin Edelmann[1,2], Mikhail Pergament[1], Yi Hua[3], Franz Kärtner[1,2]; *[1]Center for Free Electron Laser Science, Germany; [2]Department of Physics, Universität Hamburg, Germany; [3]Deutsches Elektronen Synchrotron DESY, Germany.* We present a novel fiber-interferometric mechanism that employs controlled nonlinear polarization rotation in interaction with type-I phase matched SHG to generate dual-color optical pulse trains (515/1030 nm) with concurrent >14 dB standard-quantum limited noise suppression.

10:30 -- 12:30
Room: W211
SF2R • Photonics of Low Dimensional Materials II
Presider: Wenjing Liu; Peking Univ., China

SF2R.1 • 10:30
Sustained Robust Excitonic Radiation in Suspended Monolayer Wse$_2$ within the Low Power Regime for Quantum Emitter Application, Zheng-Zhe Chen[1,2], Chiao-Yun Chang[3], Ya-Ting Tsai[1,4], Po-Cheng Tsai[1,5], Shih-Yen Lin[1,5], Min-Hsiung Shih[1,4]; *[1]Research Center for Applied Sciences, Academia Sinica, Taiwan; [2]Physics, National Taiwan Univ., Taiwan; [3]Electrical Engineering, National Taiwan Ocean Univ., Taiwan; [4]Department of Photonics and Inst. of Electro-Optical Engineering, National Yang Ming Chiao Tung Univ., Taiwan; [5]Graduate Inst. of Electronics Engineering, National Taiwan Univ., Taiwan.* We quantitatively demonstrate that suspended Wse$_2$ monolayer exhibited remarkably higher percentage of excitonic emission against contacted Wse$_2$ at low-pumping region, where

Shockley–Read–Hall recombination dominates, highlighting its potential for developing compact, high-efficiency quantum emitters in the future.

SF2R.2 • 10:45

Tunable Optical Properties and Recombination Dynamics of $Ge_{1-x-y}Si_ySn_x$ Nanoalloys, David S. Pate[1], Chineme J. Onukwughara[1], Griffin C. Spence[1], Indika U. Arachchige[1], Ümit Özgür[1]; *[1]Virginia Commonwealth Univ., USA.* We report on quantum confined $Ge_{1-x-y}Si_ySn_x$ nanocrystals demonstrating both size- and composition-tunable direct visible/NIR emission (1.77 – 2.47 eV) and recombination dynamics. Temperature-dependent time-resolved photoluminescence suggests significant enhancement of oscillator strengths with Si incorporation.

SF2R.3 • 11:00

Trion Species Splitting and Intensity Enhancement with Lateral Electrical Field in Two-dimensional $MoTe_2$, Zhen Wang[3,2], Hao Sun[2], Jialu Xu[2], Huan Zhang[3], Cun-zheng Ning[2,1]; *[1]Shenzhen Technology Univ., China; [2]Tsinghua Univ., China; [3]Zhejiang Lab, China.* Positive and negative trions generated simultaneously in two-dimensional $MoTe_2$ through optical pumping were spatially separated under a lateral electrical field. More than four times enhancement of the corresponding charge density without injection was demonstrated experimentally.

SF2R.4 • 11:15

Characterization of Two-Dimensional Materials using Ultrafast Spectroscopy and Imaging, Torben L. Purz[1], Adam Alfrey[2], Yuhang Cao[3], Hui Deng[2], Steven T. Cundiff[2,1], Eric W. Martin[1]; *[1]MONSTR Sense Technologies, USA; [2]Physics, Univ. of Michigan, USA; [3]Electrical Engineering and Computer Science, Univ. of Michigan, USA.* We demonstrate a rapid non-contact determination of layer thickness for transition metal dichalcogenides using hyperspectral four-wave mixing imaging, applicable to in-situ growth characterization. We further characterize the material with decay time maps.

SF2R.5 • 11:30

Low-voltage Injection-free Electroluminescence Device based on a Monolayer $MoSe_2$/Wse_2 Lateral Heterostructure, Yutong Zhong[1,4], Hanyuan Ma[2], Qian Lv[2,3], Yongzhuo Li[1], Jiabin Feng[1], Chen Li[1,4], Jialu Xu[1,4], Chenxin Yu[1,4], Ruitao Lv[2], Cun-zheng Ning[1,4]; *[1]Department of Electronic Engineering, Tsinghua Univ., China; [2]School of Materials Science and Engineering, Tsinghua Univ., China; [3]School of Materials Science and Engineering, Nanyang Technological Univ., Singapore; [4]College of Integrated Circuits and Optoelectronic Chips, Shenzhen Technology Univ., China.* We demonstrate an injection-free electroluminescence device fabricated with a CVD-grown monolayer $MoSe_2$/Wse_2 lateral heterostructure. The device is based on impact generation of excitons through an alternating voltage as low as ±1 V at room temperature.

SF2R.6 • 12:00

Polarization-Resolved Third-Harmonic Generation in 2-, 3-, and 4-layer Black Phosphorus, Victor L. Matias[1], Henrique B. Ribeiro[2], Tony Heinz[2,3], Henrique G. Rosa[1], Christiano J. de Matos[1,4]; *[1]School of Engineering, Mackenzie Presbyterian Univ., Brazil; [2]SLAC National Accelerator Laboratory, USA; [3]Department of Applied Physics, Stanford Univ., USA; [4]MackGraphe, Mackenzie Presbyterian Inst., Brazil.* We present THG in 2-to-4 layer exfoliated black phosphorus. We observe a change in the polarization-dependent THG pattern when compared to bulk BP, as well as an excitonically increased THG intensity peak for bilayer BP.

SF2R.7 • 12:15

Anisotropic and Nonlinear Optical Properties of 2D Transition Metal Carbides and Nitrides (Mxenes), Jeffrey Simon[1], Benjamin Reigle[1], Colton Fruhling[1], Danzhen Zhang[2], Stefano Ippolito[2], Hyunho Kim[2], Vladimir M. Shalaev[1], Yury Gogotsi[2], Alexandra Boltasseva[1]; *[1]Elmore Family School of Electrical and Computer Engineering and Birck Nanotechnology Center, Purdue Univ., USA; [2]A. J. Drexel Nanomaterials Inst. and Department of Materials Science and, Drexel Univ., USA.* We report the experimentally retrieved anisotropic optical permittivity of several Mxenes which indicate that these materials exhibit a hyperbolic dispersion relationship. Additionally, we describe the thickness dependencies of both linear and nonlinear properties of these Mxenes.

14:00 -- 16:00
Room: W201AB
SF3A • Environmental Monitoring Methodologies
Presider: Gar-Wing Truong; Thorlabs

SF3A.1 • 14:00

A Crown Ether Decorated Silicon Photonic Platform to Safeguard Against Lead Poisoning in Society, Luigi Ranno[1], Yong Zen Tan[2], Chi Siang Ong[2], Xin Guo[3], Khong Nee Koo[4], Xiang Li[3], Wanjun Wang[3], Samuel Serna[1], Chongyang Liu[5], Rusli Rusli[3], Callum Littlejohns[6], Graham Reed[6], Juejun Hu[1], Hong Wang[3], Jia Xu Brian Sia[1,3]; *[1]Department of Materials Science and Engineering, Massachusetts Inst. of Technology, USA; [2]Fingate Technologies, Singapore; [3]School of Electrical and Electronic Engineering, Nanyang Technological Univ., Singapore; [4]Vulcan Photonics, Malaysia; [5]Temasek Laboratories, Singapore; [6]Optoelectronics Research Centre, Univ. of Southampton, UK.* Lead poisoning is an ongoing public health crisis. We present the foremost development of a lead-selective crown ether/silicon photonic platform. We envisage the potential application of this technology to safeguard against pervasive societal lead poisoning.

SF3A.2 • 14:15

Sensitivity-optimized waveguide-based methane gas sensor in the mid-IR, Pen-Sheng Lin[1], Arne Quellmalz[1], Po-Han Huang[1], Shayan Parhizkar[2,3], Nour Negm[2,3], Stephan Suckow[3], Floria Ottonello-Briano[4], Max Lemme[2,3], Frank Niklaus[1], Kristinn B. Gylfason[1]; *[1]KTH Royal Inst. of Technology, Sweden; [2]Chair of Electronic Devices, RWTH Aachen Univ., Germany; [3]AMO GmbH, Germany; [4]Senseair AB, Sweden.* We demonstrate methane gas sensing using suspended silicon waveguides and experimentally validate the sensitivity optimization of waveguide-based gas sensors by varying waveguide lengths. This method enables application-optimized integrated optical gas sensors.

SF3A.3 • 14:30

Tracing Methane Down to 300 ppb with a mid-IR Photonic Chip, Marek Vlk[1,2], Henock D. Yallew[1], Roman Zakoldaev[1], Sebastián Alberti[1], Anurup Datta[3], Jana Jágerská[1]; *[1]UiT The Arctic Univ. of Norway, Norway; [2]Electrical Engineering, Stanford Univ., USA; [3]Indian Inst. of*

Technology Hyderabad, India. A Si slot waveguide was demonstrated for on-chip methane detection at 3270.4 nm. Maximizing light–analyte interaction to 68% and tailoring double-tip edge couplers to reduce spurious spectral etalons facilitated a record-low 300 ppb detection limit.

