07:00–17:30 Registration Open, *Baltimore Convention Center, Pratt Street, 300 Level Lobby*

08:00–10:30 Plenary Session II and Awards Ceremony, *Rooms III-IV*

10:00–17:00 Exhibit Open, *Exhibit Hall, 100 Level*

10:30–12:00 Coffee Break and Unopposed Exhibit-Only Time, *Exhibit Hall, 100 Level*

11:00–12:00 Lunch Break *(concessions available in Exhibit Halls E and F, 100 Level)*

11:30–13:30 Market Focus: Energy Session, *Exhibit Hall F, 100 Level*

Exhibit Hall E, 100 Level

JOINT

12:00–13:30
JWA • Towards Applications Joint Poster Session

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

JWA1
25-GHz-channel-spaced DWDM-PON based on ASE injection with reduced filtering effect, *Joon-Young Kim[1], Hoon-Keun Lee[1], Sang-Rok Moon[1], Chang-Hee Lee[1]; [1]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, *Paola Parolari[1,2], Lucia Marazzi[1,2], Davide Gatti[3], Stefano Longhi[3], Mario Martinelli[1]; [1]PoliCom Dept. of Electronics and Information, Politecnico di Milano, Italy; [2]Fondazione Politecnico di Milano, Italy; [3]Dipartimento di Fisica e IFN-CNR, Politecnico di Milano, Italy.* Brillouin scattering effect in a colorless 25-km bidirectional WDM PON is experimentally evaluated. Downstream 10-Gb/s DPSK signal is directly received with a novel FBG, seeding an R-SOA at the ONU, for upstream 1.25-Gb/s OOK transmission.

JWA3
Highly Linear Millimeter-Wave over Fiber Transmitter with Subcarrier Upconversion, *Shangyuan Li[1], Xiaoping Zheng[1], Hanyi Zhang[1], Bingkun Zhou[1]; [1]Tsinghua Univ., China.* By linearized modulation of a heterodyne subcarrier source using a dual-parallel Mach-Zehnder modulator, a subcarrier up-converted millimeter-wave over fiber transmitter is proposed and experimentally demonstrated with an SFDR of 122.7dB $Hz^{2/3}$.

JWA4
Selectively Providing Virtual Private Network (VPN) Services in TDM-PONs with Manchester Coding, *Xuezhi Hong[1], Yang Lu[1], Lei Xu[2], Changjian Guo[1], Sailing He[1]; [1]Zhejiang Univ., China; [2]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 causes no disruption to the remaining service users.

JWA5
Robustness of Coherent SPE-OCDMA to Combined Dispersion Impairments, *Yi Yang[1], A Brinton Cooper[1], Jacob B. Khurgin[1], Jin U. Kang[1]; [1]Electrical & 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, *Lijia Zhang[1,2], Xiangjun Xin[1,2], Bo Liu[1,2], Yongjun Wang[1,3], Qi Zhang[1,3]; [1]School of Electronic Engineering, Beijing Univ. of Posts and Telecommunications, China; [2]Key Laboratory of Information Photonics and Optical Communications, Ministry of Education, Beijing Univ. of Posts and Telecommunications, China; [3]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, *Lijia Zhang[1,2], Xiangjun Xin[1,2], Bo Liu[1,2], Yongjun Wang[1,3], Qi Zhang[1,3]; [1]School of Electronic Engineering, Beijing Univ. of Posts and Telecommunications, China; [2]Key Laboratory of Information Photonics and Optical Communications,Ministry of Education, Beijing Univ. of Posts and Telecommunications, China; [3]Beijing Key Laboratory of Work Safety Intelligent Monitoring, Beijing Univ. of Posts and Telecommunications, China.* This paper achieves a secure transmission at physical layer in OFDM-PON based on chaos scrambling for data encryption. The experiment successfully transmits 8.37-Gb/s OFDM data with Logistic mapped chaos scrambling over 25km.

JWA8
Simultaneous Modulation and Transmission of CATV and Radio-over-Fiber Signals, *Peng-Chun Peng[1], Li-Hsing Yen[1], Hai-Han Lu[1], Ching-Hsiu Huang[1]; [1]Electro-Optical 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, *Quang Trung Le[1], Qian Deniel[1], Fabienne Saliou[1], Philippe Chanclou[1], Serge Tsyier[2], Guilhem Devalicourt[3], Romain Brenot[3], [1]Orange Labs, France, [2]Telecom ParisTech, France, [3]Alcatel-Thalès 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 Pasquazi[1], Marco Peccianti[1], Yongwoo Park[1], Brent Little[2], Sai T. Chu[2], David Moss[3], Roberto Morandotti[1]; [1]INRS-EMT, Canada; [2]Infinera Ltd, USA; [3]IPOS and CUDOS, School of Physics, Australia.* We demonstrate a stable passively mode locked soliton laser that extends the Dissipative-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 Su[1], Po-Yi Wu[1], Hsiang-Chun Peng[1], Ching-Hung Chang[1], Peng-Chun Peng[1], Hai-Han Lu[1]; [1]Inst. 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 Injection Locked Optoelectronics Oscillator, *Dan Lu[1], Jianhua Chen[1], Xiaofan Zhao[1], Li Huo[1], Caiyun Lou[1]; [1]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 PolM-NRZ-DQPSK Using Electro-Optical Phase-Locked Loop, *He Wen[1], Lin Cheng[1], Xiaoping Zheng[1], Hanyi Zhang[1], Yili Guo[1], Bingkun Zhou[1]; [1]Electronic Engineering, Tsinghua Univ., China.* A clock recovery scheme simultaneous 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 Lin[1,2], Michael Holtmannspoetter[1,2], Rameez Asif[1,2], Bernhard Schmauss[1,2]; [1]Chair of High Frequency Technology, Univ. of Erlangen-Nuremberg, Germany; [2]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
Real-Time Self-Homodyne Coherent Receiver for BPSK Signals Using Feed-Forward Carrier Extraction, *Selwan K. Ibrahim[1], Stylianos Sygletos[1], Ruwan Weerasuriya[1], Andrew D. Ellis[1]; [1]Photonics Systems Group, Tyndall National Inst., Univ. College Cork, Ireland.* We demonstrate the first real-time self-homodyne coherent receiver for 10.66Gbit/s BPSK signals using an OEO based carrier extraction scheme without using any pilot tone.

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Exhibit Hall E, 100 Level

JOINT

JWA • Towards Applications Joint Poster Session—Continued

JWA16
PMD Mitigation in RZ-OOK PDM Systems Based on a Single Polarization-Diversified All-Optical Regenerator, *Lianshan Yan[1], Anlin Yi[1]; [1]Southwest Jiaotong Univ., China.* PMD mitigation in RZ-OOK PDM systems is demonstrated through a single all-optical-regenerator with polarization-diversified loop configuration. 3.0-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[1], Pooi Yuen Kam[1], Changyuan Yu[1,2]; [1]Department of Electrical & Computer Engineering, National Univ. of Singapore, Singapore; [2]A*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, *Meer Nazmus Sakib[1], Venkatanarayanan Mahalingam[1], Andrew J. Wong[1], Odile Liboiron-Ladouceur[1], Warren J. Gross[1]; [1]Electrical 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 9.4 dB is achieved using 20% of the incoming optical signal.

JWA19
Impact of the Maritime Environment on the Aging of Optical Fibers, *Paulo André[1,2], Fátima Domingues[1,2], Marco Granada[2]; [1]IT, Portugal; [2]Physics, Aveiro Univ., Portugal.* The effect of the maritime environment on the aging of optical fibers coatings was studied. The obtained stress decay rate was 29.05 days, however, this value is higher than for a pure water saturate environment.

JWA20
Rapid Automatic High-Precision In-situ Wavelength Calibration for Tunable Lasers Using an Athermal AWG, *Runxiang Yu[1], Roberto Proietti[1], Junya Kurumida[2], Aytug Karalar[1], Binbin Guan[1], S. J. Ben Yoo[1]; [1]UC Davis, USA; [2]NPRC, 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.

CLEO: Science & Innovations 11: Fiber Amplifiers, Lasers and Devices

JWA21
Perimeter Deposition and Annealing for Increasing Cr4 Concentration in Ultra Broadband Cr:YAG Fiber Amplifier, *Cheng-Nan Tsai[1], Sheng-Lung Huang[2], Shun-Hsing Wang[1], Yen-Sheng Lin[2], Cheng-Han Zhou[1], Wei-Chung Ho[1]; [1]Inst. of Electronic Engineering, Cheng Shiu Univ., Taiwan; [2]Graduate Inst. of Photonics and Optoelectronics, National Taiwan Univ., Taiwan.* Using laser-heated pedestal growth method to re-grow Cr:YAG single crystal fiber with CaO perimeter deposition under annealing treatment at 1500 oC. The Cr^{4+} concentration of Cr:YAG fiber amplifier was raised by a factor of 91.87%.

JWA22
Numerical Investigations on Kerr-induced Long-period Fiber Gratings, *M. Schaeferling, N. Andermahr, C. Cleff, C. Fallnich; Inst. of Applied Physics, Westfälische Wilhems-Univ. Münster, Germany.* We numerically analyze broadband (up to 60 nm) conversion of transverse modes with long-period fiber gratings that are transiently introduced via the optical Kerr effect.

JWA23
163 nJ Graphene Mode-locked Yb-doped Fiber Laser, *Jiang Liu[1], Sida Wu[2], Quanhong Yang[2], Yanrong Song[1], Zhiyong Wang[1], Pu Wang[1]; [1]Inst. of Laser Engineering, Beijing Univ. of Technology, China; [2]School of Chemical Engineering and Technology, Tianjin Univ., China.* High pulse-energy 163nJ is generated in a graphene mode-locked Yb-doped fiber laser with repetition-rate of 1.04MHz. Graphene passive-Q-switched operation of 2.2μs pulse width is also demonstrated with repetition-rate from 6kHz to 150kHz.

JWA24
Highly-stable Yb-doped fiber laser mode-locked in a regime of SESAM two-photon absorption, *Tai Hyun Yoon[1], Gwang Hoon Jang[1], Jin Ho Kim[1]; [1]Department 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.

JWA25
Modal Dynamics in Multimode Fibers, *Moti Fridman[1,2], Haim Suchowski[2], Micha Nixon[2], Asher A. Friesem[2], Nir Davidson[2]; [1]Applied Physics, Cornell Univ., USA; [2]complex systems, weizmann institution, 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.

JWA26
An all-fiber 2 μm Wavelength Tunable Mode-locked Laser, *Khanh Kieu[1], Qiang Fang[1], Nasser Peyghambarian[1]; [1]Univ. 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).

JWA • Towards Applications Joint Poster Session—Continued

JWA27
High power femtosecond source near 1 micron based on an all-fiber Er-doped mode-locked laser, *Khanh Kieu[1], Jason Jones[1], Nasser Peyghambarian[1]; [1]Univ. 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 Zhang[1], Wei-zung Chang[1], Almantas Galvanauskas[1], Herbert G. Winful[1]; [1]Univ. 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 Ultralong Erbium-Doped Fiber Laser Mode-Locked by Carbon Nanotubes, *Henrique G. Rosa[1], Eunezio A. de Souza[1]; [1]Photonics 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. Fini[1]; [1]OFS Labs, USA.* A large mode area fiber design with asymmetrical bend compensation is proposed, demonstrating Aeff>2800sq. microns, low bend loss at 15cm radius, and reasonable suppression of higher-order modes.

JWA31
182 nJ All Thulium Fiber CPA System, *Robert A. Sims[1], Pankaj Kadwani[1], Lawrence Shah[1], Martin Richardson[1]; [1]CREOL/The College of Optics and Photonics, USA.* 150 fs pulses spectrally centered at 2020 nm were generated in a Raman amplifier. Pulses were temporal stretched and amplified to 182 nJ with a spectral width of 60 nm.

JWA32
Thermal Effects in High-Power Fiber Amplifiers, *Kristian R. Hansen[1], Jesper Lægsgaard[1]; [1]Department of Photonics Engineering, Technical Univ. of Denmark, Denmark.* The effect of temperature gradients in Yb-doped fiber amplifiers is studied numerically. We investigate the dependence of the mode area on the signal power, and compare forward and backward pumping schemes.

JWA33
Analysis of ultrashort pulsed FOPOs, *Jay E. Sharping[1]; [1]Natural Science, UC Merced, USA.* Pulse propagation simulations of fiber-optical parametric oscillators reveal an interesting interplay between spectral filtering, synchronization delay, and pump power. Our analysis implies that generation of sub-20-fs pulses is possible.

JWA34
Temporal Shaping of Parabolic Chirped Pulses with 27 dB Extinction Ratio for Fiber Chirped Pulse Amplification Systems, *Dat Nguyen[1], Mohammad Umar Piracha[1], Peter J. Delfyett[1], Dimitrios Mandridis[1]; [1]College 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, *Motoichiro Murakami[1], Minoru Yoshida[2], Hitoshi Nakano[2], Yasushi Fujimoto[1], Hiroyuki Shiraga[1], Shinji Motokoshi[3], Shin-ichi Matsuoka[4], Junya Maeda[4], Hirofumi Kan[4], Tatsuhiro Sato[5]; [1]Osaka Univ., Inst. of Laser Engineering, Japan; [2]Kinki Univ., Faculty of Science and Engineering, Japan; [3]Inst. of Laser Technology, Japan; [4]Hamamatsu Photonics K. K., Japan; [5]Shin-Etsu Quartz Products Co., Ltd., Japan.* We present a laser oscillation in the shortest Nd-doped silica fiber, an only 4-mm multimode Nd-doped silica fiber. This fiber-core glass was fabricated by the zeolite method, and the glass contained 1.25 wt% of Nd_2O_3.

JWA36
Tellurite Suspended Core Nanofiber with Extremely Large Holey Region, *Meisong Liao[1], Xin Yan[1], Guanshi Qin[1], Chihiro Kito[1], Takenobu Suzuki[1], Yasutake Ohishi[1]; [1]Optical Functional Materials Lab., Toyota Technological Inst., Japan.* A tellurite suspended core nanofiber with extremely large holey 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.

JWA37
Self-Interference Lloyd's Fiber Interferometer, *Cheng-Ling Lee[1]; [1]Electro-Optical Engineering, National United Univ., Taiwan.* We proposed an ultracompact, simple and roust in reflection-type of self-interference Lloyd's fiber interferometer based on a vanished core fiber endface with Sn-overlay. Interference fringes are observed experimentally and investigated.

JWA38
Monolithic Interferometer Based on Gemini Fiber, *Patrik Rugeland[1,2], Carola Sterner[2], Walter Margulis[2]; [1]Dept. Applied Physics, Royal Inst. of Technology (KTH), Sweden; [2]Dept. Fiber Photonics, Acreo AB, Sweden.* We fabricate a Gemini fiber with two branches bound by a glass bridge to create a stable monolithic Mach-Zehnder fiber interferometer and demonstrate the function of add-drop multiplexing with flat response over the entire C-band.

JWA39
Post-Processing Multicore Photonic Crystal Fibers for Locally Coupling Selected Core Pairs, *Rodrigo M. Gerosa[1], Claudecir R. Biazoli[2], Cristiano M B. Cordeiro[2], Christiano J. de Matos[1]; [1]Grupo de Fotonica, Universidade Presbiteriana Mackenzie, Brazil; [2]Instituto de Fisica "Gleb Wataghin", UNICAMP, Brazil.* Coupling selected cores among otherwise decoupled multiple cores in photonic crystal fibers is demonstrated via the use of differential pressure and heat for local processing. Complex interferometer assemblies for all-fiber devices may be achieved.

JWA40
Phase Dependent Second-Order Fiber Bragg Gratings, *Nai-Hsiang Sun[1], Chia-Ming Hu[1], Yuan-Ju Cheng[1], Shih-Chiang Lin[2], Jung-Sheng Chiang[1], Wen-Fung Liu[3], Gary A. Evans[4], Jerome K. Butler[4]; [1]Department of Electrical Engineering, I-Shou Univ., Taiwan; [2]Department of Communication Engineering, I-Shou Univ., Taiwan; [3]Department of Electrical Engineering, Feng Chia Univ., Taiwan; [4]Department of Electrical Engineering, Southern Methodist Univ., USA.* The phase dependent properties of a second-order FBG are presented. At the second Bragg condition, the radiated power of the second-order FBG varies by a factor of 2.4 as the phase changes by π radians.

JWA41
Demonstration of side coupling between high power laser diode array and double-clad fiber using sub-wavelength grating, *Chieh-Wei Huang[1], Ding-Wei Huang[1], Chun-Lin Chang[1], Dong-Yo Jheng[1], Kuang-Yu Hsu[1], Chieh-Hsiung Kuan[2], Sheng-Lung Huang[1]; [1]Graduate Inst. of Photonics and Optoelectronics, National Taiwan Univ., Taiwan; [2]Graduate Inst. of Electronics Engineering, National Taiwan Univ., Taiwan.* A sub-wavelength gold-embedded silica binary grating for side coupling light emission from a 976-nm high-power laser diode array into the 400-μm-diameter inner cladding of a double-clad fiber was demonstrated with near 50% overall coupling efficiency.

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 Gaydardzhiev[1], Danail Chuchumishev[1], Ivan C. Buchvarov[1]; [1]Department of Physics, Sofia Univ., Bulgaria.* Near diffraction limited, single frequency, passively Q-switched Nd:YAG laser (240-μJ, 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 Petawatt Laser, *Joel K. Blakeney[1]; [1]Physics, Univ. of Texas at Austin, USA.* An all-reflective Ti:Sa power amplifier capable of extracting up to 60 joules has been designed. The power amplifier consists of four passes through a 100mm Ti:Sa crystal realy 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. Johnson[1], Tsutomu Shimada[1], Rahul C. Shah[1]; [1]Trident Laser Facility, Los Alamos National Laboratory, USA.* Non-linear pulse cleaning is used along with an OPA front end and improved stretcher designs to improve pre-pulse contrast on the high intensity short pulse beam line of the Trident Laser.

