8:00 a.m.–10:30 a.m. CLEO/IQEC Joint Plenary Session, *Ballrooms III-IV*

10:00 p.m.–5:00 p.m. Exhibit Hall Open, *Exhibit Hall*

10:30 a.m.–12:00 p.m. Coffee Break and Exhibit-Only Time, *Exhibit Hall*

11:00 a.m.–12:00 p.m. Lunch Break *(concessions available on show floor)*

Exhibit Hall

JOINT

12:00 p.m.–1:30 p.m.
JWA • Joint CLEO/IQEC Poster Session II

JWA1
Femtosecond-Laser Induced Sub-200 nm Structures in TiO_2, *Susanta K. Das, Daniela Dufft, Martin Bock, Arkadi Rosenfeld, Joern Bonse, Ruediger Grunwald; Max Born Inst., Germany.* Sub-wavelength periodic surface structures in titanium dioxide with periods of 170 and 90 nm were generated with 150 fs pulses at 800 and 400 nm, respectively. Formation mechanisms and conditions for large-area patterning are discussed.

JWA2
Fabrication of Gold-Platinum Nanoparticles by Intense, Femtosecond Laser Irradiation of Aqueous Solution, *Takahiro Nakamura, Hideyuki Magara, Yuliati Herbani, Akihiko Ito, Shunichi Sato; Inst. of Multidisciplinary Res. for Advanced Materials, Tohoku Univ., Japan.* We demonstrated fabrication of gold and platinum composite and/or alloy nanoparticles by intense, femtosecond pulsed laser irradiation of mixed auric and platinum aqueous solution.

JWA3
Pulsed Laser Ignition Thresholds of Energetic Multilayer Foils, *Joel P. McDonald[1], Yoosuf N. Picard[2], Steven M. Yalisove[3], David P. Adams[1]; [1]Sandia Natl. Labs, USA, [2]NRL, USA, [3]Univ. of Michigan, USA.* Ignition thresholds for energetic multilayer foils comprised of aluminum (Al) and platinum (Pt) layers are presented as a function of foil properties for laser pulse durations of 100 femtosecond (fs) and 30 nanosecond (ns).

JWA4
Waveguide Writing and Characterization in Tellurite Glass, *Mark Ramme[1], Troy P. Anderson[1], Jiyeon Choi[1], Heike Ebendorff-Heidepriem[2], Tanya M. Monro[2], Martin C. Richardson[1]; [1]Townes Laser Inst., College of Optics and Photonics, Univ. of Central Florida, USA, [2]Ctr. of Expertise in Photonics, School of Chemistry and Physics, Univ. of Adelaide, Australia.* Ultra-fast laser-induced positive refractive index changes in bulk Tellurite glass were investigated. The refractive indexes of waveguiding structures were measured using the far-field approach. Filamentation was observed for certain irradiation conditions.

JWA5
Ultrafast Laser Filamentation Control Techniques for Remote Applications, *Jean-François Daigle[1], Olga Kosareva[2], See Leang Chin[1], Yousef Kamali[1], Gilles Roy[3], Jacques Dubois[3], Marc Chateauneuf[3], Francis Theberge[3]; [1]Ctr. d'Optique, Photonique et Laser (COPL), Univ. Laval, Canada, [2]Intl. Laser Ctr., Physics Dept., M.V. Lomonosov Moscow State Univ., Russian Federation, [3]Defense Res. and Development Ctr.-Valcartier, Canada.* Filaments are generated from pulses focused by a telescope equiped with a AO system. Strong signals were detected at a distance of 90m. In an other scheme, an aperture enhanced the length and ionization densities.

JWA6
Investigation of Phase-Sensitive Image Amplification with Elliptical Gaussian Pump, *Michael Vasilyev[1], Nikolai Stelmakh[1], Prem Kumar[2]; [1]Univ. of Texas at Arlington, USA, [2]Northwestern Univ., USA.* We numerically analyze phase-sensitive parametric amplification of a multi-pixel text image and demonstrate that ~10-dB gain is achievable with ~10-kW total pump peak power, which makes it compatible with compact pump sources.

JWA7
Type-II Quasi-Phase-Matched Second-Harmonic Generation in Domain-Disordered Semiconductor Waveguides, *Barry M. Holmes[1], Usman Younis[1], David C. Hutchings[1], Sean J. Wagner[2], Amr S. Helmy[2], J. Stewart Aitchison[2]; [1]Univ. of Glasgow, UK, [2]Univ. of Toronto, Canada.* Second-harmonic generation is demonstrated in periodically intermixed GaAs/AlGaAs superlattice waveguides by Type-II phase matching. Second-harmonic powers of 2.0 μW were generated at fundamental phase matching wavelength of 1577.4 nm.

JWA8
Optical Auto-Correlation Peak Discriminator for Optical CDMA Signal Detection, *Mable P. Fok, Yanhua Deng, Paul R. Prucnal; Princeton Univ., USA.* We experimentally demonstrate a compact optical auto-correlation peak discriminator based on four-wave mixing in a highly-nonlinear bismuth-oxide fiber. The discriminator rejects cross-correlation peaks, thus improves the detection of optical CDMA signal and removes the error-floor.

JWA9
Comparative Study of Pump-Induced Refractive Index Changes in Aluminum and Phosphate Silicate Yb-Doped Fibers, *Andrei Fotiadi[1,2], Oleg L. Antipov[3], Igor A. Bufetov[4], Evgeny M. Dianov[4], Patrice Mégret[1]; [1]Faculté Polytechnique de Mons, Belgium, [2]Ioffe Physico-Technical Inst. of Russian Acad. of Sciences, Russian Federation, [3]Inst. of Applied Physics of Russian Acad. of Sciences, Russian Federation, [4]Fiber Optics Res. Ctr. of the Russian Acad. of Sciences, Russian Federation.* The influence of fiber glass composition on dynamics of pump-induced refractive index changes in Yb-doped silicate fibers is reported. The Yb-ions polarizability difference responsible for the effect is determined for fibers with different Yb-ion lifetimes.

JWA10
Sodium-Yellow Laser Generation from a Three-Stage $X^{(2)}$ Process in an Optical Parametric Oscillator, *Rong-Yu Tu, Yen-Yin Lin, Shoutai Lin, Tsong-Dong Wang, Chin-Yuan Chien, Yen-Chieh Huang; Inst. of Photonics Technologies, Natl. Tsinghua Univ., Taiwan.* We investigated three-stage nonlinear frequency conversion in an optical parametric oscillator to generate 589-nm laser radiation. We successfully demonstrated the sodium-yellow radiation at a threshold of 650 W by using a 1064-nm pump laser.