SF3A.4 • 14:45

Real-time Identification of Trace Gases at Ppb Level by Dispersive Mid-infrared Spectroscopy, Tsubasa Endo[1], Shuntaro Tani[1], Osamu Komeda[2], Hiroyuki Suto[2], Hiroaki Saitoh[2], Yohei Kobayashi[1]; *[1]The Inst. for Solid State Physics, The Univ. of Tokyo, Japan; [2]Toyota Technical Center Higashi-Fuji, Toyota Motor Corp., Japan.* We achieved detection of molecules in trace gases within 1 second by dispersive mid-infrared spectroscopy with detection limits of 1 ppb for methane, 1 ppb for ethane, and 10 ppb for ethylene.

SF3A.5 • 15:00

On the Large-Scale Field Experiment of Machine Learning-Aided Fiber-Optic Distributed Acoustic Sensing for Early Detection of Red Palm Weevils, Chun Hong Kang[1], Islam Ashry[1], Juan Marin[1], Talha Ariff[1], Alaaeddine Rjeb[1], Wahyu H. Gunawan[1], Tien Khee Ng[1], Boon S. Ooi[1]; *[1]Photonics Laboratory, King Abdullah Univ. of Science and Technology (KAUST), Saudi Arabia.* We report, for the first time, on the large-scale field deployment of machine learning-aided fiber-optic distributed acoustic sensing for the early detection of Red Palm Weevil larvae in fully operational date palm farms.

SF3A.6 • 15:30

Solar Spectroscopy Approaching 10^{-9} Precision with a Frequency-Modulated Laser Heterodyne Radiometer, Connor Fredrick[1,2], Ryan Cole[2,3], Winter Parts[4], Ryan Terrian[5], Suvrath Mahadevan[4], Scott A. Diddams[6,2]; *[1]Physics, Univ. of Colorado Boulder, USA; [2]Time and Frequency, National Inst. of Standards and Technology, USA; [3]Physics and Astronomy, Bates College, USA; [4]Astronomy and Astrophysics, Penn State Univ., USA; [5]Physics and Astronomy, Carleton College, USA; [6]Electrical, Computer & Energy Engineering, Univ. of Colorado Boulder, USA.* We lock a laser to a solar iron line thereby adapting laboratory spectroscopy techniques to thermal light that has traveled 150 million km. This permits frequency tracking of solar dynamics with Doppler precision approaching 1 ppb.

SF3A.7 • 15:45

Fiber-Coupled Waveguide-Enhanced Raman Spectroscopy of Trace Vapors, Nathan F. Tyndall[1], Jordan N. Butt[1], Kyle J. Walsh[1], Erik D. Emmons[2], Kevin Hung[2], Erik Roese[2], Phillip G. Wilcox[2], Jason A. Guicheteau[2], Marcel W. Pruessner[1], R A. McGill[1], Christopher C. Striemer[3], Graham S. Pennington[3], Todd H. Stievater[1]; *[1]US Naval Research Laboratory, USA; [2]US Army DEVCOM Chemical Biological Center, USA; [3]AIM Photonics Test, Assembly, and Packaging Facility, USA.* We report the first Raman detection of trace vapors with a fiber-attached photonic integrated circuit. We detected DMSO and MeS vapor with waveguide-enhanced Raman spectroscopy (WERS) using integrated edge couplers, lattice filters, and sensing trenches.

14:00 -- 16:00
Room: W201CD
SF3B • Image-based Techniques
Presider: Jennifer Black; NIST Boulder, USA

SF3B.1 • 14:00
Withdrawn

SF3B.2 • 14:15
Single 5-nm particle photothermal microscopy with microtoroid optical resonators, Shuang Hao[1], Judith Su[1]; [1]*Univ of Arizona, Coll of Opt Sciences, USA.* Fluorescence detection suffers from limited fluorophore availability, bleaching, and blinking. We detect single 5-nm quantum dots with a signal-to-noise ratio of 10^4 using a label-free FLOWER based photothermal microscopy approach.

SF3B.3 • 14:30 (Invited)
Exploring Multimode Fiber Sources for Nonlinear Microscopy, Sixian Y. You[1]; [1]*Massachusetts Inst. of Technology, USA.* Abstract not available.

SF3B.4 • 15:00
Multilayer Scintillators for Enhanced Energy Resolution in X-Ray Imaging, Seokhwan Min[1,2], Charles Roques-Carmes[1,3], Seou Choi[1], Simo Pajovic[4], Sachin Vaidya[5], Marin Soljačić[1,5]; [1]*Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA;* [2]*Department of Material Science and Technology, Korea Advanced Inst. of Science and Technology, Korea (the Republic of);* [3]*E. L. Ginzton Laboratories, Stanford Univ., USA;* [4]*Department of Mechanical Engineering, Massachusetts Inst. of Technology, USA;* [5]*Department of Physics, Massachusetts Inst. of Technology, USA.* We present a three-component multilayer scintillator that can achieve greater x-ray energy resolution than conventional single or dual-component systems, from 10 to 100 keV. Our approach relies on spectral multiplexing of different x-ray energy bins.

SF3B.5 • 15:15
Large resolution enhancement of x-ray microscopy using multipixel ghost imaging, Or Sefi[1,2], Yishay Klein[1,2], Adi H. Ben Yehuda[1,2], Shalom Bloch[3], Hila Schwartz[1,2], Eliahu Cohen[3,2], Sharon Shwartz[1,2]; [1]*Physics, Bar-Ilan Univ., Israel;* [2]*Inst. of Nanotechnology and advanced Materials, Bar-Ilan Univ., Israel;* [3]*Faculty of Engineering, Bar Ilan Univ., Israel.* We demonstrate resolution enhancement of a standard hard x-ray imaging system from 500 µm to approximately 20 µm by extending the concept of ghost imaging to multipixel ghost imaging, enabling mega-pixel scale imaging in a short timeframe.

SF3B.6 • 15:30
Wobulation in structured illumination microscopy using a tunable electrowetting prism, Catherine A. Saladrigas[1], Eduardo Miscles[2], Vikrant Kumar[3], Ioannis Kymissis[3], Victor Bright[2], Juliet Gopinath[1,4]; [1]*Electrical, Computer, and Energy Engineering, Univ. of Colorado Boulder, USA;* [2]*Mechanical Engineering, Univ. of Colorado Boulder, USA;* [3]*Electrical Engineering, Columbia Univ., USA;* [4]*Physics, Univ. of Colorado Boulder, USA.* We demonstrate a new implementation of structured illumination microscopy, in which a tunable electrowetting prism is incorporated in the microscope to “wobulate” the structured Illumination on the sample. Optical sectioning is demonstrated with fluorescent beads.

14:00 -- 16:00
Room: W204AB
FF3C • Chiral Effects in Nanophotonics and Nano-Optics
Presider: Yue Zhou; Yale Univ., USA

FF3C.1 • 14:00
Interferometric extraction of orbital angular momenta of two-component vortex beams, Maryam Setareh[1], Robert de Gille[1], Sejeong Kim[1], Kenneth B. Crozier[1]; *[1]Univ. of Melbourne, Australia.* Beams comprising the superposition of vortex beams with different orbital angular momenta (OAM) exhibit rich physics. We extract the OAMs of two-component vortex beams using interference pattern and intensity profiles.

FF3C.2 • 14:15
Probing Chiral Farfield Properties of Monolayer Transition Metal Dichalcogenides Coupled to Achiral Plasmonic Nanoantennas, Bucher Tobias[1,2], Zlata Fedorova[1,2], Mostafa Abasifard[2], Matthias Wurdack[1,2], Rajeshkumar Mupparapu[2], Emad Najafidehaghani[3], Heiko Knopf[2,4], Antony George[3], Falk Eilenberger[2,4], Thomas Pertsch[2,4], Andrey Turchanin[3,5], Isabelle Staude[1,2]; *[1]Inst. of Solid-State Physics, Friedrich Schiller Univ. Jena, Germany; [2]Inst. of Applied Physics, Abbe Center of Photonics, Friedrich Schiller Univ. Jena, Germany; [3]Inst. of Physical Chemistry, Friedrich Schiller Univ. Jena, Germany; [4]Fraunhofer-Inst. for Applied Optics and Precision Engineering, Germany; [5]Jena Center for Soft Matter (JCSM), Germany.* We investigate the polarization of valley-specific emission from monolayer MoS_2 coupled to a plasmonic nanoparticle. The chiral emission properties are lost for the hybrid system which we analyze in terms of excitation and emission.

FF3C.3 • 14:30
Fast-light edge states in valley photonic crystal waveguides with glide and time reversal symmetry, Takahiro Uemura[1,2], Taiki Yoda[1,2], Yuto Moritake[1], Shutaro Otsuka[1,2], Kenta Takata[2,3], Masaya Notomi[1,2]; *[1]Tokyo Inst. of Technology, Japan; [2]NTT Corporation, NTT Basic Research Laboratories, Japan; [3]NTT Corporation, Nanophotonics Center, Japan.* Our proposal utilizes glide and time-reversal symmetric photonic crystal waveguides to achieve anomalous mode dispersion. We also theoretically demonstrate the way to restore fast-light edge states even in gain- or loss-biased scenarios. <script src”"chrome-extension://hhojmcideegachlhfgfdhailpfhgknjm/web_accessible_resources/index.j”"></script>

FF3C.4 • 14:45
Experimental Observation of Resonant Chiral Modes in Free-Space Cavities, Behrooz Semnani[1], Mohammad Soltani[1], Anna Maria Houk[1], Sema Kuru[1], Michal Bajcsy[1]; *[1]Univ. of Waterloo, Canada.* We report on experimental observation of pure chiral resonant modes in a spin-preserving Fabry-Perot cavity enabled by geometric-phase reflective metasurfaces. The cavity, stabilizing one spin of light, also preserves the helicity during round propagation of light.

