Cleo: Science & Innovations 12: Lightwave Communications and Optical Networks

JWA1
25-GHz-channel-spaced DWDM-PON based on AKE injection with reduced filtering effect, Jason Young Kim1, Hoon-Kwan Lee1, Sang-Rak Moon1, Chang-Hee Lee1, Electrical Engineering, KAIST, Republic of Korea. We propose a color-free 25-GHz-channel-spaced DWDM-PON by employing a pre-filter for reduction of the filtering effect. Transmissions of 10 and 50 km at 1.25-Gb/s/channel are demonstrated when BLS is at OLT and RN, respectively.

JWA2
Impact of Brillouin scattering on R-SOA based WDM-PON power budget, Paolo Pardossi1,2, Lucia Marazzi1,2, Davide Gatti1, Stefano Longhi1, PoliCom Dept. of Electronics and Informatics, Politecnico di Milano, Italy; Fondazione Politecnico di Milano, Italy; 1Department of Physics and IFN-CNR, Politecnico di Milano, Italy. Brillouin scattering in a colorless 25-km bidirectional WDM-PON is experimentally evaluated. Downstream 10-Gb/s DPSK signal is directly received employing a pre-filter for reduction of the filtering effect. The sensitivity of spectrally phase encoded OCDMA performance in an environment of chromatic dispersion plus polarization mode dispersion with several signature sequence families is investigated.

JWA3
Highly Linear Millimeter-Wave over Fiber Transmitter with Subcarrier Upconversion, Shangyuan Li1, Xiaoping Zheng1, Hanyi Zhang1, Bingkun Zhou1, Tonghua Univ., China; By linearized modulation of a heterodyne subcarrier source using a dual-parallel Mach-Zehnder modulator, a subcarrier upconverted millimeter wave over fiber transmitter is proposed and experimentally demonstrated with an SDFR of 122.7dB Hz-1/2.

JWA4
Selectively Providing Virtual Private Network (VPN) Services in TDM-PONs with Manchester Coding, Xiaodong Hong1, Yang Li1, Lei Xu1, Chunyan Guo1, Sailing He1, Zhejiang Univ., China; NEC Laboratories America, USA. With Manchester coding induced spectral shaping, high-speed optical VPN service channels can be added in a low-speed legacy TDM-PON. The VPN service upgrade can be selective and cause no disruption to the remaining service users.

JWA5
Robustness of Coherent SPE-OCDMA to Combined Dispersion Impairments, Yi Yang1, A Bronson Cooper1, Jacob B. Khurgin1, Joe U. Kang1, 1Electrical & Computer Engineering, Johns Hopkins Univ., USA. The sensitivity of spectrally phase encoded OCDMA performance in an environment of chromatic dispersion plus polarization mode dispersion with several signature sequence families is investigated.

JWA6
Performance investigation and demonstration of upstream transmission in OFDM-PON with CDM coding, Liu Jiasheng1, Xiangjun Xing1, Bo Liu1, Yongjun Wang1, Qi Zhang1, School of Electronic Engineering, Beijing Univ. of Posts and Telecommunications, China; 1Key Laboratory of Information Photonics and Optical Communications, Ministry of Education, Beijing Univ. of Posts and Telecommunications, China; Beijing Key Laboratory of Work Safety Intelligent Monitoring, Beijing Univ. of Posts and Telecommunications, China. This paper has experimentally demonstrated and analyzed the performance of 2.5-Gb/s upstream transmission in OFDM-PON over 25km fiber. The performance degradation due to OBI noise can be suppressed with CDM coding.

JWA7
Secure OFDM-PON network based on chaos scrambling, Liu Jiasheng1, Xiangjun Xing1, Bo Liu1, Yongjun Wang1, Qi Zhang1, School of Electronic Engineering, Beijing Univ. of Posts and Telecommunications, China; 1Key Laboratory of Information Photonics and Optical Communications, Ministry of Education, Beijing Univ. of Posts and Telecommunications, China; Beijing Key Laboratory of Work Safety Intelligent Monitoring, Beijing Univ. of Posts and Telecommunications, China. This paper has experimentally demonstrated and analyzed the performance of 2.5-Gb/s upstream transmission in OFDM-PON over 25km fiber. The performance degradation due to OBI noise can be suppressed with CDM coding.

JWA8
Simultaneous Modulation and Transmission of CATV and Radio-over-Fiber Signals, Peng-Chun Peng1, Li-Hong Yan1, Hai-Han Liu1, Ching-Hsiu Huang1, Electrical Engineering, National Taipei Univ. of Technology, Taiwan. This study experimentally demonstrates a hybrid transport system. The obtained CNR, CSO, CTB and bit-error rate performance, not only satisfy the requirements for CATV system, but also satisfy the demand for high-quality radio-over-fiber system.

JWA9
RSOA-based External Cavity Laser as Cost-effective Upstream Transmitter for WDM Passive Optical Network, Guang Xiang Li1, Qian Deniel1, Fabienne Salis1, Philippe Chanclos1, Serge Tyzzer1, Guilhem Devaulx1, Romain Bena1, Orange Labs, France, Telecom ParisTech, France; 1Alcatel-Thales III-V Labs, France. We experimentally investigate a cost-effective upstream transmitter for WDM PON using external cavity laser based on reflective semiconductor optical amplifier. The laser can be directly modulated and shows good performance at 1.25 and 2.5 Gb/s.

JWA10
Highly Stable 200GHz Soliton Microring Resonator Laser based on Filter-Driven Four Wave Mixing, Alessia Pasquazi1, Marco Peccianti1, Yongwoo Park1, Brent Little2, Sai T. Chu2, David Mood1, Roberto Maranadti2, INRS-EMT, Canada; 1Infineon Ltd, USA; 2IPOS and CUDOS, School of Physics, Australia. We demonstrate a stable passively mode-locked soliton laser that extends the Dispersive-FWM concept, in a highly nonlinear, CMOS compatible integrated micro-ring resonator. Operation at 200GHz, free of supermode instability, is demonstrated.

JWA11
Hybrid CATV and 16-QAM OFDM to the Home Device Networks, Heng-Sheng Su1, Po-Yi Wu1, Heng-Chun Peng1, Tsung-Chun Peng1, Hai-Han Liu1, 1Inst. of Electro-Optical Engineering, National Taipei Univ. of Technology, Taiwan. CATV and 16-QAM OFDM signals are experimentally transmitted through a span of a 20 km SMF plus a 25 m POF in-house network. Without any wavelength converting process or bridge circuit, good performance was achieved.

JWA12
Fractional Frequency Multiplication by Using Optically Injected Locked Optoelectronics Oscillators, Dan Liu1, Jinhua Chen1, Xiaofan Zhao1, Li Hui1, Caiyun Lu1, Tsinghua Univ., China. Fractional frequency multiplication is demonstrated based on an optoelectronics oscillator. A multiplication ratio of 4/3 is realized by injecting an optical signal modulated by 7.5-GHz RF clock into an optoelectronics oscillator to obtain 10-GHz clock.

JWA13
Simultaneous Clock Recovery and Polarization De-multiplexing for 160-Gbit/s PMd-NRZ-DQPSK Using Electro-Optical Phase-Locked Loop, He Wen1, Lin Cheng1, Xiaoping Zheng1, Hanyi Zhang1, Yili Guo1, Bingkun Zhou1, Electronic Engineering, Tonghua Univ., China. A clock recovery scheme simultaneously providing polarization de-multiplexing is proposed and demonstrated in a 160-Gbit/s polarization-multiplexed NRZ-DQPSK system by employing optical domain frequency down-conversion with standard RF devices.

JWA14
Compensation of Signal Distortion by Optimized Digital Backward Propagation in DQPSK Transmission, Chien-Yu Lin1,2, Michael Holtsmannsposter1,2, Raman Auj2, Bernhard Schmauss1, Chair of High Frequency Technology, Univ. of Erlangen-Nuremberg, Germany; Erlangen Graduate School in Advanced Optical Technologies (SAOT), Germany. We optimize digital backward-propagation (DBP) to compensate signal distortions for various launch powers and bit rates. By optimizing transmission parameters and nonlinear phase calculating point, multi-span DBP gives significant improvement.

JWA15
PMD Mitigation in RZ-OOK PDM Systems Based on a Single Polarization-Diversified All-Optical Regenerator, Lianshan Yan, Anlin Yi; 1Department of Electrical & Computer Engineering, McGill Univ., USA; 2School of Chemical Engineering and Technology, Southwest Jiaotong Univ., China. PMD mitigation in RZ-OOK PDM systems is demonstrated through a single all-optical regenerator with polarization-diversified loop configuration. 1.0-dB SNR improvement is achieved in the presence of 6.3-ps DGD for RZ signals with 18-ps pulsewidth.

JWA17 Laser Linewidth Tolerance of Coherent Optical 64QAM and 16PSK Systems using Decision-Aided Maximum Likelihood Phase Estimation, Hongyu Zhang, Pooi Yuen Kam, Changyuan Yu; 1Department of Electrical & Computer Engineering, National Univ. of Singapore, Singapore; 2A*STAR Inst. for Infocomm Research, Singapore. The exact bit-error rate of 64-quadrature amplitude modulation (64QAM) is derived. By using decision-aided maximum likelihood phase estimation, it is found that 64QAM has almost the same laser linewidth tolerance as 16-phase-shift keying.

JWA18 Low Complexity Soft Decision Circuit for Decoding LDPC codes, Meir Nazmus Sakib, Venkataraman Nandakumar, Andrew J. Wong; 1Electrical and Computer Engineering, McGill Univ., Canada. A reduced complexity implementation is proposed of an optical receiver for the soft decoding of low density parity check codes. Coding gain of 5.4 dB is achieved using 20% of the incoming optical signal.

JWA19 Impact of the Maritime Environment on the Aging of Optical Fibers, Paolo Andrea, Fatima Dominguez, Marco Granada; 1IT, Portugal; 2Physics, Aveiro Univ., Portugal. The effect of the maritime environment on the aging of optical fibers coating was studied. The obtained stress decay rate was 29.05 days, however, this value is higher than for a pure water saturation environment.

JWA20 Rapid Automatic High-Precision In-situ Wavelength Calibration for Tunable Lasers Using an Athermal AWG, Runxiang Yu, Roberto Proietti, Junya Kumorida, Ayat Kalarali, Binbin Guan, S. J. Ben Yoo; 1UC Davis, USA; 2NPRC, National Inst. of Advanced Industrial Science and Technology, Japan. This paper presents a rapid in-situ automatic calibration technique for tunable SSG-DBR lasers using an athermal AWG. The preliminary experiment demonstrates laser calibration for 3 wavelengths in 30 seconds with an accuracy of ±0.015 nm.

JWA21 Perimeter Deposition and Annealing for Increasing Cr4 Concentration in Ultra Broadband Cr:YAG Fiber Amplifiers, Cheng-Nan Tsai, Sheng-Lung Huang, Shun-Hsing Wang, Yen-Sheng Liu; 1Inst. of Laser Engineering, Beijing Univ. of Technology, China; 2School of Chemical Engineering and Technology, Tianjin Univ., China. High pulse-energy (up to 60-nJ) is generated in a graphene mode-locked Yb-doped fiber laser with repetition-rate of 1.06 MHz. Graphene passive Q-switched operation of 2.3μs pulse width is also demonstrated with repetition-rate from 6kHz to 15kHz.

JWA22 Numerical Investigations on Kerr-induced Long-period Fiber Gratings, Daniel R. P. O'Keeffe, C. Cleff; 1Inst. of Applied Physics, Westfälische Wilhelms-Universität, Münster, Germany. We numerically analyze broadband conversion (up to 60 nm) of transverse modes with long-period fiber gratings that are transversely introduced via the optical Kerr effect.

JWA23 High-power Yb-doped Fiber Laser Mode-locked in a Regime of SESAM Two-Photon Absorption, Tae Hyun Yoon, Gwang Hoon Jang, Jeong Ho Kim; 1Department of Physics, Korea Univ., Republic of Korea. We present a PM Yb-doped fiber laser mode-locked in the SESAM two-photon absorption regime, emitting ultra-stable 2-ps pulses at 1030 nm with 1-nJ pulse-energy of 186-MHz repetition rate, 26-nm spectral-width, and 116-fs dechirped pulse-width, respectively.

JWA24 Modal Dynamics in Multimode Fibers, Moti Friedman, Haim Sadowski, Micha Ninov, Asher A. Friesem; 1Applied Physics, Cornell Univ., USA; 2complex systems, weizmann institute, Israel. We will present experimental and theoretical investigation of the dynamics of modes and their states of polarizations in multimode fibers as a function of time, space, and wavelength.

JWA25 All-fiber 2 μm Wavelength Tunable Mode-locked Laser, Qiang Fang, Nasser Peryghambarian; 1Univ. of Arizona, USA. We propose an all-fiber thulium-doped wavelength tunable mode-locked laser operating near 2 μm. Reliable self-starting mode locking over 50nm tuning range is observed using fiber taper based carbon nanotube (FTCNT) saturable absorber (SA).
JWA27 High power femtosecond source near 1 micron based on an all-fiber Er-doped mode-locked laser, Khuan Kieu1, Jason Innen1, Nassir Perghambarian1; 1Univ. of Arizona, USA. We report the design and performance of a high power femtosecond laser source near 1 micron wavelength, which is generated from an octave-spanning supercontinuum (SC) pumped by an Er-doped mode-locked laser.

JWA28 Simultaneous Passive Coherent Combining and Mode Locking in Fiber Laser Arrays, Chao Zhang1, Wei-zung Chang1, Almantas Galvanauskas1,2; 1Herbert. G. Winful1; 2Univ. of Michigan, USA. We present a detailed model of a multi-fiber interferometric resonator with a saturable absorber in the output arm. The results demonstrate coherent combining and the generation of mode locked pulses.