JWA45
High-efficiency solar-pumped Nd:YAG laser with excellent beam profile, *Dawei Liang[1], Joana Almeida[1]; [1]Physics Dept., CEFITEC, 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 thin 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 Yakshin[1]; [1]SESI, 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
Lifetest of the High Output Maximum Efficiency Resonator (HOMER) Laser for the SAFFIRE Instrument on NASA's DESDynI Project, *Paul Stysley[1], Barry Coyle[1], Richard Kay[2], Robert Frederickson[3], Demetrios Poulios[2], Bryan Blair[1], Stan Scott[1], Ed Arnold[3]; [1]Laser and Electro-Optic Branch, NASA-GSFC, USA; [2]Physics, American Univ., USA; [3]Sigma Space, USA.* We update the status of a diode-pumped, Nd:YAG oscillator that is the prototype laser for NASA's DESDynI mission. After completing TRL-6 testing, this laser has fired over 5.5 billion shots in lifetesting.

JWA48
Subpicosecond pulse generation from a chirped-pulse multipass-cavity Cr^{4+}:forsterite oscillator, *Huseyin Cankaya[1], Alphan Sennaroglu[1], Selcuk Akturk[2]; [1]Physics, Koc Univ., Turkey; [2]Physics, Istanbul Technical Univ., Turkey.* We produced the highest pulse energy directly generated from a room-temperature, mode-locked Cr^{4+} :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 Gratings in Nd:YAG, *Roland Ullmann[1], Robert Elsner[1], Axel Heuer[1], Ralf Menzel[1], Martin Ostermeyer[1,2]; [1]Inst. for Physics and Astronomy, Univ. of Potsdam, Germany; [2]IBL Innovative Berlin Laser GmbH, Germany.* To realize frequency-stable operation of a Q-switched loop resonator, a passive coupling scheme based on gain gratings is numerically investigated. Existing numerical 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 Bounce Geometry, *Václav Kubeček[1], Michal Jelínek[1], Miroslav Čech[1], Petr Hiršl[1]; [1]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.

JWA • Towards Applications Joint Poster Session—Continued

JWA51
TEM_{00} Quasi-concentric Laser Resonator with Line-shaped End-pumping Profile: Power-insensitive Operating Point, *Xing Fu[1], Qiang Liu[1], Xingpeng Yan[1], Qi Wang[1], Mali Gong[1]; [1]Tsinghua Univ., China.* We report a TEM_{00} 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^{3+} and Tm^{3+} Codoped Lead Lanthanum Zirconate Titanate Ceramics, *Hua Zhao[1], Long Xu[1], Jingwen W. Zhang[1], Yingyin Zou[2], Kewen Li[2], Hua Jiang[2], Xuesheng Chen[3], Piling Huang[3]; [1]Harbin Inst. of Technology, China; [2]Boston Applied Technologies, Inc, USA; [3]Wheaton College, USA.* Using Ho^{3+} and Tm^{3+} 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 Lee[1], Tae Jun Yu[1], Jae Hee[1], Tae Moon Jeong[1], Jongmin Lee[1]; [1]APRI, 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.

CLEO: Science & Innovations 6: Optical Materials, Fabrication and Characterization

• *Materials*

JWA54
Solution-processed 3D Chalcogenide Glass Waveguides, *Yunlai Zha[1], Craig B. Arnold[1]; [1]Princeton Univ., 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, *Maike Waldmann[1], Craig B. Arnold[1]; [1]Princeton Inst. for the Science and Technology of Materials, Princeton Univ., USA.* The stability of arsenic sulfide solutions towards absorbed moisture is investigated through accelerated aging studies. Water-induced precipitation can be mitigated, producing chalcogenide materials that are unaffected by the lifetime of the solution.

JWA56
Continuous Tuning of Terahertz Generation in Fan-out Periodically Poled Stoichiometric Lithium Tantalate, *Nan Ei Yu[1], Kyu Sup Lee[2], Do-Kyeong Ko[1,2], Shunji Takekawa[3], Kenji Kitamura[3]; [1]Gwangju Inst. of Science and Technology, Republic of Korea; [2]School of Photon Science and Technology, Republic of Korea; [3]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 1.55 THz with as narrow as band-width of 20 GHz.

JWA57
Sol-gel Preparation and Spectral Characterization of Y_2O_3 Powders Doped with Yb^{3+} and Nd^{3+}, *Zackery Fleischman[1]; [1]US Army Research Lab, USA.* A sol gel process was used to produce Y_2O_3 powders doped with varying amounts of Yb^{3+} and Nd^{3+} ions. The materials were spectrally characterized to study the energy transfer between the dopant ions.

JWA58
Quantum Dots for High Temperature Sensing, *Devin Pugh-Thomas[1,2], Mool Gupta[1], Brian M. Walsh[2]; [1]Electrical Engineering, Univ. of Virginia, USA; [2]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 were investigated from 293-540 K. The sensor sensitivity is 0.11 nm/C.

JWA59
Non-saturable absorption and its impact on amplifier performance in Al_2O_3:Er^{3+}, *Laura Agazzi[1], Kerstin Worhoff[1], Markus Pollnau[1]; [1]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 Ou[1]; [1]Technical Univ. of Denmark, Denmark.* Different sizes of Ge nanocrystals embedded in a SiO_2 matrix were formed by PECVD, and analyzed by TEM. Size effect of Ge nanocystals was demonstrated by Raman spectroscopy after excluding the thermal effect.

JWA61
Planar Silicon-Rich Nitride Resonators Doped with Neodymium, *Debo Olaosebikan[1], Michal Lipson[1], Selcuk Yerci[2], Luca Dal Negro[2]; [1]School of Electrical and Computer Engineering, Cornell Univ., USA; [2]Boston Univ., 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, *Aleksandr Ryasnyanskiy[1], Ivan Biaggio[1]; [1]Physics, Lehigh Univ., USA.* We report on the two-photon spectroscopy of Rubrene single crystal. We experimentally observed strong anisotropy of two-photon absorption coefficient and photolumineasece. The two-photon absorption spectrum was measured between 740-840 nm.

JWA63
Paper Withdrawn

• *Devices*

JWA64
Hybrid Diffractive Optical Element Based Spectrometer, *Chuan Yang[1], Perry Edwards[1], Kebin Shi[1], Zhiwen Liu[1]; [1]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. Akca[1], Nur Ismail[1], Fei Sun[1], Alfred Driessen[1], Kerstin Worhoff[1], Markus Pollnau[1], Rene M. de Ridder[1]; [1]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 As_2S_3 Microstructured Fiber, *Weiqing Gao[1], Meisong Liao[1], Xin Yan[1], Chihiro Kito[1], Takenobu Suzuki[1], Mohammed El-Amraoui[2], Jean-Charles Jules[2], Grégory Gadret[2], Frédéric Désévédavy[2], Frédéric Smektala[2], Yasutake Ohishi[1]; [1]Toyota Technological Inst., Japan; [2]UMR 5209 CNRS-Université de Bourgogne, France.* We demonstrate visible light generation in As_2S_3 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 Kim[1], Kyung Shik Ma[1], Kwanil Lee[1], Sang Bae Lee[1]; [1]Korea Inst. of Science and Technology, Republic of Korea.* MZI 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. Smith[1], Irene Fernandez-Cuesta[1], Anders Kristensen[1]; [1]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. Nanoimprint lithography maintains Λ=265nm corrugation for gold surface devices.

JWA • Towards Applications Joint Poster Session—Continued

JWA69
Au and Ag Nano-Particle Embedded Plasmonic Metal-Slotted Polymer Electro-Optic Waveguide Modulator, *Seongku Kim[1], Kevin Geary[2], Pierre Berini[3], Larry R. Dalton[4]; [1]Electrical Engineering, Univ. of California Los Angeles, USA; [2]Photonics, HRL Laboratories, USA; [3]School of Information Technology and Engineering, Univ. of Ottawa, Canada; [4]Electrical and Chemical Engineering, Univ. of Washington, USA.* A new electro-optic (EO) plasmonic metal-slotted optical waveguide (PMOW) modulator based on gold and silver metal islandized thin films is proposed and experimentally demonstrated that can be operated at both 1310 nm and 1550 nm wavelengths. The fabricated PMOWs are also able to support both TM and TE polarizations, and their characteristics of the EO PMOW modulators are discussed.

JWA70
Investigation of Blueshift of Photoluminescence Emission Peak in InGaN/GaN Multiple Quantum Wells, *Guibao Xu[1], Guan Sun[1], Yujie J. Ding[1], Hongping Zhao[1], Guangyu Liu[1], Jing Zhang[1], Nelson Tansu[1]; [1]Electrical & Computer Engineering, Lehigh Univ., USA.* We have observed peculiar behaviors on the dependence of photoluminescence emission peak on excitation fluence in InGaN/GaN multiple quantum wells.

JWA71
Below Bandgap Excitation of SnO_2 Nanowires: The Relaxation of Trap States, *San-Hui Chi[1], Lena Mazeina[2], Sharka M. Prokes[2], Joshua D. Caldwell[2], Guy Beadie[1], Steve R. Flom[1], James S. Shirk[1]; [1]Optical Science Division, United States Naval Research Laboratory, USA; [2]Electronics Science and Technology Division, United States Naval Research Laboratory, USA.* Carrier relaxation of SnO_2 nanowires is investigated by excitation at 3.2 eV, ~0.4 eV below the bandgap. The excited state transmission spectrum from 1.9-2.7 eV is intensity-dependent and recovers uniformly with a biexponential relaxation route.

JWA72
Fabrication and Optical Properties of Aligned Silicon Nanowire Arrays Realized with Thin Silver Film, *Yung-Jr Hung[1], Kai-Chung Wu[1], San-Liang Lee[1], Yen-Ting Pan[1]; [1]Department of Electronic Engineering, National Taiwan Univ. of Science and Technology, Taiwan.* Silicon nanowire arrays realized by depositing thin silver film before etching are demonstrated to have good material and optical properties. They can provide <0.4% antireflection over >1400-nm wavelength range for large-area silicon samples.

JWA73
Refractive index of nanolayered polymeric optical materials, *Michael Brindza[1], Armand Rosenberg[1], Guy Beadie[1], James S. Shirk[1], Michael Ponting[2], Eric Baer[2]; [1]Optical Sciences, Naval Research Laboratory, USA; [2]Case Western Reserve Univerity, USA.* We experimentally tested a predictive model of refractive index proposed for nanolayered polymer films for use in design and fabricating biologically inspired GRIN lenses, which enables good estimation of index based on component weight fractions.

JWA74
25.54% Efficient Single-Junction GaAs Solar Cells Using Spin-On-Film Graded-Index TiO_2/SiO_2 AR-Coating, *Wen-Jeng Ho[1], Yi-Jen Lin[1], Liang-Yin Chien[1], Yi-Yu Lee[1], Yuan-Li Chen[1], Cheng-Ming Yu[1], Quan-Ru Lai[1], Jhih-Kai Syu[1], Hung-Pin Shiao[2]; [1]Inst. of Electro-Optical Engineering, National Taipei Unversity og Technology, Taiwan; [2]Win Semiconductor Corp., Taiwan.* We report high-efficiency single-junction GaAs Solar cells of 25.54% at one sun using a spin-on graded-index TiO_2/SiO_2 films. Improved in efficiency, from 19.19% to 25.54%, was obtained when cell without/with proposed graded-index TiO_2/SiO_2 AR-coating, respectively.

CLEO: Science & Innovations 8: Ultrafast Optics, Optoelectronics and Applications

JWA75
Broadband and ultrafast measurement of transient circular dichroism in chiral molecules., *Laureen Mangot[1], Boeglin Alex[1], Kokou Dorkenoo[1]; [1]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 biosystem, as it drastically decreases acquisition time.

JWA76
650MHz-prf-femtosecond Cr^{4+} :forsterite laser with dispersion-compensating GaInNAs SESAM, *Christopher G. Leburn[1,2], Weisheng Lu[3], Sharon Vetter[4], Martin D. Dawson[4], Christian T. Brown[2], James S. Harris[3], Stephane Calvez[4], Wilson Sibbett[2]; [1]Engineering & Physical Sciences, Heriot-Watt Univ., UK; [2]Physics and Astronomy, Univ. of St Andrews, UK; [3]Solid-State and Photonics Laboratory, Stanford Univ., USA; [4]Inst. of Photonics, Univ. of Strathclyde, UK.* We report the use of a near-resonant GaInNAs SESAM in a Cr^{4+} :forsterite laser to generate transform-limited 150fs pulses around 1300nm at a repetition-rate of 0.65GHz with average powers up to 270mW.

JWA77
Sub-12 fs pulses characterization by self-referenced spectral interferometry, *Stéphanie Grabielle[1,2], Antoine Moulet[1], Nicolas Forget[1], Vincent Crozatier[1], Sébastien Coudreau[1], Olivier Gobert[2], Christian Cornaggia[2], Thomas Oksenhendler[1]; [1]FASTLITE, France; [2]IRAMIS, Service Photons Atomes & Molécules, CEA, France.* 11.7 fs 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, *Keisuke Goda[1,2], Ata Mahjoubfar[1,2], Ali Ayazi[1], Ali Fard[1], Sang Hyup Kim[1], Bahram Jalali[1,2]; [1]Electrical Engineering Department, Univ. of California at Los Angeles, USA; [2]California NanoSystems Inst., 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 record scan rate of 36.7 MHz without the need for beam scanning.

JWA79
High-power ultrafast solid-state laser using graphene based saturable absorber, *Zhipei Sun[1], Xuechun Lin[2], Haijuan Yu[2], Tawfique Hasan[1], Felice Torrisi[1], L. Zhang[2], L. Sun[2], Lin Guo[2], Wei Hou[2], Jinming Li[2], Andrea Ferrari[1]; [1]Department of Engineering, Cambridge Univ., UK; [2]Laboratory of All-solid-state Light Sources, Inst. of Semiconductors, China.* We demonstrate a graphene based saturable absorber mode-locked Nd:YVO_4 solid-state laser, generating ~14nJ pulses with ~1W average output power. This shows the potential for high-power pulse generation.

JWA80
A Novel Z-cut $LiNbO_3$ Mach-Zehnder Modulator Using Resonant CPW Electrodes with Single Driving Signal for Zero-Chirp Operation, *Masayuki Motoya[1], Junichiro Ichikawa[1], Hiroshi Murata[2], Yasuyuki Okamura[2]; [1]New technology reserch laboratories, Sumitomo Osaka Cement Co. Ltd., Japan; [2]Graduate 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, *Qingbin Zhang[1], Eiji Takahashi[1], Katsumi Midorikawa[1]; [1]Extreme Photonics Research Group, RIKEN Advanced Science Inst., Japan.* A dual-chirped optical parametric amplification scheme for generating ultrafast high-power IR pulse is proposed. Using this scheme, we can expect the generation of TW-class IR pulses in 1~2 μm.

JWA82
High Power Short Pulse Generation at High Repetition Rate from InGaN Violet Laser Diodes, *Vojtech Olle[1], Peter P. Vasil'ev[2], Adrian Wonfor[1], Richard V. Penty[1], Ian H. White[1]; [1]Electrical Engineering, Univ. of Cambridge, UK; [2]PN Lebedev Physical Inst., 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 GaAsP photomultiplier tube, *Yizhen Wei[1], Scott Howard[1], Ji Cheng[1], Zinan Wang[1], Adam Straub[1], Chris Xu[1]; [1]School of Applied and Engineering Physics, Cornell Univ., USA.* We demonstrate a novel method for high sensitivity measurement of pulsed light using a GaAsP photomultiplier tube. 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 Yang[1], Li-Fan Yang[1], Omel Mendoza-Yero[2], Angel Quiñones-Huelva[2], Gladys Míguez-Vega[2]; [1]Inst. of Photonics Technologies, National Tsing Hua Univ., Taiwan; [2]Universitat 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-ray pulses.

JWA85
Highly stabilized frequency-locked optical frequency comb signal generation using amplified optical fiber loop with SSB-SC modulation, *Atsushi Kanno[1], Takahide Sakamoto[1], Tetsuya Kawanishi[1]; [1]National 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 identical positive disversive media as signal pulse stretcher, *Yutaka Akahane[1], Kanade Ogawa[1], Koichi Yamakawa[1]; [1]Japan Atomic Energy Agency, Japan.* Idler pulses generated in ultrafast optical-parametric chirped-pulse amplification were compressed to sub-100 fs with an identical positive dispersive media as signal pulse stretcher, which is suitable for industrial applications.

JWA87
Time-to-space conversion at 1.55μm by non-degenerate SFG, *Dror Shayovitz[1], Dan M. Marom[1]; [1]The 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. Khan[1], Yan Cheng[1], Kun Zhao[1], Michael Chini[1,2], Baozhen Zhao[1], Zenghu Chang[1,2]; [1]Physics, Kansas State Univ., USA; [2]Physics, Univ. 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, *Yan Li[1], Chang-Yi Li[1], Derek Chang[2], Carsten Langrock[2], Martin M. Fejer[2], Daniel Kane[3], Luke F. Lester[1]; [1]Center for High Technology Materials, Univ. of New Mexico, USA; [2]E. L. Ginzton Laboratory, Stanford Univ., USA; [3]Mesa Photonics LLC, USA.* A comparison between the operational map of a QD MLL done by autocorrelation and FROG is made. The results show that the complete mode-locking region is significantly smaller when FROG is used versus autocorrelation.

JWA • Towards Applications Joint Poster Session—Continued

JWA90
CW and Femtosecond Modelocking Laser Operations of Yb^{3+}: $CaYAlO_4$, *Wei De Tan[1]; [1]Nanyang Technological Univ., Singapore.* Under cw operation, 1.9W corresponding to a slope efficiency of 71% was emitted. When modelocked, 156fs pulses were emitted. The modelocked output power was 0.74W which corresponded to a slope efficiency of 37%.

JWA91
High repetition rate high average power all-normal dispersion Yb:fiber ring laser, *Hongyu Yang[1], Peng Li[1], Xi Wang[1], Chen Li[1], Aimin Wang[1], Zhigang Zhang[1]; [1]Inst. of Quantum Electronics, School of Electronics Engineering and Computer Science, Peking Univ., China.* We demonstrate high repetition rate (up to 225 MHz) all-normal dispersion Yb:fiber ring laser. The average output power is 280 mW at a pump power of 600 mW. The dechirped pulse is 93 fs.