JWA11
Polarization Pulling Induced by Raman Amplification in Telecommunication Optical Fibers, *Paolo Martelli[1], Matteo Cirigliano[2], Maddalena Ferrario[1], Lucia Marazzi[1], Mario Martinelli[1,2]; [1]CoreCom, Italy, [2]Dept. di Elettronica e Informazione, Politecnico di Milano, Italy.* We exploit the polarization dependence of the Raman amplification to obtain a polarization pulling effect in telecommunication optical fibers. Experiments carried out with 1571-nm signal and copropagating high-power 1486-nm pump evidence the polarization pulling.

JWA12
Cascaded Third-Harmonic Generation in a Single Two-Dimensional Nonlinear Photonic Crystal with a Short-Range Order, *Yan Sheng[1], Solomon M. Saltiel[2], Kaloian Koynov[1]; [1]Max Planck Inst. for Polymer Res., Germany, [2]Faculty of Physics, Univ. of Sofia, Bulgaria.* Short-range ordered nonlinear photonic crystals (SRO-NPC) are new, promising class of materials for optical frequency conversion. We describe a method for designing such SRO-NPC for efficient collinear third-harmonic generation (THG) at arbitrary wavelength.

JWA13
High Repetition Rate Bismuth Borate Optical Parametric Oscillator Pumped by a Cavity-Dumped Nd:YLF Laser, *Shujie Lin[1], Mehdi Sharifi[1], R. J. Dwayne Miller[1], Robin Castelino[2], Stuart Foster[2]; [1]Inst. for Optical Sciences, Univ. of Toronto, Canada, [2]Sunnybrook Health Sciences Ctr., Canada.* We present a bismuth borate optical parametric oscillator pumped by cavity-dumped Nd:YLF laser delivering low jitter 9.5ns millijoule pulses at 1kHz tunable from 720 to 900nm that is ideally suited for photoacoustic medical imaging.

JWA14
Polarization of THz Radiation from Laser Generated Plasma Filaments, *Daniel Dietze[1], Michael Martl[1], Juraj Darmo[1], Stefan Roither[1], Audrius Pugžlys[1], James N. Heyman[2], Karl Unterrainer[1]; [1]Vienna Univ. of Technology, Austria, [2]Macalester College, USA.* We analyze the dependence of the polarization of THz radiation generated by four-wave-mixing in laser induced plasma filaments on the input polarizations and compare these results to current models for plasma assisted THz generation.

JWA15
Generation of Terahertz and Harmonic Radiation in Ultrafast Laser-Gas Interactions, *Ki-Yong Kim; Univ. of Maryland, USA.* The generation of terahertz and harmonic radiation in ultrafast laser-gas interactions is simulated on a basis of transient electron currents. The simulations include two-color laser mixing in gases and photoionization by few-cycle laser pulses.

JWA16
Improved THz Imaging with a Virtual-Source Based Synthetic Aperture Focusing Technique and Coherence Weighting, *Zhuopeng Zhang, Takashi Buma; Univ. of Delaware, USA.* We combine a virtual-source based synthetic aperture focusing technique with coherence weighting to overcome the limited depth-of-focus of high numerical aperture THz optics. Images show depth-independent spatial resolution and a 14 dB improvement in SNR.

JWA17
Fourier-Transform Terahertz Spectroscopy Using Terahertz Frequency Comb, *Dae-Su Yee[1], Youngchan Kim[1], Jaewook Ahn[2]; [1]Korea Res. Inst. of Standards and Science, Republic of Korea, [2]KAIST, Republic of Korea.* We demonstrate high-resolution Fourier-transform terahertz spectroscopy using two terahertz frequency combs with stabilized different repetition frequencies without a mechanical time delay tool.

JOINT

JWA • Joint CLEO/IQEC Poster Session II

JWA18

Terahertz Near-Field Imaging: Rigorous Model for Interpreting "Antenna Approach", *Sergei Popov[1], Yanlu Li[1], Sergey Sergeyev[2], Ari T. Friberg[1,3,4]; [1]Royal Inst. of Technology, Sweden, [2]Waterford Inst. of Technology, Ireland, [3]Helsinki Univ. of Technology, Finland, [4]Univ. of Joensuu, Finland.* Classical Mie theory fails to explain high resolution of a terahertz imaging system exploiting scattering of the near-field radiation. Reported numerical model confirms the feasibility of an antenna model which proves the enhanced resolution.

JWA19

Optical-Pump THz-Probe Spectroscopy of P3HT, *Paul D. Cunningham, L. Michael Hayden; Univ. of Maryland, Baltimore County, USA.* We measured the photoconductivity in P3HT excited above and below the band gap using OPTP spectroscopy and extracted values consistent with the intrinsic mobility. We have also investigated the advantages of broadband (>5 THz) spectroscopy.

JWA20

Distinct Dynamic Behaviors of High-Power Photonic-Transmitters Based on Uni-Traveling Carrier and Separated-Transport-Recombination Photodiodes, *Yu-Tai Li[1], Chan-Shan Yang[1], Ci-Ling Pan[1], Jin-Wei Shi[2], C.-Y. Huang[2], N.-W. Chen[2], S.-H. Chen[2], J.-I. Chyi[2]; [1]Dept. of Photonics, Natl. Chiao Tung Univ., Taiwan, [2]Natl. Central Univ., Taiwan.* We demonstrate two high-performance photonic-transmitters based on uni-traveling-carrier-photodiode (UTC-PD) and separated-transport-recombination-photodiode (STR-PD). Thanks to recombination center, STR-PD exhibits comparable maximum-peak-power and electrical pulse-width with much smaller photocurrents and less serious device-heating to those of UTC-PD.

JWA21

Quasi-Phase Matched Electro-Optic Terahertz Detector, *Juraj Darmo, Karl Unterrainer; Photonics Inst., Vienna Univ. of Technology, Austria.* An enhanced terahertz electro-optic detector with periodically-inverted crystalline structure is proposed and demonstrated. This concept enables to increase the detector sensitivity to the multi-terahretz frequencies by order of magnitude.

JWA22

Evaluating the Linear and Nonlinear Optical Properties of a Mixed Tellurite Chalcogenide Glass, *Zhian Jin, Ivan Biaggio, Jean Toulouse; Lehigh Univ., USA.* A new type of tellurite chalcogenide glass is proposed. Our theoretical study shows an enhancement that linear refractive index n_0 (~1.5times) and third-order susceptibility $\chi^{(3)}$ (~20times) are larger than the base tellurite glass.

JWA23

Characterization of Nonlinear Absorption in Phosphine-Substituted Bithiophenes, *Timothy M. Pritchett[1], Jianwei Wang[2], Christopher M. Lawson[2], Qun Zhao[2], Gary M. Gray[2]; [1]ARL, USA, [2]Univ. of Alabama at Birmingham, USA.* The two-photon absorption cross-sections of two novel derivatives of 5,5′-bis(diphenylphosphino)-2,2′-bithiophene have been measured using Z scans employing 27-ps pulses at multiple pulse energies, yielding values of 1500 ± 50 GM and 2830 ± 50 GM.