JWA29 58 kHz Ultra-low Repetition Rate Ultrafast Erbium-Doped Fiber Laser Mode-Locked by Carbon Nanotubes, Henriquex G. Raso1,2; 1Linceio A de Souza1; 2Ceramics Laboratory, Mackenzie Presbyterian Univ., Brazil. We present a 58 kHz fundamental repetition rate 3.5 km long EDFL mode-locked by SWCNT saturable absorbers. Because high nonlinearity and dispersion, soliton pulse formation was observed, with chirped 6.79 ps pulses and 0.49 nm spectral bandwidth.

JWA30 Large Mode Area Fiber Design With Asymmetric Bend Compensation, John M. Chin1; 1OFFS Labs, USA. A large mode area fiber design with asymmetrical bend compensation is proposed, demonstrating Adiab-2800µm. microns, low bend loss at 15cm radius, and reasonable suppression of higher-order modes.

JWA31 182 nJ All Thulium Fiber CPA System, Robert A. Simp1; 1Pankaj Kadwani1; 1Luceo A de Souza1; 2Ceramics Laboratory, Mackenzie Presbyterian Univ., Brazil; 2Instituto de Fisica “Gleb Wataghin”, UNICAMP, Brazil. We implement a thulium CPA system to generate 4 mm multimode Nd-doped fiber laser with chirped pulses. This fiber core glass was fabricated by the zeolite method, and the glass contained 1.25 wt% of Nd2O3.

JWA32 Thermal Effects in High-Power Fiber Amplifiers, Kerstin B. Hansen1, Jesper Lægsgaard1; 1Department of Photonics Engineering, Technical Univ. of Denmark, Denmark. The effect of temperature gradients in Yb-doped fiber amplifiers is studied using sub-wavelength grating, an only 4-mm multimode Nd-doped silica fiber laser. This fiber core glass was fabricated by the zeolite method, and the glass contained 1.25 wt% of Nd2O3.

JWA33 Tellurite Suspended Core Nanofiber with Extremely Large Hole Region, Meisong Liao1, Xin Yao1, Guanglu Qin1, Chuhua Liu1, Takahito Suzuki1, Yasutake Ohtomi1; 1Optical Functional Materials Lab, Toyota Technological Inst., Japan. A tellurite suspended core nanofiber with extremely large hole region is demonstrated for the first time. A single-mode third harmonic generation is observed under the 1557 nm pump by a femtosecond fiber laser.

JWA34 Temporal Shaping of Parabolic Chirped Pulses with 27 dB Extinction Ratio for Fiber Chirped Pulse Amplification Systems, Dat Nguyen1, Mohammad Umar Piracha1, Peter J. Delfyett1,2; 1College of Optics and Photonics, CREOL, Univ. of Central Florida, USA. A novel temporal pulse shaping technique for chirped pulses is presented. Parabolic pulses with residual error of less than 5% and signal to noise ratio of 27dB is achieved, ideal for chirped pulse amplification applications.

JWA35 Demonstration of 4-mm short length fiber laser oscillation in Nd-doped silica fiber fabricated by zeolite method, Matoiuchi Murakami1, Minoru Yoshida1, Hitoshi Nakano1, Yasushi Fujimoto1, Hiroki Shingue1, Shunji Matsukata1, Shin-ichi Matsuiya1, Yuina Maeda1, Hirofumi Kar1, Tatsunori Sato; 2Osaka Univ., Inst. of Laser Engineering, Japan; 3Kinki Univ., Faculty of Science and Engineering, Japan; 4Inst. of Laser Engineering, Japan; 5Hamamatsu Photonics K. K., Japan; 6Shin-Etsu Quartz Products Co., Ltd., Japan. We present a laser oscillation in the shortest Nd-doped silica fiber cavity with an only 4-mm multimode Nd-doped silica fiber laser. This fiber core glass was fabricated by the zeolite method, and the glass contained 1.25 wt% of Nd2O3.

CLEO: Science & Innovations 2: Solid-State, Liquid, Gas, and High-Intensity Lasers

JWA42 9.5-mJ, 830-ps, 0.5-kHz Single Frequency MOPA System with Near Diffraction Limited Beam Quality, Alexander Gudyanzhev1, Danail Chuchumishev1, Ivan C. Buchvarov1; 1Department of Physics, Sofia Univ., Bulgaria. Near diffraction limited, single frequency, passively Q-switched Nd:YAG laser (240µJ, 830 ps at 0.5 kHz) is amplified up to 9.5-mJ in a two stage diode pumped amplifiers whilst preserving pulse duration, beam quality and linear polarization.

JWA43 All-Reflective Ti:Sa Power Amplifier for Peta-Watt Laser, Joel K. Blakeney1; 2Physics, Univ. of Texas at Austin, USA. We produced a multi-pass amplifier capable of extracting up to 60 joules has been designed. The power amplifier consists of four passes through a 100µm Ti:Sa crystal. The amplified beam is imaged by off-axis parabolas enclosed in a vacuum chamber.

JWA44 Techniques for Pre-pulse Contrast Improvement on the 0.5 ps, 80 J, “C” Beamline of the Trident Laser, Randall P. Johnson1, Tsutomu Shimada1, Rahul C. Shah1; 2Trident Laser Facility, Los Alamos National Laboratory, USA. An all reflective femtosecond Ti:Sa amplifier capable of extracting up to 60 joules has been designed. The power amplifier consists of four passes through a 100µm Ti:Sa crystal. The amplified beam is imaged by off-axis parabolas enclosed in a vacuum chamber.

JWA45 High-efficiency solar-pumped Nd:YAG laser with excellent beam profile, Dawei Liang1, Jinmei Almeida1, Physics Dept., CEITEC, Portugal. By using a fused silica light guide with 2D-CPC output end and a roof-shaped cavity, concentrated solar radiation is efficiently coupled into a tiny Nd:YAG rod. High collection efficiency and excellent beam profile are achieved.

JWA46 Compact, Diode-Pumped Yb:YAG Laser with combination acousto-optic and passive Q-switch for LIDAR Applications, Mikhail Takshein1; 1SES, USA. We have developed a Yb:YAG laser equipped with both an acousto-optic and passive Q-switches. With this setup, we obtained 1 mJ/pulse energy and a pulse width of ~7 ns, at a repetition rate of 2 kHz.

JWA47 Leti's Integration of the High Output Maximum Efficiency Resonator (HOMER) Laser for the SAFIRE Instrument on NASA's DESDynl Project, Paul Stysky1, Barry Covey1, Richard Kay1, Robert Frederickson1, Demetrios Poulios1, Bryan Blair1, Stan Scott1, Ed Arnold1, Laser and Electro-Optic Branch, NASA-GSFC, USA; 2Physics, American Univ., USA, “Sigma Space, USA. We update the status of a diode-pumped, Nd:YAG oscillator that is the prototype laser for NASA’s DESDynl mission. After completing TRL-6 testing, this laser has fired over 5.5 billion shots in lifesifting.

JWA48 Subpicosecond pulse generation from a chirped-pulse multipass cavity Cr+:forsterite oscillator, Huseyn Cankaya1, Alphan Semargonlu1, Selcuk Akturk2; 1Physics, Koc Univ., Turkey; 2Physics, Istanbul Technical Univ., Turkey. We produced the highest pulse energy directly generated from a room-temperature, mode-locked Cr+:forsterite oscillator. The chirped-pulse, multipass-cavity, 1261-nm oscillator operated at 4.9 MHz and produced 81-nJ pulses which could be externally compressed to 620 fs.

JWA49 Frequency Stable Coupling of Laser Oscillators using Gain Grating in Nd:YAG, Roland Ulmann1, Robert Elsner1, Axel Heuer1, Ralf Mentzel1, Martin Ostermeyer1; 2Inst. for Physics and Astronomy, Univ. of Potsdam, Germany; 3IBL Innovative Berlin Laser GmbH, Germany. To realize frequency-stable operation of a Q-switched laser resonator, a passive coupling scheme based on gain normalisation is numerically investigated. Existing normalised models are extended to two spatial dimensions and selected results are presented.

JWA50 15 ps Quasi-continuously Pumped Passively Mode-locked 2.4% doped Nd:YAG Laser in a Bounce Geometry, Vlaha Kubecb1, Michal Jelinek1, Milanov Cecb1, Petr Heil1, Faculty of Nuclear Sci. and Phys. Eng., Czech Technical Univ., Czech Republic. Passive mode locking of a quasi-continuously pumped 2.4% Nd:YAG slab in a bounce geometry is reported. The 500 µJ trains with 15 ps pulse duration and excellent stability ± 2 ps were generated.
JWA51  TEM, Quasi-concentric Laser Resonator with Line-shaped End-pumping Profile: Power-insensitive Operating Point, Xing Fei, Qing Liu, Xingpeng Yan, Qi Wang, Malin Gong; Tonghu University, China. We report a TEM, quasi-concentric laser resonator with line-shaped end-pumping profile, based on the design method of thermal lensing and power-insensitive operating point.

JWA52  Upconversion with Ho⁺ and Tm⁺ Codoped Lead Lanthanum Zirconate Titanate Ceramics, Haizhe Zhou, Long Xiu, Jingwen W. Zhang, Yingjun Zou, Kewen Li, Hua Jiang, Xuefeng Chen, Piling Huang; Harbin Inst. of Technology, China; Boston Applied Technologies, Inc, USA; Wheaton College, USA. Using Ho⁺ and Tm⁺ codoped PLZT ceramic gain media, excellent upconversion was observed and investigated. A new model was proposed, leading ways towards upconversion-based laser and sensor development.

JWA53  Effects of Laser Spectrum on Amplified Spontaneous Emission Prepulse Duration in Chirped Pulse Amplification Lasers, Seong Ku Lee1, Tae Jun Yu1, Jae Hee1, Tae Moon Jeong1, Jongmin Lee1; APRIL, GIST, Republic of Korea. We demonstrate experimentally and theoretically that prepulse duration via amplified spontaneous emission (ASE) is strongly related to laser spectra in chirped-pulse amplification lasers due to pulse compressor dispersion.

JWA54  Solution-processed 3D Chalcogenide Glass Waveguides, Yunlai Zha 1, Craig B. Arnold 1; Princeton University, USA. We use solution-based micro-molding in capillaries and micro-transfer molding methods to fabricate and characterize integrated chalcogenide glass waveguides on non-planar, such as curved or stepped, surfaces for communication or sensing applications.

JWA55  Stability of Chalcogenide Glass Solutions for Photonic Applications, Maiko Waldmann1, Craig B. Arnold1; Princeton Inst., USA. We use solution-based micro-molding in capillaries and micro-transfer molding methods to fabricate and characterize integrated chalcogenide glass waveguides on non-planar, such as curved or stepped, surfaces for communication or sensing applications.

JWA56  Continuous Tuning of Terahertz Generation in Fan-out Periodically Poled Stoichiometric Lithium Tantalate, Nan Yi1, Yi Yu2, De-Kyeong Ko1, Shanju Taekan1, Kenji Kitamura1; Guangju Inst. of Science and Technology, Republic of Korea; School of Photon Science and Technology, Republic of Korea; National Inst. for Materials Science, Japan. Tunable terahertz pulses were generated in fan-out periodically poled structure with QPM period of 50 to 90 μm. Center frequency was tuned from 0.94 to 3.55 THz with as narrow as band-width of 20 GHz.

JWA57  Sol-gel Preparation and Spectral Characterization of Y₂O₃ Powders Doped with Yb⁺ and Nd⁺, Zackery Fleischman1; US Army Research Lab, USA. A sol gel process was used to produce Y₂O₃ powders doped with varying amounts of Yb⁺ and Nd⁺ ions. The materials were spectrally characterized to study the energy transfer between the dopant ions.

JWA58  Quantum Dots for High Temperature Sensing, Devin Pugh-Thoms1,2, Mool Gupta1, Brian M. Walsh1; Electrical Engineering, Univ. of Virginia, USA; NASA Langley Research Center, USA. High temperature photoluminescence sensing is demonstrated by embedding colloidal CdSe(ZnS) quantum dots into a high temperature dielectric. Temperature-dependent modes are investigated from 293-540 K. The sensor sensitivity is 0.11%/C.

JWA59  Non-saturable absorption and its impact on amplifier performance in Al₂O₃-R̃₄, Laura Agazzi1, Kerstin Worhoff1, Markus Pollnau1; Integrated Optical Microsystems Group, MESA+ Inst. for Nanotechnology, Univ. of Twente, Netherlands. Luminescence decay and non-saturable absorption experiments in erbium-doped aluminum oxide waveguides determine the energy-transfer-upconversion parameter and reveal the presence of quenched ions. We quantify their impact on amplifier performance.

JWA60  Size-effect of germanium nanocrystals, Haiyan Ou1,2; Technical Univ. of Denmark, Denmark. Different sizes of Ge nanocrystals embedded in a SOI matrix were formed by PECVD, and analyzed by TEM. Size effect of Ge nanocrystals was demonstrated by Raman spectroscopy after excluding the thermal effect.

JWA61  Planar Silicon-Rich Nitride Resonators Doped with Neodymium, Debo Olaosebikan1, Michal Lipson1, Selcuk Yerci2, Luca Dal Negro2; 1School of Engineering, Columbia University, USA; 2S3 Microstructured Fiber, USA. We report on the characterization of neodymium doped silicon rich nitride resonators at 1550nm. We demonstrate the feasibility of use in photonic circuits and demonstrate ring resonators with quality factors of > 5,000.

JWA62  Two-photon spectroscopy of Rubrene single crystals, Alexandre Rynavsky1, Ivan Blaga2; 1Physics, Lehigh University, USA. We report on the two-photon spectroscopy of Rubrene single crystal. We experimentally observed strong anisotropy of two-photon absorption coefficient and photoluminescence. The two-photon absorption spectrum was measured between 740-840 nm.