FF3C.5 • 15:00
Probing Molecular Chirality with a Tunable Achiral Plasmonic System, Aritra Biswas[1], Pablo Cencillo-Abad[1], Debashis Chanda[1]; *[1]Univ. of Central Florida, USA.* We demonstrate helicity preserving engineered chiral light on a tunable achiral nanostructured SEIRA-VCD platform that can enable precise detection and classification of diverse chiral compounds, reshaping drug design and biomolecular applications.

FF3C.6 • 15:15

Orbit–Orbit Interaction of Light: Harnessing Vortex–Trajectory Interplay for Light Manipulation, Raghvendra P. Chaudhary[1], Avraham Reiner[1], Nir Shitrit[1]; *[1]School of Electrical and Computer Engineering, Ben-Gurion Univ. of the Negev, Israel.* We report the orbit–orbit interaction of light in a plasmonic ellipse cavity, whose unique geometry facilitates vortex–trajectory interplay. This interaction opens a new paradigm for light manipulation by leveraging the manifold vortex states.

FF3C.7 • 15:30

Broadband Measurement of Feibelman *d*-parameters, Zeling Chen[1], Shu Yang[1], Zetao Xie[1], Jinbing Hu[1,2], Yipu Xia[1], Yonggen Shen[3], Huirong Su[3], Maohai Xie[1], Thomas Christensen[4], Yi Yang[1]; *[1]Department of Physics and HK Inst. of Quantum Science and Technology, The Univ. of Hong Kong, Hong Kong; [2]College of Optical-Electrical Information and Computer Engineering, Univ. of Shanghai for Science and Technology, China; [3]Genuine Optronics Limited, China; [4]Department of Electrical and Photonics Engineering, Technical Univ. of Denmark, Denmark.* We introduce a general broadband ellipsometric method to measure the quantum optical surface response functions known as Feibelman *d*-parameters, and demonstrate it using a gol–-air interface in the visibl–-ultraviolet regimes under ambient conditions.

14:00 -- 16:00
Room: W205AB
SF3D • Optical Fiber Networks and Comb Generation
Presider: Judith Olson; Infleqtion (ColdQuanta Labs), USA

SF3D.1 • 14:00 (Invited)

Recent Progress on the Optic Fiber Time Distribution Network in China, Xinxing Guo[1], Bingan Hou[4], Bo Liu[1], Fan Yang[4], Jun Ju[3], Weicheng Kong[1], Ruifang Dong[1,2], Tao Liu[1,2], Shougang Zhang[1]; *[1]National Time Service Center, China; [2]School of Astronomy and Space Science, Univ. of Chinese Academy of Sciences, China; [3]Jiangsu Starlink Time-frequency Technology Co., Ltd., China; [4]Sichuan Taifu tech Co., Ltd., China.* An implementation of high-precision time transfer over a 1839 km field fiber link is reported. Time transfer stability of 6.5 ps at an averaging time of 1 s and 4.6 ps at 40000 s were achieved. The time transfer uncertainty was estimated to be <50 ps. The results are to our knowledge a record for the real-field test of the time transfer in thousands-kilometer-level fiber links. This work paves the solid way for constructing the high-precision time service via fiber network across China.

SF3D.2 • 14:30

Enhanced Stability in RF Transmission for Star Topology Fiber Optic Networks, Jie Zhang[1], Hao Gao[1], Zhuoze Zhao[1], Bin Luo[1], Song Yu[1]; *[1]Beijing Univ. of Posts and Telecommunications, China.* We characterize a star topology fiber optic network frequency transmission system. The achieved frequency transmission instability is 3.3×10^{-14} @ 1 s within a 103 km fiber optic link in point-to-multipoint experiments.

SF3D.3 • 14:45

Flexible Data Rate and Power Efficiency Pulse-Position-Modulation Communication with Independent Free-Running Clocks, Cheng Guo[2,1], René-Jean Essiambre[2], Sai Kanth Dacha[2], Andrea Blanco-Redondo[2], Frank R. Kschischang[3], Konrad Banaszek[4], James D. Sandoz[5], John Cloonan[5], Michael Vasilyev[1]; *[1]Electrical Engineering, Univ. of Texas at Arlington, USA; [2]Nokia Bell Labs, USA; [3]Electrical and Computer Engineering, Univ. of Toronto, Canada; [4]Centre for Quantum Optical Technologies, Univ. of Warsaw, Poland; [5]Nokia, USA.* Pulse-Position Modulation (PPM) format using independent free-running clocks transmitted optically is demonstrated with PPM orders from 2^{10} to 2^{16}, enabling flexible data rate and Photon Information Efficiency (PIE).

SF3D.4 • 15:00
Development of a High-Doppler Shift Femtosecond Optical Time Transfer Testbed, Matthew S. Bigelow[1], Kyle W. Martin[1], John Elgin[2], Kimberly A. Frey[2]; *[1]Blue Halo LLC, USA; [2]Air Force Research Lab, USA.* We have developed a two-way optical time transfer testbed potentially capable of simulating relative motion greater than 1 km/s in the lab using multiple optical frequency combs and no moving components.

SF3D.5 • 15:15
Self-referenced mid-infrared frequency comb using a silicon-carbide nanophotonic waveguide, Bingxin Xu[1], Lucas Deniel[1], Melissa A. Guidry[2], Daniil Lukin[2], Jérémie Pilat[1], Ki Youl Yang[2], Joshua Yang[2], Jelena Vuckovic[2], Theodor W. Hänsch[1,3], Nathalie Picqué[1]; *[1]Max-Planck-Institut fur Quantenoptik, Germany; [2]Stanford Univ., USA; [3]Ludwig-Maximilian Univ. of Munich, Germany.* A dispersion-engineered SiC waveguide on a photonic chip simultaneously provides an f-2f interferometer and mid-infrared dispersive-wave frequency-comb generation at 120-pJ pulse energies. Accurate comb-assisted tunable-laser molecular spectroscopy is demonstrated at 3.6 µm.

SF3D.6 • 15:30
Low Noise Self-Oscillating Filtered Electro-Optic-Comb Generation, Lawrence Trask[1], Srinivas Pericherla[1], Peter Delfyett[1]; *[1]Univ. of Central Florida, USA.* We demonstrate an alternative architecture for generating low-noise, terahertz spanning, optically filtered electro-optic-modulated combs without an external RF drive signal. Results demonstrate a 70 dB OSNR and RF SNR > 90 dB at 10.5 GHz.

SF3D.7 • 15:45
A 10 MHz Repetition Rate Er:fiber Laser Frequency Comb, Tsung-Han Wu[2,1], Scott A. Diddams[1,2]; *[1]Univ. of Colorado at Boulder, USA; [2]NIST, USA.* We present a low-noise Er:fiber laser frequency comb at 10 MHz repetition rate. Self-referencing with nanophotonic lithium niobate waveguides requires only 3 mW of optical power and electrical power of 540 mW.

14:00 -- 16:00
Room: W205CD
SF3E • Nonlinear Effects in Semiconductor Lasers
Presider: Vijay Kumar Gudelli; KAUST, Saudi Arabia

SF3E.1 • 14:00 (Invited)
Chiral and Edge-lasing with Perovskite Crystals of Arbitrary Shape, Barbara Pietka[1], Mateusz Kedziora[1], Andrzej Opala[1,2], Rosanna Mastria[3], Luisa De Marco[3], Mateusz Król[1,4], Karolina Lempicka-Mirek[1], Krzysztof Tyszka[1], Przemyslaw Morawiak[5], Rafal Mazur[5], Wiktor Piecek[5], Przemyslaw Kula[5], Marek Ekielski[6], Karolina Bogdanowicz[6,8], Anna Szerling[6], Helgi

Sigurdsson[1,7], Tomasz Czyszanowski[8], Jacek Szczytko[1], Michal Matuszewski[9], Daniele Sanvitto[3]; [1]*Uniwersytet Warszawski, Poland; [2]Inst. of Physics, Polish Academy of Sciences, Poland; [3]CNR Nanotec, Inst. of Nanotechnology, Italy; [4]The Australian National Univ., Australia; [5]Military Univ. of Technology, Poland; [6]Lukasiewicz Research Network - Inst. of Microelectronics and Photonics, Poland; [7]Univ. of Iceland, Iceland; [8]Lodz Univ. of Technology, Poland; [9]Center for Theoretical Physics, Polish Academy of Sciences, Poland.* We developed a versatile method for fabricating perovskite microstructures of any arbitrary, pre-defined shape, a first step towards perovskite integrated photonics. Our structures demonstrate waveguiding capabilities and polariton lasing.