JWA24

Nonlinear Optical Characterization of H-Bonded Chromophores in Linear-Dendritic Block Copolymers, *Melvina Leolukman[1], Peerasak Paoprasert[1], Solimar Jimenez Diaz[2], David J. McGee[3], Padma Gopalan[1]; [1]Univ. of Wisconsin-Madison, USA, [2]Univ. of Puerto Rico at Cayey, USA, [3]Drew Univ., USA.* A linear-dendritic block copolymer was synthesized by end-functionalizing poly(methylmethacrylate) with dendrons that acted as H-bond acceptors for nonlinear optical chromophores. High quality spin coated films exhibit r_{33} electro-optic values of 25 pm/V at 1550 nm.

JWA25

A Near-IR Transmitting "Black Glass" Synthesized from 70%TeO_2-25%ZnO-5%ZnS, *Zhian Jin, Aidong Zhang, Andriy Kovalskiy, Ivan Biaggio, Jean Toulouse; Lehigh Univ., USA.* A new type of tellurite glass synthesized with composition 70%TeO_2-25%ZnO-5%ZnS transmits between 2µm to 6µm. XPS reveal the existence of Zn-O-S and a reduction of tellurium oxide with formation of Te-Te bonds in the glass.

JWA26

Near-Infrared Quantum Cutting in SrF_2:Pr^{3+}, Yb^{3+} for Photovoltaics, *Bryan M. van der Ende, Linda Aarts, Ramon Muller, Andries Meijerink; Condensed Matter and Interfaces, Debye Inst. for NanoMaterials Science, Utrecht Univ., Netherlands.* Visible to NIR downconversion efficiency up to 140% is observed using time-resolved spectroscopy in SrF_2:Pr^{3+},Yb^{3+}. With sensitization, this has potential for application in converting the solar spectrum to boost the efficiency of silicon solar cells.

JWA27

Nonlinear Refractive Indices in Undoped and Yb-Doped $KT(WO_4)_2$ T=Y, Yb, Gd, Lu Crystals, *Nicky Thilmann[1], Gustav Strömqvist[1], Maria-Cinta Pujol[2], Valdas Pasiskevicius[1], Valentin Petrov[3], Francesc Díaz[2]; [1]Royal Inst. of Technology, Sweden, [2]FiCMA-FiCNA, Univ. Rovira i Virgili, Spain, [3]Max-Born-Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany.* Nonlinear index was investigated in undoped and Yb-doped monoclinic double-tungstates for $E||N_m$ and $E||N_p$ polarized 819nm light. Anisotropic n_2 with maximum for $E||N_m$ in all investigated compounds is proportional to the rare earth ion polarizability.

JWA28

Anomalously High Refractive Index of an Array of Vertically Aligned Gold Nanopillars on Silicon, *Gustavo E. Fernandes[1], Jin-Ho Kim[1], Zhijun Liu[1], Jeffrey Shainline[1], Richard Osgood III[2], Jimmy Xu[1]; [1]Brown Univ., USA, [2]U.S. Army Natick Soldier Res. Development Ctr., USA.* Reflectivity measurements on a film consisting of gold nanopillars surrounded by an anodized aluminum oxide medium suggest a refractive index much larger than that predicted by considering the dispersion curves of gold and aluminum oxide.

JWA29

Paper Withdrawn.

JWA30

Nano-Ag:Polymeric Photonic Crystal All-Optical Switching, *Xiaoyong Hu, Ping Jiang, Cheng Xin, Hong Yang, Qihuang Gong; Dept. of Physics, Peking Univ., China.* An ultrafast and low-power photonic crystal all-optical switching is realized, made of nano-Ag:MEH-PPV composite. The pump intensity is as low as 0.2 MW/cm^2. An ultrafast swiching time of 35 ps is achieved.

JWA31

Sub Nanosecond Electroholographic Switching, *Noam Sapiens, Aharon Weissbrod, Aharon J. Agranat; Hebrew Univ., Israel.* Electroholographic switching with rise-time of less than a nanosecond is henceforth demonstrated. The switching was done in the g_{44} configuration in which the Bragg condition is fulfilled for a single value of the electric field.

JWA32

Ultrafast All-Fiber Third-Order Temporal Differentiator, *Luis M. Rivas[1,2], Sylvain Boudreau[3], Yongwoo Park[1], Radan Slavík[4], Sophie Larochelle[3], Alejandro Carballar[2], José Azaña[1]; [1]INRS-Énérgie, Matériaux et Télécommunications, Canada, [2]Dept. Ingeniería Electrónica, Escuela Técnica Superior de Ingenieros, Univ. de Sevilla, Spain, [3]Ctr. d'Optique, Photonique et Laser, Univ. Laval, Canada, [4]Inst. of Photonics and Electronics, ASCR, Czech Republic.* We propose and demonstrate a new, simple and compact scheme for arbitrary-odd-order optical temporal differentiation. It is implemented by cascading an even-order fiber Bragg grating differentiator and a first-order long period fiber grating differentiator.

JWA33

Intracavity Phase Modulation for Phase Noise and Supermode Noise Spur Suppression in Mode-Locked Lasers, *Sarper Ozharar, Ibrahim T. Ozdur, Franklyn J. Quinlan, Peter J. Delfyett; CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA.* Using intracavity active phase modulation, we have verified the theory of Haus and Rana and realized timing jitter reduction from 304fs to 150fs integrated to Nyquist frequency on a 10.24 GHz actively mode-locked pulse train.

JWA34

Statistical Analysis of Incoherent Pulse Shaping, *Christophe Dorrer; Lab for Laser Energetics, Univ. of Rochester, USA.* The statistical properties of incoherent pulse shaping are obtained from the derived probability density function of the shaped intensity obtained by temporal gating of an incoherent source followed by chromatic dispersion.

JWA35

Single-Drive Electro-Optic Modulator for Duo-Binary Modulation Utilizing Non-Periodically Polarization-Reversed Structure, *Hiroshi Murata[1], Ha Viet Pham[1], Yasuyuki Okamura[1], Takahide Sakamoto[2], Tetsuya Kawanishi[2]; [1]Osaka Univ., Japan, [2]NICT, Japan.* A new electro-optic duo-binary modulator is proposed. Utilizing non-periodic polarization reversal structures, a pair of Gaussian-like modulation frequency responses with an opposite sign is obtainable. It operates with a single duo-binary signal without electrical/optical filters.

JWA36

Picosecond Pulse Generation Using Low-Driving-Voltage MZM Driven with Step Recovery Diodes, *Takahide Sakamoto, Isao Morohashi, Tetsuya Kawanishi, Iwao Hosako; NICT, Japan.* We demonstrated synthesis of picosecond pulse train from a continuous-wave laser source using low-driving-voltage Mach-Zehnder modulator (MZM) asymmetrically large-amplitude driven with step-recovery diodes, without using high-power driver amplifiers. 2-GHz, 5.2-ps pulse train was successfully generated.