CLEO: Science & Innovations 15: LEDS, Photovoltaics and Energy-Efficient ("Green") Photonics

JWA92
Design of Three-terminal GaN Light Emitting HBT for Free Space Communication, *Shengling Deng[1], Z.Rena Huang[1]; [1]Electrical, Computer, and Systerm, Rensselaer Polytechnic Inst., USA.* This abstract presents design and simulation results of a GaN-based multi-quantum well (MQW) heterojunction transistor (HBT) LED. The combination of the narrow base and collector terminal allows a very fast turn-off delay in the device.

JWA93
Spectral Analysis of Noise Sources in InGaN Light Emitting Diodes, *Gray Lin[1], Kuan-Lin Su[1], Shih-Tsun Yang[2], Tzung-Te Chen[2], Chiu-Ling Chen[2]; [1]Department of Electronics Engineering, National Chiao-Tung Univ., Taiwan; [2]Electronics and Optoelectronics Reaserch Laboratories, Industrial Technology Research Inst., Taiwan.* Noise characterization of InGaN light emitting diodes shows that the exponent in current dependence of low-frequency noise amplitude and the corner frequency in high-frequency noise spectra are two possible indicators for device reliability.

JWA94
Reduction of Efficiency Droop in Semipolar (1-101) InGaN/GaN Light Emitting Diodes Grown on Patterned Silicon Substrates, *Ching-Hsueh Chiu[1], Da-Wei Lin[1], Chien-Chung Lin[3], Zhen-Yu Li[1], Hao-chung Kuo[1], Tien-Chang Lu[1], Shing-chung Wang[1], Wei-Tsai Liao[2], Tomoyuki Tanikawa[4], Yoshio Honda[4], Masahito Yamaguchi[4], Nobuhiko Sawaki[5]; [1]Department of Photonics and Inst. of Electro-Optical Engineering, National Chiao Tung Univ., Taiwan; [2]Department of Opto-Electronics Epitaxy and Devices, Industrial Technology Research Inst., Taiwan; [3]Inst. of Photonic Systems, College of Photonics, National Chiao-Tung Univ., Taiwan; [4]Department of Electronics, Nagoya Univ., Japan; [5]Department of Electrical and Electronic Engineering, Aichi Inst. of Technology, Japan.* The semi-polar InGaN-based LEDs exhibits low efficiency droop because the reduction of the polarization field not only made the band diagram smoother but also restricted electron overflow to the p-GaN layer as shown in simulations.

JWA95
GaN-based LEDs with Photonic Crystal Nanorod Sidewall Reflectors for Versatile Radiation Directionality Control, *Yun-Wei Cheng[1], Szu-Chieh Wang[1], Yu-Feng Yin[1], JianJang Huang[1,2]; [1]Graduate Inst. of Photonics and Optoelectronics, National Taiwan Univ., Taiwan; [2]Department of Electrical Engineering, National Taiwan Univ., Taiwan.* GaN-based light emitting diodes with proper-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.

JWA96
Promotion of the Inverted Polymer Solar Cells with NiO Modification, *Jian-Lin Chiu[1], Ming-Yi Lin[1], Chau-Shuo Chen[1], Chih-Heng Shia[1], Shuo-Yuan Ma[1], Yu-Min Shen[1], Ching-Fuh Lin[1,2]; [1]Graduate Inst. of Photonics and Optoelectronics, Taiwan; [2]Department of Electrical Engineering, Graduate Inst. of Electrical Engineering, Taiwan.* The solution derived NiO suppresses the leakage current and acts as the oxide and moisture barrier to improve the stability with 80% of the maximum efficiency retained over 60 days and the efficiency to 3.87%.

JWA97
Plasmonic Nanostructures for Organic Photovoltaic Devices, *Xiaoqiang Yu[1], Natalia Azarova[1], Saumil Joshi[1], Won Park[1]; [1]Electrical & Computer Engineering, Univ. of Colorado, USA.* Plasmonic nanostructures were investigated for absorption enhancement of organic photovoltaic devices. Nanostructures were fabricated by scalable laser interference lithography. Experimental results agreed well with theoretical modeling.

CLEO: Science & Innovations 10: Biophotonics and Optofluidics

• *Biophotonics*

JWA98
Multiexposure speckle contrast imaging using current pulsed VCSELs, *Hart Levy[1,2], Dene Ringuette[2], Ofer Levi[1,2]; [1]Electrical and Computer Engineering, Univ. of Toronto, Canada; [2]Inst. of Biomaterials and Biomedical Engineering, Univ. of Toronto, Canada.* We implement multiexposure contrast imaging using VCSELs to quantify cortical blood flow, towards a portable technique. Device characterization and noise compensations algorithms are used to show robustness of our technique in non ideal conditions.

JWA99
Resolution Improvement of Fluorescence Laminar Optical Tomography by Angled Incidence and Detection, *Chao-Wei Chen[2], Yu Chen[1,2]; [1]Fischell Department of Bioengineering, Univ. of Maryland, USA; [2]Department of Electrical Engineering, Univ. of Maryland, USA.* Theoretical analysis indicated FLOT resolution can be improved by angled incidence and detection. We developed an angled FLOT system and experimentally demonstrated its capability for depth-resolved fluorescence imaging in scattering medium.

JWA100
Combining Phase Contrast Microscopy and Laser Tweezers Raman Spectroscopy to Characterize Germination of Single Bacterial Spores, *Lingbo Kong[1], Pengfei Zhang[1], Peter Setlow[2], Yong-qing Li[1]; [1]Department of Physics, East Carolina Univ., USA; [2]Department 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.

JWA101
The Study of Apoptotic Morphological Changes by Dual-Wavelength Digital Holographic Microscopy, *Alexander Khmaladze[1], Rebecca Matz[1], Joshua Jasensky[1], Tamir Epstein[1], Chi Zhang[1], Mark Banaszak Holl[1], Zhan Chen[1]; [1]Univ. of Michigan, USA.* We present the study of morphology changes during apoptosis by digital holographic microscopy. The population of cells undergoing staurosporine induced apoptosis was monitored in-situ for several hours and 35% overall volume decrease was observed.

JWA102
Light Scattering in Biomimetic Structures with Short-range Order, *Seng Fatt Liew[1], Jason Forster[2], Heeso Noh[1], Carl Schreck[3], Vinodkumar Saranathan[4], Xinhui Lu[5], Lin Yang[6], Corey S. O'Hern[2,3], Eric Dufresne[2,3], Hui Cao[1,3]; [1]Applied Physics, Yale Univ., USA; [2]Mechanical Engineering, Yale Univ., USA; [3]Physics, Yale Univ., USA; [4]Ecology and Evolutionary Biology, Peabody Museum of Natural History, Yale Univ., USA; [5]Condensed Matter Physics and Materials Science, Brookhaven National Laboratory, USA; [6]National 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.

JWA103
Focusing of the LP02 Mode from a Higher Order Mode Fiber, *Jennifer H. Lee[1], Michael E. Durst[1], Demirhan Kobat[1], Chris Xu[1], Lars Grüner-Nielsen[2]; [1]School of Applied and Engineering Physics, Cornell Univ., USA; [2]OFS Fitel Denmark, Denmark.* We characterize the focusing properties of the LP02 mode in a typical multiphoton microscope. Under varying back-aperture filling conditions, we measure vastly different point spread functions, including a null at the focus.

JWA104
Mid-Infrared Transmission and Reflection of Porcine Skin, *Anna P. Michel[1,2], Stephen Ma[2,3], Kelly Ostrander[2,4], Kathryn Vogel[2,5], Claire F. Gmachl[2,3]; [1]PRISM, Princeton Univ., USA; [2]MIRTHE, Princeton Univ., USA; [3]Electrical Engineering, Princeton Univ., USA; [4]Univ. of Rochester, USA; [5]Massachusetts Inst. of Technology, USA.* Mid-infrared light interactions with porcine skin are quantified using a Fourier Transform Infrared Spectrometer and a Quantum Cascade Laser. Transmission is achieved in 600 μm thick samples. The absorption coefficient is estimated at 5.6 mm^{-1}.

JWA • Towards Applications Joint Poster Session—Continued

JWA105
Evaluation of High Quality Factor Photonic Crystal Slabs for Biosensing, *Hooman Akhavan[1], Mohamed El-Beheiry[2], Ryan Schilling[1,2], Deniz Aydin[1,2], Ofer Levi[1,2]; [1]Inst. of Biomaterials and Biomedical Engineering, Univ. of Toronto, Canada; [2]The Edward S. Rogers Sr. Department of Electrical and Computer Engineering, Univ. of Toronto, Canada.* Guided resonance modes in photonic crystal slab biosensors are characterized. Quality factors for TE-like and TM-like resonances of approximately 3000 and 1000 respectively are observed. These are the highest reported values to date.

• *Optofluidics*

JWA106
Microfluidic Integration of Aperiodic Gold Nanoparticle Arrays for Local Refractive Index Sensing, *Sylvanus Y. Lee[1-3], Fiorenzo Omenetto[2,4], Luca Dal Negro[3,5]; [1]Mechanical Engineering, Boston Univ., USA; [2]Biomedical Engineering, Tufts Univ., USA; [3]Electrical and Computer Engineering & Photonics Center, Boston Univ., USA; [4]Physics, Tufts Univ., USA; [5]Division of Materials Science and Engineering, Boston Univ., USA.* We present microfluidic integration of a novel optical sensing technique based on distinctive structural color modifications in aperiodic nano-structures. The liquid-induced index sensitivity of the proposed devices is quantified by autocorrelation analysis in the visible spectral range.

JWA107
Large scale structural color patterning using magnetochromatic microspheres with patterned magnet, *Song Younghoon[1], Junhoi Kim[1], Howon Lee[1], Sunghoon Kwon[1]; [1]Seoul National Univ., Republic of Korea.* Large scale structural color patterning is demonstrated using magnetochromatic microspheres involving 1D chain-like ordered structure of superparamagnetic nanoparticle under a patterned external magnetic field.

JWA108
Lable-free Enzyme Sensing with a Si_3N_4 Grated Waveguide Optical Cavity, *S.v. Pham[1], M. Dijkstra[1], A.j.f Hollink[1], L.j. Kauppinen[1], R.m de Ridder[1], H.j.w.m. Hoekstra[1]; [1]EWI, MESA+, Univ. of Twente, Netherlands.* We report the label-free, sensitive detection of PepN enzyme using a Si_3N_4 grated waveguide optical cavity covered with an immobilized, selective (antibody) receptor layer. The receptor-enzyme reaction was monitored in real-time.

JWA109
Dielectrophoresis of Nanoparticles for Polymer Waveguide Manipulation, *Aminuddin Kayani[1], Adam Chrimes[1], Khashayar Khoshmanesh[2], Kourosh Kalantar-zadeh[1], Arnan Mitchell[1]; [1]School of Electrical and Computer Engineering, RMIT Univ., Australia; [2]Centre for Intelligent Systems Research, Deakin Univ., Australia.* Suspended silica and tungsten trioxide nanoparticles were dispersed into a microfluidic channel adjacent to a polymeric rib waveguide. Dielectrophoresis used to manipulate nanoparticles into forming various nanoparticle concentrations was capable of altering waveguide transmission properties.

JWA110
Optical manipulation of microparticles using whispering-gallery-modes in a silicon nitride microdisk resonator, *Hong Cai[1], Andrew W. Poon[1]; [1]ECE, The Hong Kong Univ. of Science and Technology, Hong Kong.* We demonstrate optical manipulation of microparticles on a silicon nitride microdisk resonator in an optofluidic chip. We observe three trapping channels at 1.3, 2.3 and 3.0 μm from the microdisk rim upon different whispering-gallery modes.

JWA111
A Hybrid Waveguide Sensor for Highly Sensitive Biosensing, *Muhammad Alam[1], Farshid Bahrami[1], J. Stewart Aitchison[1], Mohammad Mojahedi[1]; [1]Univ. of Toronto, Canada.* We propose a highly sensitive biosensor consisting of a metal-plane separated from a silicon layer by a nano-fludic channel. The sensor performance is estimated and a method to distinguish bulk and surface sensitivity is proposed.

JWA112
Innovative hematology analyzer, *Nelly Rongeat[1], Patrick Brunel[1], Sylvain Ledroit[1], Didier Cremien[1], Stéphane Hilaire[3], Guillaume Huss[3], Vincent Couderc[2], Philippe Leproux[2], Philippe Nérin[1]; [1]HORIBA Medical, France; [2]87, Université de Limoges, XLIM, France; [3]LEUKOS, France.* We are presenting an innovative hematological analyzer based on a broadband supercontinnum light source. This new design allows to characterize several populations of blood cells based on fluorescence and scattering pulsed flow cytometry.

CLEO: Applications & Technology 1: Biomedical

JWA113
Thickness dependent contrast of human oral epithelial nuclei in vivo observed by third-harmonic generation microscopy, *Ming-Rung Tsai[1], Dar-Bin Shieh[2], Pei-Jen Lou[3], Chi-Kuang Sun[1]; [1]Department of Electrical Engineering and Graduate Inst. of Photonics and Optoelectronics, National Taiwan Univ., Taiwan; [2]Inst. of Oral Medical and Inst. of Basic Medical Sciences, Center for Micro/Nano Sciences and Technology, National Cheng-Kung Univ., Taiwan; [3]Department of Otolaryngology, National Taiwan Univ. Hospital and National Taiwan Univ. College of Medicine, Taiwan.* In this paper, we demonstrate that the third-harmonic-generation contrast on epithelial nuclei *in vivo* observed in human oral cavity depends strongly on the thicknesses, rather than nonlinear susceptibility, of cell nuclei.

JWA114
Experimental Evaluation of a System for Broadband UV-Vis Optical Property Measurement in Layered Tissue, *Quanzeng Wang[1], Du Le[1,2], Jessica Ramella-Roman[2], Josh Pfefer[1]; [1]Center for Devices and Radiological Health, Food and Drug Administration, USA; [2]Department of Biomedical Engineering, School of Engineering, Catholic Univ. of America, USA.* A fiberoptic system was constructed for optical property measurement of two-layer tissue at 350-630 nm. Evaluation with phantoms indicates that although accurate results can be generated, measurement error varies with superficial layer thickness.

JWA115
Using Integrated Multiple Microscopies to Monitor the Kinetics of SYTO 16 Dye Uptake during the Germination of Single Bacterial Spores, *Lingbo Kong[1], Pengfei Zhang[1], Guiwen Wang[1], Peter Setlow[2], Yong-qing Li[1]; [1]Department of Physics, East Carolina Univ., USA; [2]Department of Molecular, Microbial and Structural Biology, Univ. of Connecticut Health Center, USA.* We present a methodology that combines fluorescence microscopy, phase contrast microscopy and laser tweezers Raman spectroscopy to monitor the kinetics of uptake of the nucleic acid dye SYTO 16 during germination of individual bacterial spores.

CLEO: Applications & Technology 2: Environment/Energy

JWA116
Laser Texturing for Solar Thermal Systems, *Ankit Shah[1], Mool Gupta[1]; [1]Univ. of Virginia, USA.* High solar absorptance and low thermal emittance is desired for absorber surface in solar thermal systems. Molybdenum surface was textured by pulsed fiber laser and reflectance/emittance measurements were performed.

JWA117
Temperature Impact on the Long-Term Stability of a Portable Laser Spectroscopic CO_2 Sensor, *Clinton J. Smith[1], Stephen So[1], Amir Khan[2], Mark A. Zondlo[2], Gerard Wysocki[1]; [1]Electrical Engineering, Princeton Univ., USA; [2]Civil and Environmental Engineering, Princeton Univ., USA.* The influence of ambient temperature on the stability of a low-power laser spectroscopic CO_2 sensor was investigated. Several methods, such as WMS over-modulation and environmental temperature control, were devised for mitigating this influence.

JWA118
A Novel Optical Frequency Rectifying Device: Application as an IR and Optical Sensor, *Brock L. Weiss[1,5], Alexandre Mayer[3], Moon S. Chung[4], Paul H. Cutler[5], Nicholas M. Miskovsky[5], Brian Willis[2]; [1]Physics, Penn State, USA; [2]Chemical, Materials & Biomolecular Engineering, Univ. of Connecticut, USA; [3]Physics, Univ. of Namur, Belgium; [4]Physics, Univ. of Ulsan, Republic of Korea; [5]Scitech Solar, USA.* We propose a novel optical frequency rectifying device consisting of arrays of nanoscopic tunnel junctions made of sharp edged patch antennae or nanowires. Experimental and theoretical work shows the device can operate into the green.

CLEO: Applications & Technology 3: Government & National Science, Security & Standards Applications

JWA119
Low Cost, Battery Powered Optical Detection of Pathogens, *Raghav Khanna[1], William Stanchina[1], Abhay Vats[2]; [1]Electrical and Computer Engineering, Univ. of Pittsburgh, USA; [2]Nephrology, Univ. of Pittsburgh Medical Center, USA.* To satisfy an emergent demand in developing countries, we integrated optical and bio-medical engineering to implement a device which detects pathogens. The device employs DNA amplification and off the shelf components to obtain the diagnosis.

JWA120
Fiber MOPA Based Tunable Source for Terahertz Spectroscopy, *Andrew Malinowski[1], Dejiao Lin[1], Shaif-ul Alam[1], Zhaowei Zhang[1], Morten Ibsen[1], David J. Richardson[1], John Young[2], Paul Wright[2], Krikor Ozanyan[2], Mark Stringer[3], Bob Miles[3]; [1]Optoelectronics Research Centre, Univ. of Southampton, UK; [2]School of Electrical and Electronic Engineering, Univ. of Manchester, UK; [3]Inst. of Microwaves and Photonics, Univ. of Leeds, UK.* We have developed a terahertz spectrometer based on difference frequency generation of beams from a fiber MOPA. We present some demonstration data on water vapor absorption lines.