SF3E.2 • 14:30
Defect mode lasing in a non-Hermitian 1D trivial SSH lattice, Kiyanoush Goudarzi[1], Abouzar Gharajeh[2], Fargol Seifollahi[3], Hamidreza Ramezani[3], Qing Gu[1,4]; [1]*Electrical and Computer Engineering, North Carolina State Univ., USA; [2]Electrical and Computer Engineering, The Univ. of Texas at Dallas, USA; [3]Physics and Astronomy, Univ. of Texas Rio Grande Valley, USA; [4]Physics, North Carolina State Univ., USA.* We experimentally demonstrate single-mode robust lasing in the telecommunication wavelengths. Introducing a defect ring leads to a lower lasing threshold and tunability of the lasing location by adjusting the position of the defect ring.

SF3E.3 • 14:45
Hysteresis Behavior of Continuous-Wave External Cavity Quantum Cascade Lasers, Jonas Schundelmeier[1], Quankui Yang[1], Stefan Hugger[1]; [1]*Fraunhofer IAF, Germany.* We investigate hysteresis of an external-cavity-QCL for variations of resonator length and grating angle. Experimental results are compared with two different theoretical models. Simulations suggest that hysteresis is caused by self-stabilization due to mode coupling

SF3E.4 • 15:00
Amplitude-Modulated and Frequency-Modulated Comb States in Quantum-Dot Laser, Bozhang Dong[1], Weng W. Chow[2], Mario Dumont[1], Frédéric Grillot[3,4], John Bowers[1]; [1]*Univ. of California Santa Barbara, USA; [2]Sandia National Laboratories, USA; [3]Institut Polytechnique de Paris, France; [4]Univ. of New-Mexico, USA.* This paper reports on an investigation of the frequency-modulated comb operation in a quantum-dot laser. Both the amplitude-modulated and the frequency-modulated combs can be generated independently from the same device through bias and the engineering of the optical nonlinearities.

SF3E.5 • 15:15
Re-growth-free III-V QD Discrete Mode Lasers Directly Grown on SOI Substrates for DWDM Applications, Jing-Zhi Huang[1], Zi-Hao Wang[1], Jian-Jun Zhang[1], Wang Ting[1]; [1]*Chinese Academy of Science, China.* We have demonstrated a novel single-longitudinal-mode QD laser directly grown on SOI with over 43 dB SMSR and 80 Gbps external modulation speed, which exhibits great integrating potential with silicon photonic components on single chip.

SF3E.6 • 15:30
Passive-mode-locked InP/LiNbO3 integrated soliton laser, Zhengdong Gao[1], Jingwei Ling[1], Shixin Xue[1], Qili Hu[1], Mingxiao Li[1], Kaibo Zhang[1], Usman A. Javid[1], Raymond L. Rios[1], Jeremy Staffa[1], Qiang Lin[1]; [1]*Univ. of Rochester, USA.* We report the first passive mode-locked soliton laser on a hybrid integrated InP/LiNbO3 platform, with a sech2 -shaped spectrum and a

repetition rate of 43.9 GHz. The passive mode locking results from a combined effect of optical gain, optical Kerr effect, and group-velocity dispersion inside the laser cavity

SF3E.7 • 15:45
Beyond the Linear Sweep of Frequency-Modulated Combs – Multi-Pulse Generation in Single-Section Diode Lasers, Lukasz A. Sterczewski[1,2], Maghmood Bagheri[2]; *[1]Politechnika Wroclawska, Poland; [2]Jet Propulsion Laboratory, USA.* Frequency comb generation with a linearly swept instantaneous frequency is a phenomenon occurring in many single-section semiconductor lasers. Here, we unveil a different emission profile consisting of bunches of pulses with a strong CW component.

14:00 -- 16:00
Room: W206B
SF3F • Advanced Photonic Integrated Devices
Presider: Vien Van; Univ. of Alberta, Canada

SF3F.1 • 14:00 (Invited)
Machine Learning Tools for the Multi-objective Design of Photonic Integrated Devices, Daniele Melati[1,2]; *[1]CNRS, France; [2]Université Paris-Saclay, France.* The quest for an ever increasing scale of integration, high performance, and fabrication robustness leads to photonic devices that exploit non-trivial geometries to optimize simultaneously a plethora of figures of merit. Here, we will discuss the use of machine learning and optimization tools to address these complex design problems that emerge in the development of innovative photonic systems.

SF3F.2 • 14:30
Inverse Design of Digital Mode (De)multiplexer with Large Fabrication Tolerance Using the Modified Adjoint Method, Kaiyuan Wang[1,2], Yuanrong Zhang[1,2], Yunlong Li[1,2], Qiaomu Hu[1,2], Deming Liu[1,2], Shuang Zheng[1,2], Minming Zhang[1,3]; *[1]School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China; [2]National Engineering Research Center for Next Generation Internet Access System, China; [3]Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, China.* A three-channel mode (de)multiplexer with fabrication tolerance using the Modified adjoint method is proposed and experimentally demonstrated, providing insertion losses < 2 dB, crosstalks of < 17 dB and large fabrication tolerance of ±10 nm.

SF3F.3 • 14:45
Wide Waveguide Concatenated Euler Bends for Compact and Fabrication Error-Tolerant Pseudo-Single Mode Silicon Photonics, Shota Kita[2,1], Daniel Bedilu[1], Yuriko Maegami[3], Morifumi Ohno[3], Guangwei Cong[3], Noritsugu Yamamoto[3], Koji Yamada[3], Akihiko Shinya[2,1], Masaya Notomi[2,1]; *[1]NTT Basic Research Laboratories, Japan; [2]NTT Nanophotonics Center, Japan; [3]National Inst. of Advanced Industrial Science and Technology, Japan.* We propose novel wide waveguide bends for compact, fabrication error-tolerant silicon photonics. They experimentally show ultrasmall bend loss < 0.005 dB/bend with an 8-um radius. Their 10×10 interferometers show a fidelity of 0.979 without calibration.

SF3F.4 • 15:00

Ultrabroadband and Compact Silicon-to-Silicon Nitride Light Couplers, Can C. Ozcan[1], J Stewart Aitchison[1], Mo Mojahedi[1]; [1]*Univ. of Toronto, Canada.* We demonstrate a significant length reduction for silicon- to-silicon nitride light couplers with experimentally measured losses below 0.1 dB over a 200 nm bandwidth for a device length of only 25 µm

SF3F.5 • 15:15

3-D Free-Form Micro-Reflectors for Broadband and Low-Loss Scalable Fiber to Si-Waveguide Coupling, Luigi Ranno[1], Jia Xu Brian Sia[1,2], Cosmin Popescu[1], Drew M. Weninger[1], Samuel F. Serna Otálvaro[1,3], Shaoliang Yu[4], Lionel Kimerling[1], Anuradha Agarwal[5], Tian Gu[1,5], Juejun Hu[1,5]; [1]*Department of Materials Science and Engineering, Massachusetts Inst. of Technology, USA;* [2]*School of Electrical and Electronic Engineering, Nanyang Technological Univ., Singapore;* [3]*Department of Physics, Photonics and Optical Engineering, Bridgewater State Univ., USA;* [4]*Zhejiang Lab, China;* [5]*Materials Research Laboratory, Massachusetts Inst. of Technology, USA.* We report on the design and experimental verification of backend-compatible free-form reflectors designed for Si waveguides. Losses as low as 0.8 dB and 1-dB bandwidths exceeding 180 nm combined with high alignment tolerances were demonstrated.

SF3F.6 • 15:30

Demonstration of Thermal Characteristics of 3D Mirror-based Optical Link for Co-packaged Optics, Fumi Nakamura[1], Satoshi Suda[1], Takayuki Kurosu[1], Yasuhiro Ibusuki[2], Akihiro Noriki[1], Takeru Amano[1]; [1]*The National Inst. of Advanced Industrial Science and Technology (AIST), Japan;* [2]*Photonics Electronics Technology Research Association (PETRA), Japan.* The thermal tolerance of 3D mirror-based polymer optical link for co-packaged optics was demonstrated by both multi-physical analysis and experiment. The thermal-dependent difference of average insertion loss measured in the full O-band was 0.92 dB.

SF3F.7 • 15:45

High-Capacity Transmission with Single External Laser Source and Polymer-Based Splitters for Co-Packaged Optics, Satoshi Suda[1], MD Omar Faruk Rasel[1], Takayuki Kurosu[1], Akihiro Noriki[1], Fumi Nakamura[1], Takeru Amano[1]; [1]*Natl Inst of Adv Industrial Sci & Tech, Japan.* We demonstrated high-capacity optical transmission using a polymer-based 1×4 splitter and a single external laser source (ELS) with an extremely high power of +20 dBm per channel, potentially achieving a bandwidth of 3.2 Tbps.