JWA37

Extremely Simple Device for Measuring Ultrashort Pulses in the Visible, *Dongjoo Lee, Rick Trebino; Georgia Tech, USA.* We demonstrate an extremely simple frequency-resolved optical-gating device (GRENOUILLE) for the visible range. By angle-tuning a thick crystal, its range includes the entire visible spectrum and should be ideal for measuring pulses from visible OPAs.

JWA38

Thin Film P-Ridge N-Stripe III-V Laser Broad Area Metal-Metal Bonded to Silicon, *Sabarni Palit[1], Jeremy Kirch[2], Luke Mawst[2], Thomas Kuech[2], Nan Jokerst[1]; [1]Duke Univ., USA, [2]Univ. of Wisconsin-Madison, USA.* A p-ridge single quantum well thin film laser has been metal/metal bonded onto silicon for good thermal dissipation and low threshold current. The threshold current density is 244 A/cm^2.

JWA39

Silicon-on-Insulator Integrated Waveguide Filters for Photonic Channelizer Applications, *Marcel W. Pruessner, Todd H. Stievater, William S. Rabinovich, Preetpaul S. Devgan, Vincent J. Urick; NRL, USA.* We demonstrate integrated waveguide microcavity filters for channelizer applications. Various filters exhibit bandwidths of BW<2 GHz (16 pm), free spectral range FSR>83 GHz (1.87nm), and maximum finesse F=77. Several contributions to filter loss are examined.

JWA40

High-Density Optical Interconnect Based on TIR and Metal Coated Precise Mirror Attached Waveguide, *Hidetoshi Numata, Shigeru Nakagawa, Yoichi Taira; IBM Tokyo Res. Lab, Japan.* We present high density optical interconnect based on TIR and metal coated precise mirror attached waveguide on a PCB. The structure and performance of 12-channel transmitter and receiver operating at 8-10 Gbps are presented.

JWA41

Broad Band 1 nm Channel Spacing Silicon-on-Insulator Wavelength Division Multiplexer, *Bernardo B. C. Kyotoku[1,2], Long Chen[1], Michal Lipson[1]; [1]School of Electrical and Computer Engineering, Cornell Univ., USA, [2]Dept. de Fisica, Univ. Federal de Pernambuco, Brazil.* We demonstrate a compact silicon-on-insulator wavelength division multiplexer. The device supports 21 channels, has 1 nm channel spacing and less than -10 dB crosstalk.

JOINT

JWA42

Colorless, Surface Normal Optical Modulator Based on Free Carrier Effect in Gallium Arsenide, *Ojas P. Kulkarni, Malay Kumar, Mohammed N. Islam, Fred L. Terry, Jr.; Dept. of Electrical Engineering and Computer Science, Univ. of Michigan, USA.* We demonstrate a surface-normal modulator based on free-carrier effect in GaAs and phase-to-amplitude conversion coupling to a single mode fiber. Operation over 1200-2400nm, modulation depth up to 43% and frequency up to 270MHz is observed.

JWA43

Influence of Free Carrier Absorption to Mach-Zehnder Interference-Based Photonic Switches, *Haifeng Zhou, Yong Zhao, Fan Wang, Wanjun Wang, Huiling Mao, Jianyi Yang, Minghua Wang, Xiaoqing Jiang; Dept. of Information Science and Electronics Engineering, Zhejiang Univ., China.* The absorption penalty to free carrier dispersion effect seriously constraints the crosstalk of Mach-Zehnder interference-based photonic switch to a limit, which is demonstrated by theory and the fabricated 1×2 *p-i-n* silicon optical switches.

JWA44

2-D Confinement and Reduction of Polarization Dependence in Hollow Waveguide with High Index Contrast Grating, *Mukesh Kumar[1], Fumio Koyama[1], C.J. Chang-Hasnain[2]; [1]Tokyo Inst. of Technology, Japan, [2]Univ. of California at Berkeley, USA.* A tunable hollow waveguide with distributed Bragg reflector (DBR) mirror and a high-index-contrast-grating (HCG) mirror has been proposed. We numerically show the possibility of 2-D-confinement and reduction in polarization-dependence of the proposed hollow waveguide.

JWA45

Multi-Channel Sensing with Resonant Microcavities Coupled to a Photonic Crystal Waveguide, *Elisa Guillermain, Philippe M. Fauchet; Univ. of Rochester, USA.* Resonant cavities coupled to a single photonic crystal waveguide operating as a multi-channel sensor are reported. The transmission spectrum presents as many dips as there are cavities. Infiltration of a solvent shifts the resonance wavelengths.

JWA46

Resolution Enhancement through Focal Field Polarization Control in Third Harmonic Generation Microscopy, *Omid Masihzadeh, Philip Schlup, Randy A. Bartels; Colorado State Univ., USA.* Increased spatial resolution through control of the focal field polarization state in a laser scanning third harmonic generation (THG) microscope is demonstrated. THG polarization tomography is used to characterize the focal field polarization state.

JWA47

Atmospheric Pressure Femtosecond Laser Imaging Mass Spectrometry, *Yves Coello, Tissa C. Gunaratne, Marcos Dantus; Michigan State Univ., USA.* We present a novel imaging mass spectrometry technique using femtosecond laser pulses to ionize the sample at atmospheric pressure and without the need of a laser-absorbing matrix. A 10µm-resolution image of biological tissue is demonstrated.

JWA48

Optical Coherence Tomography Based on Intensity Correlations of Quasi-Thermal Light, *Petros Zerom[1], Giovanni Piredda[1], Robert W. Boyd[1], Jeffrey H. Shapiro[2]; [1]Inst. of Optics, Univ. of Rochester, USA, [2]Res. Lab of Electronics, MIT, USA.* We show theoretically that the longitudinal resolution of conventional OCT can be improved by a factor of $\sqrt{2}$ when a two-photon (as opposed to single-photon) sensitive detector is used, and we present preliminary supporting results.

JWA49

Near-Infrared *in vivo* Fluorescence Sensor with Integrated Dielectric Emission Filter, *Thomas D. O'Sullivan[1], Elizabeth Munro[2], Christopher Conca[3], Natesh Parashurama[1], Adam de la Zerda[1], Sanjiv S. Gambhir[1], James S. Harris[1], Ofer Levi[2]; [1]Stanford Univ., USA, [2]Univ. of Toronto, Canada, [3]Chroma Technology Corp., USA.* We present a monolithically integrated near-infrared fluorescence sensor incorporating a dielectric emission filter for *in vivo* applications. We successfully integrated a dielectric emission filter (OD3) onto a low-noise detector and sensed 50nM fluorescent dye concentration.