JWA63  Paper Withdrawn

JWA64  Hybrid Diffractive Optical Element Based Spectrometer, Chuan Yang1, Perry Edwards1, Kebin Shi1, Zhiwen Liu2; Electrical Engineering, The Pennsylvania State Univ., USA. We present the fabrication and characterization of a hybrid planar diffractive element, which combines the functions of a grating and a Fresnel lens (G-Fresnel). A proof-of-concept spectrometer based on the G-Fresnel is also demonstrated.

JWA65  High-Resolution Integrated Spectrometers in Silicon-Oxynitride, Imran B. Akca1, Nur Imasa2, Fai Sun3, Alfred Driessen1, Kerstin Worhoff1, Markus Pollnau1, Rene M. de Riedt1; Integrated Optical Microsystems Group, MESA+ Inst. for Nanotechnology, Univ. of Twente, Netherlands. Arrayed waveguide grating spectrometers operating around 800 nm and 1300 nm are demonstrated, with the highest resolution (0.16 nm) and largest free-spectral range (77 nm) achieved in silicon-oxynitride technology to date.

JWA66  Visible Light Generation and its Influence to Supercontinuum in As₂S₃, Microstructured Fiber, Wengang Guo1, Meisong Liao1, Xin Yan1, Chiharu Kito1, Takanobu Suzuki1, Muhammad Al-Amnaoui1, Jean-Charles Jules1, Gregory Gader2, Frédéric Devidéry3, Frédéric Smektala2, Tatatuke Ohishi1,2; Toyota Technological Inst., Japan; UMIST 529 CNRS-Université de Bourgogne, France. We demonstrate visible light generation in As₂S₃ microstructured fiber for the first time. It limits the spectral range of supercontinuum. The visible light generation can be avoided by designing the fiber for the single-mode operation.

JWA67  Characteristics of In-fiber Mach-Zehnder Type Interferometer in Hollow-core Photonic Bandgap Fiber, Gil Hwan Kim1, Kyung Sik Ma2, Kwanil Lee1, Sang Bae Lee1; Korea Inst. of Science and Technology, Republic of Korea; MZIF based on off-set splicing technique of HC-PBGF and SMFs was fabricated. Interference fringe is observed with a maximum contrast of better than 12dB. We measured the strain, temperature, refractive index response of the interferometer.

JWA68  Gratings in plasmonic V-groove waveguides, Cameron L. Smith1, Irene Fernandez-Cuesta1, Anders Kristensen1; DTU Nanotech, Denmark. We introduce visible light optical gratings to surface plasmon Vgroove waveguides. Gradient ebeam dosage onto silicon stamp enables structuring Vgrooves of varying depth. Nanosimprint lithography maintains λ=263nm corrugation for gold surface devices.
Cleo: Science & Innovations 8: Ultrafast Optics, Optoelectronics and Applications

JWA74
25.54% Efficient Single-Junction GaAs Solar Cell Using Spin-On Film Graded-Index TiO2/ SiO2 AR-Coating. Wen-jeng Hsu1, Yi-Lin Lin1, Liang-Yin Chi1, Yi-Yu Lee1, Yun-Lien Chen1, Cheng-Ming Yu1, Quan Ra1, Liih-Fai Syu1, Hong-Pin Shu1. Institute of Electro-Optical Engineering, National Taiwan University, Taiwan. We report high efficiency single-junction GaAs solar cells of 25.54% at one sun using a spin-on graded-index TiO2/SiO2 films. Improved in efficiency, from 19.19% to 25.54%, was obtained when cell without/with proposed graded-index TiO2/SiO2 AR-coating, respectively.

JWA75
Broadband and ultrafast measurement of transient circular dichroism in chiral molecules, Laurent Mongeot1, Boglín Abele1, Kowab Darkow2,3,4, DON, IPCMS, France. We measure transient and static optical activities by coupling pump-probe and ellipsometric experiments. Its broadband capacity makes our set-up attractive to study structural changes in bio-system, as it drastically decreases acquisition time.

JWA76
650MHz-pr femtosecond Cr+:forsterite laser with dispersion-compensating GallNASA SESAM, Christoph G. Leburn1,2, Weisheng Lu3,4, Martin D. Dawson1, Christian Brown1, James S. Harris1, Stephen Calvez4. Institute of Photonics, University of Strathclyde, UK. We report the use of a near-resonant GallNASA SESAM in a Cr+:forsterite laser to generate transform-limited 156fs pulses around 130nm at a repetition-rate of 0.65GHz with average powers up to 270W.

JWA77
Sub-12 fs pulses characterization by self-referenced spectral interferometry, Stéphane Grabule1, Antoine Moulard1, Nicolas Forget1, Vincent Comtat1, Sébastien Coudrain1, Christian Cortet1, Christian Cornaggia1, Thomas Okenendeh1, 2FASTLITE, France; IBIS, Service Photons Atomes & Molécules, CEA, France. 11.7 fs is nearly perfect Fourier Transform pulses were characterized with self-referenced spectral interferometry after precise optimization. A measurement quality control criterion is presented. Each experimental result was cross-checked with SPIDER.

JWA78
High-Speed Nanometer-Resolved Imaging-Based Laser Vibrometry, Kiscica Góda1, Aita Mahshubara2, Ali Ayaz1, Ali Fard1, Sang Hyup Kim1, Bahram Jalali2. Electrical Engineering Department, University of California at Los Angeles, USA. We report a new type of laser vibrometer that performs high-speed imaging-based surface vibration measurements with >1 nm axial resolution at a repetition rate of 36.7 MHz without the need for beam scanning.

JWA79
High-power ultrafast solid-state laser using graphene based saturable absorber, Ezent Siu1, Xuefan Li1, Harum Hui1, Tawfique Hasan2, Felice Torrisi1, L. Zhang1, L. Sun1, Lin Gu1, Wei Hou2, Jingli Feng1, Andrea Ferrari2; 1Department of Engineering, Cambridge University, UK; 2Laboratory of All-solid-state Light Sources, Inst. of Semiconductors, China. We demonstrate a graphene based saturable absorption mode-locked Nd:YVO4, solid-state laser, generating ~1-kJ pulses with ~1W average output power. This shows the potential for high power laser generation.

JWA80
A Novel Z-cut LiNbO3 Mach-Zehnder Modulator Using Resonant CPW Electrodes with Single Driving Signal for Zero-Chirp Operation, Masayuki Matuyama1, Junkun Ishikawa1, Eihoji Murata1, Yasuyuki Okamuro1, New technology research laboratories, Sumitomo Osaka Cement Co. Ltd, Japan; 2Graduate School of Engineering Science, Osaka Univ., Japan. We propose a novel zero-chirp electro-optic modulator using resonant CPW electrodes operated with a single driving signal. The measured chirp parameter was below 0.1 at the frequency of 20.4GHz.

JWA81
Generation of high-power infrared laser pulses by dual-chirped optical parametric amplification scheme, Qingshun Zhang1, Eiji Takahashi1, Katsumi Midorikawa1; 1Extreme Photonics Research Laboratory, Leibniz University, Germany; 2Nanowires: Optical Sciences, Naval Postgraduate School, Monterey, USA. We report a new type of laser vibrometer that performs high-speed imaging-based surface vibration measurements with >1 nm axial resolution at a repetition rate of 36.7 MHz without the need for beam scanning.

JWA82
High Power Short Pulse Generation at High Repetition Rate from InGaN Violet Laser Diodes, Wojciech Olle1, Peter P. Vasiliev1, Adrian Woja1, Richard V. Penny1, Ian H. White1, Electronic Engineering Centre, University of Cambridge, UK; 2PLASMONIC, Russian Federation. The generation of 22 ps pulses with peak powers of 0.74 W by a gain-switched InGaN violet laser diode is reported. Significant pulse width dependence on repetition rate is observed.

JWA83
Pulse measurement based on simultaneous two- and three-photon autocorrelation in a GaAs optical multimode fiber, Yihen Wei1, Scott Howard1, Ji Cheng1, Zhenan Wang2, Adam Strach1, Chris Xu1, School of Applied and Engineering Physics, Cornell University, USA. We demonstrate a novel method for high sensitivity measurement of pulsed light using a GaAs optical multimode fiber, 2nd- and 3rd-order autocorrelations are obtained simultaneously by modulating the input power and analyzing the RF harmonic components.

JWA84
Experimental demonstration of an all-diffractive quasi-direct space-to-time pulse shaper by frequency-resolved optical gating, Shang-Da Yang1, Li-Fan Yang1, Ome Mendozas-Ver1, Angel Quintones-Huarte1, Gladys Alvez-Yepez1; 1Inst. of Photonics Technologies, National Tsing Hua University, Taiwan; 2University Jaume I, Spain. We experimentally characterized the pulse sequences generated by an all-diffractive quasi-direct space-to-time pulse shaper for the first time. This technique is promising in generating user-defined XUV and X-rays pulses.

JWA85
Highly stabilized frequency-locked optical frequency comb signal generation using amplified optical fiber loop with SSB-SC modulation, Atsushi Kanno1, Takahide Sakamoto1, Tetsuya Kawai1,2; 1National Inst. of Information and Communications Technology, Japan. Frequency-locked optical frequency comb generation was successfully demonstrated with SSB-SC modulation loop technique. We show no significant effect on the frequency comb signal with changes of loop length from 0 mm to 5 mm.

JWA86
Generation of intense femtosecond laser pulse by compression of an idler pulse with an identically positive dispersive media as signal pulse stretcher, Yutaka Akahane1, Kanade Ogawa1, Koichi Yamakawa1; 1Japan Atomic Energy Agency, Japan. Idler pulses generated in ultrashort optical-parametric chirped-pulse amplification were compressed to sub-100 fs with an identical positive dispersive medium as signal pulse stretcher, which is suitable for industrial applications.

JWA87
Time-to-space conversion at 1.55μm by non-degenerate SFG, Dyer Shoyatzov1, Dan M. Maron1; 1The Hebrew Univ of Jerusalem, Israel. We report the first demonstration of time-to-space conversion of 1.55μm femtosecond optical pulses using non-degenerate, collinearly phase-matched sum frequency generation. A quasi-monochromatic output signal with a resolution of 10 was obtained.

JWA88
Ellipticity dependence of high harmonics from 400 nm driving pulses, Sabih D. Khan1, Yan Cheng1, Kun Zhao1, Michael Chini1; 2Physics, Kansas State Univ., USA; 3Physics, University of Central Florida, USA. First experimental measurement of ellipticity dependence of high harmonics produced from 400 nm driving pulses is reported and compared with harmonics produced from 800 nm driving pulses in an argon filled gas cell.

JWA89
Pulse characterization of a passively mode-locked quantum dot semiconductor laser using FROG and autocorrelation, Yun Li1, Chang Yi Li1, Derek Chang2, Carsten Langrock2, Martin M. Fejer1, Daniel Kante1, Luke F. Lester2; 1Center for High Technology Materials, University of New Mexico, USA; 2E. L. Ginzton Laboratory, Stanford University, USA; 3Mesa Photonics LLC, USA. A comparison between the operational map of a QD MLD, done by autocorrelation and FROG is made. The results show that the complete mode-locking region is significantly more when FROG is used versus autocorrelation.
GW91 High repetition rate high average power all-normal dispersion Yb:fiber ring laser, Hongyu Yang1, Peng Li1, Xi Wang1, Chen Li1, Aimin Wang1, Zheng Li1, Zhigang Zhang2; 1Institute of Photonic Systems, Epitaxy and Devices, Industrial Technology Research Institute, National Taiwan University, Taiwan; 2Department of Electrical Engineering, National Taiwan University, Taiwan; Department of Electrical Engineering, National Taiwan University. Taiwan. GaN-based light emitting diodes with properly designed photonic crystal structures as surface texturing and sidewall reflectors are fabricated to improve the collection of laterally propagated light and the directionality of the device.

GW96 Promotion of the Inverted Polymer Solar Cells with p-NiO Modification, Jyun-Lin Chiu1, Ming-Yi Lin5, Chia-Shuo Chen1, Chi-Hsing Shiu1, Shao-Yuan Ma2, Yu Min Shen3, Ching-Fuh Lin4; 1Graduate Institute of Photonics and Optoelectronics, National Taiwan University, Taiwan; 2Department of Electrical Engineering, National Taiwan University, Taiwan; Department of Electrical Engineering, National Taiwan University. Taiwan. GaN-based light emitting diodes with properly designed photonic crystal structures as surface texturing and sidewall reflectors are fabricated to improve the collection of laterally propagated light and the directionality of the device.

GW98 Multimode speckle contrast imaging using current pulsed VCSELs, Hart Levit1, Dene Ringuaite1, Ofer Lev1; 1Electrical and Computer Engineering, University of Toronto, Canada; 2Institute of Biomedical and Biomedical Engineering, University of Toronto, Canada. We implement multimode speckle contrast imaging using VCSELs to quantify cortical blood flow, towards a portable technique. Device characterization and noise compensation algorithms are used to show robustness of our technique in non ideal conditions.

GW99 Resolution Improvement of Fluorescence Laminar Optical Tomography by Angled Incidence and Detection, Chao-Wei Chen1, Yu-Feng Yin1, Jian-Jang Huang1,2; 1Graduate Institute of Photonics and Optoelectronics, National Taiwan University, Taiwan; 2Department of Electrical Engineering, National Taiwan University, Taiwan. We implement multimode speckle contrast imaging using VCSELs to quantify cortical blood flow, towards a portable technique. Device characterization and noise compensation algorithms are used to show robustness of our technique in non ideal conditions.

GW100 Combining Phase Contrast Microscopy and Laser Tweezers Raman Spectroscopy to Characterize Germination of Single Bacterial Spores, Lingbo Kong1, Pengfei Zhang2, Peter Sellin2, Yong-Qing Li1; 1Department of Physics, East Carolina University, USA; 2Department of Molecular, Microbial and Structural Biology, Univ. of Connecticut Health Center, USA. We report a method that combines external phase contrast microscopy, Raman spectroscopy and optical tweezers to monitor a variety of changes during the germination of single bacterial spores.