14:00 -- 16:00
Room: W207A
SF3G • Optoelectronic Nanodevices
Presider: Craig Zuhlke; Univ. of Nebraska Lincoln, USA

SF3G.1 • 14:00

Low-loss Zero-index Waveguides and Devices, Tian Dong[1], Tianxiang Dai[2], Ye Chen[3], Yueyang Liu[1], Hancheng Liu[4], Yiting Wang[1], Anqi Ma[2], Haifeng Hu[5], Lihua Xu[5], Le Zhao[5], Weiguo Chu[5], Chao Peng[3], Jianwei Wang[2], Yang Li[1]; [1]*State Key Laboratory of Precision Measurement Technology and Instrument, Department of Precision Instrument, Tsinghua Univ., China;* [2]*State Key Laboratory for Mesoscopic Physics, School of Physics, Peking Univ.,*

China; [3]State Key Laboratory of Advanced Optical Communication Systems and Networks, Department of Electronics and Frontiers Science Center for Nano-optoelectronics, Peking Univ., China; [4]Beijing Advanced Innovation Center for Big Data and Brain Computing, Beihang Univ., China; [5]Nanofabrication Laboratory, National Center for Nanoscience and Technology, China. We report flexible zero-index waveguides and devices whose loss is two orders of magnitude lower than the state of the art, enabling phase-error-free high-dense photonic integrated circuits for classical and quantum information processing and computing.

SF3G.2 • 14:15
Exploring Chiral Laser Emission in Optical Cavities with achiral dye systems and 2D Chiral Organic Thin Film, Li-Zhi Lin[1], Yi-Jan Huang[1], Andrew Salij[4], Francesco Zinna[2], Lorenzo D. Bari[2], Chia-Yen Huang[1], Roel Tempelaar[4], Randall Goldsmith[3], Chen Tzu-Ling[1,3]; *[1]Department of photonics, National Yang Ming Chiao Tung Univ., Taiwan; [2]Dipartimento di Chimica e Chimica Industriale, Universita di Pisa, Greece; [3]Department of Chemistry, Univ. of Wisconsin-Madison, USA; [4]Department of Chemistry, Northwestern Univ., USA.* Recent advancements demonstrate successful cavity-enhanced optical chirality via 2D chiral organic PTPO thin films. Investigating further, we explore the potential for chiral stimulated emission by incorporating this thin film into a POPOP dye laser cavity.

SF3G.3 • 14:30
Bound states in the continuum in monolithic van der Waals metasurfaces, Luca Sortino[1], Stefan A. Maier[2,3], Andreas Tittl[1]; *[1]Ludwig-Maximillians-Universität Munchen, Germany; [2]Monash Univ., Australia; [3]Imperial College London, UK.* We merge bound states in the continuum for strong light-matter interactions and the exceptional properties of van der Waals materials, demonstrating coupling with spin defects in hBN metasurfaces, and self-hybridized exciton-polaritons in WS_2 metasurfaces.

SF3G.4 • 14:45
Charge Separation in Metal-Semiconductor Nanocatalytic Heterojunctions, Sunil Gyawali[1], Ravi Teja Addanki Tirumala[2], Marimuthu Andiappan[2], Alan Bristow[1]; *[1]Department of Physics and Astronomy, West Virginia Univ., USA; [2]School of Chemical Engineering, Oklahoma State Univ., USA.* The rate equation associated with recombination dynamics of photoexcited charge carriers in Cu_2O and Cu_2O/Pd nanocatalysts shows suppressed Auger scattering in Cu2O/Pd possibly due to the photoexcited electron transfer across the heterojunction.

SF3G.5 • 15:00
Self-Hybridized Quasi-Bound State in the Continuum in Perovskite Metasurfaces, Abhinav Kala[1], Jie Fang[1], Rose Johnson[1], Rui Chen[1], Cheng Chang[1], Christopher Munley[2], David Sharp[2], Lih Y. Lin[1], Arka Majumdar[1,2]; *[1]Electrical and Computer Engineering, Univ. of washington, USA; [2]Physics, Univ. of Washington, USA.* Self-hybridized exciton-polaritons in solid-state systems are interesting as they overcome the limitations of hybrid integration. Here, we present the design and experimental demonstration of self-hybridized quasi-bound state in continuum polaritons in a $FAPbBr_3$ perovskite metasurface.

SF3G.6 • 15:15
Normal-direction Yellow Laser Emission by Quasi-BIC TiO_2 Metasurface, Ayesheh Bashiri[1], Aleksandr Vaskin[1], Katsuya Tanaka[1], Michael Steinert[1], Marijn Rikers[1], Maximilian A. Weissflog[1], Bayarjargal Narantsatsralt[1], Thomas Pertsch[1], Isabelle Staude[1]; *[1]Friedrich Schiller*

Univ. Jena, Germany. We study the lasing action from rhodamine 6G laser dyes integrated with a quasi-BIC TiO_2 metasurface supporting high Q-factor resonances. We experimentally observe low threshold lasing (8 nJ) at 568 nm from the integrated system.

SF3G.7 • 15:30
Mitigating Electron Beam Induced Defects for Low-Loss and Stable Active Photonic Circuits, Dylan L. Renaud[1], Daniel R. Assumpcao[1], Chang Jin[1], David Barton[1], Jeffrey Holzgrafe[2], Keith Powell[1], Matthew Yeh[1], Amirhassan Shams-Ansari[1], Marko Loncar[1]; *[1]Harvard Univ., USA; [2]Hyperlight Corporation, USA.* We report on the controlled generation and annihilation of defects in photonic platforms using low-energy electron beams. We show how these defects impact propagation losses and EO-stability in LNOI, and how they can be rectified.

SF3G.8 • 15:45
On-Chip Stimulated Brillouin Scattering Exploiting Polymer Waveguides with Nanoscale Footprint, Deepanshu Yadav[1], Karanveer Singh[1], Thomas Schneider[1]; *[1]Technical Univ. Braunschweig, Germany.* We demonstrate for the first time on-chip forward and backward stimulated Brillouin scattering (SBS) in nanoscale polymer (Ip-Dip) waveguides through numerical simulations, in which the maximum Brillouin gain coefficients up to (~ 2312 $W^{-1}m^{-1}$) has been obtained.

14:00 -- 16:00
Room: W206BC
SF3H • Strong-field Light-matter Interactions
Presider: Euan McLeod, USA

SF3H.1 • 14:00 (Invited)
Strong-field Laser Driven Dynamics in Solids, Shima Gholam Mirzaeimoghadar[1,2]; *[1]National Research Council of Canada, Canada; [2]Univ. of Ottawa, Canada.* In this talk, I describe how the novel techniques of field sampling and high harmonic spectroscopy allow for exploring the light-driven effects in metal-semiconductor heterostructures, to further enable light manipulation at ultra-small length- and timescales.

SF3H.2 • 14:30
Impact of Polarization Direction on Ultrafast Laser Stress Generation in Fused Silica, Caroline Humphreys[1], Kevin A. Laverty[1], Ian J. Arnold[1], Brandon D. Chalifoux[1]; *[1]Univ. of Arizona, USA.* Ultrafast laser-generated stress in fused silica, from lines of overlapping spots, depends on the linear polarization and writing directions. We present experimental evidence that this is not solely due to rotation of the nanograting orientation.

SF3H.3 • 14:45 (Invited)
Probing and Controlling Dynamics in Quantum Materials with Terahertz Light Waves, Richard D. Averitt[1]; *[1]Univ. of California San Diego, USA.* Coherent terahertz waves enable investigations of nonlinear many-body dynamics in quantum materials. Our recent work in this area has focused on condensates in superconductors and excitonic insulator

SF3H.4 • 15:15

Photovoltaic Effect in Ohmic Metal-Semiconductor Structures Excited by Multiple Femtosecond Laser Pulses, Luke Emmert[1], Wolfgang Rudolph[1], Payman Zarkesh-Ha[1], Landon Schmucker[1], Alireza Jalouli[1], Sadhvikas Addamane[2], Vitaly Gruzdev[1]; *[1]Univ. of New Mexico, USA; [2]Center for Integrated Nanotechnologies, Sandia National LAboratories, USA.* Photovoltage 2D mapping of low-temperature GaAs metal-semiconductor-metal micro-structures reveals thermovoltaic and photovoltaic effects with the former being the dominant process at high average power for both cw and femtosecond-pulse excitations.

SF3H.5 • 15:30

Electron Dynamics of Femtosecond Laser Induced Plasma Inside Multilayer Dielectric High Reflectors Studied Using Particle-in-Cell (PIC) Approach, Ziyao Su[1], Joseph Smith[2], Enam Chowdhury[1]; *[1]Ohio State Univ., USA; [2]Physics, Marietta College, USA.* The strong field ionized electron motion and energy in the interaction of few-cycle femtosecond laser and SiO_2/HfO_2-based multilayer dielectric reflector designed for 800nm is studied using the PIC method incorporated with the Keldysh photoionization theory.

SF3H.6 • 15:45

Significant Increase of Performances of a kHz Laser-Plasma Accelerator Using a H_2 Plasma, Josephine Monzac[1], Slava Smartsev[1], Julius Huijts[2], Lucas Rovige[3], Igor Andriyash[1], Aline Vernier[1], Jaismeen Kaur[1], Antoine Cavagna[1], Zhao Cheng[1], Rodrigo Lopez-Martens[1], Jerome Faure[1]; *[1]Laboratoire d'Optique Appliquée, France; [2]Eindhoven Univ. of Technology, Netherlands; [3]Univ. of California (UCLA), USA.* By using a Hydrogen plasma, we significantly increased the performances of our kHz laser-plasma accelerator. We achieved excellent level of stability both on the spectrum and the spatial profile of the electron beam.