JWA50

Near-Infrared Fluorescent Labeling of Tissue Transglutaminase Substrates for Wound Healing Monitoring, *Chia-Pin Pan[1], Yihui Shi[1], Charles Greenberg[2], Zishan Haroon[1], Gregory W. Faris[1]; [1]SRI Intl., USA, [2]Duke Univ. Medical Ctr., USA.* A novel imaging strategy is developed to optically monitor the wound healing process by crosslinking near-infrared fluorescent-labeled tissue transglutaminase substrates into the wound.

JWA51

Ultrahigh Resolution Optical Coherence Tomography Using Cr^{4+}:YAG Fiber, *Yu-Ta Wang[1], Po-Jui Liao[1], Kuang-Yao Huang[2], Po-Kai Hsu[1], Sheng-Lung Huang[1]; [1]Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Inst. of Electro-Optical Engineering, Natl. Sun Yat-Sen Univ., Taiwan.* Using a CW 265-nm broadband source from Cr^{4+}:YAG double-clad fiber, ultrahigh resolution optical coherence tomography was demonstrated with a 73-dB S/N ratio. A 3-µm TiO_2 thin film was used to verify its 3.5-µm axial resolution.

JWA52

Hollow-Core Photonic Bandgap Fibers with Broadband Negative Dispersion Slope, *Kunimasa Saitoh[1], Zoltan Várallyay[2], Kuniaki Kakihara[1], Masanori Koshiba[1], Robert Szipőcs[3]; [1]Hokkaido Univ., Japan, [2]Furukawa Electric Inst. of Technology Ltd., Hungary, [3]Res. Inst. for Solid State Physics and Optics, Hungary.* Hollow-core photonic bandgap fibers exhibiting negative dispersion slope over a wide wavelength range around one micron for the fundamental air-core mode are presented by the introduction of partial reflector layer around the core.

JWA53

Tight Control of the Spectral Broadening Obtained by Nonlinear Conversion in a Photonic BandGap Fiber, *Raphaël Jamier[1], Nicolas Ducros[1], Sébastien Février[1], Mikhail E. Likhachev[2], Mikhail Salganskii[3]; [1]Xlim - Univ. of Limoges, France, [2]Fiber Optics Res. Ctr., Russian Federation, [3]Inst. of Chemistry of High Purity Substances, Russian Federation.* We experimentally observed the control of the extent of a spectral broadening obtained in a nonlinear photonic bandgap fiber. A spatially singlemode 430 nm-wide spectrum is then obtained by the fiber self-filtering effect.

JWA54

3-D Modeling of Modal Competition in Fiber Laser: Application to HOM Suppression in Multi-Layered Fiber, *Mathieu Devautour, Philippe Roy, Sébastien Février; Xlim, Univ. of Limoges, France.* Three-dimensional modeling of modal competition in fiber lasers is presented. The numerical model is used to design a large mode area active fiber laser in which high order modes' suppression is wavelength insensitive.

JWA55

Upconversion Assisted Auto-Oscillations in Erbium Doped Fiber Laser, *Sergey V. Sergeyev[1], Kieran O'Mahoney[1], Sergei Popov[2], Ari T. Friberg[2,3,4]; [1]Waterford Inst. of Technology, Ireland, [2]Royal Inst. of Technology, Sweden, [3]Helsinki Univ. of Technology, Finland, [4]Univ. of Joensuu, Finland.* A new model of auto-oscillations in high concentration erbium doped fiber laser has been developed with accounting for statistical nature of the excitation migration and upconversion, as well as resonance-like pump-to-signal intensity noise transfer.

JWA56

Temperature Response of Photonic Bandgap Fibers Based on High-Index Inclusions, *Rafael E. P. de Oliveira[1], Christiano J. S. de Matos[1], Jonathan C. Knight[2], Toshiki Taru[2], Arismar C. Sodré[3]; [1]Univ. Presbiteriana Mackenzie, Brazil, [2]Univ. of Bath, UK, [3]UNICAMP, Brazil.* We observed spectral shifts for short heated lengths of photonic bandgap fibers based on high-index rods. Shifts are observed in even shorter lengths if the fiber is bent. Application as alternative distributed sensors is envisaged.

JWA57

Fiber Raman Amplifiers with Suppressed Polarization Impairments, *Sergey V. Sergeyev[1], Sergei Popov[2], Ari T. Friberg[2,3,4]; [1]Waterford Inst. of Technology, Ireland, [2]Royal Inst. of Technology, Sweden, [3]Helsinki Univ. of Technology, Finland, [4]Univ. of Joensuu, Finland.* By using two-section fiber where the first section has no spin and the second one is periodically spun, we demonstrate reduced polarization dependent gain and polarization mode dispersion in a distributed fiber Raman amplifier.

JWA58

Polarization Rotation in a Nanosecond Yb^{3+} Rod-Type Fiber Amplifier, *Ramatou Bello-Doua[1], François Salin[1], Eric Freysz[2]; [1]EOLITE Systems, France, [2]Univ. Bordeaux 1, France.* We evidenced the polarization rotation in an Yb^{3+} rod type fiber amplifier injected by a sub-nanosecond microlaser. Simple numerical simulations account for the observed phenomena.

JWA59

Zero-Broadening and Pulse Compression Brillouin Slow Light Based on Doublet Gain Lines in an Optical Fiber, *Guanshi Qin, Takenobu Suzuki, Yasutake Ohishi; Toyota Technological Inst., Japan.* We numerically demonstrate zero-broadening and pulse compression Brillouin slow light based on doublet gain lines in an optical fiber.

JWA60

Tm:Germanate Fiber Laser for Planetary Water Vapor Atmospheric Profiling, *Norman Barnes, Russell J. De Young; NASA Langley Res. Ctr., USA.* The atmospheric profiling of water vapor is necessary for finding life on Mars and weather on Earth. The design and performance of a water vapor lidar based on a Tm:germanate fiber laser is presented.

JWA61

All-Optical Gain-Clamping Dispersion-Compensated Raman/EDFAs for WDM Systems, *Jeng-Cherng Dung, You-Ren Jian, Bing-Sheng Wu; Natl. Dong Hwa Univ., Taiwan.* We design dispersion-compensated Raman/EDFA hybrid amplifiers recycling residual Raman pump for WDM systems. The first experimentally demonstration of broad band gain-clamped and gain flattened dispersion-compensated Raman/EDFA hybrid amplifiers with a single FBG for WDM systems.

JWA62

Optimization of Microresonator Parameters for a Quartz-Enhanced Photoacoustic Spectroscopy Sensor, *Lei Dong, Anatoliy A. Kosterev, David Thomazy, Frank K. Tittel; Rice Univ., USA.* A Quantz-Enhanced Photoacoustic Spectroscopy based gas sensor was optimized to improve its compact spectrophone design and performance. The impact of a 2-tube microresonator geometry on the detected signal and signal to noise ratio was investigated.