JWA121
Single-Shot Imaging of Nanoscale Dynamics by Extreme Ultraviolet Microscopy, *Sergio Carbajo[1,5], Fernando Brizuela[1,5], Anne Sakdinawat[3,5], Yanwei Liu[3,5], Weilun Chao[2,5], Weilun Chao[2,5], Erik H. Anderson[2,5], Alexander Vinogradov[4], Igor Artioukov[4], David T. Attwood[3,5], Mario C. Marconi[1,5], Jorge Rocca[1,5], Kristen Buchanan[1], Carmen Menoni[1,5]; [1]Colorado State Univ., USA; [2]Center for X-Ray Optics, Lawrence Berkeley National Laboratory, USA; [3]ECE, Univ. of California Berkeley, USA; [4]Lebedev Physical Inst., Russian Federation; [5]NSF ERC for EUV Science and Technology, USA.* Snap-shot imaging with nanometer spatial resolution and nanosecond temporal resolution is used to make movies of the interaction dynamics of nanostructures.

JWA122
Electro-Optic Microwave-Lightwave Converter Using Patch Antenna Embedded with a Narrow Gap for Optical Modulation, *Yusuf Nur Wijayanto[1], Hiroshi Murata[1], Hidehisa Shiomi[1], Yasuyuki Okamura[1]; [1]Graduate School of Engineering Sceince, Osaka Univ., Japan.* New electro-optic microwave-lightwave converters using a patch antenna embedded with a narrow gap are proposed. Basic operations for the conversion from wireless to optical signals were demonstrated at 18 GHz with no external power supply.

JWA123
A 10Gb/s DFT Based Fast Optical OFDM scheme with Double Spectral Efficiency, *Cheng Lei[1], Hongwei Chen[1], Minghua Chen[1], Shizhong Xie[1]; [1]EE, Tsinghua Univ., China.* A novel DFT based fast OFDM scheme is proposed and experimentally demonstrated. The spectral efficiency of the conventional OFDM is doubled and the computational complexity is almost the same as the conventional OFDM system.

JWA124
FIR Analog Filter Dependence of HCG-Based Hollow-Core Waveguides upon Varying of Waveguide Parameters, *Bishara Shamee[1]; [1]Univ. of Southern California, USA.* We designed and characterized a high performance narrow band FIR filter based on the low loss High Contrast Grating (HCG) Hollow-core Waveguides (HCW) with at least 30 dB rejection and 0.1 dB power leakage.

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. Shahriar[1], Shih Tseng[1], Subramanian Krishnamurthy[1]; [1]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 Jian[1], Kun Xu[1], Min R. Duan[1], Jian Wu[1], Tong J. Lin[1]; [1]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 CeO_2 on the low carbon steel 1015*Gholamreza Fayaz[1], Sepideh Sadat Zakeri[2], M. Vaghefi, A. Seyedin; [1]Physics, Tafresh Univ., Islamic Republic of Iran; [2]Physics, 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 CeO_2 as the powder particles is modeled.

JWA128
All-optical Logic Gates (NAND and AND) Based on Multiinjection in Single Mode Fabry-Perot Laser, *Bikash Nakarmi[1], Mohammad Rakib-Uddin[1], Tran Hoai[1], Yong Hyub Won[1]; [1]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 Tsai[1,2], Feng-Yu Chang[1]; [1]Department of Electrical Engineering, Chang Gung Univ., Taiwan; [2]Graduate of 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.

NOTES

CLEO: QELS-Fundamental Science

CLEO: Science & Innovations

13:30–15:15
QWA • Optical Waveguides and Quantum Information Science
James Franson, Univ. of Maryland Baltimore County, USA, Presider

QWA1 • 13:30
New Photonic components for Quantum information science, *Alberto Politi[1], Jonathan C. Matthews[1], Anthony Laing[1], Alberto Peruzzo[1], Konstantinos Poulios[1], Jasmin Meinecke[1], Damien Bonneau[1], Pete Shadbolt[1], Pruet Kalasuwan[1], Xiao-Qi Zhou[1], Maria Rodas Verde[1], Mirko Lobino[1], Terry Rudolph[2], John G. Rarity[1], Mark G. Thompson[1], Jeremy L. O'Brien[1]; [1]Physics, Univ. of Bristol, UK; [2]Inst. for Mathematical Sciences, Imperial College London, UK.* Optical quantum technologies require new photonic components to exploit integrated architecture. We demonstrate quantum interference in MMI couplers and coupled waveguides that implement two-particle quantum walks, showing unique quantum behaviour.

QWA2 • 13:45
Generation of Correlated Photons in an Integrated Chalcogenide As_2S_3 Waveguide, *Chunle Xiong[1], Graham D. Marshall[2], Alberto Peruzzo[3], Mirko Lobino[3], Alex S. Clark[3], Duk-Yong Choi[4], Steve J. Madden[4], Chandra M. Natarajan[5], Michael G. Tanner[5], Robert H. Hadfield[5], Sander N. Dorenbos[6], Tony Zijlstra[6], Val Zwiller[6], Mark G. Thompson[3], John G. Rarity[3], Michael J. Steel[2], Barry Luther-Davies[4], Ben Eggleton[1], Jeremy L. O'Brien[3]; [1]Physics, Univ. of Sydney, Australia; [2]Physics & Astronomy, Macquarie Univ., Australia; [3]Centre for Quantum Photonics, Univ. of Bristol, UK; [4]Laser Physics Centre, Australian National Univ., Australia; [5]School of Engineering and Physical Sciences, Heriot-Watt Univ., UK; [6]Kavli Inst. for Nanoscience, Delft Univ. of Technology, Netherlands.* We demonstrate the first 1550 nm correlated photon-pair source in a highly nonlinear integrated glass waveguide. A pair coincidence rate of 80 s^{-1} was achieved with the correlation ratio limited by Raman effects.

QWA3 • 14:00
Silicon-on-Insulator Microresonator-based Source of Frequency-Bin Entangled Comb of Photon Pairs, *Jun Chen[1,2], Zachary H. Levine[1], Jingyun Fan[1,2], Alan Migdall[1,2]; [1]Optical Technology Division, National Inst. of Standards and Technology, USA; [2]Joint Quantum 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 microresonator. We also provide design principles for such a microresonator through extensive numerical simulations.

13:30–15:15
CWA • THz Plasmonics
Ajay Nahata, Univ. of Utah, USA, Presider

CWA1 • 13:30
Tunable Terahertz 3D Metamaterials, *Kebin Fan[1], Andrew C. Strikwerda[1], Xin Zhang[1], Richard D. Averitt[1]; [1]Boston 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.

CWA2 • 13:45
Dynamic Variation of Plasmon-Induced Transparency in Terahertz Metamaterials, *Zhongyang Li[1], Yingfang Ma[1], Ran Huang[2], Jianqiang Gu[1], Zhen Tian[1], Shuang Zhang[3], Jiaguang Han[1], Weili Zhang[2]; [1]Center for Terahertz Waves and College of Precision Instrument and Optoelectronics Engineering, Tianjin Univ., China; [2]School of Electrical and Computer Engineering, Oklahoma State Univ., USA; [3]School of Physics and Astronomy, Univ. of Birmingham, UK.* A novel planar metamaterial is proposed to enable the plasmon-induced transparency (PIT) in the terahertz regime. Dynamic variation of the PIT effect is observed when the two independently excitable resonance modes are manipulated.

CWA3 • 14:00
Resonant Transmission of Ring Aperture for Switching Terahertz Waves, *Jie Shu[1], Ciyuan Qiu[1], Victoria Astley[1], Daniel Nickel[1], Daniel Mittleman[1], Qianfan Xu[1]; [1]ECE, 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.

13:30–15:15
CWB • OCT, Tomography, and Sensing
Brian Applegate, Texas A&M Univ. USA, Presider

CWB1 • 13:30
FDML laser for megahertz retinal OCT imaging, *Thomas Klein[1], Benjamin R. Biedermann[1], Christoph M. Eigenwillig[1], Robert Huber[1]; [1]LMU Munich, Germany.* A novel Fourier-domain mode locked (FDML) laser design is presented, yielding the highest wavelength sweep speed reported so far around 1050nm. This enables retinal imaging over a ~70° ultra-wide field of view.

CWB2 • 13:45
Ultra-high resolution all-reflective OCT system with a compact fiber-based supercontinuum source, *Khanh Kieu[1], Anna Evans[1], Justin Klein[1], Jennifer Barton[1], Nasser Peyghambarian[1]; [1]Univ. 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 micron in tissue at a center wavelength around 1300 nm.

CWB3 • 14:00
Towards a Miniaturized Optical Coherence Tomography System, *Imran B. Akca[1], Duc V. Nguyen[2], Jeroen Kalkman[2], Ton G. van Leeuwen[2,3], Kerstin Worhoff[1], Rene M. de Ridder[1], Markus Pollnau[1]; [1]Integrated Optical MicroSystems Group, MESA+ Inst. for Nanotechnology, Univ. of Twente, Netherlands; [2]Academic Medical Center, Biomedical Engineering & Physics, Univ. of Amsterdam, Netherlands; [3]Biomedical 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.

13:30–15:15
CWC • Dynamical Microsystems
Shayan Mookherjea, Univ. of California San Diego, USA, Presider

CWC1 • 13:30
Electro-Optical Tunable Time Delay and Advance in Silicon Feedback-Microring Resonators, *Shaoqi Feng[1], Xianshu Luo[1], Andrew W. Poon[1]; [1]Electronic and Computer Engineering Department, The Hong Kong Univ. of Science and Technology, Hong Kong.* We report electro-optical tunable time delay/advance using silicon feedback-microring resonators integrated with p-i-n diodes. We demonstrate tuning of time delay/advance from -84 to 114 ps at a fixed resonance wavelength by changing feedback phase.

CWC2 • 13:45
High Frequency Oscillations in Ultra-high Q Silicon Microresonators, *Mohammad Soltani[2], Ali Asghar Eftekhar[1], Ali Adibi[1]; [1]ECE, Georgia Inst. of Technology, USA; [2]ECE, Cornell Univ., USA.* We report the experimental observation of long-sustained GHz electronic oscillations resulting from coupled electron-photon dynamics in ultra-high-Q Si microdisk resonators with CW pumping.

CWC3 • 14:00 Invited
From Analog to Digital Conversion to Blood Screening; Evolution of Photonic Time Stretch, *Bahram Jalali[1,3], Keisuke Goda[1,2], Ali Fard[1,2], Sang Hyup Kim[1]; [1]Electrical Engineering, Univ. of California at Los Angeles, USA; [2]California NanoSystems Inst., Univ. of California at Los Angeles, USA; [3]Department 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.

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 Andrekson[1,2]; [1]Department of Microtechnology and Nanoscience, Chalmers Univ. of Technology, Sweden; [2]EXFO 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 Slavik[1], Joseph Kakande[1], Francesca Parmigiani[1], David J. Richardson[1]; [1]Univ. of Southampton, UK.* We review recent results regarding regeneration of binary and quadruple phase encoded signals using phase sensitive amplification in fibers.

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 DeMille[1]; [1]Physics 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.

David DeMille is Professor of Physics at Yale Univ.. He received his Ph.D. from the Univ. of California, Berkeley in 1994 and was on the faculty at Amherst College before joining Yale in 1998. His interests lie in the fields of ultracold molecules and precision measurements. He is a Fellow of the American Physical Society and received the Francis M. Pipkin Award of the APS in 2006. He received the Yale Univ. Condé Award for Teaching Excellence in 2004 and has given over 125 invited talks at conferences and departmental colloquia.

CLEO: Science & Innovations

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

CWE1 • 13:30

Laser Control of Self-organization Process in Microscopic Region, *Yukimasa Matsumura[1], Wataru Inami[2,3], Yoshimaa Kawata[1,3]; [1]Graduate School of Science and Technology, Shizuoka Univ., Japan; [2]Division of Global Research Leaders, Shizuoka Univ., Japan; [3]Japan 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 • 13:45

Femtosecond laser patterning and replication of PMMA for spatially tailored wettabilty in microfluidic channels, *Shane M. Eaton[1], Camela De Marco[2], Stefano Rampini[3], Rebecca Martiniz Vázquez[1], Giulio Cerullo[3], Roberta Ramponi[3], Stefano Turri[2], Marinella Levi[2], Roberto Osellame[1]; [1]Inst. for Photonics and Nanotechnologies - CNR, Milano, Italy; [2]Giulio Natta Dept. of Chemistry, Politecnico di Milano, Milano, Italy; [3]Dept. 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.

CWE3 • 14:00 Tutorial

Laser Fabrication of 3D Microenvironments for Small Cellular Populations, *Jason B. Shear[1,3], Eric T. Ritschdorff[1], Jodi L. Connell[1], Eric Spivey[2]; [1]Chemistry & Biochemistry, Univ. of Texas at Austin, USA; [2]Biomedical Engineering, Univ. of Texas, USA; [3]Bioengineering, Rice Univ., USA.* I will discuss development of a lithographic strategy based on multiphoton-excited crosslinking of proteins and other biological molecules and application of this approach to study cultured cells in physiologically relevant, 3D microenvironments.

Jason Shear was a Howard Hughes Predoctoral Fellow at Stanford Univ., receiving his Ph.D. in Chemistry in 1995. He then worked as an NSF

(Continued on pg. 139)

CLEO: QELS-Fundamental Science

CLEO: Science & Innovations

13:30–15:15
QWC • Emission Control with Nanooptics
Harald Giessen, Univ. of Stuttgart, Germany, Presider

QWC1 • 13:30 Invited

Unidirectional emission of a quantum dot coupled to an optical nanoantenna, *Niek F. van Hulst[1]; [1]ICFO - 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° HWHM angle.

QWC2 • 14:00

Enhancement of Optical Emission by Coupled Metal Nanoparticles, *Greg Sun[1], Jacob B. Khurgin[2]; [1]Physics, Univ. of Massachusetts Boston, USA; [2]Electrical and Computer Engineering, Johns Hopkins Univeristy, USA.* We present an analytical model of "coupled modes" describing enhancement of emission by the atoms and molecules placed within complexes of metal nanoparticles.

13:30–15:15
CWF • Toward More Efficient Visible LEDs
E. Fred Schubert, Rensselaer Polytechnic Inst., USA, Presider

CWF1 • 13:30 Invited

Highly efficient InGaN/GaN blue LED grown on Si (111) substrate, *Jun-Youn Kim[1], Yongjo Tak[1], Jae Won Lee[1], Hyun-Gi Hong[1], Suhee Chae[1], Hyoji Choi[1], Bokki Min[1], Youngsoo Park[1], Min-Ho Kim[2], Seongsuk Lee[2], Namgoo Cha[2], Yunhee Shin[2], Jong-Ryeol Kim[3], Jong-In Shim[4]; [1]Samsung electronic company, Republic of Korea; [2]R&D 2Team, Samsung LED, Republic of Korea; [3]Optical Engineering, Sejong Univ., Republic of Korea; [4]Electrical and Computer Engineering, Hanyang Univ., 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 mm^2 LED chips exceeded 420 mW under un-encapsulated condition.

CWF2 • 14:00

Optical Characterization of Semipolar GaN Light-Emitting Diodes on Sapphire, *Benjamin Leung[1], Yu Zhang[1], Qian Sun[1], Christopher Yerino[1], Zhen Chen[2], Steve Lester[2], Kuan-Yung Liao[3], Yun-Li Li[3], Jung Han[1]; [1]Yale Univ., USA; [2]Bridgelux, Inc., USA; [3]Genesis Photonics, Inc., Taiwan.* Semipolar (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.

13:30–15:15
CWG • High Intensity and Short Pulse
Constantin Haefner, Lawrence Livermore Natl. Lab, USA, Presider

CWG1 • 13:30

Amplification to the Period-Doubling Limit in an All-Fiber Regenerative Amplifier for High-Intensity Laser Systems, *Ran Xin[1], Jonathan D. Zuegel[1]; [1]LLE, Univ. of Rochester, USA.* Optical pulses at 1053 nm are amplified to 240 nJ in a Yb-doped all-fiber regenerative amplifier (AFRA) at the period-doubling limit. To the best of our knowledge, this is the highest AFRA output energy.

CWG2 • 13:45

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

CWG3 • 14:00

High Temporal Contrast Front End with a multipass Ti:Sa amplifier and a CaF_2-based XPW temporal filter, *Mikhail Kalashnikov[1], Karoly Osvay[1,2], Roman Volkov[3], Horst Schönnagel[1], Wolfgang Sandner[1]; [1]Max-Born-Inst., Germany; [2]Univ. of Szeged, Hungary; [3]M.V. Lomonosov Moscow State Univ., Russian Federation.* A laser system applying spectrally shaped multipass amplifier and cross polarized wave generation produces pulses with 80 nm bandwidth at 0.1mJ energy level, while the temporal contrast of the amplified 100 TW pulses exceeds 5.10^{10}.

13:30–15:15
CWH • Optical Measurements and Waveform Characterization
Jason Jones, Univ. of Arizona, USA, Presider

CWH1 • 13:30

Two-Color Interferometry using Frequency Combs for High-Accuracy Self-Correction of Air Refractive Index, *Kaoru Minoshima[1], Kaoru Arai[2], Hajime Inaba[1]; [1]AIST, Japan; [2]Tokyo Univ. of Science, Japan.* Long-path interferometry of two-color frequency combs is developed for high-accuracy self-correction of air refractive index fluctuation. Interferometric phase difference was highly consistent with calculation: 3×10^{-10} for 10-h measurements.

CWH2 • 13:45

Toward a picometer displacement-sensing interferometry for the next generation of calculable capacitor, *Mathieu Durand[1], John Lawall[1], Yicheng Wang[1]; [1]Physical Measurement Laboratory, National Inst. of Standards and Technology, USA.* High resolution Fabry-Perot interferometer system is designed to measure displacement by measuring both the cavity mode spacing and the mode position shift. We achieve a fractional uncertainty of $2.10^{-9}/Hz^{1/2}$ without any optical frequency standard.

CWH3 • 14:00

Experimental Implementation of Classical Far-Field Phase-Sensitive Ghost Imaging, *Dheera Venkatraman[1], Nicholas D. Hardy[1], Franco Wong[1], Jeffrey H. Shapiro[1]; [1]Electrical Engineering, Massachusetts Inst. of 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.