GW102 Light Scattering in Biomimetic Structures with Short-range Order, Song Fatt Liew1, Jason Forster1, Hees Noble1, Carl Schreck2, Vinodkumar Saranathan1, Xinbei Lu1, Lin Yang1, Corey S. O’Hern1, Eric Dufresne1, Hui Cao1; 1Applied Physics, Yale University, USA; 2Mechanical Engineering, Yale University, USA; 3Physics, Yale University, USA; 4EcoSystems and Evolutionary Biology, Peabody Museum of Natural History, Yale University, USA; 5Condensed Matter Physics and Materials Science, Brookhaven National Laboratory, USA; 6National Synchrotron Light Source, Brookhaven National Laboratory, USA. We performed coherent backscattering experiments to measure transport mean free path in closely packed biomimetic structures. Due to short-range order and near-field effect, low-order light scattering becomes dominant and produces structural colors.

GW103 Focusing of the LP02 Mode from a Higher Order Mode Fiber, Jennifer H. Lee1, Michael E. Dart1, Deminian Kabir1, Chris Xu1, Lars Gruner-Nielsen2; 1Optics Research and Engineering (ORIE) Lab, Cornell University, Ithaca, NY, USA; 2School of Applied and Engineering Physics, Cornell University, USA. We characterize the focusing properties of the LP02 mode in a typical multimode microscope. Under varying back-aperture filling conditions, we measure vastly different point spread functions, including a null at the focus.
A Hybrid Waveguide Sensor for Highly Sensitive Biosensing, Muhammad Alam1, Farhad Bahrami1, J. Stewart Aitchison1, Mohammad Madadih2; 1University of Windsor, Canada; 2Rice University, USA. We are presenting a novel approach to label-free and real-time monitoring of biomolecules using a hybrid waveguide sensor. The sensor is based on a silicon nitride microdisk resonator and a waveguide that couples light into and out of the resonator. The sensor sensitivity is demonstrated using a specific biomolecule and the results show excellent performance.

An Innovative Optical Microscope for Bacterial Imaging, Yining Qi1, Shailesh Samal2, Brian F. Rodriguez2, Robert L. Jenkins1; 1University of Washington, USA; 2Microscopy Technologies, Inc., USA. We present an innovative optical microscope that utilizes a novel detection scheme to achieve high contrast imaging of bacteria. The microscope is capable of imaging bacteria in 3D with sub-micron resolution.

A Novel Optical Frequency Rectifying Device: Application as an IR and Optical Sensor, Brock L. Wetzel1, Alexander Mayer2, Moon S. Chung2, Paul H. Cutler3, Nicholas M. Moskowitz2, Brian Willner2, Physics, Penn State, USA; 3Chemical, Materials & Bioengineering, Univ. of Connecticut, USA. We present a novel optical frequency rectifying device that can be used as an IR and optical sensor. The device is fabricated using a novel detection scheme that allows for high sensitivity and selectivity.

Temperature Impact on the Long-Term Stability of a Portable Laser Spectroscopic CO2 Sensor, Chetan J. Smith1, Stephen So1, Amir Khan2, Mark A. Zondlo2, Gerard Wysocki1; 1Electrical Engineering, Princeton Univ., USA; 2Civil and Environmental Engineering, Princeton Univ., USA. We present a novel CO2 sensor that is portable and can measure CO2 concentrations over long periods of time. The sensor is based on a novel detection scheme that allows for high sensitivity and selectivity.

A Novel DFT Scheme for Optical Modulation, Bishara Shamee1; 1Univ. of Southern California, USA. We present a novel DFT scheme that can be used for optical modulation. The scheme is based on a novel detection scheme that allows for high sensitivity and selectivity.

A Low Cost, Battery Powered Optical Detection of Pathogens, Raghubir Khanna1, William Stanchina2, Steve Kite2; 1Electrical and Computer Engineering, Univ. of Pittsburgh, USA; 2Neurology, Univ. of Pittsburgh Medical Center, USA. We present a novel optical detection scheme that can be used for the detection of pathogenic bacteria. The scheme is based on a novel detection scheme that allows for high sensitivity and selectivity.
JOINT

JWA • Towards Applications Joint Poster Session—Continued

JWA125
Demonstration of a Video Frame Rate Full Muller-metric Eye-safe Imaging Laser Radar, Selim M. Shahriar1, Shih Tseng2, Sudarsanam Krishnamurthy3; 'Northwestern Univ., USA. We report a video frame rate eye-safe imaging laser radar that can detect all four components of the Stokes parameters in the reflected signal, with a variable input polarization state, capable of full Mueller-metric imaging.

JWA126
Photonic-assisted Instantaneous Frequency Measurement based on a Single Mach-Zehnder Interferometer, Dai Jian1, Kun Xu1, Min R. Duan1, Jian Wu1, Tong J. Lin2; 'Beijing Univ. of Posts and Telecommunications, China. A novel configuration with only one MZI for photonic-assisted instantaneous microwave frequency measurement has been proposed. An experiment from 5 to 10GHz is performed, and the measurement errors almost less than 0.2GHz is successfully achieved.

CLEO: Applications & Technology 4: Industrial

JWA127
Three dimensional finite element modeling of laser cladding of nickel alloy with 1.5wt.% and 3wt.% nano CeO2 on the low carbon steel 1015, Gholamreza Fayazi1, Sepideh Sadat Zakereh1, M. Vaghefi1, A. Seyedin2; 'Physics, Tafresh Univ., Islamic Republic of Iran; 2Physics, Sharif Univ. of Technology, Islamic Republic of Iran. Multilayer laser cladding process for the material properties of low carbon steel 1015 for workpiece and nickel alloy with 1.5 wt.% and 3 wt.% nano CeO2 as the powder particles is modeled.

JWA128
All-optical Logic Gates (NAND and AND) Based on Multiinjection in Single Mode Fabry-Perot Laser, Bikash Nakarmi1, Mohammad Rakib-Uddin1, Tran Hoa1, Yong Hyub Won1; 'ICE, KAIST, Republic of Korea. All-optical NAND and AND gate using single mode Fabry-Perot Laser diode (SMFPLD) is demonstrated. The operating principle is based on the intensity modulation of SMFP-LD with combined input power of the logic gates.

JWA129
Optical Inspection of ITO Conducting Glass with Optical Coherence Tomography, Meng Tsan Tsai1,2, Feng-Yu Chang1; 'Department of Electrical Engineering, Chang Gung Univ., Taiwan; 2Graduate Inst. of Medical Mechatronics, Chang Gung Univ., Taiwan. A new approach for defect inspection and properties evaluation of ITO conducting glass is demonstrated with OCT. Several parameters also can be estimated including the thickness of glass, refractive index, reflection and transmission coefficients.
CWEA1 • 13:30
Generation of Correlated Photons in an Integrated Chalcogenide As₃S₅ Waveguide, Charlie Xiong¹, Graham D. Marshall², Alberto Peruzzo³, Jingyun Fan¹,², Alan Migdall¹,²; ¹Optical Technology, Univ. of Bristol, UK; ²Joint Quantum Institute, Univ. of Maryland, USA. We demonstrate quantum interference in MMI couplers and coupled waveguides that implement two-particle quantum walks, showing unique quantum behaviour.

CWEA2 • 13:45
Dynamic Variation of Plasmon-Induced Transparency in Terahertz Metamaterials, Zhongyang Li¹, Yingfang Ma¹, Ran Huang¹, Jiangang Gu¹, Zhen Tian¹, Shuang Zhang¹, Jagapati Han¹, Weil Zhang¹; ¹Center for Terahertz Waves and College of Precision Instrument and Optoelectronics Engineering, Tianjin Univ., China; ²School of Electrical and Computer Engineering, Oklahoma State Univ., USA. We report an all-reflective OCT (R-OCT) system using a newly developed compact fiber-based broadband supercontinuum source. We achieved an axial resolution of 1.5 μm in tissue at a center wavelength around 1300 nm.

CWEA3 • 14:00
Silicon-on-Insulator Microring Resonator-based Source of Frequency-Bin Entangled Comb of Photon Pairs, Jun Chen¹,², Zachary H. Levine¹, Jingyun Fan¹, Alig Mirdadi¹; ¹Optical Technology Division, National Inst. of Standards and Technology, USA; ²Quantum Inst., Univ. of Maryland, USA. We present a quantum theory for frequency-bin entangled photon-pair generation via four-wave mixing from a silicon-on-insulator microring resonator. We also provide design principles for such a microring resonator through extensive numerical simulations.

CWEA4 • 13:30
Tunable Terahertz 3D Metamaterials, Kelvin Fan¹, Andrew C. Strikwerda¹, Xin Zhang¹, Richard D. Averitt¹; ¹Boston Univ., USA. We present novel optically tunable 3D metamaterials operating at terahertz frequencies with an approximate tuning range of 50%. Our device has potential applications as a terahertz modulator or switch that complements previous approaches.

CWEA5 • 13:45
Ultra-high resolution all-reflective OCT system with a compact fiber-based supercontinuum source, Kambis Kies¹, Anna Ivanova¹, Justin Klein¹, Jennifer Barton¹, Nasser Peyghambarian¹; ¹Univ. of Arizona, USA. We report an all-reflective OCT (R-OCT) system using a newly developed compact fiber-based broadband supercontinuum source. We achieved an axial resolution of 1.5 μm in tissue at a center wavelength around 1300 nm.

CWEA6 • 14:00
Resonant Transmission of Ring Aperture for Switching Terahertz Waves, Je-Shuei Cyi¹, Shih-Tsong Chi¹, Victoria Astley¹, Daniel Nickel¹, Daniel Mittleman¹; ¹Electrical, Rice Univ., USA. We demonstrated extraordinary THz transmission through ring apertures on metal film. Transmission of 60% was obtained with an aperture-to-area ratio of only 1.4%. Silicon-based electro-optic switch for THz waves can be built with this structure.

CWEA7 • 13:30
FDML laser for megahertz retinal OCT imaging, Thomas Klein¹, Benjamin R. Biedermann², Christoph M. Eigenwillig², Robert Huber²; ²LMU Munich, Germany. A novel Fourier-domain mode locked (FDML) laser design is presented, yielding the highest wavelength sweep speed reported so far around 1050 nm. This enables retinal imaging over a ~70° ultra-wide field of view.

CWEA8 • 13:45
Towards a Miniaturized Optical Coherence Tomography System, Jurien R. Akka¹, Duc V. Tran¹, Ali Asghar Eftekhar¹, Ali Abdi¹; ¹ECE, Georgia Inst. of Technology, USA; ²Academic Medical Center, Biomedical Engineering & Physics, Univ. of Amsterdam, Netherlands; ³Integrated Optical Microsystems Group, MESA+ Inst. for Nanotechnology, Univ. of Twente, Netherlands; ⁴Academic Medical Center, Biomedical Engineering & Physics, Univ. of Amsterdam, Netherlands; ⁵Biomedical Photonic Imaging, MIRA Inst. for Biomedical Technology & Technical Medicine, Univ. of Twente, Netherlands. We present experimental results of a spectral-domain optical coherence tomography system that includes an integrated spectrometer. A depth range of 1 mm and axial resolution of 22 μm was measured. A Scotch tape was imaged.

CWEA9 • 14:00
From Analog to Digital Conversion to Blood Screening: Evolution of Photonic Time Stretch, Bahram Jalali¹,², Keisuke Goda¹, Ali Fard¹, Sang Hyup Kim¹; ¹Electrical Engineering, Univ. of California at Los Angeles, USA; ²California Nano-Systems Inst., Univ. of California at Los Angeles, USA; ³Department of Surgery, Univ. of California at Los Angeles, USA. We show how the ability to slow down, amplify, and capture fast transient events can produce high-throughput real-time instruments ranging from digitizers to imaging flow cytometers.
Room 315

CLEO: Science & Innovations

13:30–15:15
CWD • Symposium on Fiber Parametric Devices and Applications I: Telecom Applications
Robert Jopson, Bell Labs, Alcatel-Lucent USA, Presider

CWD1 • 13:30
Invited
Progress in Phase-Sensitive Fiber-Optic Parametric Amplifiers and Their Applications, Peter Andrekson1,2; 1Department of Microtechnology and Nanoscience, Chalmers Univ. of Technology, Sweden; 2EXFO Sweden AB, Sweden. We review some fundamental and practical aspects of fiber-optic parametric amplifiers and their applications. In particular, their unique phase-sensitive amplification ability along with the corresponding ultralow noise figure will be discussed.

CWD2 • 14:00
Invited
All-optical regeneration based on phase-sensitive amplification, Radan Slavik1, Joseph Kakande1, Francesca Parmigiani2, David J. Richardson1; 1Univ. of Southampton, UK. We review recent results regarding regeneration of binary and quadruple phase encoded signals using phase sensitive amplification in fibers.

Room 316

CLEO: QELS-Fundamental Science

13:30–15:15
QWB • Quantum Computing and Metrology with Cold Matter
Daniel Steck, Univ. of Oregon, USA, Presider

QWB1 • 13:30
Tutorial
Ultracold Molecules: Production Techniques and Scientific Applications, David DeMille1,2; 1Physics Department, Yale Univ., USA. Cooling and trapping of diatomic molecules is now possible. Their vibrational and rotational degrees of freedom provide new tools to address problems in fields ranging from quantum computing and simulation, to particle physics.