14:00 -- 16:00
Room: W207D
AF3I • Novel Technologies for Environmental Sensing

Presider: Jennifer Lee; Ball Aerospace, USA

AF3I.1 • 14:00

Room-Temperature Fourier Transform Spectrometer Covering the Spectral Range from 2 to 30 µm and Beyond, Jakub Mnich[1], Mihai Suster[2], Aleksandra Szymanska[2], Johannes Kunsch[3], Matthias Budden[4], Thomas Gebert[4], Marco Schossig[5], Jaroslaw Sotor[1], Lukasz A. Sterczewski[1]; *[1]Wroclaw Univ. of Science and Technology, Poland; [2]Univ. of Warsaw, Poland; [3]Laser Components Germany GmbH, Germany; [4]WiredSense GmbH, Germany; [5]Infrasolid GmbH, Germany.* Using a lithium tantalate ($LiTaO_3$) pyroelectric detector and a thermal incoherent source we demonstrate broadband room-temperature Fourier transform spectrometry from the near-infrared to THz range without changing optics. Atmospheric species are measured with GHz resolution.

AF3I.2 • 14:15 (Invited)

Mid-infrared Interband Cascade Devices for Sensing Applications, Rui Q. Yang[1]; *[1]Univ. of Oklahoma, USA.* Status and prospects of interband cascade (IC) devices will be reviewed and discussed for sensing applications. Specific examples include widely tunable single-mode IC lasers (ICLs) and room temperature high-speed IC infrared photodetectors (ICIPs).

AF3I.3 • 14:45

A Feed Forward Digital PID Controller with Auto-relocking Features for Sub-kHz External Cavity Diode Lasers, Herve Tatenguem Fankem[1], Christian Assmann[1], Sebastian Schmidtmann[2], Patricia Sacher[1], Martin Honsberg[2], Joachim Sacher[1]; *[1]Sacher Lasertechnik GmbH, Germany; [2]Sensor Photonics GmbH, Germany.* Narrow linewidth lasers with high stability are a key enabling technology in high-impact applications such as quantum technologies. Stabilizing such lasers requires the design of efficient PID controllers. We address this challenge by successfully designing a PID to stabilize VBG-based external-cavity diode lasers with ultra-narrow linewidth.

AF3I.4 • 15:00

Temperature-insensitive Refractive Index Sensing Governed by Quasi-bound States in the Continuum with Thermo-optic Effect Balance, Zhe Han[1], Donghe Sheng[1], Chengbo Du[1], Ludan Yu[1], Jieru Zhai[1], Tianpei Dong[1], Huiping Tian[1]; *[1]Beijing Univ of Posts & Telecom, China.* We propose a temperature insensitive refractive index sensor based on quasi-bound states in the continuum. The effect of temperature on the sensing results is effectively suppressed by balancing the thermo-optic effect.

AF3I.5 • 15:15

Metasurface Microspectrometer with Mid Infrared Free-Standing Guided Mode Resonance Bandpass Filters, Jiajun Meng[1,2], Sivacarendran Balendhran[1], Kenneth Crozier[1,2]; *[1]Univ. of Melbourne, Australia; [2]Australian Research Council (ARC) Centre of Excellence for Transformative Meta-Optical Systems, Australia.* A mid-infrared metasurface microspectrometer featuring free-standing guided mode resonance bandpass filters is presented. We combine it with a thermal emitter infrared source and show that it functions as a material classifier.

AF3I.6 • 15:30

One-dimensional Seedless Velocimetry in a N2-enriched Subsonic Flow using Femtosecond Electronic Excitation Tagging, Youchan Park[1], Kyeongsun Kim[1], Hyunseung Rhee[1], Wonjik Shin[1], Hyungrok Do[1]; *[1]Seoul National Univ., Korea (the Republic of).* Spatially elongated femtosecond laser-induced plasma electronically excites nitrogen molecules generating visible range fluorescence. The fluorescence temporally traces the displacement of the nitrogen molecules enabling one-dimensional velocimetry aided by decomposition-based denoising and center-detecting algorithm.

AF3I.7 • 15:45

Sample Rate-Limited Distance and Velocity Characterizations in a Silicon Platform, Ting-Qing Liao[1], Ting-Chia Chang[1], Shih-Hsiang Hsu[1]; *[1]National Taiwan Univ of Science & Tech, Taiwan.* Direct Hilbert-transform resampling on silicon-based interferometers could correct optical-source phase errors to characterize distances and velocities precisely through frequency-modulated continuous waves. The half-of-one-mega samples per second in data acquisition limit the range to 876.86 cm.

14:00 -- 16:00
Room: W208
SF3J • Nonlinear Quantum and Topological Photonics
Presider: Mikko Huttunen; Tampere Univ., Finland

SF3J.1 • 14:00
Topological Frequency Combs, Christopher Flower[1], Mahmoud Jalali Mehrabad[1], Lida Xu[1], Gregory Moille[2,1], Kartik Srinivasan[2,1], Sunil Mittal[3], Mohammad Hafezi[1]; *[1]Department of Physics, Joint Quantum Inst., UMD, USA; [2]National Inst. Of Standards and Technology, USA; [3]Department of Physics, Northeastern Univ., USA.* We demonstrate the generation of a novel type of frequency comb, the topological frequency comb, in a lattice of hundreds of ring resonators. Our results bring together the fields of topological photonics and frequency combs.

SF3J.2 • 14:15
Optical Limiter Based on PT-Symmetry Breaking of Reflectionless Modes, Andrey A. Chabanov[1], Rodion Kononchuk[1,2], Suwun Suwunnarat[2], Tsampikos Kottos[2], Igor Anisimov[3], Ilya Vitebskiy[3], Francesco Riboli[4], Alice Boschetti[4,5], Diederik S. Wiersma[4,5], Federico Tommasi[5], Stefano Cavalieri[5]; *[1]Physics and Astronomy, Univ. of Texas at San Antonio, USA; [2]Physics, Wesleyan Univ., USA; [3]Air Force Research Laboratory, USA; [4]European Laboratory for Nonlinear Spectroscopy, Italy; [5]Fisica e Astronomia, Università degli Studi di Firenze, Italy.* We use the concept of parity-time symmetry and reflectionless modes to implement a passive optical limiter. The new approach overcomes current technical limitations in protecting photosensitive devices from damage caused by intense optical radiation.

SF3J.3 • 14:30
Soliton crystals in 4H-silicon carbide-on-insulator-based integrated optical microring resonator, Adnan A. Afridi[1], Yaoqin Lu[1], Xiaodong Xi[2], Ruixuan wang[2], Jingwei Li[2], Qing Li[2], Haiyan Ou[1]; *[1]Technical Univ. of Denmark, Denmark; [2]Carnegie Mellon Univ., USA.* We experimentally demonstrated the deterministic access of soliton crystals in a 4H-silicon carbide microring resonator. The soliton crystals with various line spacings of 6, and 10 times the free spectral range are generated within the same microring resonator but under different pump wavelengths.

SF3J.4 • 14:45
Fluctuation and Dissipation in Quantum Nonlinear Optics, Shiekh Zia Uddin[1], Nicholas Rivera[1], Devin Seyler[1], Yannick Salamin[1], Jamison Sloan[1], Shutao Xu[2], Michelle Sander[2], Marin Soljačić[1]; *[1]Massachusetts Inst. of Technology, USA; [2]Boston Univ., USA.* We present a new fluctuation-dissipation relation that shows how quantum noise transforms under engineered nonlinear dissipation found in many important nonlinear optical devices and validate the theory with experiments on nonlinear interferometers.

SF3J.5 • 15:00
Photonic Probabilistic Computing Leveraging Quantum Vacuum Noise, Seou Choi[1], Yannick Salamin[1,2], Charles Roques-Carmes[1,3], Rumen Dangovski[1,4], Di Luo[2,4], Zhuo Chen[2,4], Michael Horodynski[2], Jamison Sloan[1], Marin Soljačić[1,2]; *[1]Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA; [2]Department of Physics, Massachusetts Inst. of Technology, USA; [3]E. L. Ginzton Laboratory, Stanford Univ., USA; [4]The NSF AI Inst. for Artificial Intelligence and Fundamental Interactions, USA.* We present a photonic probabilistic

computing platform with a measurement-feedback scheme in a biased optical parametric oscillator. Probabilistic inference and generation of MNIST handwritten-digits are experimentally demonstrated.

SF3J.6 • 15:30
Efficient Single-Photon Upconversion Detection from SWIR to SPAD using PPLN Waveguides, Ruaridh Smith[1], Lewis Wright[2], Krish Pandiyan[2], Imogen Morland[1], Sarah McCarthy[1], Ali Anwar[1], Noelia P. Davidson[3], Corin Gawith[2,3], Loyd J. McKnight[1]; *[1]Fraunhofer Centre for Applied Photonics, UK; [2]Covesion Ltd., UK; [3]Southampton Univ., UK.* We present efficient single-photon upconversion detection from SWIR using a precision-machining waveguide fabrication process that offers high power handling and good mode coupling. We demonstrate an internal photon upconversion efficiency of 69%.

SF3J.7 • 15:45
Orthogonal Spatial Coding with Stimulated Parametric Down-Conversion, Yang Xu[1], Sirui Tang[2], Robert W. Boyd[3,1], Andy N. Black[1]; *[1]Univ. of Rochester, USA; [2]Department of Electrical Engineering and Computer Sciences, Univ. of California, Berkeley, USA; [3]Department of Physics, Univ. of Ottawa, Canada.* Orthogonal optical coding is common in classical multi-user communication networks. We develop the spatial analog of orthogonal coding using the pattern-transfer property of the non-degenerate stimulated parametric down-conversion in the low-gain regime.