NOTES

CLEO: Science & Innovations

13:30–15:15
CWI • Ultrafast Pulse Generation I
François Légaré, INRS, Canada, Presider

CWI1 • 13:30 Invited

High-fidelity Frontend Based on XPW Filter for High-contrast Few-cycle OPCPAs, *Aurélie Jullien[1], Aurelien Ricci[1,2], Xiaowei Chen[1,3], Jean-Philippe Rousseau[1], Rodrigo Lopez-Martens[1], Lourdes P. Ramirez[4], Dimitris Papadopoulos[3,4], Alain Pellegrina[3,4], Patrick Georges[4], Frederic Druon[4]; [1]ENSTA-CNRS-Ecole Polytechnique, Laboratoire d'Optique Appliquée, France; [2]Thales Optronique SA, France; [3]Institut de la Lumière Extrême, France; [4]Laboratoire Charles fabry de l'Insitut d'Optique, France.* We demonstrate a 80μJ, 5fs, CEP-stable 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 OPCPA systems.

CWI2 • 14:00

High energy and efficient cross polarized wave generation for high contrast ultrashort laser sources, *Lourdes P. Ramirez[1], Dimitris Papadopoulos[1,2], Alain Pellegrina[1,2], Patrick Georges[1], Frederic Druon[1], Pascal Monot[3], Aurélien Ricci[4,5], Aurélie Jullien[4], Xiaowei Chen[2,4], Jean-Philippe Rousseau[4], Yi Liu[4], Aurélien Houard[4], Rodrigo Lopez-Martens[4]; [1]Laboratoire Charles Fabry de l'Institut d'Optique, CNRS, Université Paris Sud, France; [2]Institut de la Lumière Extrême, CNRS, Ecole Polytechnique, Ensta Paristech, Institut d'Optique, Université Paris Sud, France; [3]CEA, IRAMIS, Service des Photons Atomes et Molécules, France; [4]Laboratoire d'Optique Appliquée, ENSTA Paristech, CNRS, Ecole Polytechnique, France; [5]Thales Optronique SA, Laser Solutions Unit, France.* We present a compact and energy-scalable crossed polarized wave generation setup with waveguide filtering. A 1.4 mJ, 14.5 fs FTL, 10^{-4} contrast ratio enhanced XPW pulse is produced with 11 mJ, 40 fs input pulse.

CLEO: QELS-Fundamental Science

13:30–15:15
QWD • Strongly Correlated Electron Systems
Nuh Gedik, MIT, USA, Presider

QWD1 • 13:30

Large Strain-Induced Conductivity Anisotropy in VO_2 Thin Films Probed by THz Spectroscopy, *Mengkun Liu[1], Elsa Abreu[1], Jiwei Lu[2], Kevin West[2], Salinporn Kittiwatanakul[3], Wenjing Yin[2], Stuart Wolf[3], Richard D. Averitt[1]; [1]Department of Physics, Boston Univ., USA; [2]Department of Materials Science and Engineering, Univ. of Virginia, USA; [3]Department of Physics, Univ. of Virginia, USA.* We probe the temperature dependent far-infrared conductivity of highly strained (100)VO_2 thin films using THz TDS. A large in-plane anisotropy is observed in both the metallic conductivity and the metal-insulator transition temperature.

QWD2 • 13:45

Effect of Phase-Transforming Medium on Coherent Electron Dynamics in Gold Nanoantennas, *Kannatassen Appavoo[2,1], Richard F. Haglund[1,2]; [1]Physics and Astronomy, Vanderbilt Univ., USA; [2]Inst. of Nanoscale Science and Engineering, Vanderbilt Univ., USA.* We probed the coherent plasmon dephasing time (T_2) in gold nanostructures while thermally modulating the surrounding VO_2. Our findings indicate three distinct lifetimes corresponding to insulating, metallic and one at the phase-transformation onset.

QWD3 • 14:00

Femtosecond Dynamics of Superconducting and Spin-Density Wave Gaps in Pnictides, *Kyungwan Kim[1,2], Alexej Pashkin[1], Markus Beyer[1], Hanjo Schäfer[1], Mihael Porer[1], Thomas Wolf[3], Christian Bernhard[2], Jure Demsar[1], Rupert Huber[1,4], Alfred Leitenstorfer[1]; [1]Department of Physics, Univ. of Konstanz, Germany; [2]Department of Physics, Univ. of Fribourg, Switzerland; [3]Institut für Festkörperphysik, Karlsruher Institut für Technologie, Germany; [4]Department of Physics, Univ. of Regensburg, Germany.* We study $Ba(Fe,Co)_2As_2$ by combined ellipsometry and ultrabroadband terahertz pump-probe experiments. The distinctive destruction/recovery dynamics of the superconducting and spin density wave gaps as well as coherent oscillations are resolved.

13:30–15:15
QWE • Optomechanical Systems I
David Hagan, CREOL, The College of Optics and Photonics, USA, Presider

QWE1 • 13:30 Tutorial

Cavity Optomechanics, *Pierre Meystre[1]; [1]Department of Physics and Optical Sciences Center, Univ. of Arizona, USA.* The talk will present a tutorial introduction to the emerging field of cavity optomechanics, review some of its recent developments, both in "top down" and in "bottom up" approaches, and comment on potential applications.

Pierre Meystre obtained his PhD from the Swiss Federal Inst. of Technology in Lausanne, Switzerland, and the Habilitation in Theoretical Physics from the Univ. of Munich, Germany. His research area is theoretical AMO physics, including laser physics, cavity QED, atom optics, Bose-Einstein condensation, and cavity optomechanics. He has authored and coauthored nearly 300 refereed publications, as well as the text "Elements of Quantum Optics", together with Murray Sargent III., and the monograph "Atom Optics." He is the recipient of several awards, including the R. W. Wood Prize of the OSA, and is a Fellow of APS, OSA and AAAS.

NOTES

CLEO: QELS-Fundamental Science

CLEO: Science & Innovations

QWA • Optical Waveguides and Quantum Information Science—Continued

QWA4 • 14:15
Quantum Optics of Spontaneous Four-Wave Mixing in a Silicon Nitride Microring Resonator, *L. G. Helt[1], Marco Liscidini[2], Alessandro Farsi[3], Stéphane Clemmen[3], Vivek Venkataraman[3], Jacob S. Levy[4], Michal Lipson[4], Alexander L. Gaeta[3], J. E. Sipe[1]; [1]Department of Physics, Univ. of Toronto, Canada; [2]Department of Physics "A. Volta", Univ. of Pavia, Italy; [3]School of Electrical and Computer Engineering, Cornell Univ., USA; [4]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 unentangled, is possible in existing Si_3N_4 microring resonators.

QWA5 • 14:30
High-Performance Entangled Photon Pair Generation in Bragg Reflection Waveguides, *Sergei V. Zhukovsky[1,2], L. G. Helt[1], Payam Abolghasem[2], Dongpeng Kang[2], J. E. Sipe[1], Amr S. Helmy[2]; [1]Dept. of Physics, Univ. of Toronto, Canada; [2]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 4×10^8 pairs/s/mW/nm.

QWA6 • 14:45
Type II Parametric Downconversion in a Poled Fiber, *Eric Y. Zhu[1], Edward A. Lee-Kim Koon[1], Li Qian[1], L. G. Helt[2], Marco Liscidini[2,3], J. E. Sipe[2], Costantino Corbari[4], Albert Canagasabey[4,5], Morten Ibsen[4], Peter Kazansky[4]; [1]Dept. of Electrical & Computer Engineering, Univ. of Toronto, Canada; [2]Dept. of Physics, Univ. of Toronto, Canada; [3]Dipartimento di Fisica 'A. Volta', Universita degli Studi di Pavia, Italy; [4]Optoelectronics Research Centre, Univ. of Southampton, UK; [5]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
Characterization of high-purity, pulsed squeezed light at telecom wavelengths from pp-KTP for quantum information applications, *Thomas Gerrits[1], Burm Baek[1], Martin Stevens[1], Brice Calkins[1], Adriana Lita[1], Scott Glancy[1], Emanuel Knill[1], Sae Woo Nam[1], Richard P. Mirin[1], Robert H. Hadfield[2], Ryan S. Bennink[3], Warren P. Grice[3], Sander N. Dorenbos[4], Tony Zijlstra[4], Teun Klapwijk[4], Val Zwiller[4]; [1]National Inst. of Standards and Technology, USA; [2]Heriot-Watt Univ., UK; [3]Center for Quantum Information Science, Oak Ridge National Laboratory, USA; [4]Kavli Inst. for Nanoscience, Delft Univ. of Technology, Netherlands.* We characterize a pp-KTP crystal designed to produce pure single mode squeezed vacuum at 1570 nm. Measurements show Hong-Ou-Mandel interference with 97% visibility and a circular joint spectral distribution with a Schmidt number of 1.08.

CWA • THz Plasmonics—Continued

CWA4 • 14:15
Bending Terahertz Beams in "Free Space", *Rajind Mendis[1], Jingbo Liu[1], Daniel Mittleman[1]; [1]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 Invited
Three-dimensional Terahertz Cloak, *Cheng Sun[1], Yongjun Bao[1], Wei Cao[2], Colin Stuart[1], Jianqiang Gu[2], Weili Zhang[2], Fan Zhou[1]; [1]Northwestern Univ., USA; [2]Oklahoma State Univ., USA.* We report the first three-dimensional invisibility cloak operates at a broad Terahertz frequency band (0.3~0.6 THz). The cloaking device is then used to conceal both the geometrical and spectroscopic signatures of α-lactose monohydrate test structure.

CWA6 • 15:00
TM and TE1 Operation of Cylindrical Terahertz Waveguides, *Alisha J. Shutler[1], Michael Theuer[2,1], S. Sree Harsha[1], Daniel R. Grischkowsky[1]; [1]Electrical Engineering, Oklahoma State Univ., USA; [2]Department of Terahertz Measurement and Systems, Fraunhofer Institue for Physical Measurement Techniques, Germany.* We report on a cylindrical-based guided wave structure that omits the need for the high index silicon lenses used for parallel plate waveguides, showing good performance in both TM and TE propagational modes.

CWB • OCT, Tomography, and Sensing—Continued

CWB4 • 14:15
Concurrent Multi-scale Imaging Combining Optical Coherence Tomography with MRI, *Chia-Pin Liang[1], Bo Yang[1], Alan McMillan[2], Rao Gullapalli[2], Jaydev P. Desai[1], Yu Chen[1]; [1]Univ. of Maryland, College Park, USA; [2]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 MRI guidance. The feasibility of real-time multi-scale imaging is demonstrated on a tissue phantom of breast tumor.

CWB5 • 14:30
Motion compensation for two photon microscopy by optical coherence tomography feedback, *Serghei Malkov[1]; [1]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
Non-Contact Human Cardiac Activity Monitoring Using a High Sensitivity Pulsed Laser Vibrometer, *ChenChia Wang[1], Sudhir Trivedi[1], Susan Kutcher[1], Ponciano Rodriguez[1], Feng Jin[1], V. Swaminathan[2], Sheela Nagaraj[2], Shafik Quoraishee[2], Narasimha S. Prasad[3]; [1]Brimrose Corp., USA; [2]US Army, USA; [3]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.

CWB7 • 15:00
Tomographic Imaging with Single Detector Lateral Frequency Modulation Projections, *Philip Schlup[1], Greg Futia[1], Randy Bartels[1,2]; [1]Electrical and Computer Engineering, Colorado State Univ., USA; [2]School of Biomedical Engineering, Colorado State Univ., USA.* A lateral tomographic imaging technique that forms object projections with a single photodetector is demonstrated. A spatially-varying modulation applied to the illumination beam encodes object projections in the photodiode signal spectrum.

CWC • Dynamical Microsystems—Continued

CWC4 • 14:30
Engineering Optical Bistability in Silicon Ring Resonators, *Lian-Wee Luo[1], Gustavo Wiederhecker[1], Kyle Preston[1], Michal Lipson[1,2]; [1]Cornell Univ., USA; [2]Kavli Inst. at Cornell for Nanoscale Science, USA.* We demonstrate an atypical reverse optical bistability (blue shift of the resonance) in designed silicon ring resonators by compensating the thermo-optic red shift with a strong free carrier dispersion blue shift.

CWC5 • 14:45
Wavelength Tracking with Thermally Controlled Silicon Resonators, *Ciyuan Qiu[1], Qianfan Xu[1]; [1]ECE, Rice Univ., 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.

CWC6 • 15:00
Observation of frequency shift in a dynamically tuned fiber grating cavity by a beating technique, *Irina Kabakova[1], David Halliwell[1], C. Martijn de Sterke[1], Zhangwei Yu[2], Pierre-Yves Fonjallaz[2], Walter Margulis[2], O. Tarasenko[2]; [1]Univ. of Sydney, Australia; [2]Acreo AB, Sweden.* Dynamic frequency changes of light trapped in a fiber grating-based cavity, which is detuned by RF pulses, are detected by a simple, elegant, high-resolution method in which the trapped light beats with the incoming light.

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*

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[1]; [1]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.

CWD4 • 15:00

Experimental Demonstration of Variable Optical Hexadecimal Coding/Decoding of 10-Gbaud/s 16-QAM Using FWM in HNLFs, *Jian Wang[1], Jeng-Yuan Yang[1], Xiaoxia Wu[1], Alan E. Willner[1]; [1]Ming Hsieh Dept. of Electrical Engineering - Systems, Univ. of Southern California, USA.* We demonstrate optical coding/decoding of 16-QAM using degenerate FWM in HNLFs. Constellation manipulation for variable coding/decoding of 10-Gbaud/s 16-QAM is implemented with OSNR penalty <1.1dB with CW pump and <1.2dB with phase-modulated Key.

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[1], Kelly C. Younge[1], Georg Raithel[1]; [1]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.

QWB3 • 14:45

Production of Ultracold Molecular Ion, *Kuang Chen[1], Steven Schowalter[1], Svetlana Kotochigova[2], Alexander Petrov[2], Wade Rellergert[1], Scott Sullivan[1], Eric Hudson[1]; [1]Physics, Univ. of California, Los Angeles, USA; [2]Physics, Temple Univeristy, USA.* We present experimental data to produce ultracold, internal ground-state molecular ions via sympathetic cooling with ultracold atoms. Ultracold molecular ions find applications in ultracold chemistry, precision measurement and quantum computation.

QWB4 • 15:00

Momentum-space engineering of gaseous Bose-Einstein condensates, *Mark A. Edwards[2], Brandon Brenton[2], Jeffrey Heward[2], Charles W. Clark[1]; [1]Electron and Optical Physics Division, NIST, USA; [2]Department of Physics and Astronomy, Georgia Southern Univ., USA.* Bose-Einstein condensate momentum distributions can be shaped by standing-wave laser pulse sequences. We find that several momentum distributions, important in atom-interferometry applications, can be engineered with high fidelity with two or three pulses.

CLEO: Science & Innovations

CWE • Laser Fabrication for Life Science Applications—Continued

Postdoctoral Fellow with Watt Webb at Cornell before joining the faculty at the Univ. of Texas at Austin in 1996. He has received various recognitions, including MIT Technology Review's TR100 (1999) and the ACS's Arthur Findeis Award (2005). Prof. Shear's group has focused on laser-based strategies for microanalysis and microfabrication, concentrating on the design and characterization of microscopic biological environments. He currently is a Professor of Chemistry at the Univ. of Texas and the K. Bala Texas Instruments Visiting Professor in Bioengineering at Rice Univ.

CWE4 • 15:00

Laser immobilization of photosynthetic material on Screen Printed Electrodes, *Christos Boutopoulos[1], Eleftherios Touloupakis[2,3], Ittalo Pezzotti[3], Maria T. Giardi[2], Ioanna Zergioti[1]; [1]Physics Department, National Technical Univ. of Athens, Greece; [2]National Research Council, Inst. of Crystallography, Italy; [3]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*

CLEO: QELS-Fundamental Science

CLEO: Science & Innovations

QWC • Emission Control with Nanooptics—Continued

QWC3 • 14:15
First Observation of Raman Scattering Emission from Silicon High-Q Photonic Crystal Nanocavities, *Yasushi Takahashi[1], Ryo Terawaki[1], Masahiro Chihara[1], Takashi Asano[2], Susumu Noda[2]; [1]NanoSquare, Osaka Prefecture Univ., Japan; [2]Electronic Science and Engineering, Kyoto Univ., Japan.* We report the first observation of spontaneous Raman scattering in silicon nanocavities with high quality factors. Stokes Raman scattering enhanced by the Q factor was spectrally measured under uW pumping.

QWC4 • 14:30
Raman Antenna Formed by Molecule/Plasmonic Nanostructure Hybrid System, *Shiuan-Yeh Chen[1], Jack J. Mock[1], Ryan T. Hill[1], Ashutosh Chilkoti[1], David R. Smith[1], Anne Lazarides[1]; [1]Duke Univ., USA.* 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.

QWC5 • 14:45
Nanophotonic circular dielectric grating for efficient free-space extraction of single quantum dot emission, *Marcelo Davanço[1,2], Matthew T. Rakher[1], Antonio Badolato[3], Kartik Srinivasan[1]; [1]Center for Nanoscale Science and Technology, National Inst. of Standards and Technology, USA; [2]Maryland NanoCenter, Univ. of Maryland, USA; [3]Dept. of Physics and Astronomy, Univ. of Rochester, USA.* We demonstrate a suspended circular grating for efficient, broadband photoluminescence spectroscopy of single InAs quantum dots. Collected photon rates 20 times greater than in bulk and significant radiative lifetime reduction are observed.

QWC6 • 15:00
Differentiating the Roles of Surface Plasmon Polaritons in Excitation and Spontaneous Emission Rates and Outcoupling Efficiency Enhancement from Nanohole Arrays, *Kay Fung Chan[1], Hock Chun Ong[1]; [1]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.