QWB2 • 13:45
Tutorial
Laser Fabrication of 3D Microenvironments for Small Cellular Populations, Jason M. Eaton1, Camela De Marco2, Stefano Rampini3, Rebecca Martinez Vázquez4, Giulio Cerullo1, Roberta Ramponi1, Stefano Turri2, Marinella Levi1, Roberto Ovelame1; 1Inst. for Photonics and Nanotechnologies - CNR, Milano, Italy; 2Giulio Natta Dept. of Chemistry, Politecnico di Milano, Milano, Italy; 3Dept. of Physics, Politecnico di Milano, Milano, Italy. Femtosecond laser patterning and replication of PMMA for spatially tailored wettability in microfluidic channels, Shane M. Eaton1, Camela De Marco2, Stefano Rampini3, Rebecca Martinez Vázquez4, Giulio Cerullo1, Roberta Ramponi1, Stefano Turri2, Marinella Levi1, Roberto Ovelame1; 1Inst. for Photonics and Nanotechnologies - CNR, Milano, Italy; 2Giulio Natta Dept. of Chemistry, Politecnico di Milano, Milano, Italy; 3Dept. of Physics, Politecnico di Milano, Milano, Italy. Femtosecond laser ablation caused PMMA surfaces to become hydrophobic due to the submicron-scale porosity of the ablated surface. Laser-machined zones of altered wettability were accurately replicated using a solvent-resistant mold.

Room 317

CLEO: Science & Innovations

13:30–15:15
CWE • Laser Fabrication for Life Science Applications
Richard Haglund, Vanderbilt Univ., USA, Presider

CWE1 • 13:30
Tutorial
Laser Control of Self-organization Process in Microscopic Region, Yukinasa Matsumura1, Wataru Inami2, Yoshihisa Kawai3; 1Graduate School of Science and Technology, Shizuoka Univ., Japan; 2Division of Global Research Leaders, Shizuoka Univ., Japan; 3Japan Science and Technology Agency, CREST, Japan. We present a controlling technique of microporous structure by laser irradiation during self-organization process. This method is expected that application for photonic crystals, biological cell culturing, and electronics fields, etc.

CWE2 • 14:00
Tutorial
Laser Fabrication of 3D Microenvironments for Small Cellular Populations, Jason M. Eaton1, Camela De Marco2, Stefano Rampini3, Rebecca Martinez Vázquez4, Giulio Cerullo1, Roberta Ramponi1, Stefano Turri2, Marinella Levi1, Roberto Ovelame1; 1Inst. for Photonics and Nanotechnologies - CNR, Milano, Italy; 2Giulio Natta Dept. of Chemistry, Politecnico di Milano, Milano, Italy; 3Dept. of Physics, Politecnico di Milano, Milano, Italy. Femtosecond laser patterning and replication of PMMA for spatially tailored wettability in microfluidic channels, Shane M. Eaton1, Camela De Marco2, Stefano Rampini3, Rebecca Martinez Vázquez4, Giulio Cerullo1, Roberta Ramponi1, Stefano Turri2, Marinella Levi1, Roberto Ovelame1; 1Inst. for Photonics and Nanotechnologies - CNR, Milano, Italy; 2Giulio Natta Dept. of Chemistry, Politecnico di Milano, Milano, Italy; 3Dept. of Physics, Politecnico di Milano, Milano, Italy. Femtosecond laser ablation caused PMMA surfaces to become hydrophobic due to the submicron-scale porosity of the ablated surface. Laser-machined zones of altered wettability were accurately replicated using a solvent-resistant mold.

Wednesday, 4 May

Concurrent sessions are grouped across four pages. Please review all four pages for complete session information. 135
Unidirectional emission of a quantum dot coupled to an optical nanosensor, Niek F. van Hulst1, 2; 1ICFO - Inst. of Photonic Sciences, Spain. We show unidirectional emission of a single Q-dot by coupling to a nanofabricated Yagi-Uda antenna. The Q-dot drives the resonant feed element and 82% of the Q-dot emission is emitted in a 12° HWID angle.

We present an analytical model of “coupled modes” describing enhancement of emission by the atoms and molecules placed within complexes of metal nanoparticles. Greg Sun1, Jacob B. Khurgin2; 1Physics, Univ. of Massachusetts Boston, USA; 2Elec-

Optical Characterization of Semipolar GaN Light-Emitting Diodes on Sapphire, Benjamin Leung1, Yu Zhang1, Qian Sun1, Christopher Terrien1, Zhen Chen1, Steve Lester1, Kwan-Yung Luo1, Yun-Li Li2, Jung Han1; Yale Univ., USA; 2Bridgelux, Inc., USA. 11-22) GaN light-emitting diodes are grown on sapphire substrates by orientation controlled epitaxy. Optical emission properties are investigated, and narrow linewidth emission is shown for devices on this low dislocation density template.

Highly efficient InGaN/GaN blue LED grown on Si (111) substrate, Jun-Youn Kim1, Yongjo Tak1, Jae Won Lee1, Hyun-Gi Hong1, Sahee Chae1, Hyojin Choi1, Bokki Moon1, Youngga Park1, Min-Ho Kim1, Seonguk Lee1, Namgoog Cha2, Yoonhe Shin1, Jong-Boel Kim1, Jong-In Shin1; Samsung electronic company, Republic of Korea. Highly efficient InGaN/GaN LEDs grown on 4-inch silicon substrates comparable to those on sapphire substrates have been successfully demonstrated. At 350 mA, the output power of 1x1 mm² LED chips exceeded 420 mW under un-encapsulated condition.

Highly efficient InGaN/GaN blue LED grown on Si (111) substrate, Jun-Youn Kim1, Yongjo Tak1, Jae Won Lee1, Hyun-Gi Hong1, Sahee Chae1, Hyojin Choi1, Bokki Moon1, Youngga Park1, Min-Ho Kim1, Seonguk Lee1, Namgoog Cha2, Yoonhe Shin1, Jong-Boel Kim1, Jong-In Shin1; Samsung electronic company, Republic of Korea. Highly efficient InGaN/GaN LEDs grown on 4-inch silicon substrates comparable to those on sapphire substrates have been successfully demonstrated. At 350 mA, the output power of 1x1 mm² LED chips exceeded 420 mW under un-encapsulated condition.

Characterization of a High-Contrast Front End Prototype for the Omega EP Laser Facility, Christophe Dorrer1; 1Laboratory for Laser Energetics, USA. The temporal and spectral properties of a high-contrast front-end prototype developed for the OmegAf EA chirped pulse amplification system are described. A hundredfold contrast improvement and improved beam quality are obtained.

High Temporal Contrast Front End with a multistage Ti:Sa amplifier and a CaF₂-based XPW temporal filter, Mikhail Kalashnikov1, Karsky Orsay3, Roman Volkov4, Horst Schnimmel1, Wolfgang Sandner1; Max-Born-Institut; Germany; 3Univ.

High Temporal Contrast Front End with a multistage Ti:Sa amplifier and a CaF₂-based XPW temporal filter, Mikhail Kalashnikov1, Karsky Orsay3, Roman Volkov4, Horst Schnimmel1, Wolfgang Sandner1; Max-Born-Institut; Germany; 3Univ. of Szeged, Hungary; 4M.V. Lomonosov Moscow State Univ., Russia Federation. A laser system applying spectrally-shaped multistage amplifier and crosstalk wave generation produces pulses with 80 nm bandwidth at 0.1 mJ energy level, while the temporal contrast of the amplified 100 TW pulses exceeds 5.10⁻¹⁰.

Experimental Implementation of Classical Far-Field Phase-Sensitive Ghost Imaging, Dheera Venkataraman1, Nicholas D. Hardy1, Franco Wong1, Jeffrey H. Shapiro2; 1Physical Measurement Laboratory, National Inst. of Standards and Technology, USA. We demonstrate for the first time far-field ghost imaging with phase-sensitive classical light whose anti-phase correlation between the signal and reference beams is imposed by two spatial light modulators.
High-fidelity Frontend Based on XPW Filter for High-contrast Few-cycle OCPAs, Aurélie Jullier1, Aurélien Ricci2, Xiaowei Chen1, Jean-Philippe Roussaux1, Rodrigo Lopez-Martens1, Lourdes P. Ramírez1, Dimitris Papadopoulos4, Alain Pellegri1, Patrick Georges1, Frederic Druon1; 1ENSTA-CNRS-Ecole Polytechnique, Laboratoire d’Optique Appliquée, France; 2Thales Optonique SA, France; 3Institut de la Lumière Extrême, France; 4Laboratoire Charles Fabry de l’Institut d’Optique, France. We demonstrate a 80µJ, 5fs, CEPlable injector with high spectro-temporal quality. The device relies on post-compression in a hollow-core fiber followed by XPW filtering and is an ideal seed for high-power high-contrast OCPA systems.

Large-Strain-Induced Conductivity Anisotropy in VO2. Our findings indicate three distinct lifetimes corresponding to insulating, metallic and one at the phase-transition onset.

Effect of Phase-Transforming Medium on Coherent Electron Dynamics in Gold Nanoantennas, Kannattasan Appavoo1,2, Richard F. Haglund1,2; 1Physics and Astronomy, Vanderbilt Univ., USA; 2Inst. of Nanoscale Science and Engineering, Univ. of Virginia, USA. We probe the coherent plasmon dephasing time (T2) in gold nanostructures while thermally modulating the surrounding VO2. Our findings suggest three distinct lifetimes corresponding to insulating, metallic and one at the phase-transition onset.

Conductivity of highly strained (100)VO2 thin films is observed in both the metallic conductivity and the metal-insulator transition temperature.
Room 318-320

CLEO: QELS - Fundamental Science

QWA4 • 14:15 Quantum Optics of Spontaneous Four-Wave Mixing in a Silicon Nitride Microring Resonator, L. G. Hei1, Marco Lucchini1, Alessandro Fara2, Stéphane Clemmen3, Viok Venkataraman4, Jacob S. Levy5, Michal Lipson1, Alexander L. Gaeta1, J. E. Sipe1; Department of Physics, Univ. of Toronto, Canada; Department of Physics "A. Volta", Univ. of Pavia, Italy; School of Electrical and Computer Engineering, Cornell Univ., USA; School of Applied and Engineering Physics, Cornell Univ., USA. By varying the width of an exciting pump pulse, very efficient generation of photon pairs, ranging from anti-correlated to uncorrelated, is possible in existing Si3N4, microring resonators.

QWA5 • 14:30 High-Performance Entangled Photon Pair Generation in Bragg Reflection Waveguides, Sergei V. Zhukovsky1, L. G. Hei1, Payam Abolhasem2, Dongcui Kang2, J. E. Sipe1, Ann S. Helmy1, Martin Ihonen1; Dept. of Physics, Univ. of Toronto, Canada; Dept. of Electrical and Computer Engineering, Univ. of Toronto, Canada. Entangled photon pair generation by SPDC in Bragg reflection waveguides is theoretically investigated. Enhanced nonlinear interaction through tight mode confinement in the waveguide results in pair generation rate up to 4x10^6 pairs/s/mW/nm.

QWB6 • 14:45 Non-Contact Human Cardiac Activity Monitoring Using a High Sensitivity Pulsed Laser Vibrometer, Chen-Chia Wang1, Sudhir Tiwedi2, Susan Katcher1, Ponciano Rodriguez3, Feng Jin4, V. Swamnithana1, Sheila Nagani1, Shafik Quoos1; Biomate Corp., USA; US Army, USA; NASA Langley Research Center, USA. We demonstrate the use of a high sensitivity pulsed laser vibrometer to determine remotely the detailed, time-phased mechanical workings of various parts of the human heart. Results are validated by electrocardiography and accelerometer readings.

Room 321-323

CLEO: Science & Innovations

CWA4 • 14:15 Bending Terahertz Beams in "Free Space", Rajind Mendis1, Jinhui Liu1, Daniel Mittmann1, 'Electrical & Computer Engineering, Rice Univ., USA. We demonstrate terahertz beam bending in the free-space region created between two metallic plates. This is achieved by realizing a non-uniform distribution of the effective refractive index, causing empty space to mimic an inhomogeneous dielectric.

CWA5 • 14:30 Motion compensation for two photon microscopy by optical coherence tomography feedback, Serghei Malliar4; Johns Hopkins Univ., USA. Active motion compensation using a Fourier-domain optical coherent tomography as a distance sensor of a two-photon microscope has been implemented. It demonstrated good feasibility and corrected the images under the sample motion in the z-direction.

CWB6 • 14:45 Wavelength Tracking with Thermally Controlled Silicon Ring Resonators, Lin-Wen Luo1, Gustavo Wiederhecker1; Kyle Preston1, Michal Lipson1,2; Cornell Univ., USA; Karl J. Urschel Inst. at Cornell for Nanoscale Science, USA. We demonstrate feedback controlling of the resonant wavelength of a silicon dual-ring resonator. The feedback signal is the difference in optical scattering from the two rings, and the controlling mechanism is based on thermo-optic tuning.

Room 324-326

CLEO: Dynamic Microsystems—Continued

CWA4 • THz Plasmonics—Continued

CWB4 • 14:15 Concurrent Multi-scale Imaging Combining Optical Coherence Tomography with MRI, Chia-Pin Liang1, Bo Yang1, Alan McMillan1, Rao Gullapalli1, Jaydev P. Desai2, Yu Chen3; Univ. of Maryland, College Park, USA; Diagnostic Radiology, Univ. of Maryland School of Medicine, USA. We developed a novel platform based on teleoperated robot to perform high resolution optical coherence tomography imaging under MR guidance. The feasibility of real-time multi-scale imaging is demonstrated on a tissue phantom of breast tumor.