14:00 -- 16:00
Room: W209A
SF3K • Long-haul Communications
Presider: Lauren Dallachiesa; Nokia Bell Labs, USA

SF3K.1 • 14:00
Anomaly Detection of WSS in ROADM Enabled by Single Sideband Multi-Tone Signal, Zhuofan Zhang[1], Rui Xue[1], Longquan Dai[1], Ziheng Zhang[1], Hongyu Li[1], Lei Deng[1]; *[1]School of Optical and Electronic Information, Huazhong Univ. of Science and Techn, China.* We report an anomaly detection scheme of the wavelength selective switch using a single sideband multi-tone signal and 28.5MHz photodiode. The maximum measurement error of 0.5GHz and maximum error deviation of 0.15GHz are achieved.

SF3K.2 • 14:15
Integration of Communication and Vibration Sensing Based on Frequency Pilot Tones in DSCM System Using Commercial 100 kHz ECL, Bang Yang[1], Jianwei Tang[1], Yanfu Yang[1], Linsheng Fan[1], Yongchao Jin[1], Yong Yao[1]; *[1]Harbin Institute of Technology,Shenzhen, China.* Integrated optical communication and vibration sensing in DSCM systems is demonstrated with frequency pilot tones used for signal demodulation and phase-based vibration sensing simultaneously under 100 kHz ECL.

SF3K.3 • 14:30
Enhancing Unrepeated Link Transmission by Signal Pre-Distortion in Tailored Fiber and Optical Phase Conjugation, Mark D. Pelusi[1], Christian Schou[2], Ryosuke Matsumoto[1], Takashi Inoue[1], Shu Namiki[1], Leif K. Oxenløwe[2], Michael Galili[2]; *[1]AIST Tokyo, Japan; [2]Technical Univ. of*

Denmark, Denmark. Pre-compensation of Kerr nonlinearity in unrepeated fiber links is demonstrated by optical phase conjugation and advanced signal pre-distortion fiber designs. Improved Q-factor by up to 3.7 dB is achieved for WDM 5×8-Gbaud DP-16-QAM signals in 224 km standard fiber.

SF3K.4 • 14:45
Rate-adaptive Long-haul Transmission with Semiconductor Optical Amplifiers for In-line Amplification, Smaranika Swain[1], Christian Schou[1], Metodi P. Yankov[1], Michael Galili[1], Leif K. Oxenløwe[1]; *[1]Danmarks Tekniske Universitet, Denmark.* We investigate off-the-shelf semiconductor optical amplifiers for long-haul transmission and find error-free performance after 2400 km of 7×WDM, polarization division multiplexed 32-Gbaud probabilistically-constellation-shaped 16 and 64-QAM rate-adaptive signal in a recirculating loop system.

SF3K.5 • 15:00 (Invited)
Long-distance Transmission Using Multi-mode Fibers, Menno van den Hout[1]; *[1]Technische Universiteit Eindhoven, Netherlands.* Space-division multiplexing through multi-mode fibers has been proposed as a solution for the ever-increasing demand for bandwidth. This invited talk addresses how large-mode-count multi-mode fibers can be used for long-distance optical communication.

SF3K.6 • 15:30
300-km Full C-band EDFA-only Unrepeated Transmission, Smaranika Swain[1], Christian Schou[1], Metodi P. Yankov[1], Michael Galili[1], Leif K. Oxenløwe[1]; *[1]Danmarks Tekniske Universitet, Denmark.* We investigate unrepeated transmission with EDFA-only amplification and demonstrate an order of magnitude improvement in energy per bit compared to an EDFA-Raman hybrid scheme using 32-Gbaud probabilistically-constellation-shaped PDM-16QAM WDM data in a fully loaded C-band.

14:00 -- 16:00
Room: W209B
SF3L • High Energy and High Intensity Lasers
Presider: Gabrielle Thomas; Menlo Systems GmbH, Germany

SF3L.1 • 14:00 (Tutorial)
Lasers for Fusion, Markus Roth[1,2]; *[1]Focused Energy GmbH, Germany; [2]Inst. for nuclear physics, TU Darmstadt, Germany.* With the science of laser fusion proven, the transition into a working power plant still is a challenge of similar size. One key aspect is the development of efficient, high-repetition rate lasers that meet the demand to ignite a million fusion capsules a day.

SF3L.2 • 15:00
100Hz Joule class ultra-short pulses TiSa laser, Alain Pellegrina[1], Adeline Kabacinski[1], Antoine Jeandet[1], Vincent Leroux[1], Loic Lavenu[1], Olivier Chalus[1], Olivier Casagrande[1], Christophe Simon-Boisson[1], Herve Besaucele[1]; *[1]Thales LAS France, France.* Joule class lasers at 100Hz with ultra-short pulse involve a lot of challenges to manage thermal issues in the amplifiers as well as in the compressors. Recent results achieved in this direction are presented

SF3L.3 • 15:15

Laser and Optical System for Sequential Resonant Excitation of High Energy Hydrogen Ion Beams, Abdurahim Rakhman[1]; *[1]Oak Ridge National Laboratory, USA.* We report the design and operation of 140 mJ UV (355 nm) laser and optical system used in the sequential photoexcitation of hydrogen ion beams at 1.0 GeV energy recently demonstrated at the Spallation Neutron Source accelerator.

SF3L.4 • 15:30

Loss-free shaping of few-cycle terawatt-scale pulses at 1 kHz, Lucas M. Railing[1], Manh Le[1], Carlo Lazzarini[2,3], Howard M. Milchberg[1]; *[1]Univ. of Maryland College Park, USA; [2]Czech Technical Univ. in Prague, Czechia; [3]ELI Beamlines Facility, The Extreme Light Infrastructure ERIC, Czechia.* We demonstrate pulse shaping of few-cycle terawatt-scale pulses without energy loss. In particular, we demonstrate double few-cycle pulse generation with pulse separations as short as ~10 fs.

SF3L.5 • 15:45

Temporal and Spectral Characterization of Sub-100 ps in the OMEGA Laser Amplifier Chain, William Donaldson[1]; *[1]Laboratory for Laser Energetics, USA.* Sub-100-ps pulse propagation in a 1-kJ-class laser amplifier chain has been characterized both temporally and spectrally. The short pulses have temporal and spectral widths that increase as the output energy increases, unlike nanosecond pulses.

14:00 -- 16:00
Room: W209C
FF3M • Sub-wavelength Systems and Photonic Crystals
Presider: Luca Razzari; INRS-Energie Materiaux et Telecom, Canada

FF3M.1 • 14:00

Arbitrary Dispersion Engineering in High-Refractive-Index Photonic Crystal Cavities, Alberto Nardi[1,2], Alisa Davydova[2,3], Thomas Karg[1], Tobias J. Kippenberg[2,3], Paul Seidler[1]; *[1]IBM Research Europe, Zurich, Switzerland; [2]Inst. of Physics, Swiss Federal Inst. of Technology Lausanne (EPFL), Switzerland; [3]Center of Quantum Science and Engineering (EPFL), Switzerland.* We present an algorithm to arbitrarily engineer the dispersion of photonic-crystal Fabry-Pérot resonators via the accurate design of chirped reflectors, opening avenues to exotic dispersion profiles, dispersive-wave engineering and near-zero-dispersion soliton microcombs.

FF3M.2 • 14:15

Photonic Crystal Superpotentials: Realization of Airy Resonances, Zeyu Zhang[1], Maria G. Barsukova[1], Mikael C. Rechtsman[1]; *[1]The Pennsylvania State Univ., USA.* We theoretically show that a slowly-varying perturbation to photonic crystal is described using a Schrodinger equation in the vicinity of a quadratic band edge. We use such a 'superpotential' to describe photonic crystal Airy resonances.

FF3M.3 • 14:30

All-Optical Spin-Valve Effect in Nonlinear Optics, Shani Izhak[1], Aviv Karnieli[1], Ofir Yesharim[1], Shai Tsesses[2], Ady Arie[1]; *[1]Tel Aviv Univ., Israel; [2]Technion, Israel.* Inspired by spintronics, we theoretically demonstrate an all-optical spin-valve device and a spin-dependent beamsplitter, where the optical pseudospin is a superposition of signal and idler beams undergoing sum-frequency generation within a 2D nonlinear photonic crystal.

FF3M.4 • 14:45
Spatial Avoided Crossing in Optical Emission of Site-Controlled Pyramidal Quantum Dots in Photonic Crystal Cavities, Jiahui Huang[1], Alessio Miranda[2], Benjamin Dwir[2], Alok Rudra[2], Eli Kapon[2], Chee Wei Wong[1]; *[1]Department of Electrical and Computer Engineering, Univ. of California, Los Angeles, USA; [2]Inst. of Physics, École Polytechnique Fédérale de Lausanne, Switzerland.* Interactions of site-controlled quantum dots with a high-order cavity mode of an *L*7-type photonic crystal cavity are resolved spatially and spectrally. We observed a spatial avoided crossing in polarization-resolved optical emission of quantum dots.