CWF • Toward More Efficient Visible LEDs—Continued

CWF3 • 14:15
On the symmetry of efficiency-versus-carrier-concentration curves in GaInN/GaN light-emitting diodes and relation to droop-causing mechanisms, *Qi Dai[1], Qifeng Shan[1], Jaehee Cho[1], E. Fred Schubert[1], Mary H. Crawford[2], Daniel D. Koleske[2], Min-Ho Kim[3], Yongjo Park[3]; [1]Rensselaer Polytechnic Inst., USA; [2]Sandia National Laboratories, USA; [3]Samsung LED, Republic of Korea.* The ABC model (without and with phase-space filling) predicts IQE-versus-n curves of GaInN light-emitting diodes that have even symmetry. Analysis of IQE-versus-n curves shows the need for a carrier leakage term to explain the droop.

CWF4 • 14:30
Efficiency Droop Reduction in InGaN/GaN Light-emitting Diodes by Graded-thickness Multiple Quantum Wells, *Chao-Hsun Wang[1], Wei-Ting Chang[2], Shih-Pang Chang[1], Jinchai Li[1], Hao-chung Kuo[1], Tien-Chang Lu[1], Shing-chung Wang[1]; [1]Inst. of Electro-Optical Engineering, National Chiao-Tung Univ., Taiwan; [2]Department of Electrophysics, National Chiao-Tung Univ., Taiwan.* InGaN LED with graded-thickness MQWs has superior hole and radiative recombination distribution by simulation modeling, and EL spectrum reveals additional emission from the narrower wells. Output power and efficiency droop behavior are both improved.

CWF5 • 14:45
Surface Plasmon Dispersion Engineering via Double-Metallic Au / Ag Layers for Nitride Light-Emitting Diodes, *Hongping Zhao[1], Jing Zhang[1], Guangyu Liu[1], Nelson Tansu[1]; [1]Department of Electrical and Computer Engineering, Lehigh Univ., USA.* The use of double-metallic Au / Ag layers coupled to InGaN quantum well (QW) results in wide-spectrum tuning of the Purcell peak enhancement of the spontaneous recombination rate for nitride light-emitting diodes.

CWF6 • 15:00
Monochromatic Organic Photodiodes Made by Stackable Ink-jet Fabrication for Integrated Laser Chips, *Tokuma Nakamichi[1], Yu Yang[1], Soichiro Omi[1], Hiroaki Yoshioka[1], Hirofumi Watanabe[1], Masayuki Yahiro[2], Masanao Era[3], Yuji Oki[1]; [1]Graduate School of Information Science and Electrical Engineering, Kyushu Univ., Japan; [2]Inst. of Systems, Information Technologies and Nanotechnologies, Japan; [3]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, indicating the realization of integrated flow-cytometry chips.

CWG • High Intensity and Short Pulse—Continued

CWG4 • 14:15
50-MW, 12-ps Nd:YVO_4 Slab Amplifier for OPCPA Pumping, *Clemens Heese[1], Andreas E. H. Oehler[1], Lukas Gallmann[1], Ursula Keller[1]; [1]Department of Physics, Inst. of Quantum Electronics, ETH Zurich, Switzerland.* We demonstrate 12-ps pulses with 50-MW peak power from a Nd:YVO_4 slab amplifier. The amplifier is seeded at repetition rates of 50 kHz and 100 kHz and provides output energies of up to 600 μJ.

CWG5 • 14:30 Invited
Extreme ultraviolet free electron laser seeded by high-order harmonic, *Tadashi Togashi[1,2], Eiji Takahashi[3], Katsumi Midorikawa[3], Makoto Aoyama[4], Hideaki Yamakawa[4], Takahiro Sato[1,5], Atsushi Iwasaki[5], Shigeki Owada[5], Tomoya Okino[5], Kaoru Yamanouchi[5], Marie E. Couprie[6], Toru Hara[1], Noritaka Kumagai[1], Shinichi Matsubara[1,2], Mitsuru Nagasono[1], Takashi Ohshima[1,2], Yuji Otake[1,2], Tsumoru Shintake[1], Hitoshi Tanaka[1,2], Takashi Tanaka[1,2], Kazuaki Togawa[1], Hiromitsu Tomizawa[1,2], Takahiro Watanabe[2], Makina Yabashi[1], Tetsuya Ishikawa[1]; [1]XFEL Project Head Office, Riken, Japan; [2]Japan Synchrotron Radiation Research Inst., Japan; [3]Advanced Science Inst., Riken, Japan; [4]Quantum Beam Science Directorate, Japan Atomic Energy Agency, Japan; [5]The Univ. of Tokyo, Japan; [6]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-peak spectra with drastic enhancements of intensity by nearly three-orders of magnitude.

CWG6 • 15:00
Tabletop generation of carrier envelope phase stabilized multi-mJ few-cycle pulses, *Alexandria Anderson[1], Fabian Luecking[1], Thomas Prikoszovitz[1], Martin Hofer[1], Zhao Cheng[1], Tuan Le[1], Catalin C. Neacsu[1], Gabriel Tempea[1], Andreas Assion[1]; [1]Femtolasers Produktions GmbH, Austria.* A compact system for the generation of few-cycle multi-mJ carrier envelope phase (CEP) stabilized pulses is presented. The output 5.4 fs, 1.9 mJ pulses have CEP noise of only 190 mrad rms over seven hours.

CWH • Optical Measurements and Waveform Characterization—Continued

CWH4 • 14:15
Ultra-Broadband Chirp Linearity Characterization with an Optical Frequency Comb, *Zeb Barber[1], Jason R. Dahl[1], Peter A. Roos[2], Randy R. Reibel[2], Nathan Greenfield[2], Fabrizio Giorgetta[3], Ian Coddington[3], Nathan Newbury[3]; [1]Spectrum Lab, Montana State Univ., USA; [2]Bridger Photonics Inc., USA; [3]National Inst. of Standards and Technology, USA.* The linearity of actively stabilized laser chirp from approximately 1530 to 1570 nm is measured by use of an optical frequency comb showing residuals of < 60 kHz after removing low order dispersion related effects.

CWH5 • 14:30
Demonstration of Dynamic Optical Arbitrary Waveform Generation with 5-ns Record Lengths and 33-ps Features, *Ryan P. Scott[1], Nicolas K. Fontaine[1], David J. Geisler[1], Tingting He[1], Jonathan P. Heritage[1], S. J. Ben Yoo[1]; [1]Electrical and Computer Engineering, Univ. of California, Davis, USA.* We demonstrate bandwidth-scalable, high-fidelity dynamic arbitrary optical waveforms with 30-GHz of bandwidth by coherently combining three 10-GHz spectral slices generated with just 5.5 GHz of electrical bandwidth per I/Q modulator signal.

CWH6 • 14:45
Narrow-Linewidth Chirped Frequency Comb from a Seeded Frequency-Shifted Feedback Ti:Sapphire Laser, *Matthias F. Brandl[1,2], Oliver D. Muecke[1]; [1]Photonics Inst., Vienna Univ. of Technology, Austria; [2]Inst. of Electrodynamics, 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.

CWH7 • 15:00
Single-Shot Frequency-Resolved-Optical-Gating Device for Complete Temporal Intensity-and-Phase Measurements of Nanosecond Pulses, *Pamela Bowlan[1,2], Rick Trebino[1,2]; [1]Swamp Optics, USA; [2]Physics, Georgia Tech, USA.* We demonstrate a simple FROG device for completely measuring nanosecond pulses. Its key innovation is its use of ~89.9° pulse-front tilt to obtain a several-ns delay range. We measure even complex several-ns Yb-fiber amplifier pulses.

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*

CLEO: Science & Innovations

CWI • Ultrafast Pulse Generation I—Continued

CWI3 • 14:15
Mid-IR Few-Cycle Pulses Approaching a 0.1 TW Peak Power, *Giedrius Andriukaitis[1], Tadas Balciunas[1], Igor Diomin[1], Audrius Pugzlys[1], Andrius Baltuska[1]; [1]Photonics Inst., Vienna Univ. of Technology, Austria.* We demonstrate a compact 20-Hz-repetition-rate mid-IR OPCPA for application in high-field science which operates at 3900 nm with a FWHM bandwidth of 600 nm delivering 6-mJ pulses compressed to 75±10 fs (< 6 optical cycles).

CWI4 • 14:30
Octave-Spanning Carrier-Envelope Phase Stable Sub-3-fs Pulse in Visible, *Kotaro Okamura[1,2], Takayoshi Kobayash[1,2]; [1]Advanced Ultrafast Laser Research Center, and Department of Engineering Science, Faculty of Informatics and Engineering, The Univ. of Electro-Communications, Japan; [2]ICORP, Ultrashort Pulse Laser Project, JST, Japan.* The second-harmonic of idler from a non-collinear optical parametric amplifier is compressed using adaptive dispersion control with a deformable mirror. The spectrum of isolated ultrashort pulse is smooth and suitable for spectroscopic applications.

CWI5 • 14:45
Transmission Bragg-grating Grisms for Pulse Compression, *Nicolas Forget[1], Vincent Crozatier[1], Pierre Tournois[1]; [1]FASTLITE, France.* We design a grism compressor based on Bragg transmission gratings and high index prisms. Single-pass throughput of ~76% over 740-840nm with large negative third order dispersion matchable to bulk stretcher dispersion is demonstrated.

CWI6 • 15:00
A Simple Linear Technique for Measuring the Carrier-Envelope Offset Phase of Ultrashort Pulses, *Peter Jojart[1,2], Borzsonyi Adam[1,2], Sebastian Koke[3], Mihaly Gorbe[2,4], Karoly Osvay[1]; [1]Optics and Quantum Electronics, Univ. of Szeged, Hungary; [2]CE Optics Kft., Hungary; [3]Max-Born-Institut für Nichtlineare Optik und Ultrakurzzeitspektroskopie, Germany; [4]Faculty of Mechanical Engineering and Automation, Kecskemet College, Hungary.* A spectrally resolved multiple beam interferometer is capable for measuring the carrier-envelope offset phase of ultrashort laser pulses with an accuracy of 70mrad. The performance has been cross-calibrated with a conventional f-to-2f interferometer.

CLEO: QELS-Fundamental Science

QWD • Strongly Correlated Electron Systems—Continued

QWD4 • 14:15
Ultrafast Optical Spectroscopy of Multiferroic $LuFe_2O_4$, *Jinho Lee[1], D. Talbayev[1], C. L. Zhang[2], X. S. Xu[3], S. W. Cheong[2], Antoinette J. Taylor[1], Rohit P. Prasankumar[1]; [1]CINT, Los Alamos national Laboratory, USA; [2]Rutgers Center for Emergent Materials and Department of Physics and Astronomy, Rutgers Univ., USA; [3]Department of Chemistry, Univ. of Tennessee, USA.* Temperature-dependent femtosecond optical spectroscopy is used to track polaron dynamics in the spin and charge frustrated system $LuFe_2O_4$, revealing the influence of charge and spin ordering on polaron excitation and coupling to on-site excitations.

QWD5 • 14:30 Invited
Terahertz Frequency Magnetoelectric Phenomena in Condensed Matter, *Ryo Shimano[1]; [1]Department of Physics, School of Science, Univ. of Tokyo, Japan.* Magnetoelectric(ME) correlation in condensed matter provides unique opportunity to electrically control the magnetization or vice versa. We report on terahertz frequency ME phenomena such as electromagnon in multiferroics and exotic Hall effect.

QWD6 • 15:00
Photoinduced Femtosecond Formation of Ferromagnetism in a Strongly Correlated Antiferromagentic Manganite, *Tianqi Li[1], Aaron Patz[1], Jiaqiang Yang[2], Thomas Lograsso[2], Ilias E. Perakis[3], Jigang Wang[1]; [1]Department of Physics & Astronomy, Ames Laboratory, Iowa State Univ., USA; [2]Ames Laboratory, USA; [3]Physics, Univ. of Crete, Greece.* 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.

QWE • Optomechanical Systems I—Continued

QWE2 • 14:30
Thermo-optical effects on the transduction of mechanical motion of a microspherical pendulum, *Jonathan Ward[1,2], Amy Watkins[1,3], Yuqiang Wu[1,3], Sile NicChormaic[1,3]; [1]Physics Department, Univ. College Cork, Ireland; [2]Department of Physics, Humboldt Univ., Germany; [3]Tyndall National Inst., Ireland.* 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.

QWE3 • 14:45
Surface Optomechanics: Observation of Surface Acoustic Resonances in Whispering Gallery Resonators, *Gaurav Bahl[1], John Zehnpfennig[1], Matthew Tomes[1], Tal Carmon[1]; [1]Univ. of Michigan, USA.* We experimentally demonstrate the excitation of a mechanical Rayleigh surface mode through optical electrostriction in a silica microsphere resonator. These modes have applications in optomechanical photonic oscillators and surface acoustic wave based sensing.

QWE4 • 15:00
Optomechanical self-channelling of light in freely suspended dual-planar-waveguide structure, *Anna Butsch[1], Fabio Biancalana[1], Claudio Conti[2], Philip Russell[1]; [1]Max Planck Inst. for the Science of Light, Germany; [2]Department of Physics, Univ. La Sapienza, Italy.* It is shown that optomechanical forces can cause nonlinear self-channelling of light in two parallel silica nanowebs suspended inside a fibre capillary. The effective optical nonlinearity is a million times higher than the Kerr effect.

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*

CLEO: Science & Innovations

16:45–18:15
CWJ • Advanced Formats
Cristian Antonelli, Univ. of L'Aquila, Italy, Presider

CWJ1 • 16:45 Tutorial

Advances in Modulation Formats for Fiber-Optic Transmission Systems, *Sander L. Jansen[1], Dirk van den Borne[1], Maxim Kuschnerov[1]; [1]Nokia Siemens Networks, Germany.* Abstract not available.

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 US-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".

16:45–18:30
CWK • THz Metamaterials II
Weili Zhang, Oklahoma State Univ., USA, Presider

CWK1 • 16:45 Tutorial

Terahertz Metamaterials: Recent Developments and New Opportunities, *Richard D. Averitt[1]; [1]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.

Richard Averitt received his PhD 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.

16:45–18:30
CWL • Optofluidic Biosensing and Biomolecular Analysis
David Erickson, Cornell Univ., USA, Presider

CWL1 • 16:45

Opto-fluidic Detection Platform for Pathogen Detection in Water, *Peter Kiesel[1], Joerg Martini[1], Malte Huck[1], Marshall Bern[1], Noble Johnson[1]; [1]Palo 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 ~200MEPE, sufficient to reliably identify and count specifically-tagged pathogens.

CWL2 • 17:00

Detecting and measuring single viruses and nanoparticles with an optical microresonator, *Jiangang Zhu[1], Sahin K. Ozdemir[1], Lina He[1], Da-Ren Chen[2], Lan Yang[1]; [1]Electrical & Systems Engineering, Washington Univ. in St. Louis, USA; [2]Energy, Environmental & Chemical Engineering, Washington Univ. in St. Louis, USA.* We show that adsorption of individual viruses and nanoparticles leads to discrete changes in the mode splitting spectra of a whispering-gallery-mode (WGM) microcavity, which enables a single nanoparticle spectrometry scheme to measure each particle.

CWL3 • 17:15 Invited

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

16:45–18:30
CWM • Silicon Microresonators
Michael Watts, MIT, USA, Presider

CWM1 • 16:45 Invited

Fabless Nanophotonics, *Michael Hochberg, Univ. of Washington, USA.* Leveraging CMOS manufacturing economics for photonics represents a huge opportunity. The OPSIS project aims to radically reduce the cost of building complex silicon photonic-electronic circuits by leveraging existing commercial infrastructure for shared photonic-electronic shuttle runs.

CWM2 • 17:15

Thermally Tuned Dual 20-Channel Ring Resonator Filter Bank in SOI (Silicon-on-Insulator), *Steven Spector[1], Anatol Khilo[2], Michael Peng[2], Franz X. Kaertner[2], Theodore Lyszczarz[1]; [1]Chemical, Biological and Nanotechnologies Group, MIT Lincoln Laboratory, USA; [2]Electrical 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.

CWM3 • 17:30

Statistics of photon transport in hundreds of coupled resonators, *Michael L. Cooper[1], Greeshma Gupta[1], Mark A. Schneider[1], Yiran Shen[1], William M. Green[2], Solomon Assefa[2], Fengnian Xia[2], Yurii A. Vlasov[2], Shayan Mookherjea[1]; [1]Electrical and Computer Engineering, Univ. of California San Diego, USA; [2]IBM Thomas J. Watson Research Center, USA.* The first experimental evidence is presented that coherent oscillations of the coupled resonators constitute the propagating eigenmodes in long silicon microring coupled-resonator optical waveguides (CROWs).

Thank you for attending CLEO: 2011. Look for your post-conference survey via email and let us know your thoughts on the program.

CLEO: Science & Innovations

16:45–18:30
CWN • Symposium on Fiber Parametric Devices and Applications II: Physics and Sources
Jay Sharping, Univ. of California Merced, USA, Presider

CWN1 • 16:45 Invited

Recent Advances in Fiber Optic Parametric Amplifiers, *J.D.Harvey, S.G.Murdoch, Y. Q. Xu, R.Leonhardt; 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 utilising both conventional fibers and photonic crystal fibers.

CWN2 • 17:15

All-Fiber Optical Parametric Oscillator, Pumped by an All-Fiber Yb-based MOPA, *Gys J. Van der Westhuizen[1], Johan Nilsson[1]; [1]Optoelectronics Research Centre, Univ. of Southampton, UK.* We report on an all-fiber PCF-based optical parametric oscillator, synchronously pumped by an all-fiber Yb-doped MOPA. A pump-to-anti-Stokes conversion efficiency of 8.6% is reached at a frequency-shift of 142 THz.

CWN3 • 17:30

Broadband, Spectrally Flat Frequency Combs and Short Pulse Sources from Phase modulated CW: Bandwidth Scaling and Flatness Enhancement using Cascaded FWM, *V.r. Supradeepa[1], Andrew M. Weiner[1]; [1]Electrical and Computer Engineering, Purdue Univ., USA.* We demonstrate a scheme to scale the bandwidth by several times while enhancing spectral flatness of frequency combs generated by intensity and phase modulation of CW lasers using cascaded four-wave mixing in highly nonlinear fiber.