JWA63

Multiple-Pass Tapered Fiber-Optic Sensor with Logarithmic Detection, *Ertan Salik, Gabriel Anday a; California State Polytechnic Univ., USA.* We report doubling of sensitivity for tapered fiber-optic sensors with logarithmic detection when light passes through the tapered region twice. Further sensitivity enhancement is possible with multiple passes through the taper.

JWA64

Sound Recording by Laser Interferometry, *Balthasar Fischer, Ernst Wintner; Vienna Univ. of Technology, Austria.* A Fabry-Perot etalon is used as microphone. Refractive index dependant transmission is proportional to sound pressure over a large dynamic range. The current of the laser diode is tuned to take into account environmental influences.

JWA65

Measurement of the Oxygen (1-0) Band at 690 nm Using Continuous-Wave Cavity Ring-Down Spectroscopy, *James M. Ray, Berley L. Rister III, George M. Brooke IV; Virginia Military Inst., USA.* We have measured the (1-0) band of the $b^1\Sigma_g^+$-$X^3\Sigma_g^-$ system in molecular oxygen at pressures ranging from 25 torr to 500 torr using continuous-wave cavity ring-down spectroscopy (CW-CRDS).

JWA66

Assessment of Dual Ammonia and Ozone Open-Path Sensing with a Quantum Cascade Laser, *Paul Corrigan, Maung Lwin, Barry Gross, Fred Moshary; City College of New York, USA.* We present a theoretical assessment of two open-path quantum cascade laser (QCL) approaches (mono/bi-static and backscatter) to measure ambient ozone and ammonia concentrations to within 1 - 10 % accuracy at distances to 10 km.

JOINT

JWA67
Fiber Optic Sensor System for Stress Monitoring in Power Cables, *Jörg Burgmeier, Wolfgang Schippers, Wolfgang Schade; Clausthal Univ. of Technology, Germany.* A sensor system for power cables, based on a single microchip-laser and single mode fibers is presented. The system is capable of monitoring temperature, squeezing, bending and torsion, spatially resolved down to a few centimetres.

JWA68
Fiber Bragg Grating Fabry-Perot Resonator Based Acoustic Emission Sensor Using Active Feedback System, *Raja P. Pappu, Wei Zhang, Ian Bennion, Kate Sugden; Aston Univ., UK.* We propose a novel optical fiber grating based Fabry-Perot acoustic emission sensor and active feedback system that eliminates low frequency spectrum shifts caused by environmental perturbations, ensuring the sensor always work at optimum operation point.

JWA69
Optical Fiber Refractometer with Improved Sensitivity Based on an Offset Tilted Fiber Bragg Grating, *Tuan Guo[1], Hwa-Yaw Tam[1], Jacques Albert[2]; [1]Dept. of Electrical Engineering, Hong Kong Polytechnic Univ., Hong Kong, [2]Dept. of Electronics, Carleton Univ., Canada.* Highly sensitive fiber-optic refractometer with an over-offset tilted fiber Bragg grating configuration is proposed based on strong cladding-core recoupling. Reflection with two well-defined bands performs an improved refractive index measurement combining with power self-calibration property.

JWA70
Simultaneously Transfer Microwave and Optical Frequency through Fiber Using Mode-Locked Fiber Laser, *Chun–Wei Kang[1,2], Tze-An Liu[1], Ren-Huei Shu[1], Ci-Ling Pan[2], Jin-Long Peng[1]; [1]Ctr. for Measurement Standards, Taiwan, [2]Natl. Chiao Tung Univ., Taiwan.* Microwave and optical frequency references are simultaneously transferred through fiber using a frequency-stabilized mode-locked Er-fiber laser comb. The instability for transferred microwave and optical frequencies are 2.0×10^{-13} and 7.5×10^{-15}@1 s, respectively, for 3 km transmission.

JWA71
Microwave Frequency Transfer by Propagation of an Optical Frequency Comb over Optical Fiber, *Giuseppe Marra, Stephen Lea, Helen Margolis, Patrick Gill; Natl. Physical Lab, UK.* The repetition rate of a mode-locked laser is transferred over 50 km of spooled fiber with instability below 5×10^{-15} $\tau^{-1/2}$, rendering this technique suitable for disseminating state-of-the-art microwave oscillators and optically-derived microwave references.

JWA72
Development of a Compressive Programmable Array Microscope, *Yuehao Wu, Caihua Chen, Peng Ye, Gonzalo Arce, Dennis Prather; Univ. of Delaware, USA.* We present a compressive programmable array microscope design, which incorporates the compressive sensing principle into the patterned illumination microscope design, so that single pixel detectors can be used to capture microscopic images without mechanical scanning.

JWA73
Temporally Resolved Characterization of Iron Nanoparticles Using a Time-Resolved Laser Technique, *Johannes Kiefer[1], Roland Sommer[1], Katya Danova[2], Nadejda Popovska[2], Alfred Leipertz[1]; [1]Lehrstuhl für Technische Thermodynamik, Univ. Erlangen-Nürnberg, Germany, [2]Lehrstuhl für Chemische Reaktionstechnik, Univ. Erlangen-Nürnberg, Germany.* For the first time, time-resolved laser-induced incandescence (TiRe-LII) has been used to investigate the metal-organic chemical vapor deposition (MOCVD) process of iron in a fluidized bed reactor characterizing nanoparticles deposited on a substrate surface.

JWA74
All-Fiber Common-Path Fourier-Domain Optical Coherence Microscopy for 3-D *in vivo* Endoscopic Subcellular Imaging, *Kang Zhang, Jae-Ho Han, Jin U. Kang; Johns Hopkins Univ., USA.* We demonstrated a Fourier-domain all-fiber common-path optical coherence microscopy for 3-D *in vivo* endoscopic subcellular imaging. Image resolution of 2μm × 9μm (transverse × axial) is achieved with nucleus and cell walls clearly visualized.

JWA75
Observation of 100 GHz Beat Signal for Millimeter-Wave Generation Using Mach-Zehnder-Modulator-Based Flat Comb Generator, *Isao Morohashi[1], Takahide Sakamoto[1], Hideyuki Sotobayashi[2,1], Tetsuya Kawanishi[1], Iwao Hosako[1]; [1]NICT, Japan, [2]Aoyama Gakuin Univ., Japan.* We proposed a method for millimeter and terahertz wave generation using a Mach-Zehnder-modulator-based flat comb generator, and showed a 100 GHz beat signal by extracting two modes from 12.5 GHz-spaced comb signals.

JWA76
Strain Relaxation and Emission Characteristics of Size-Dependent InGaN/GaN Nanorod Arrays, *ChingHua Chiu[1], Peichen Yu[1], H. C. Kuo[1], T. C. Lu[1], S. C. Wang[1], C. Y. Chang[2], Y. R. Wu[2]; [1]Dept. of Photonics and Inst. of Electro-Optical Engineering, Natl. Chiao Tung Univ., Taiwan, [2]Inst. of Photonics and Optoelectronics and Dept. of Electrical Engineering, Natl. Taiwan Univ., Taiwan.* InGaN/GaN nanorod arrays with various sizes are fabricated using self assembled Ni nano-masks and inductively-coupled-plasma reactive ion etching. Numerical analysis using a valence force field model showx excellent agreement with the experiment results.