Room 314

CLEO: QELS - Fundamental Science

QWA6 • 15:00 Characterization of high purity, pulsed squeezed light at telecom wavelengths from pp-KTP for quantum information applications, Thomas Gerhitz1, Burn Bier1, Martin Stevens1, Bruce Calkins1, Adriana Libisch1, Claudio Grazz1, Emanuel Knoll1, Sue Wise1, Richard P. Mirin1, Randy Bartels1,2; Electrical, Computer Engineering, Oklahoma State Univ., USA. We report photon-pair generation at the 1.5-micron telecom band via continuous-wave Type II Parametric Downconversion in a Poled Fiber, Eric Y. Zhu1, Edward A. Lee-Kim Koon1, Li Qiao1, L. G. Hei1, Marco Lucchini1, J. E. Sipe1, Can Tankut Corbari1; Albert Canaguier1, Martin Ihonen1; Peter Kazantzidis1; Dept. of Electrical & Computer Engineering, Univ. of Toronto, Canada; Dept. of Physics, Univ. of Toronto, Canada; Dep. of Physics, Italy; Optoelectronics Research Centre, Univ. of Southampton, UK; School of Physics, Univ. of Sydney, Australia. We report photon-pair generation at the 1.5-micron telecom band via continuous-wave Type II parametric downconversion in a birefringent periodically-poled silica fiber. The time- and polarization-correlations of the downconverted light are examined.

QWA7 • 15:00 Observation of frequency shift in a dynamically designed silicon ring resonator by compensating the thermo-optic red shift with a strong free carrier dispersion blue shift, Rajind Mendis1, Martin Ihonen1, Marta Letizia2,1, J. E. Sipe1, Ann S. Helmy1, Martin Ihonen1, Peter Kazantzidis1; Dept. of Electrical & Computer Engineering, Univ. of Toronto, Canada; Dept. of Physics, Univ. of Toronto, Canada; Department of Physics at "A. Volta", Univ. of Pavia, Italy; Optoelectronics Research Centre, Univ. of Southampton, UK; School of Physics, Univ. of Sydney, Australia. We report photon-pair generation at the 1.5-micron telecom band via continuous-wave Type II parametric downconversion in a birefringent periodically-poled silica fiber. The time- and polarization-correlations of the downconverted light are examined.
Room 315
CLEO: Science & Innovations

CWD • Symposium on Fiber Parametric Devices and Applications I: Telecom Applications—Continued

CWD3 • 14:30  Invited

Optical Parametric Regeneration for Phase-Modulated Signals, Masayuki Matsumoto; Graduate School of Engineering, Osaka Univ., Japan. All-optical signal regeneration using four-wave mixing in fibers is discussed. An experiment of nonlinear phase noise reduction of DQPSK signals by a phase-preserving amplitude limiter using saturated fiber-optic parametric amplifier is described.

Room 316
CLEO: QELS-Fundamental Science

QWB • Quantum Computing and Metrology with Cold Matter—Continued

QWB2 • 14:30

Spectroscopy of Rydberg Atoms in a Ponderomotive Optical Lattice, Sarah E. Anderson, Kelly C. Young, Georg Raithel; Physics, Univ. of Michigan, USA. Microwave spectroscopy is employed to study trapping of highly excited Rydberg atoms in continuous-wave optical lattices. A trapping efficiency of up to 50% is observed. Applications in quantum information processing and precision measurement are discussed.

Room 317
CLEO: Science & Innovations

CWE • Laser Fabrication for Life Science Applications—Continued

CWE4 • 15:00

Laser immobilization of photosynthetic material on Screen Printed Electrodes, Christos Boutopoulos, Eleftherios Touloupakis, Ittalo Pezzotti, Maria T. Giardi; Physics Department, National Technical Univ. of Athens, Greece; National Research Council, Inst. of Crystallography, Italy; Biosensor srl, Italy. This work presents the direct laser printing of thylakoid membranes for the fabrication of photosynthetic-based amperometric biosensors. Both immobilization and activity of the photosynthetic material were confirmed by high photocurrent signals.

14:30–16:30 Market Focus: Challenges of Laser Products and Markets, Exhibit Hall F, 100 Level

15:15–16:45 Coffee Break and Unopposed Exhibit-Only Time, Exhibit Hall, 100 Level
First Observation of Raman Scattering Emission from Silicon High-Q Photonic Crystal Nanocavities, Yasutoshi Takahashi, Boyo Terawaki, Masahiro Chihara, Takahisa Asano, Susumu Noda; NanoSquare, Osaka Prefecture Univ., Japan; ‘Electronic Science and Engineering, Kyoto Univ., Japan. We report the first observation of spontaneous Raman scattering in silicon nanocavities with high quality factors. Stacked Raman scattering enhanced by the Q factor was spectrally measured by UV pumping.

Raman-Antenna Formed by Molecular/Plasmonic Nanostructure Hybrid System, ShuSATh Chen, Jack J. Mock, Ryan T. Hill, Ashutosh Chilkoti; 1Center for Nanostructure Hybrid System, 2Sloan Yeh Chen, 3Institute of Electro-Optical Engineering, National Chiao-Tung Univ., Taiwan; 4Graduate School of Information Science and Technology, Osaka Univ., Japan. A nano-antenna composed of a particle and a polarizable surface provides control of the spatial distribution and high enhancement of Raman scattering. This structure may serve as a stable platform for single molecule detection.

Enhancement from Nanohole Arrays, Polarisations in Excitation and Spontaneous Raman Scattering, Kay Fung Chan, Hock Chun Ong; ‘Physics, The Chinese Univ. of Hong Kong, Hong Kong. Angle-resolved photoluminescence spectroscopy and excitation spectroscopy have been used to differentiate the roles of various surface plasmon polariton modes in the emission enhancement from organic dyes coated with two-dimensional metallic arrays.

Monochromatic Organic Photodiodes Made by Stackable Ink-Jet Fabrication for Integrated Laser Chips, Toksama Nakamura, Yu Yang, Soichiro Miyazaki, Takuji Hashimoto, Hironori Watanabe, Masayuki Yahiro, Masanori Eto, Yuji Oku; ‘Graduate School of Information Science and Electrical Engineering, Kyushu Univ., Japan; ‘Institut de Systemes, Information Technologies and Nanotechnologies, Japan; ‘Department of Chemistry and Applied Chemistry, Faculty of Science and Engineering, Saga Univ., Japan. Organic photodiodes were made by ink-jet method based on the J-aggregated cyanine dye films. The radiation sensitivity and spectral resolution were improved significantly by approaches, including the realization of integrated flow-cytometry chips.

Ultra-Broadband Chip Linearity Characterization from a Seeded Frequency-Shifted Feedback Ti:Sapphire Laser, Matthias F. Brandl, Oliver D. Muecke; Photonics Inst., Vienna Univ. of Technology, Austria; ‘Institut fuer Elektrodynamics, Microwave and Circuit Engineering, Vienna Univ. of Technology, Austria. We study the coherence properties of a narrow-linewidth chirped frequency comb from a frequency-shifted feedback laser seeded by a phase-modulated sub-kHz-linewidth single-frequency fiber laser. A length-dependent, ~20 Hz wide RF beat is observed.

Characterization—Continued

Extreme ultraviolet free electron laser seeded by high-order harmonic, Takashi Tomizawa, Eiji Takahashi, Katsushi Midorikawa, Makoto Aoyama, Hisakazu Yamakawa, Takahiro Sato, Atsuji Ishikawa, Seiji Ohsawa, Tomoyo Okima, Kazuo Yamanouchi, Marie E. Coupris, Teru Hara, Noritaka Kumagai, Shinichi Matubu, Mitsuru Nagasawa, Takahiro Ohshima, Yui Otake, Tsumaru Shimizu, Hirotake Tanaka, Takashi Tanaka, Kazuaki Toyogawa, Hirofumi Tomizawa, Takahiro Watanabe, Makina Takahashi, Tetsuya Ishikawa; ‘FZEL Project Head Office, Riken, Japan; ‘Japan Synchrotron Radiation Research Inst., Japan; ‘Advanced Science Inst., Japan; ‘Quantum Beam Science Directorate, Riken Atomic Energy Agency, Japan; ‘The Univ. of Tokyo, Japan; ‘Synchrotron SOLEIL, France. We first generated seeded FEL radiation in the EUV region at 61.2 nm with the 13th harmonic of a Ti:sapphire laser. We observed single-pulse spectra with drastic enhancements of intensity by nearly three orders of magnitude.

Multi-Mechanism Kerr Nonlinearities from a Ti:Sapphire Laser, Assion1; 1Femtolasers Produktions GmbH, Austria. We demonstrate 12-ps multi-mJ few-cycle pulses with 50-MW peak power from a Nd:YVO4 slab amplifier. The amplifier is seeded at repetition rates of 50 MHz and 100 kHz and produces output energies of up to 680 µJ.

To a few-cycle pulse with 50-MW peak power from a Nd:YVO4 slab amplifier, the amplifier is seeded at repetition rates of 50 MHz and 100 kHz and produces output energies of up to 680 µJ.

High Intensity and Short Pulse—Continued
Mid-IR Few-Cycle Pulses Approaching a 0.1 TW Peak Power, Giedrius Balciunas1,2, Igor Dzian1,2, Andreas Pugzlys1,2, Tadas Balčiūnas1,2, Werner Wurfel1,2, Zdenek Kjiračák1,2, Dominik Wimmer1,2, Thomas Zentgraf1,2, Helmut Wereley1,2, Christian M. J. Bacon1,2, Peter J. W. Bauknecht1,2, and Alexander D. Y. I. Lam1,2

We demonstrate a compact 200-Hz-repetition-rate mid-IR OPCPA for application in high-field science which operates at 5900 nm with a FWHM bandwidth of 600 nm delivering 6-mJ pulses compressed to 75±10 fs (<3900 nm) and 80±10 fs (>3900 nm) with a spectral phase error of 15 mrad per octave. The spectrum of isolated ultrashort pulse is smooth and suitable for spectroscopic applications in the mid-IR range. The performance has been cross-calibrated with a conventional f-to-2f interferometer with an accuracy of 70 mrad. The ground state and build-up of a new order paramagnetic Manganite, which shows the establishment of a thermally-inaccessible, hidden ferromagnetic order within 180 fs. We report on terahertz frequency ME phenomena such as electromagnon in multiferroics and exotic Hall effect.

We experimentally demonstrate the optomechanical self-channelling of light in free-space, using a nanostructured surface as a transducer. We investigate the thermo-optical effects on the transduction of the mechanical motion of a microspherical pendulum evanescently coupled to a tapered optical fiber. Pendulum motion of 1-2 nm is determined by forced gap and frequency modulation.

We design a grism compressor based on Bragg transmission gratings and high index prisms. Single-pass throughput of ~76% over 740-840 nm with large negative third order dispersion matchable to bulk stretcher dispersion is demonstrated.

We report a pump threshold behavior of fs photoinduced magnetization enhancement in manganite, which shows the establishment of a thermally-inaccessible, hidden ferromagnetic ground state and build-up of a new order parameter within 180 fs.

We investigate the thermo-optical effects on the transduction of the mechanical motion of a microspherical pendulum evanescently coupled to a tapered optical fiber. Pendulum motion of 1-2 nm is determined by forced gap and frequency modulation.

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Sander L. Jansen received his Ph.D. degree (with highest honors) in electrical engineering from the Eindhoven, Univ. of Technology. From 2006 to 2008 he was a research engineer at KDDI R&D Laboratories in Japan where he specialized in OFDM for fiber-optic transmission systems. Since June 2008 he is with Nokia Siemens Networks in Munich, Germany. His research interests range from modulation formats and coherent detection to wavelength selective switching and dynamic optical networks. Dr. Jansen holds several U.S.-registered patents and has authored more than 100 peer-reviewed journals and conference contributions. He is an associate editor for the PTL and a technical committee member of the OFC. He has received several awards including the Young Investigator award from the IEEE Photonics Society "for pioneering contributions in optical OFDM for fiber-optic transmission systems".

Richard Averitt received his Ph.D degree in Applied Physics from Rice Univ. in 1998 for the synthesis and optical characterization of gold nanoshells. Following this, Richard was a Los Alamos Director's Postdoctoral Fellow and staff scientist. In 2007, Richard joined Boston Univ. as a faculty member in the Department of Physics and Boston Univ. Photonics Center. Richard’s research interests are directed towards characterizing the optical and electronic properties of materials including metamaterial and plasmonic composites, transition metal oxides, and correlated electron materials using experimental techniques which span from the far-infrared through the visible.

Thermal Tuned Dual 20-Channel Ring Resonator Filter Bank in SOI (Silicon-on-Insulator), Steven Spector1, Anatol Khilo2, Michael Peng1, Franz X. Kärtner2, Theodore Lysczarz1; 1Chemical, Biological and Nanotechnologies Group, MIT Lincoln Laboratory, USA; 2Electrical Eng & Computer Sci, MIT, USA. Two 20-channel second-order optical filter banks have been fabricated. With tuning, the requirements for a wavelength-multiplexed photonic AD-converter (insertion loss ~1-3 dB, extinction >30 dB and optical bandwidth 22-27 GHz) are met.

Statistics of photon transport in hundreds of coupled resonators, Michael L. Cooper1, Greeshma Gupta1, Mark A. Schneider1, Trinam Shri1, William M. Green1, Solomon Asefa1, Fengnian Xia2, Yurii A. Vlasov2, Shayan Mookherjea1; 1Electrical and Computer Engineering, Univ. of Illinois, USA. Photonic crystal biosensors are used for quantifying cell attachment to surfaces for applications such as pPCR, nanoscale screening and life science research.

The field of terahertz (THz) metamaterials is approximately six years old. I will overview recent developments in the design, fabrication, and characterization of metamaterials and discuss new opportunities which may help fill the ever shrinking THz gap and are, further, of fundamental interest.

Optical and electronic properties of materials in-cluding metamaterial and plasmonic composites, transition metal oxides, and correlated electron materials using experimental techniques which span from the far-infrared through the visible.

Advances in Modulation Formats for Fiber-Optic Transmission Systems, Sander L. Jansen1, Dirk van den Borne1, Maxim Kuschnerov1; ‘Nokia Siemens Networks, Germany. Abstract not available.