CLEO: QELS-Fundamental Science

16:45–18:30
QWF • Quantum Interface of Light and Matter
Alan Migdall, NIST, USA, Presider

QWF1 • 16:45

Interfacing Single Photons from Dissimilar Sources, *Sergey V. Polyakov[1], Andreas Muller[1], Alex Ling[1], Edward Flagg[1], Natalia Borjemscaia[1,2], Edward Van Keuren[2], Alan Migdall[1], Glenn Solomon[1]; [1]Joint Quantum Inst., NIST, USA; [2]Physics Department, Georgetown Univ., USA.* We interface single photons generated by a quantum dot with those generated via parametric down-conversion. The photon indistinguishability is assessed by measuring their coalescence probability; it is 16% and limited by quantum dot decoherence.

QWF2 • 17:00

Enhanced Single Photon Emission by Diamond-Plasmon Nanostructures, *Jennifer Choy[1], Birgit J. Hausmann[1], Thomas Babinec[1], Irfan Bulu[1], Marko Loncar[1]; [1]School of Engineering and Applied Sciences, Harvard Univ., USA.* We demonstrate plasmon-enhanced single photon emission by NV centers in diamond nanoposts embedded in silver. The resulting hybrid structures exhibit six-fold enhancements in spontaneous emission with increased single photon counts.

QWF3 • 17:15

Preparation and storage of frequency-uncorrelated entangled photons from cavity-enhanced SPDC, *Xian-min Jin[1], Jian Yang[1,4], Han Zhang[1], Han-Ning Dai[1], Sheng-Jun Yang[1], Tian-Ming Zhao[1], Jun Rui[1], Yu He[1], Xiao Jiang[1], Fan Yang[2], Ge-Sheng Pan[1], Zhen-Sheng Yuan[1,2], Youjin Deng[1], Zeng-Bing Chen[1], Xiao-Hui Bao[1,2], Bo Zhao[3], Shuai Chen[1], Jian-Wei Pan[1,2]; [1]Hefei National Laboratory for Physical Sciences at Microscale and Department of Modern Physics, Univ. of Science and Technology of China, China; [2]Physikalisches Institut, Universitaet Heidelberg, Germany; [3]Inst. for Theoretical Physics, Univ. of Innsbruck, Austria; [4]Department of Physics, Univ. of Illinois, 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.

QWF4 • 17:30

Photonic Zitterbewegung: Relativistic physics in waveguide arrays, *Felix Dreisow[1], Matthias Heinrich[1], Robert Keil[1], Andreas Tünnermann[1], Stefan Nolte[1], Stefano Longhi[2], Alexander Szameit[1,3]; [1]Inst. Of Applied Physics, Friedrich Schiller Universität Jena, Germany; [2]Dipartimento di Fisica, Politecnico di Milano, Italy; [3]Physics Department and Solid State Inst., Technion, Israel.* We report on the observation of relativistic wave evolution in a waveguide array. The high frequency trembling motion, known as Zitterbewegung is observed in specially designed waveguide arrays.

CLEO: Science & Innovations

16:45–18:30
CWO • Advanced Ultrafast Laser Processing
Eric Mottay, Amplitude Systemes, France, Presider

CWO1 • 16:45 Invited

Synthesis of Materials by Ultrafast Microexplosion, *Saulius Juodkazis[6], Arturas Vailionis[1,2], Eugene Gamaly[5], Vygantas Mizeikis[3], Wenge Yang[4], Andrei Rode[5]; [1]Geballe Laboratory for Advanced Materials, Stanford Univ., USA; [2]Stanford Inst. for Materials and Energy Sciences, SLAC National Accelerator Laboratory, USA; [3]Division of Global Research Leaders, Shizuoka Univ., Japan; [4]HPSynC - Carnegie Institution of Washington, Argonne National Laboratory, USA; [5]Laser Physics Centre, The Australian National Univ., Australia; [6]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.

CWO2 • 17:15

Exploring 5th dimension of optical recording with ultrashort light pulses, *Mindaugas Gecevičius[1], Martynas Beresna[1], Peter Kazansky[1]; [1]Optoelectronics Research Centre, Univ. of Southampton, UK.* A 5th dimensional optical recording is demonstrated by means of ultrafast laser writing. The three spatial dimensions are supplemented by retardance and slow axis orientation of selfassembled form-birefringence in glass.

CWO3 • 17:30

Polarization vortex converter imprinted by femtosecond laser nanostructuring in glass, *Martynas Beresna[1], Mindaugas Gecevičius[1], Peter Kazansky[1]; [1]Univ. of Southampton, UK.* A polarization converter by femtosecond laser imprinting of space variant birefringence is demonstrated. Switching from radial to azimuthal polaration with orbital angular momentum is achieved by handedness control of incident circular polarization.

CLEO: QELS-Fundamental Science

16:45–18:30
QWG • Optomechanics and Optical Forces
Henri Lezec, NIST, USA, Presider

QWG1 • 16:45 Invited

Optical Bonding And Antibonding Forces In Asymmetric Geometries For Casimir Force Detection, *David N. Woolf[3], Pui-Chuen Hui[1], Eiji Iwase[1], Alejandro Rodriguez[1,2], Alexander McCauley[2], Igor Lovchinsky[1], Mughees Khan[1], Steven G. Johnson[2], Marko Loncar[1], Federico Capasso[1]; [1]School of Engineering and Applied Science, Harvard Univ., USA; [2]Department of Mathematics, Massachusetts Inst. 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.

QWG2 • 17:15 Invited

Nanoparticle manipulation using a plasmonic nano-tweezer with an integrated heat sink, *Kai Wang[1], Ethan Schonbrun[2], Paul Steinvurzel[3], Kenneth B. Crozier[1]; [1]School of Engineering and Applied Sciences, Harvard Univ., USA; [2]Rowland Inst., Harvard Univ., USA; [3]Electrical & Computer Engineering, Boston Univ., USA.* Making use of the field enhancement and confinement, and thermal management, of a template-stripped localized surface plasmon resonance structure, we experimentally demonstrate the trapping and rotation of 110 nm diameter polystyrene nanoparticles.

CLEO: Applications & Technology

16:45–18:30
AWA • Energy Efficient Lighting
Tanya Paskova, Kyma Technologies, USA, Presider

AWA1 • 16:45 Invited

High-power LED Technology and Solid State Lighting, *Werner Goetz;[1]Philips Lumileds Lighting Company, USA.* The rapid adoption of LEDs in general illumination is fueled by high-power phosphor-conversion and direct color blue 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.

AWA2 • 17:15

Superior warm-white light-emitting diodes integrated with quantum dot nanophosphors for high luminous efficacy and color rendering, *Sedat Nizamoglu[1], Talha Erdem[1], Xiao Wei Sun[2], Hilmi Volkan Demir[1,2]; [1]Bilkent Univ., Turkey; [2]Nanyang Technological Univ., Singapore.* Quantum dot nanophoshor hybridized warm-white LEDs are reported to exhibit high photometric performance of luminous efficacy exceeding 350 lm/Wopt and color rendering index close to 90 at correlated color temperatures <3000 K.

AWA3 • 17:30

Spatially Resolved Thermal Analysis of High Power LEDs Using Thermoreflectance Imaging, *Kadhair Al-hemyari[1], Susu Yan[1], Joseph A. Summers[1], Janice A. Hudgings[1]; [1]Physics Department, Mount Holyoke College, USA.* 2D thermal images of LEDs vary laterally with contact design. Thermoreflectance imaging of LEDs is quantitatively compared with standard bulk temperature measurements. Encapsulation improves heat dissipation and reduces optical reabsorption heating.

CLEO: Science & Innovations

16:45–18:30
CWP • Thin Disk and Waveguide Laser
Takunori Taira, Inst. for Molecular Science, Japan, Presider

CWP1 • 16:45

First CW and Modelocked Operation of an Yb:$(Sc,Y,Lu)_2O_3$ Thin-disk Laser, *Clara Saraceno[1], Oliver Heckl[1], Cyrill Baer[1], Matthias Golling[1], Thomas Südmeyer[1], Kolja Beil[2], Christian Kränkel[2], Klaus Petermann[2], Günter Huber[2], Ursula Keller[1]; [1]Department of Physics, ETH Zurich, Switzerland; [2]Inst. of Laser Physics, Univ. of Hamburg, Germany.* We present the first cw and modelocked thin-disk laser based on the broadband sesquioxide material Yb:$(Sc,Y,Lu)_2O_3$. We demonstrated 50 W in cw operation with a slope efficiency >70% and 3.9 W in 236-fs pulses in modelocked operation.

CWP2 • 17:00

Energies above 30 µJ and average power beyond 100 W directly from a mode-locked thin-disk oscillator, *Dominik Bauer[1,2], Philipp Wagenblast[2], Farina Schättiger[1], Jochen Kleinbauer[2], Dirk H. Sutter[2], Alexander Killi[2], Thomas Dekorsy[1]; [1]Department of Physics and Center of Applied Photonics, Univ. of Konstanz, Germany; [2]TRUMPF-Laser GmbH + Co. KG, Germany.* We demonstrate the generation of pulses containing more than 30 µJ of energy directly out of a thin-disk oscillator. The laser was operated at 3.5 MHz, 1040 fs and 108 W average output power.

CWP3 • 17:15

A VBG-Stabilized Narrow Linewidth, Spectrally Tunable, Yb:YAG Thin-Disk Laser, *Michael Hemmer[1], Andreas Vaupel[1], Mark Ramme[1], Christina Willis[1], Joshua D. Bradford[1], Vadim Smirnov[2], Lawrence Shah[1], Leonid Glebov[1], Martin Richardson[1]; [1]CREOL, The College of Optics and Photonics, USA; [2]OptiGrate Corp., USA.* We present an Yb:YAG thin-disk oscillator providing a tunable linewidth of 50-pm via VBG-based feedback. Output powers of up to 2 W have been recorded while maintaining an excellent spatial profile.

CWP4 • 17:30

Yb^{3+} and Tm^{3+} doped $KGd_xLu_yY_{1-x-y}(WO_4)_2$ Channel Waveguide Lasers, *Dimitri Geskus[1], K. van Dalfsen[1], Shanmugam Aravazhi[1], Kerstin Worhoff[1], Markus Pollnau[1]; [1]IOMS-EWI, Univ. of Twente, Netherlands.* Channel waveguides with high refractive-index contrast are fabricated in double tungstates. Yb^{3+} lasers with 71% slope efficiency and 418 mW output power are demonstrated. Tm^{3+} lasers at 1843 nm have also been demonstrated.

16:45–18:30
CWQ • Astro-Combs and Source Calibration
Kristan Corwin, Kansas State Univ., USA, Presider

CWQ1 • 16:45

Calibration of an Astronomical Spectrograph using a 25 GHz Laser Frequency Comb, *Gabriel Ycas[1], Scott Diddams[2], Frank Quinlan[2], Steve Osterman[3], Suvrath Mahadevan[4], Lawrence Ramsey[4], Stephen Redman[4], Ryan Ryan Terrien[4]; [1]Physics, Univ. of Colorado at Boulder, USA; [2]National Inst. for Standards and Technology, USA; [3]Center for Astrophysics and Space Astronomy, Univ. of Colorado at Boulder, USA; [4]Department of Astronomy and Astrophysics, Penn State, USA.* A 25 GHz frequency comb for calibration of astronomical spectrographs in the 1.4-1.65 µm region is demonstrated with the R=50,000 λ/Δλ Pathfinder spectrograph at the Hobby-Eberly telescope.

CWQ2 • 17:00

Suppressed Mode Recovery in Nonlinear Fibers of a Fabry-Perot-filtered Frequency Comb, *Tobias Wilken[1], Rafael Probst[1], Theodor W. Hänsch[1], Thomas Udem[1], Tilo Steinmetz[1,2], Ronald Holzwarth[1,2], Antonio Manescau[3], Gaspare Lo Curto[3], Luca Pasquini[3], Sebastian Stark[4], Holger Hundertmark[4], Philip St.J. Russell[4]; [1]MPQ, Germany; [2]Menlosystems GmbH, Germany; [3]ESO, Germany; [4]MPL, Germany.* A Yb-fiber based frequency comb spanning more than 150 nm with a multi-GHz mode spacing was set up. Dynamic reamplification of suppressed modes in a nonlinear fiber after the filter cavities was observed and analyzed.

CWQ3 • 17:15

Power amplification of astro-combs: optimization of filtering schemes, *Guoqing Chang[1], Chih-Hao Li[2], David Phillips[2], Ronald Walsworth[2], Franz X. Kaertner[1]; [1]MIT, USA; [2]Harvard, 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 radial-velocity calibration accuracy of an amplified astro-comb.

CWQ4 • 17:30

Broadband, large-spacing frequency-comb employing complementary interleavers for mode filtering, *Guoqing Chang[1], Chih-Hao Li[2], David Phillips[2], Ronald Walsworth[2], Franz X. Kaertner[1,2]; [1]EECS, MIT, USA; [2]Harvard Univ., USA.* We propose and analyze an approach to generate broadband large-spacing frequency-combs using complementary interleavers for mode-filtering and nonlinear fibers for spectral broadening. 350-nm bandwidth with negligible side-mode asymmetry is achieved.

CLEO: Science & Innovations

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. Leindecker[1], Alireza Marandi[1], Robert L. Byer[1], Konstantin L. Vodopyanov[1]; [1]Ginzton Laboratory, Stanford Univ., USA.* Recent results using a degenerate OPO pumped by a 1560nm ultrafast 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, *Guoqing Chang[1], Li-Jin Chen[1], Franz X. Kaertner[1]; [1]MIT, 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 Hegenbarth[1], Andy Steinmann[1], János Hebling[2], Harald Giessen[1]; [1]4th Physics Inst. and Research Center SCOPE, Univ. of Stuttgart, Germany; [2]Department of Experimental Physics, Univ. of Pécs, Hungary.* We report on a 42MHz femtosecond two-color MgO:PPLN OPO pumped by a mode-locked 7.4 W Yb:KGW fs 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 Nanojoule Pulses at 830 nm, *Claire Lefort[1], Méri Kalashyan[1,2], Donald Peyrot[3], Tigran Mansuryan[1], Levon Mouradian[2], Frédéric Louradour[1], Alain Barthélémy[1]; [1]XLIM Laboratory, France; [2]Ultrafast Optics Laboratory, Armenia; [3]ANBioPhy Laboratory, France.* Powerful Sub-30 fs pulses (830 nm) are delivered by 2 meters long standard and LMA fibers despite nonlinearity and dispersion. A "GRISMs" line, accurately compensated second and third orders of dispersion.

CLEO: QELS-Fundamental Science

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 Seletskiy[1], Michael Hasselbeck[1], Chia-Yeh Li[1], Jeffrey Cederberg[2], Aaron Katzenmeyer[3], Maria Toimil-Molares[3], Francois Leonard[3], A. Alec Talin[3], Mansoor Sheik-Bahae[1]; [1]Univ. of New Mexico, USA; [2]Sandia National Laboratories, USA; [3]Sandia 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 Terahertz-Probe Spectroscopy of Oriented Ge and Ge/Si Core/Shell Nanowires, *Momchil T. Mihnev[1,2], Wayne Fung[1], Wei Lu[1], Theodore B. Norris[1,2]; [1]Electrical 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. Versteegh[1], Daniel A. Vanmaekelbergh[1], Jaap I. Dijkhuis[1]; [1]Debye Inst. for Nanomaterials Science, Utrecht Univ., Netherlands.* Lasing in ZnO nanowires is often interpreted as exciton lasing. However, our experiments and theoretical calculations on the laser threshold and the emission spectrum show that ZnO nanowire lasing is electron-hole plasma lasing.

QWH4 • 17:30
Femtosecond excitation of confined acoustic modes in 2-D arrayed GaN nanorods, *Hung-Pin Chen[1], Yueh-Chun Wu[1], Jinn-Kong Sheu[2], Chi-Kuang Sun[1,3]; [1]Department of Electrical Engineering,National Taiwan Univ., Inst. of Electro-Optical Science and engineering, Taiwan; [2]National Cheng Kung Univ., Inst. of Electro-Optical Science and engineering, Taiwan; [3]Academia Sinica, Physics and Research Center for Applied Sciences, 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.

16:45–18:30
QWI • Optomechanical Systems II
Roberto Morandotti, INRS-EMT, Canada, Presider

QWI1 • 16:45
Long-range synchronization of optomechanical structures, *Sasikanth Manipatruni[1], Gustavo Weiderhecker[1], Michal Lipson[1,2]; [1]School of Electrical and Computer Engineering, Cornell Univ., USA; [2]Kavli Inst. at Cornell for Nanoscale Science, Cornell Univ., USA.* We theoretically show that long-range radiation force mediated mechanical coupling & synchronization arise in optomechanical systems. We propose a device that exhibits non-linear frequency & phase synchronization of two unlike mechanical resonators.

QWI2 • 17:00
Optical "tractor beams" with nonconservative forces, *Sergey Sukhov[1], Aristide Dogariu[1]; [1]CREOL, Univ. of Central Florida, USA.* We demonstrate that, for an entire class of optical beams, nonconservative forces can point in a direction opposite to propagation wavevector. The properties of these forces are examined in the Rayleigh and geometrical optics limits.

QWI3 • 17:15 Invited
An Optically Pumped Phonon Laser in a Silicon Micromechanical Oscillator, *Marcel W. Pruessner[2], Jacob B. Khurgin[1], Todd Stievater[2], William S. Rabinovich[2]; [1]Johns Hopkins Univ., USA; [2]Naval Research Laboratory, USA.* We experimentally demonstrate and explain phonon "lasing" ("PhASER") in a photopumped micromechanical cavity that exhibits all the characteristic of a standard laser near threshold and is described by the standard laser equations.