JWA77
Efficiency Enhancement of GaN/InGaN Vertical-Injection Light Emitting Diodes Using Distinctive Indium-Tin-Oxide Nanorods, *C. S. Yang, Peichen Yu, ChingHua Chiu, C. H. Chang, H. C. Kuo; Dept. of Photonics and Inst. of Electro-Optical Engineering, Natl. Chiao Tung Univ., Taiwan.* Distinctive indium-tin-oxide nanorods are demonstrated using glancing-angle deposition. The nanostructured material exhibits enhanced transmission and is employed to enhance the light-output-power of GaN/InGaN vertical-injection light emitting diodes by 20% at an injection current of 350mA.

JWA78
Nanorod Light Emitting Diode Arrays with Highly Concentrated Radiation Profile and Strain Relaxed Structure, *Liang-Yi Chen, Ying-Yuan Huang, Pei-hsuan Lin, Min-Yung Ke, JianJang Huang; Natl. Taiwan Univ., Taiwan.* We have developed a nature lithography method to fabricate nanorod structure. The strain is released in nanorod structured LED, which is indicated by their nearly constant electroluminescence peak wavelength. The radiation profile is highly concentrated.

JWA79
Etching Depth Dependence of Emission Properties from InGaN/GaN Light Emitting Diodes with Nanohole Arrays: Analysis of Strain Relaxation and Surface States, *Cheng-Yu Chang, Yuh-Renn Wu; Inst. of Photonics and Optoelectronics and Dept. of Electrical Engineering, Natl. Taiwan Univ., Taiwan.* Our studies shows that the surface states and strain relaxation play significant roles when the etching hole depth is close to or penetrates the quantum well region, which leads the blue shift of the spectrum.

JWA80
White Light Emission from Organic Diode with Electroluminescent Quantum Dots and Organic Molecules, *Torris Badr, Serge Gauvin, Alain Haché; Dépt. de Physique et d'Astronomie, Univ. de Moncton, Canada.* An organic light-emitting device is used in combination with quantum dots and blue-light emitting organic molecules to produce flexible white light. Quantum dots are excited via direct electronic injection, unlike previously reported.

JWA81
Influence of Guided Mode Absorption on the Effectiveness of GaN-on-Sapphire Photonic Crystal Light-Emitting Diodes, *Philip A. Shields[1], Szymon Lis[1], Tom Lee[2], Duncan W. E. Allsopp[1], Martin D. B. Charlton[2], Majd E. Zoorob[2], Wang N. Wang[1]; [1]Dept. of Electronic and Electrical Engineering, Univ. of Bath, UK, [2]Mesophotonics Ltd., UK.* Enhanced light extraction from photonic crystal light-emitting diodes etched into the device surface is described. Finite Difference Time Domain modeling indicates that scattering or absorption at the substrate-epilayer interface is the dominant limiting process.

JWA82
Confocal Thermoreflectance for Spatially Resolved Surface Thermography of Transparent LEDs, *Joseph A. Summers, Janice A. Hudgings; Mount Holyoke College, USA.* We report on the use of confocal thermoreflectance for accurate surface temperature measurement of transparent LEDs. Confocal thermoreflectance effectively suppresses light from beneath the LED surface, compared to widefield measurements, for a red GaP LED.

JWA83
Effects of Prestrained Layers on Piezoelectric Field and Indium Incorporation in InGaN/GaN Quantum Wells, *Jae-Ho Song[1], Ho-Jong Kim[1], Byung-Jun An[1], Jung-Hoon Song[1], Youngboo Moon[2], Hwan-Kuk Yuh[2], Sung-Chul Choi[2]; [1]Dept. of Physics, Kongju Univ., Republic of Korea, [2]THELEDS Co., Ltd, Republic of Korea.* We report significant effects of prestrained layers on piezoelectric fields and indium incorporation in blue-emitting InGaN/GaN quantum wells by using reverse biased electroreflectance spectroscopy.

JWA84
Nonlocal Dispersion Cancellation Using Entangled Photons, *So-Young Baek, Young-Wook Cho, Yoon-Ho Kim; Pohang Univ. of Science and Technology (POSTECH), Republic of Korea.* Using an entangled photon-pair traveling through two separate dispersive media, we experimentally demonstrate nonlocal dispersion cancellation in which the dispersion experienced by one photon cancels the dispersion experienced by the other photon.

JWA85
Sequential Time-Bin Entanglement Generation Using Periodically Poled KTP Waveguide, *Lijun Ma, Oliver Slattery, Tiejun Chang, Xiao Tang; NIST, USA.* We demonstrated non-degenerate sequential time-bin entanglement using periodically poled KTP waveguide at a repetition rate of 1 GHz. The wavelengths of signal and idler are 895 and 1310 nm. The two-photon-interference-fringe visibility is 79 %.

JWA86
Unconditional Continuous Variable Entanglement Cascading, *Xueyuan Hu[1], Ying Gu[1], Qihuang Gong[1], Guangcan Guo[2]; [1]State Key Lab for Mesoscopic Physics and Dept. of Physics, Peking Univ., China, [2]Key Lab of Quantum Information, Univ. of Science and Technology, China.* A sequence of continuous-variable entanglement swapping is studied. We obtain the upper-bound of Gaussian cascaded entanglement and propose an unconditional protocol achieving it. We demonstrate entanglement can be unconditionally cascaded for any nonzero-squeezed entangled sources.

JWA87
Characterizing Single Photons by Photon Counting, *Kaisa Laiho, Malte Avenhaus, Katiuscia N. Cassemiro, Christine Silberhorn; Max Planck Res. Group, Germany.* We study the ability to measure the non-Gaussian character of the single photon Fock states via direct measurements of the photon number statistics of displaced quantum states.

JWA88
Observation of Whispering Gallery Modes in m-plane GaN/InGaN Microdisks, *Adele C. Tamboli, Mathew C. Schmidt, Elaine D. Haberer, Asako Hirai, James S. Speck, Steven P. DenBaars, Evelyn L. Hu; Materials Dept., Univ. of California at Santa Barbara, USA.* Microdisks support high quality modes and low threshold lasing in GaN. We have fabricated nonpolar microdisks that have high quality whispering gallery modes with quality factors limited by quantum well reabsorption rather than cavity roughness.