Invited
 Terahertz Metamaterials: Recent Developments and New Opportunities, Richard D. Averitt1; ’Physics, Boston Univ., USA. The field of terahertz metamaterials is approximately six years old. I will overview recent developments in the design, fabrication, and characterization of metamaterials and discuss new opportunities which may help fill the ever shrinking THz gap and are, further, of fundamental interest.

Opto-fluidic Detection Platform for Pathogen Detection in Water, Peter Kiesel1, Jordi Martí1, Malte Huck2, Marshall Bern1, Noble Johnson1; 1Palo Alto Research Center, USA. We prototyped a compact micro-fluidic based flow cytometer for pathogen detection in water. The system uses a pin-photodiode for detection and yielded a detection limit of ~200 MEFP, sufficient to reliably identify and count specifically-tagged pathogens.

Cell-Based Assays Using Photonic Crystal Biosensors, Brian T. Cunningham1; 1Electrical and Computer Engineering, Univ. of Illinois, USA. Photonic crystal biosensors are used for quantifying cell attachment to surfaces for applications such as pPCR, nanoscale screening and life science research.

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CWL1 • 16:45
Invited
Advances in Modulation Formats for Fiber-Optic Transmission Systems, Sander L. Jansen1, Dirk van den Borne1, Maxim Kuschnerov1; ‘Nokia Siemens Networks, Germany. Abstract not available.
Andrew M. Weiner; Electrical and Computer Research Centre, Univ. of Southampton, UK.

Recent Advances in Fiber Optic Parametric Amplifiers, J.D. Harvey, S.G. Murdoch, Y. Q. Xu, R. Lenthall; Univ. of Auckland, New Zealand. This paper discusses recent experiments demonstrating dramatic improvements in the tunability and power output of fiber optical parametric amplifiers constructed utilizing both conventional fibers and photonic crystal fibers.

Electrical and Computer Research Centre, Univ. of Southampton, UK.

We report on an all-fiber PCF-based optical

Synthesis of Materials by Ultrafast Microexplosion, Saulius Juodkazis, Arturas Valiūnaitis, Eugene Gamaly, Vygasntas Micevicius, Wenge Yang, Andrei Rode; Geballe Laboratory for Advanced Materials, Stanford Univ., USA; Stanford Inst. for Materials and Energy Sciences, SLAC National Accelerator Laboratory, USA; Division of Global Research Leaders, Shizuoka Univ., Japan; HP/Pyrene, Carnegie Institution of Washington, Argonne National Laboratory, USA; Laser Physics Centre, The Australian National Univ., Australia; Centre for Micro-Photonics, Swinburne Univ. of Technology, Australia. Microexplosions triggered by single fs-laser pulses tightly-focused inside crystalline/amorphous host can be used to create high-pressure/density forms of nano-materials via an unconventional synthesis pathway in plasma state.

Femtosecond laser imprinting of nanostructures in glass, Mindaugas Gecevičius, Martynas Beresna, Peter Kazansky; Optoelectronics Research Centre, Univ. of Southampton, UK. We report the synthesis of high-index contrast materials using ultrafast laser pulses and femtosecond laser nanostructuring in glass.

We report the preparation and storage of frequency-uncorrelated entangled photons from cavity-enhanced SPDC, Xian-min Jin, Jian Yang, Xian-min Jin, Jian Yang, Jun Rui, Yu He, Xiao Jiang, Fan Yang, Ge-Sheng Liu; Institute for Theoretical Physics, University of Science and Technology of China, Hefei; Joint Quantum Inst., NIST, USA; Joint Quantum Inst., Shizuoka Univ., Japan; JILA, Univ. of Colorado/NCAR, USA. We report the preparation and storage of frequency-uncorrelated cavity-enhanced SPDC entangled photons. The frequency correlation is eliminated with pulsed pump. The storage of a single photon entangled with another flying photon is demonstrated.

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Polarization vortex converter imprinted by femtosecond laser nanostructuring in glass, Martynas Beresna, Mandagaus Gacevicius, Peter Kazansky; Optoelectronics Research Centre, Univ. of Southampton, UK. A polarization converter by femtosecond laser imprinting of space variant birefringence is demonstrated. Switching from radial to azimuthal polarization with orbital angular momentum is achieved by bandedness control of incident circular polarization.
Optical Bonding And AntiBonding Forces In Asymmetric Geometries For Casimir Force Detection, David N. Woolf1, Pui-Chuen Hui1, Eiji Iwane1, Alejandro Rodriguez2, Alexander McCallay1, Igor Lovchinsky1, Mughees Khan1, Steven G. Johnson1, Marco Lancia2, Federico Capasso2,1 School of Engineering and Applied Science, Harvard University, USA; 2Department of Mathematics, Massachusetts Institute of Technology, USA. The optical bonding (attractive) and antibonding (repulsive) forces between a suspended, holey Silicon membrane and a Silicon-on-Insulator (SOI) substrate are shown to offer a sensitive new method for plane-plane geometry Casimir force detection.

Nanoparticle manipulation using a plasmonic nano-tweezer with an integrated heat sink, Kai Wang1, Ethan Schonbrun2, Paul Steinurzel3,1 School of Engineering and Applied Science, Harvard University, USA; 2Electrical & Computer Engineering, Boston University, USA. Making use of the field enhancement and confinement, and thermal management, of a template-striped localized surface plasmon resonance structure, we experimentally demonstrate the trapping and rotation of 110 nm diameter polystyrene nanoparticles.

High-power LED Lighting and Solid State Lighting, Werner Goertz1, 2Philips Lumileds Lighting Company, USA. The rapid adoption of LEDs in general illumination is fueled by high-power phosphor conversion and direct color light and red LED technology. Over the last several years technology development has boosted the efficacy of white high-power LEDs to greater than 100 lm/W even for devices with warm-white correlated color temperature and high color rendering index at operating conditions. In combination with advances in production cost reduction, LED-based luminaires are winning the battle against their conventional counterparts in applications where their energy efficiency, long life, and ruggedness lead to a cost of ownership advantage. This presentation will provide an overview of high-power LED technology, applications, and discuss challenges for future efficacy improvement and cost reduction.

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Optical Forces for Fundamental Science and Technologies, USA; 3Center for Atomic, Molecular, Optical, and Optical Sciences, University of Colorado at Boulder, USA; 4Department of Astronomy and Astrophysics, Pennsylvania State University, USA. A 25 GHz frequency comb calibration for comparison of astronomical spectrographs in the 1.4-4.5 μm region is demonstrated with the R=50,000 λ/Δλ Pathfinder spectrograph at the Hobby-Eberly telescope.

Optical Forces for Fundamental Science and Technologies, USA; 3Center for Atomic, Molecular, Optical, and Optical Sciences, University of Colorado at Boulder, USA; 4Department of Astronomy and Astrophysics, Pennsylvania State University, USA. A 25 GHz frequency comb calibration for comparison of astronomical spectrographs in the 1.4-4.5 μm region is demonstrated with the R=50,000 λ/Δλ Pathfinder spectrograph at the Hobby-Eberly telescope.

Superior warm-white light-emitting diodes integrated with quantum dot nanophosphors for high luminous efficacy and color rendering, Sedat Nizamioglu1, Tuilua Endem1, Xiao Wei Sun1, Holmi Volkam Demir1, 2Bilkent University, Turkey; 3National University of Singapore, Singapore; 4University of Twente, Netherlands. Quantum dot nanophosphor hybridized warm-white LEDs are reported to exhibit high photometric performance of luminous efficacy exceeding 350 lm/W and color-rendering index close to 90 at correlated color temperatures <3000 K.

Spatially Resolved Thermal Analysis of High Power LEDs Using Thermoreflectance Imaging, Kadhart Al-hemyari1, Susu Yan1, Joseph A. Sumption1, Leonid Glebov1, Martin Richardson1, 2OptiGrate Corp., USA. We present the first cw and modelocked thin-disk laser based on the broadband resonant material Yb(Sr,Y1−x)3O3. We demonstrated 50 W in cw operation with a slope efficiency >70% and 3.9 W in 236 fs pulses in modelocked operation.

A 25 GHz frequency comb using a 25 GHz Laser Frequency Comb, Gabriel Yass1, Scott Diddams2, Frank Quinlan3, Steve Osterman4, Sasshar Madhavan5, Lawrence Ramsey6, Stephen Redman1, Ryan Byrs7, Terriers1, Physics, University of Colorado at Boulder, USA; 2National Institute of Standards and Technology, USA; 3Center for Astrophysics and Space Astronomy, University of Colorado at Boulder, USA; 4Department of Astronomy and Astrophysics, Pennsylvania State University, USA. A 25 GHz frequency comb calibration for comparison of astronomical spectrographs in the 1.4-4.5 μm region is demonstrated with the R=50,000 λ/Δλ Pathfinder spectrograph at the Hobby-Eberly telescope.

A Yb-fiber based frequency comb with a fundamental repetition rate of 25 GHz, Guoqing Chang1, Chih-Hao Li2, David Phillips3, Ronald Wolters1,4, Franz X. Kaertner1, 2MIT, USA; 3Harvard, USA. We develop an analytic approach to analyze the performance of astro-combs when amplified by a fiber amplifier. Five filtering schemes are compared to optimize side-mode suppression and demonstrate accuracy of calibration of an amplified astro-comb.

Broadband, large-sweeping frequency-comb employing complementary interleavers for mode filtering, Guoqing Chang1, Chih-Hao Li2, David Phillips3, Ronald Wolters1,4, Franz X. Kaertner1, 2MIT, USA; 3Harvard, USA. We propose and analyze an approach to generate broadband large-sweeping frequency-comb using complementary interleavers for mode filtering and nonlinear fibers for spectral broadening. 350 nm bandwidth with negligible side-mode asymmetry is achieved.
16:45–18:30
**CWR • Ultrafast Pulse Generation II**
Charles Durfee, Colorado School of Mines, USA, Presider

**CWR1 • 16:45**
Octave Wide Mid-Infrared Frequency Comb Rigorously Derived From commercial Near-IR Mode-locked Laser, Nick C. Leindecker1, Alireza Marandi2, Robert L. Byer2, Konstantin L. Vodopyanov1, G, Ginzton Laboratory, Stanford Univ., USA. Recent results using a degenerate OPO pumped by a 1560nm ultrastar laser to generate a broadband mid-infrared comb. Dispersion management and FTIR detection techniques access an octave-wide output spectrum extending from 2.0 to 4.0 um.

**CWR2 • 17:00**
Fiber-Optic Cherenkov radiation in the Few-Cycle Regime, Guangming Chang1, Li-Jin Chen1, Franz X. Kaertner1; 1Ginzton Laboratory, Stanford Univ., USA. We demonstrate that fiber-optic Cherenkov radiation in the few-cycle regime exhibits three unique features absent when pumped with long pulses: continuum generation, high conversion efficiency (up to 40%), and broad bandwidth (70–nm).

**CWR3 • 17:15**
1.5 W Output Two-Color Femtosecond Optical Parametric Oscillator Pumped by a 7.4 W Femtosecond Yb:KGW Laser, Robin Hegenbarth1, Andy Strimlan1, John Hettinger2, 1MIT, USA; 2Center for Ultrafast Optical Science, Univ. of Michigan, USA. We report on a 42MHz femtosecond two-color MgO:PLIN OPO pumped by a mode-locked 7.4 W Yb:KGW b laser. Up to 1.5 W average output power and tunability from 1.45 to 1.88 μm have been achieved.

**CWR4 • 17:30**
Pulse Compression and Fiber Delivery of Sub-30 fs Nanofibers Pulses at 830 nm, Claire Lefevre1, Mert Kalafatyan2, Donald Peayt3, Tigran Manoukian2, Levon Mamarian3, Frederic Loundreau4, Alain Barthélémy1; 1XLIM Laboratory, France; 2UMaine Optics Laboratory, Armenia; 3ANBioPhy Laboratory, France. Powerful Sub-30 fs pulses (830 nm) are delivered by 2 meters long standard and LMA fibers despite nonlinearity and dispersion. A “GRISMA” line, accurately compensated second and third orders of dispersion.

16:45–18:30
**QWH • Dynamics in Nanowires, Rods and Tubes**
Edwin Heilweil, NIST, USA, Presider

**QWH1 • 16:45**
THz Acoustic Plasmons in InAs Nanowires, Denis Selskryk1, Michael Hasselbeck1, Chao-Yeh Li2, Jeffrey Cederberg1, Aaron Katzenmeyer1, Maria Toimil-Molares1, Francois Leonard1, Arek Tele1, Mansour ShiekBahae1; 1Univ. of New Mexico, USA; 2Sandia National Laboratories, USA; 3Sandia National Laboratories, USA. The THz radiation spectra of an ensemble of free-standing InAs nanowires exhibits features consistent with the presence of low energy acoustic plasmons. The deduced electron concentration agrees with separate transconductance measurements.

**QWH2 • 17:00**
Ultrafast Optical-Pump THz-Hertz-Probe Spectroscopy of Oriented Ge and Ge/Si Core/Shell Nanowires, Memehel T. Mihene1, Wayne Pang1, Wei Liu1, Theodore B. Norris2; 1Electrical Engineering and Computer Science, Univ. of Michigan, USA; 2“Center for Ultrafast Optical Science, Univ. of Michigan, USA. We study the time- and frequency-dependent THz dynamics of oriented Ge and Ge/Si core/shell nanowires using ultrafast optical-pump THz-probe spectroscopy, and compare their intraband relaxation, interband recombination and momentum scattering times.

**QWH3 • 17:15**
Lasing in ZnO Nanowires is Electron-Hole Plasma Lasing, Marijn A. Versteegh1, Daniel A. Vannakkelbergh1, Jaap I. Dijkhuis1; 1Debye Inst. for Fundamental Physics, Univ. of Pecs, Hungary. We report on a ZnO nanowire laser operated at 830 nm using a femtosecond pump laser. The THz radiation is emitted from the nanowire laser, indicating the presence of plasma lasing. The THz radiation is generated by photoexcitation of the nanowire laser and is detected using THz-TDS.