FF3M.5 • 15:00
Light Guiding and Directional Coupling in Nonlinear Photonic Crystals, Ofir Yesharim[1], Shani Izhak[1], Ady Arie[1]; *[1]Tel Aviv Univ., Israel.* A new waveguiding mechanism is theoretically and experimentally demonstrated, using sum frequency generation and 2D periodically poled KTP crystals, where a frequency superposition beam is guided and manipulated on-chip without any linear refractive index change.

FF3M.6 • 15:15
Designing Higher-Order Exceptional Points of Photonic Resonators by the Nilpotent Condition, Kenta Takata[1,2], Adam Mock[2], Masaya Notomi[1,3], Akihiko Shinya[1,2]; *[1]Nanophotonics Center, NTT Corporation, Japan; [2]NTT Basic Research Laboratories, NTT Corporation, Japan; [3]Department of Physics, Tokyo Inst. of Technology, Japan.* We show that the nilpotence of matrices is effective for design of exceptional points. We reveal a series of Hamiltonians with third-order exceptional points exhibiting 3-vector chirality and numerically demonstrate one in photonic crystal cavities.

14:00 -- 16:00
Room: W209F
SF3N • Microwave Generation and Timing
Presider: Daniele Nicolodi; PTB, Germany

SF3N.1 • 14:00 (Invited)
Title to be Announced, Ingmar Hartl[1]; *[1]DESY, Germany.* Abstract not available.

SF3N.2 • 14:30
Photonic-Chip-Based Ultralow-Noise Microwave Generation, Yun Zhao[1], Jae K. Jang[1], Garrett J. Beals[1], Karl J. McNulty[1], Yoshitomo Okawachi[1], Michal Lipson[1], Alexander L. Gaeta[1]; *[1]Columbia Univ., USA.* We demonstrate the generation of a 16-GHz microwave signal via optical frequency division of an optical-parametric oscillator by Kerr-soliton comb, which is optically synchronized. The resulting noise levels represent the lowest phase noise achieved in a chip-based device.

SF3N.3 • 14:45

Low Noise Millimeter-Wave Generation with Integrated Lasers and a Compact Fabry-Perot, William Groman[1], Igor Kudelin[1], Alexander Lind[1], Dahyeon Lee[1], Takuma Nakamura[1], Megan L. Kelleher[1], Charles McLemore[1], Joel Guo[2], Warren Jin[2], John Bowers[2], Franklyn Quinlan[1], Scott Diddams[1]; *[1]NIST/CU Boulder, USA; [2]Univ. of California, Santa Barbara, USA.* We generate millimeter-waves up to 118 GHz via heterodyning two photonic chip lasers which are phase-locked to the same miniature F-P cavity. Phase noise as low as -120 dBc/Hz at 40 kHz offset is achieved.

SF3N.4 • 15:00

Tunable X-band opto-electronic synthesizer for low noise microwave generation, Igor Kudelin[2,1], Pedram Shirmohammadi[3], William Groman[2,1], Samin Hanifi[3], Megan L. Kelleher[2,1], Dahyeon Lee[2,1], Takuma Nakamura[2,1], Charles McLemore[2,1], Steven Bowers[3], Franklyn Quinlan[2,1], Scott Diddams[1,2]; *[1]Univ. of Colorado at Boulder, USA; [2]Time and Frequency Division, National Inst. of Standards and Technology, USA; [3]Univ. of Virginia, USA.* An opto-electronic synthesizer is presented with phase noise at 10 kHz offset of -152 dBc/Hz, -146 dBc/Hz, and -140 dBc/Hz in the frequency range of 10±0.5 GHz, 10±1 GHz, and 10±2 GHz, respectively.

SF3N.5 • 15:15

A yoctosecond-precision timing detector, Tong Wang[1], Chongwu Sun[1], Mingzhe Li[1], Yi Zhang[1], Jie Yang[1], Yulin Shen[1], Ming Xin[1]; *[1]Tianjin Univ., China.* We experimentally presented a yoctosecond-precision timing detector based on the electrooptic modulator. The minimum detection floor is 2.35×10^{-15} fs^2/Hz and a large dynamic range of 127.78dB is achieved with 1.5 mW input optical power.

SF3N.6 • 15:30

Optical-to-Microwave Phase Coherent Link at 19th Digit Accuracy, Benjamin Rauf[1], Ignacio Baldoni[1], Martin Wolferstetter[1], Andreas Fricke[1], Marc Fischer[1], Michele Giunta[1,2], Ronald Holzwarth[1,2]; *[1]Menlo Systems GmbH, Germany; [2]Laser Spectroscopy Division, Max-Planck-Institut für Quantenoptik, Germany.* We present a transportable clockwork system capable of porting the optical spectral purity down to the microwave domain at the level of a few parts in 10^{-19}.

SF3N.7 • 15:45

Mechanical-Sharing Dual-Comb Fiber Laser for Terahertz Dual-Comb Spectroscopy, Yoshiaki Nakajima[1], Takumi Yumoto[1], Ryusei Uchiyama[1], Naoki Takeshi[1], Takuma Yoshioka[1], Shinichi Matsubara[2], Yu Tokizane[3], Takeshi Yasui[3,4]; *[1]Toho Univ., Japan; [2]JASRI, Japan; [3]Inst. of Post-LED Photonics, Japan; [4]Tokushima Univ., Japan.* We developed a simple and compact terahertz spectroscopy system based on asynchronous optical sampling using a mechanical-sharing dual-comb fiber laser. The streamlined spectroscopy system successfully detected the absorption of airborne water molecules.

14:00 -- 16:00
Room: W210
SF3O • Laser Sources for Dual-comb Spectroscopy
Presider: Sergey Vasilyev; IPG Photonics Corp, USA

SF3O.1 • 14:00
Spacing Tunable Frequency Comb with a Maintained Spectral Shape, Yijia Cai[1], Zhixin Liu[1]; [1]*Univ. College London, UK.* We study the spacing tunability of an EO-comb-seeded parametric frequency comb generator with 90 nm bandwidth and 8-dB spectral flatness, demonstrating space tuning over 25 and 32 GHz with a maintained spectral profile.

SF3O.2 • 14:15
Dual-Comb UV Spectroscopy Based on High Harmonic Generation from Cr:ZnS Laser Combs, Andrey V. Muraviev[1], Dmitrii D. Konnov[1], Vadim Smirnov[2], Sergey Vasilyev[3], Konstantin L. Vodopyanov[1]; [1]*Univ. of Central Florida, CREOL, USA;* [2]*IPG Photonics / OptiGrate, USA;* [3]*IPG Photonics, USA.* We have demonstrated high-resolution dual-comb spectroscopy in the UV region (326–343 and 372–408 nm), simultaneously resolving up to 900,000 comb modes spaced by 80 MHz in a single measurement.

SF3O.3 • 14:30 (Invited)
Phase Noise in Free-running Dual-comb Spectroscopy, Lukasz A. Sterczewski[2], Haochen Tian[1]; [1]*National Inst. of Metrology, China;* [2]*Wroclaw Univ. of Science and Technology, Poland.* Dual-comb spectroscopy is becoming a pillar of precise optical measurements. Here we study the impact of the laser source timing jitter and carrier-envelope fluctuations on the shape of molecular absorption lines probed using this technique.

SF3O.4 • 15:00
Shot-Noise Limited Interferometry of a Dual-Comb Supercontinuum Source Generated from a Single ANDi Fiber, Sandro L. Camenzind[1], Anuparnaa Rampur[2], Benoit Sierro[2], Benjamin Willenberg[1], Alexander Heidt[2], Ursula Keller[1], Christopher R. Phillips[1]; [1]*ETH Zurich, Switzerland;* [2]*Univ. of Bern, Switzerland.* We report shot-noise limited and coherently-averaged dual-comb interferometry from a watt-level gigahertz supercontinuum source. Both combs are generated in the same free-running laser cavity arrangement and directly coupled into a single all-normal-dispersion photonic crystal fiber

SF3O.5 • 15:15
Measurement speed enhancement of dual-comb spectroscopy using two types of combs, Ken Kashiwagi[1], Sho Okubo[1], Hajime Inaba[1]; [1]*National Metrology Inst. of Japan, AIST, Japan.* We demonstrate dual comb spectroscopy using two different types of combs for high-speed measurement with high frequency resolution. The high resolution and high measurement speed were achieved by Er-fiber comb and EOM comb, respectively.

SF3O.6 • 15:30
Mid-Infrared Cross-Comb Spectroscopy with a Single-Cavity Dual-Comb OPO Operating at 250 MHz, Carolin Bauer[1], Justinas Pupeikis[1], Benjamin Willenberg[1], Ursula Keller[1], Christopher R. Phillips[1]; [1]*ETH Zurich, Switzerland.* We demonstrate high-resolution spectroscopy by using a tunable 250-MHz OPO cavity as a transceiver for mid-infrared cross-comb spectroscopy. In a 2-s-long coherently-averaged measurement at 3.1µm we obtain a high spectral signal-to-noise ratio of 42 dB

SF3O.7 • 15:45
All-Polarization-Maintaining, Polarization Multiplexed, All-Fiber Dual-Comb Laser, Yuanyuan Lv[1], Yihan Li[1]; [1]*Beihang Univ., China.* We present an all-polarization-

maintaining, polarization multiplexed, dual-comb all fiber laser based on a nonlinear amplifying loop mirror and gain sharing.