CLEO: Science & Innovations

CWJ • Advanced Formats—Continued

CWJ2 • 17:45
32 Gb/s Multilevel Modulation of an 850 nm VCSEL for Next-Generation Datacommunication Standards, *Jonathan D. Ingham[1], Richard V. Penty[1], Ian H. White[1], Petter Westbergh[2], Johan Gustavsson[2], Asa Haglund[2], Anders Larsson[2]; [1]Department of Engineering, Univ. of Cambridge, UK; [2]Department of Microelectronics and Nanoscience, Chalmers Univ. of Technology, Sweden.* An 850 nm vertical-cavity surface-emitting laser is modulated at 32 Gb/s using pulse-amplitude modulation with four levels. Transmitter predistortion generates an optimized modulation waveform, which requires a receiver bandwidth of only 15 GHz.

CWJ3 • 18:00
A 112 Gb/s Duobinary-Shaped PolMux DQPSK System with Enhanced Narrow Filtering Tolerance, *Yu-Ting Hsueh[1], Hung-Chang Chien[1], Arshad Chowdhury[1], Charles Su[2], Gordon Gu[2], Gee-Kung Chang[1]; [1]Georgia Inst. of Technology, USA; [2]AOC Technologies, Inc., USA.* 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 changing DQPSK demodulation structure.

CWK • THz Metamaterials II—Continued

CWK2 • 17:45
Drawn Metamaterial Fibers With Negative Permeability, *Alessandro Tuniz[1], Anna Wang[1], Peter Hunt[1], Elise Pogson[2], Roger Lewis[2], Avi Bendavid[3], Simon C. Fleming[1], Boris T. Kuhlmey[1], Maryanne C. Large[1]; [1]Inst. of Photonics and Optical Science, School of Physics, Univ. of Sydney, Australia; [2]School of Engineering Physics, Univ. of Wollongong, Australia; [3]Materials Science and Engineering, Commonwealth Scientific and Industrial Research Organization, Australia.* 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 arrays with different orientations.

CWK3 • 18:00
LC resonance modulation in asymmetric double split-ring resonator metamaterials, *Jiaguang Han[1], Yuanmu Yang[1], Ran Huang[2], Longqing Cong[1], Jianqiang Gu[1], Zhen Tian[1], Ranjan Singh[3], Weili Zhang[2,1]; [1]Center for Terahertz Waves and College of Precision Instrument and Optoelectronics Engineering, Tianjin Univ., China; [2]School of Electrical and Computer Engineering, Oklahoma State Univ., USA; [3]Center for Integrated Nanotechnologies, Materials Physics and Applicas Divisiontion, USA.* 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.

CWK4 • 18:15
Active tuning of coupled resonance modes in terahertz metamaterials, *Dibakar Roy Chowdhury[1], Abul Azad[1], Matthew T. Reiten[1], Antoinette J. Taylor[1], John F. O'Hara[1]; [1]Los Alamos National Laboratory, USA.* We demonstrate 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.

CWL • Optofluidic Biosensing and Biomolecular Analysis—Continued

CWL4 • 17:45
Plasmonic Monopole Antenna Arrays for Biosensing, Spectroscopy and nm-Precision Optical Trapping, *Arif E. Cetin[1,2], Ahmet A. Yanik[1,2], Cihan Yilmaz[3], Sivasubramanian Somu[3], Ahmed Busnaina[3], Hatice Altug[1,2]; [1]Electrical Engineering, Boston Univ., USA; [2]Photonics Center, Boston Univ., USA; [3]NSF Nanoscale Science and Engineering Center for High-rate Nanomanufacturing, Northeastern Univ., USA.* We propose surface plasmon polariton driven plasmonic monopole antenna array system for biosensing, nanospectroscopy and optical trapping. The structure exhibits high refractive index sensitivities, nearfield resolution and optical gradient force.

CWL5 • 18:00
Metal-grating trapezoidal plasmonic waveguide sensor, *Michelle Y. Xu[1], J. Stewart Aitchison[1]; [1]Univ. of Toronto, Canada.* Metal-Bragg-grating-embedded trapezoidal SPP waveguides are fabricated using a novel enclosure method. We will show theoretical and experimental data demonstrating a device having 1100 nm/RIU detection sensitivity.

CWL6 • 18:15
Highly Selective Single-Nucleotide Polymorphism Detection with Optofluidic Ring Resonator Lasers, *Yuze Sun[1], Xudong Fan[1]; [1]Biomedical Engineering, Univ. of Michigan, USA.*Optofluidic ring resonator microlasers in conjunction with molecular beacons are used for intracavity detection of DNA single-nucleotide polymorphism. A discrimination ratio of 100 is achieved between the target DNA and single-base-mismatched DNA.

CWM • Silicon Microresonators—Continued

CWM4 • 17:45
Correlations between light at spectrally distant wavelengths in coupled microring resonator waveguides, *Michael L. Cooper[1], Greeshma Gupta[1], Junrong Ong[1], William M. Green[2], Solomon Assefa[2], Fengnian Xia[2], Yurii A. Vlasov[2], Shayan Mookherjea[1]; [1]Electrical and Computer Engineering, Univ. of California San Diego, USA; [2]IBM T. J. Watson Research Center, USA.* We demonstrate that propagation through a silicon microring coupled-resonator optical waveguide can introduce spectral correlations between two or more light sources separated by almost 1 THz over information bandwidths up to 40 GHz.

CWM5 • 18:00
Evanescent Coupling to the Slow-Light Modes in Periodically Patterned Silicon Microring Resonators, *Jonathan Y. Lee[1], Philippe Fauchet[1]; [1]Department of Electrical and Computer Engineering, Univ. of Rochester, USA.* We demonstrate evanescent coupling between a strip waveguide and a periodically-patterned ring resonator in the slow light regime. Resonances with a group index >22 are efficiently coupled with an extinction ratio of >20 dB.

CWM6 • 18:15
Designing Bessel Filters Based on Coupled-Resonator Optical Waveguides for Dispersion-Free Slow Light, *Hsi-Chun Liu[1], Amnon Yariv[1]; [1]California Inst. of Technology, USA.* We have developed a formalism for designing Bessel filters based on coupled-resonator optical waveguides (CROWs). The CROWs feature maximally flat group delay and can be realized on different types of resonators.

CLEO: Science & Innovations

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

CWN4 • 17:45 Invited

Parametric replication and sampling of optical fields, *Stojan Radic[1]; [1]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.

CWN5 • 18:15

Fast Control of a Phase-Sensitive Fiber-Optic Parametric Amplifier by Frequency-Swept Brillouin-Gain Dispersion, *Thomas D. Whitehead[1], Prem Kumar[1]; [1]EECS, Northwestern Univ., USA.* We demonstrate in-line control of a phase-sensitive fiber-optic parametric amplifier by tuning the pump frequency of a Brillouin fiber pre-amplifier. This approach achieves an order of magnitude faster response compared to piezoelectric control.

CLEO: QELS-Fundamental Science

QWF • Quantum Interface of Light and Matter—Continued

QWF5 • 17:45

Observation of a Red-Blue Detuning Asymmetry in Matter-Wave Superradiance, *Lu Deng[1], Edward Hagley[1], Ruquan Wang[2]; [1]NIST, USA; [2]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 Philbin[1]; [1]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 Ronen[1]; [1]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.

CLEO: Science & Innovations

CWO • Advanced Ultrafast Laser Processing—Continued

CWO4 • 17:45

Materials Processing with Femtosecond Vortex Pulses, *Cyril Hnatovsky[2,1], Vladlen Shvedov[1,2], Wieslaw Krolikowski[1], Andrei Rode[1]; [1]Laser Physics Center, Australian national Univ., Australia; [2]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 <100 nm uniform groove thickness.

CWO5 • 18:00

Spatio-temporally Focused Femtosecond Laser Pulses for Anisotropic Writing in Optically Transparent Materials, *Dawn N. Vitek[1], Erica Block[1], Yves Bellouard[2], Daniel E. Adams[3,4], Sterling Backus[5], David Kleinfeld[6], Charles G. Durfee[1], Jeff A. Squier[1]; [1]Physics, Colorado School of Mines, USA; [2]Mechanical Engineering, Eindhoven Univ. of Technology, Netherlands; [3]Physics and JILA, Univ. of Colorado at Boulder, USA; [4]National Inst. of Standards and Technology, USA; [5]Kapteyn-Murnane Laboratories, USA; [6]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, *Luís A. Fernandes[1,2], Jason R. Grenier[1], Jin H. Kim[1], Peter R. Herman[1], J. Stewart Aitchison[1], Paulo V. Marques[2]; [1]Inst. for Optical Sciences, Department of Electrical and Computer Engineering, Univ. of Toronto, Canada; [2]INESC-Porto, Departamento de Física e Astronomia da Universidade do Porto, 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^{-5} and 10^{-4}.

CLEO: QELS-Fundamental Science

QWG • Optomechanics and Optical Forces—Continued

QWG3 • 17:45
Photonic crystal dumbbell cavity for low-power opto-mechanical actuation, *Wolfram H. Pernice[1]; [1]Electrical Engineering, Yale Univ., USA.* Photonic crystal slot cavities are designed with Q up to $2x10^6$. Strong field confinement allows for significant gradient optical force actuation. Measured devices show high extinction ratio and mechanical resonance at low optical driving power.

QWG4 • 18:00
Electrostatic tuning of optomechanical cavities to semiconductor quantum dots, *Justin D. Cohen[1,2], Sean Meenehan[1], Oskar Painter[1]; [1]Applied Physics, California Inst. of Technology, USA; [2]Physics, California Inst. of Technology, USA.* The integration of optomechanically coupled photonic crystal cavities to indium arsenide quantum dots is studied experimentally and theoretically. Electrostatic tuning results for one- and two-dimensional photonic crystals are presented.

QWG5 • 18:15
Optomechanical coupling in a two-dimensional photonic crystal defect cavity, *Emanuel Gavartin[1], Remy Braive[2,3], Isabelle Sagnes[2], Isabelle Sagnes[2], Olivier Arcizet[4], Alexios Beveratos[2], Tobias Kippenberg[1,5], Isabelle Robert-Philip[2]; [1]Ecole Polytechnique Fédérale de Lausanne, Switzerland; [2]Laboratoire de Photonique et de Nanostructures, France; [3]Université Paris Denis Diderot, France; [4]Institut Néel, France; [5]Max-Planck-Institut für Quantenoptik, Germany.* 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.

CLEO: Applications & Technology

AWA • Energy Efficient Lighting—Continued

AWA4 • 17:45 Invited
True Bulk GaN Substrates for High Efficiency Devices, *David F. Bliss[1], Buguo Wang[2], Matthew Mann[2]; [1]US Air Force Research Laboratory, USA; [2]Solid State Scientific Corp., USA.* This paper outlines the progress of bulk GaN crystal growth techniques, and compares their various merits and deficiencies. Three main contenders must prove their ability to provide high quality material consistently and at a competitive price.

AWA5 • 18:15
VAGNT-on-Silicon Platform for Improving Heat Conduction in Optoelectronic Packaging, *Szu-Chieh Chen[1], Hsinyi Lo[2], Yung-Jr Hung[1], Yen-Ting Pan[1], San-Liang Lee[1,2], Rajeev J. Ram[2]; [1]Department of Electronic Engineering, National Taiwan Univ. of Science and Technology, Taiwan; [2]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 for LED packaging.

CLEO: Science & Innovations

CWP • Thin Disk and Waveguide Laser—Continued

CWP5 • 17:45
Tm-doped $KY(WO_4)_2$ Planar Waveguide Laser Operating in the Continuous-wave and Q-switched Regimes, *Western Bolaños[1], Joan Josep Carvajal[1], Xavier Mateos[1], Eugenio Cantelar[2], Gines Lifante[2], Uwe Griebner[3], Valentin Petrov[3], Vladimir Panyutin[3], Senthil Murugan[4], James S. Wilkinson[4], Magdalena Aguiló[1], Francesc Díaz[1]; [1]Univ. of Tarragona, Spain; [2]Universidad Autónoma de Madrid, Spain; [3]Max Born Inst., Germany; [4]ORC, Univ. of Southampton, UK.* Waveguide lasing of a $Tm:KY(WO_4)_2$ epitaxial layer in a monolithic cavity is reported. The laser was operated at 2 μm in the Q-switched mode using Cr^{2+}:ZnSe as saturable absorber and in the continuous-wave regime.

CWP6 • 18:00
Sub-joule level high repetition rate cryogenic disk laser, *Ivan B. Mukhin[1], Anton Vyatkin[1], Evgeny Perevezentsev[1], Olga Vadimova[1], Oleg Palashov[1], Efim Khazanov[1]; [1]nonlinear and laser optics, Inst. of Applied Physics Russian Academy of Science, Russian Federation.* Spectral and thermooptical properties, the stored energy and amplification in Yb:YAG disks are investigated at 77-300K temperature range. The current status of the laser system development with 0.5J output energy at 1kHz repetition rate is presented.

CWP7 • 18:15
Yb:YLF as Active Medium in the Thin Disk Laser, *Susanne T. Fredrich-Thornton[1], Kolja Beil[1], Christian Kränkel[1], Klaus Petermann[1], Daniela Parisi[2], Mauro Tonelli[2], Günter Huber[1]; [1]Inst. of Laser-Physics, Germany; [2]NEST-Nanoscience Insitute-CNR, Italy.* Results of the first Yb:$LiYF_4$ 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.

CWQ • Astro-Combs and Source Calibration—Continued

CWQ5 • 17:45 Invited
Dual-Comb Based Measurement of Frequency Agile Lasers, *Ian Coddington[1], Fabrizio Giorgetta[1], Esther Baumann[1], William C. Swann[1], Nathan Newbury[1]; [1]Optoelectronics, NIST, USA.* Properly stabilized, frequency combs form high accuracy references across much of the optical spectrum. Here we employ dual frequency combs to harness this accuracy for fast and high resolution measurements of frequency agile CW lasers.

CWQ6 • 18:15
White Light Sampling and Cross-Correlation via Multi-heterodyne Detection with an Optical Frequency Comb, *Marcus Bagnell[1], Josue Davila-Rodriguez[1], Charles Williams[1], Peter J. Delfyett[1]; [1]CREOL, 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 10ps.

NOTES

CLEO: Science & Innovations

CWR • Ultrafast Pulse Generation II—Continued

CWR5 • 17:45
The Role of Plasma Formation in Mode-locking of Few-cycle Ti:sapphire Lasers: A Spatiotemporal Model, *Li-Jin Chen[1], Chien-Jen Lai[1], Franz X. Kaertner[1]; [1]MIT, 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.

CWR6 • 18:00
Saturation of the all-optical Kerr effect, *Carsten Bree[1,2], Günter Steinmeyer[2], Ayhan Demircan[1]; [1]Weierstrass Inst. for Applied Analysis and Stochastics, Germany; [2]Max-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.

CWR7 • 18:15
Temporal Compression of Ultrafast Optical Filaments by Molecular Quantum Wakes in Atmosphere, *Arman Fallahkhair[1], Sanjay R. Varma[1], Howard Milchberg[1], Yu-hsin Chen[1]; [1]Inst. 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.

CLEO: QELS-Fundamental Science

QWH • Dynamics in Nanowires, Rods and Tubes—Continued

QWH5 • 17:45
Motional Narrowing of Dysonian Lineshape in Electron Spin Resonance of Single-Walled Carbon Nanotubes, *William Rice[1], Ralph Weber[2], Ashley Leonard[3], Ah-Lim Tsai[4], Sivaram Arepalli[5], Junichiro Kono[1]; [1]ECE, Rice Univ., USA; [2]Bruker BioSpin Instruments Inc., USA; [3]Chemistry, Rice Univ., USA; [4]Univ. of Texas Medical School, Univ. of Texas, USA; [5]Energy 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.

QWH6 • 18:00
Tracking Charge Transfer in Carbon Nanotube Networks with Chirped Pump-Probe Spectroscopy, *Daniele Brida[1], Dario Polli[1], Jared Crochet[2], Tobias Hertel[3], Guglielmo Lanzani[1], Giulio Cerullo[1]; [1]Politecnico di Milano, Italy; [2]Los Alamos National Laboratory, USA; [3]Universität 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.

QWH7 • 18:15
Splitting and lasing of whispering gallery modes in quantum dot micropillars, *Ben D. Jones[1], Mark Oxborrow[2], Vasily N. Astratov[3], Mark Hopkinson[4], Abbes Tahraoui[4], Maurice Skolnick[1], Mark Fox[1]; [1]Department of Physics and Astronomy, Univ. of Sheffield, UK; [2]National Physical Laboratory, UK; [3]Department of Physics and Optical Science, Univ. of North Carolina, USA; [4]EPSRC National Centre for III-V Techologies, Univ. of Sheffield, UK.* Whispering gallery mode splitting in high quality-factor InAs quantum dot micropllars is observed and attributed to resonant scattering from the dots themselves. Low-threshold multimode lasing with beta-factors approaching unity is demonstrated.

QWI • Optomechanical Systems II—Continued

QWI4 • 17:45
High Sensitivity Optical Refrigeration Spectroscopy: Local Cooling of Yb:YLF Crystal to 110 K, *Seth Melgaard[1], Denis Seletskiy[1], Alberto Di Lieto[2], Mauro Tonelli[2], Mansoor Sheik-Bahae[1]; [1]Univ. of New Mexico, USA; [2]Univ. 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.

QWI5 • 18:00
Sheet Optical Parametric Oscillator, *Zhenda Xie[1], Xinjie Lv[1], Yanhua Liu[1], Wen Ling[1], Zhenlin Wang[1], Yaxian Fan[1], Shining Zhu[1]; [1]Nanjing Univ., China.* We experimentally demonstrate cavity phase matching for the first time using a sheet optical parametric oscillator. It presents unique features such as high power capability, high slope efficiency, and single-longitudinal-mode oscillation.

QWI6 • 18:15
Trapping and manipulating aerosols with optical bottle beams generated by Moiré technique, *Peng Zhang[1], Ze Zhang[2,1], Jai Prakash[1], Simon Huang[1], Demetrios Christodoulides[2], Zhigang Chen[1,3]; [1]Department of Physics and Astronomy, San Francisco State Univ, USA; [2]CREOL/College of Optics, Univ. of Central Florida, USA; [3]TEDA Applied Physics School, Nankai Univ., China.* We demonstrate optical trapping and manipulation of C_{60} 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.

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