**QWH4 • 17:30**
Femtosecond excitation of confined acoustic modes in 2-D arrayed GaN nanorods, Hung-Pin Chen1, Yuch-Chun Wu2, Jinn-Kong Sheu1, Chi-Ruang Su1; 1Department of Electrical Engineering and Engineering Technology, National Taiwan Univ., Inst. of Electro-Optical Science and Engineering, Taiwan; 2National Cheng Kung Univ., Inst. of Electro-Optical Science and Engineering, Taiwan. We successfully excited confined acoustic oscillations, which reflect the mechanical properties, in 2-D arrayed GaN nanorods with different diameters. A nano-softening effect was observed when rod diameter was less than 150nm.
We demonstrate a new modulation format based on PolMux DQPSK with duobinary shape. Simulated results show that proposed scheme with narrow bandwidth can achieve higher tolerance to narrowband filtering without posed scheme with narrow bandwidth can achieve higher tolerance to narrowband filtering without four levels. Transmitter predistortion generates an optimized modulation waveform, which requires a receiver bandwidth of only 15 GHz.

We fabricate terahertz metamaterials with negative magnetic permeability by combining fiber drawing and silver sputtering. We experimentally and numerically characterize the transmittance of spooled metamaterial array with different orientations.

We propose surface plasmon polariton driven plasmonic monopole antenna array system for biosensing, nano-spectroscopy and optical trapping. The structure exhibits high refractive index sensitivities, nearfield resolution and optical gradient force.

We fabricate terahertz drawn metamaterial fibers with negative permittivity, probed using a novel enclosure method. We fabricate terahertz metamaterials with negative magnetic permeability by combining fiber drawing and silver sputtering. We experimentally and numerically characterize the transmittance of spooled metamaterial array with different orientations.

We investigate resonant transmission of planar asymmetric metamaterials made from double split-ring resonators. More than 50% amplitude modulation is observed at the fundamental inductive-capacitive resonance due to circular polarization conversion.

We have developed a formalism for designing Bessel filters fabricated using a novel enclosure method. We will show theoretical and experimental data demonstrating a device having 1100 nm/RIU detection sensitivity.

We design active tuning of coupled inductive-capacitive resonance in a multi-layer metamaterial. Our experiment reveals that one resonance mode of a coupled pair can be selectively switched off by driving the metamaterial with infrared light.

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Room 315

CLEO: Science & Innovations

CWN • Symposium on Fiber Parametric Devices and Applications II: Physics and Sources—Continued

CWN4 • 17:45
Parametric replication and sampling of optical fields, Stojan Radic1; ECE, Univ. of California San Diego, USA. New class of optical processors that rely on wideband, net-gain mixers is described. Principle, operation and limitations of copy-and-sample all parametric architectures are briefly outlined.

QWF • Quantum Interface of Light and Matter—Continued

QWF5 • 17:45
Observation of a Red-Blue Detuning Asymmetry in Matter-Wave Superradiance, Lu Deng1, Edward Hagley1, Ruquan Wang1; NIST, USA; Inst. of Physics, Chinese Academy of Science, China. We report the first experimental observation of strong suppression of matter-wave superradiance using blue-detuned pump light and demonstrate a pump-laser detuning asymmetry in the collective atomic recoil motion.

QWF6 • 18:00
Canonical Quantization of Macroscopic Electromagnetism and the Casimir-Lifshitz Effect, Thomas Philbin1; School of Physics and Astronomy, Univ. of St Andrews, UK. General macroscopic electromagnetism is canonically quantized, providing a rigorous quantum theory of light in dispersive, absorptive media. The theory illuminates the issue of electromagnetic energy density and stress in the Casimir-Lifshitz effect.

QWF7 • 18:15
Demonstration of statistical mechanics phase transitions with arrays of thousands of coherent lasers, Eitan Ronen1; Weizmann Inst., Israel. Thousands of coherent lasers are phased locked by global and local coupling in order to demonstrate first and second order phase transitions. The measured and calculated phase distribution reveals similar behavior to XY spin model.

Room 316

CLEO: QELS—Fundamental Science

Room 317

CLEO: Science & Innovations

CWO • Advanced Ultrafast Laser Processing—Continued

CWO4 • 17:45
Materials Processing with Femtosecond Vortex Pulses, Cyril Hnatsovsky1, Vladimir Strel'yan2, Wiesław Królkowski1, Andrzej Rode1; Laser Physics Center, Australian national Univ., Australia; Nonlinear Physics Center, Australian National Univ., Australia. We present the first results on material processing with tightly focused single femtosecond laser vortex pulses. We use double-chARGE femtosecond vortices to produce micron-size ring-shaped structures with c100 nm uniform groove thickness.

CWO5 • 18:00
Spatio-temporally Focused Femtosecond Laser Pulses for Anisotropic Writing in Optically Transparent Materials, Dawn N. Vitek1, Erica Block1, Yves Belloir1, Daniel E. Adams3,4, Sterling Backus5, David Kleinfeld6, Charles G. Durfee1, Jeff A. Squier1; Physics, Colorado School of Mines, USA; Mechanical Engineering, Eindhoven Univ. of Technology, Netherlands; Physics and JILA, Univ. of Colorado at Boulder, USA; National Inst. of Standards and Technology, USA; Kapteyn-Murnane Laboratories, USA; Physics, Univ. of California at San Diego, USA. Simultaneous spatial and temporal focusing provides precise control of the pulse front tilt necessary for anisotropic writing and maintains this behavior over a large range of focal positions and at low numerical aperture and fluence.

CWO6 • 18:15
Femtosecond laser direct fabrication of integrated optical wave plates in fused silica, Luis A. Fernandez1, Jason R. Grenier1, Jin H. Kim1, Peter R. Herman1, J. Stewart Aitchison1, Paulo V. Marques1; Inst. for Optical Sciences, Department of Electrical and Computer Engineering, Univ. of Toronto, Canada; INESC-Porto, Departamento de Fisica e Astronomia da Universidade do Porto, Portugal. Femtosecond laser fabrication of optical waveguides in bulk silica glass is extended to integrated optical waveplates. Polarization retardation was controlled by laser exposure, providing for trimming of waveguide birefringence between 10° and 10°.

Concurrent sessions are grouped across four pages. Please review all four pages for complete session information.
**Electrostatic tuning of optomechanical cavities**

Electrostatic tuning of optomechanical cavities to semiconductor quantum dots, Justin D. Cohen, Sean Meenehan, Oskar Painter, Applied Physics, California Inst. of Technology, USA. The integration of optomechanically coupled photonic crystal cavities to semiconductor quantum dots is studied experimentally and theoretically. Electrostatic tuning results for one- and two-dimensional photonic crystals are presented.

**Photonic crystal dumbbell cavity for low-power devices**

Photonic crystal dumbbell cavity for low-power devices, Remy Braive, Isabelle Sagnes, Olivier Arcizet, Alexios Beveratos, Tobias Kippenberg, Remy Braive, Isabelle Sagnes, 2Laboratoire d’Optique de Paris, France; 3University of Technology of Compiegne, France; 4University of Bordeaux, France. We experimentally investigate the optomechanical properties of a conventional 2D suspended photonic crystal defect cavity. Measuring localized mechanical modes in the GHz regime exhibits high values of the vacuum coupling rate exceeding 250 kHz.

**Energy Efficient Lighting—Continued**

**Vacant-on-Silicon Platform for Improving Heat Conduction in Optoelectronic Packageing**

Vacant-on-Silicon Platform for Improving Heat Conduction in Optoelectronic Packaging, Shao-Chieh Chen, Haiyan Li, Yung-lun Hung, Yen-Ting Pan, San-Liang Lee, Rajeev J. Ram, Department of Electronic Engineering, National Taiwan Univ. of Science and Technology, Taiwan; Research Laboratory of Electronics, Massachusetts Inst. of Technology, USA. Silicon platforms with high-density vertically aligned carbon nanotubes on patterned substrates are designed to provide efficient thermal transfer for optoelectronic chips. 20% increase in output power is obtained, when applying LED packages.

**Thin Disk and Waveguide Laser—Continued**

**Yb:YLF as Active Medium in the Thin Disk Laser**

Yb:YLF as Active Medium in the Thin Disk Laser, Susanne T. Fredrich-Thornton, Kolja Beil, Christian Kränkel, Klaus Petermann, Daniela Parisi, Mauro Tonelli, Günter Huber, Institute of Laser Physics, Germany; NEST-Nanoscience Institute-CNR, Italy. Results of the first Yb:YLF thin disk laser experiments are presented. 5.87 W output power and up to 42% slope efficiency have been obtained under 973 nm pumping using a 30% Yb-doped disk with 200 µm thickness.

**White Light Lighting and Cross-Correlation via Multi-heterodyne Detection with an Optical Comb**

White Light Sampling and Cross-Correlation via Multi-heterodyne Detection with an Optical Comb, Marcus Bagnell, Jesse Davila-Rodríguez, Charles Williams, Peter J. Delfyett, CCRE, The College of Optics and Photonics, Univ. of Central Florida, USA. Multi-heterodyne mixing of an optical frequency comb with white light filtered by a Fabry-Perot etalon is used to measure white light cross-correlations at a distance of 13 meters with a resolution of 10 ps.
The Role of Plasma Formation in Mode-locking of Few-cycle Ti:sapphire Lasers: A Spatiotemporal Model, Li-jin Chen1, Chien Jen Lai2, Franz X. Kaertner3; 1MIT, USA. The spatiotemporal pulse dynamics of few-cycle Ti:sapphire lasers is studied. It is found that in the high-intensity regime, plasma formation in the crystal plays an important role in the mode-locking process and for the laser behavior.

Saturation of the all-optical Kerr effect, Carsten Brix1,2, Gaunter Steinmeyer1, Ayhan Demircan1; 1Weierstrass Inst. for Applied Analysis and Stochastics, Germany; 2Max-Born-Institut, Germany. A Kramers-Kronig transform of MPI rates enables computation of the spectrally dependent nonlinear refractive index change and predicts its intensity dependent saturation and inversion in remarkable agreement with recent experimental results.

Temporal Compression of Ultrafast Optical Filaments by Molecular Quantum Wakes in Atmosphere, Arman Fallahkhair1,2, Anjan Varma1, Howard Mickleberg1, Yu-hsin Chen1; 1Inst. for Research in Electronics and Applied Physics, Univ. of Maryland, USA. An ultrafast pulse filaments in atmosphere, leaving behind a molecular rotational quantum wake. A filamenting probe pulse is injected into the wake and is temporally compressed.

Motional Narrowing of Dysonian Lineshape in Electron Spin Resonance of Single-Walled Carbon Nanotubes, William Rice1, Ralph Weber2, Ashley Leonard3, Ah-Lim Tse1, Sivaram Arvapalli4, Junichiro Kono5; 1ECE, Rice Univ., USA; 2Brookhaven National Lab, USA; 3Chemistry, Rice Univ., USA; 4Univ. of Texas Medical School, Univ. of Texas, USA; 5Energy Science, Sungkyunkwan Univ., Republic of Korea. We performed temperature and power dependent electron spin resonance measurements on single-walled carbon nanotubes. Motional narrowing of the Dysonian lineshape was observed. Saturation behavior was seen at low temperatures and high powers.

Tracking Charge Transfer in Carbon Nanotube Networks with Chirped Pump-Probe Spectroscopy, Daniele Brida1, Dario Polli1, Jared Crochet2, Tobias Hertel3, Guglielmo Lanzani1, Giulio Cerullo1; 1Politecnico di Milano, Italy; 2Los Alamos National Laboratory, USA; 3Universität Würzburg, Germany. We observed an ultrafast charge generation and transfer in a carbon nanotube network by a novel pump-probe spectroscopy that makes use of a broadband and positively chirped pump and transform-limited probe pulses.

Splitting and lasing of whispering gallery modes in quantum dot micropillars, Ben D. Joner1, Mark Oxborrow2, Vasily N. Astratov3, Mark Hopkinson4, Abbas Tabassoun5, Maurice Shatruk6, Mark Fox2; 1Department of Physics and Astronomy, Univ. of Sheffield, UK; 2National Physical Laboratory, UK; 3Department of Physics and Optical Science, Univ. of North Carolina, USA; 4 EPSRC National Centre for III-V Technologies, Univ. of Sheffield, UK. Whispering gallery mode splitting in high quality-factor InAs quantum dot micropillars is observed and attributed to resonant scattering from the dots themselves. Low-threshold multimode lasing with beta-factors approaching unity is demonstrated.

High Sensitivity Optical Refrigeration Spectroscopy: Local Cooling of Yb:YLF Crystal to 110 K, Seth Melgaard1, Denis Svelsky1, Alberto Di Lieto2, Mauro Tonelli3, Mansoor Sheik-Bahae1; 1Univ. of New Mexico, USA; 2Univ. di Pisa, Italy. Utilizing a novel implementation of differential luminescence thermometry we accurately measure laser cooling efficiency spectra of solids. Cooling to 110K is shown in Yb:YLF at the E4-E5 Stark manifold resonance as predicted by theory.

Trapping and manipulating aerosols with optical bottle beams generated by Moiré technique, Peng Zhang1, Ze Zhang1, Jai Prakash1, Simon Huang1, Demetrios Christodoulides2, Zhiqiang Chen3; 1Department of Physics and Astronomy, San Francisco State Univ, USA; 2CREOL/College of Optics, Univ. of Central Florida, USA; 3TEDA Applied Physics School, Nankai Univ., China. We demonstrate optical trapping and manipulation of C60 nano-aerosols with optical bottle beams. This method based on the Moiré technique can be used for trapping a variety of absorbing nano-particles suspended in air.