JWA89
Photon Management in Thin Film Solar Cells, *Carsten Rockstuhl[1], Stephan Fahr[1], Thomas Paul[1], Christoph Menzel[1], Karsten Bittkau[2], Thomas Beckers[2], Reinhard Carius[2], Falk Lederer[1]; [1]Inst. of Condensed Matter Theory and Solid State Optics, Friedrich-Schiller-Univ. Jena, Germany, [2]Inst. für Energieforschung, Forschungszentrum Jülich, Germany.* We analyze the absorption enhancement in single and tandem solar-cells comprising nanostructures that increase the path of the photons inside the solar cell. For this purpose we exploit different physical phenomena in different material systems.

JWA90

Modified Surface Plasmon Antenna for Localized Field Enhancement, *Dongxing Wang, Tian Yang, Kenneth B. Crozier; Harvard Univ., USA.* A modified surface plasmon antenna design is proposed. Simulation results show that the modified design has higher localized field enhancement than traditional rod and bowtie antennas.

JWA91

Design of Nanoslotted Photonic Crystal Waveguide Cavities for Single Nanoparticle Trapping, *Shiyun Lin[1], Juejun Hu[2], Lionel Kimerling[2], Kenneth Crozier[1]; [1]Harvard Univ., USA, [2]MIT, USA.* We design and numerically simulate a photonic crystal waveguide cavity with a nanoslot structure for single nanoparticle trapping. A 135x enhancement of optical gradient trapping force compared to plain waveguide trapping devices has been achieved.

JWA92

Photonic Crystal Cavities for Sensing: Dielectric Modes versus Air Modes, *Snjezana Tomljenovic-Hanic[1], Adel Rahmani[2], Michael J. Steel[3], C. Martijn de Sterke[1]; [1]CUDOS, School of Physics, Univ. of Sydney, Australia, [2]CUDOS, Dept. of Mathematical Sciences, Univ. of Technology Sydney, Australia, [3]CUDOS, Dept. of Physics, Macquarie Univ., Australia.* Effective sensing with photonic crystal cavities requires optimization of modal quality factor and field overlap. For several unrelated cavities, we find the quality factor dominates, so that dielectric modes are strongly favored over air modes.

JWA93

Fused Microfiber Resonators, *Parama Pal, Wayne H. Knox; Inst. of Optics, Univ. of Rochester, USA.* We demonstrate a ~2.6 mm-diameter optical ring resonator fabricated from a 7.2 µm-thick silica fiber with a CO_2 laser- fused coupling region for mechanical robustness. We experimentally obtain a *Q*-factor of ≥25,000 at 1.55 µm.

JWA94

Fabrication of Intrinsic Fiber Mach-Zehnder Interferometer by Imbedding Micro Air-Cavity, *Minkyu Park[1], Sejin Lee[1], Woosung Ha[1], Dae-Kyu Kim[1], Woojin Shin[2], Ik-Bu Sohn[2], Kyunghwan Oh[1]; [1]Inst. of Physics and Applied Physics, Yonsei Univ., Republic of Korea, [2]Advanced Photonics Res. Inst., GIST, Republic of Korea.* We have fabricated an intrinsic fiber Mach-Zehnder interferometer (MZI) by imbedding a micro air-cavity using femtosecond laser and optimal arc-splicing. Spectral analysis confirmed the MZI with experimental results. Temperature dependence was also measured.

JWA95

A Hollow Triangular-Core Fiber: Investigation of Its Modal Propagation and Polarization Control, *Woosung Ha[1], Sejin Lee[1], Jongki Kim[1], Jens Kobelke[2], Kay Schuster[2], Sonja Unger[2], Anka Schwuchow[2], Jun Ki Kim[3], Kyunghwan Oh[1]; [1]Yonsei Univ., Republic of Korea, [2]Inst. of Photonic Technology, Germany, [3]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* We propose and demonstrate a hollow triangular-core fiber (HTCF) having low-fold symmetry in contrast to conventional cylindrical optical fibers. Near-field intensity variations, Fresnel diffraction patterns, and polarization modes of the HTCF were investigated.

JWA96

Submicron Diameter Micropillar Cavities with High Quality Factor and Ultra-Small Mode Volume, *Yinan Zhang, Marko Lončar; Harvard Univ., USA.* We theoretically demonstrated high quality factor (Q~250,000) micropillar cavities with record low mode volume for a 340nm diameter titania/silica micropillar. It represents a three orders of magnitude *Q*/*V* enhancement compared to any previous micropillar cavities.

JWA97

Impact of Anti-Zeno Effect on a Coupled Nanocavity-Quantum-Dot System, *Makoto Yamaguchi, Takashi Asano, Kazunobu Kojima, Susumu Noda; Kyoto Univ., Japan.* A comprehensive theory of couplings between a cavity and different charge configurations in a quantum dot is developed. It is shown that the quantum anti-Zeno effect is essential for the results obtained by QED experiments.

JWA98

Exploring the Limits of Single Emitter Detection in Fluorescence and Extinction, *Jaesuk Hwang[1], Gert Wrigge[1], Ilja Gerhardt[1,2], Gert Zumofen[1], Vahid Sandoghdar[1]; [1]ETH Zurich, Switzerland, [2]Ctr. for Quantum Technologies, Singapore.* We show experimentally that the signal-to-noise ratio of extinction detection can be advantageous to fluorescence measurements of a single molecule. We discuss the prospects of detecting weak emitters such as rare earth ions.

JWA99

Emission Control of NV Centers Embedded in an Opal Photonic Crystal, *Luke A. Stewart, Yan-Hua Zhai, Michael J. Steel, Judith M. Dawes, James R. Rabeau, Michael J. Withford; Macquarie Univ., Australia.* We investigate emission of diamond nanocrystals containing nitrogen-vacancy (NV) centers within opal photonic crystals (PC). The PC exhibits a stopband that overlaps the NV photoluminescence spectrum. A modified emission spectrum and increased lifetime were measured.

JWA100

Electromagnetically Induced Transparency Using Spatially Periodic Light Control, *Bin Luo, Hong Guo; Peking Univ., China.* Using spatially periodic coupling light, we demonstrate that an ideal electromagnetically induced transparency (EIT) medium can be transparent in a wide frequency range at the cost of the vanishing of slow light effect.

JWA101

Contrary Behavior of Absorption and Dispersion, *Katrin Dahl, Luca Spani Molella, Rolf-Hermann Rinkleff, Karsten Danzmann; Albert Einstein Inst., Max Planck Inst. for Gravitational Physics, and Inst. for Gravitational Physics, Leibniz Univ. Hannover, Germany.* A degenerate two-level system was investigated with circularly polarized probe and coupling lasers. An intensity dependent switch of an absorption peak to a dip was measured. The corresponding dispersion did not change.

JWA102

Time-Resolved Fourth-Order Optical Interference with a Narrow-Band Photon-Pair Source, *Xingxing Xing[1], Luciano Cruz[1], Florian Wolfgramm[2], Morgan W. Mitchell[2], Aephraim M. Steinberg[1]; [1]Ctr. for Quantum Information and Quantum Control and Inst. for Optical Sciences, Dept. of Physics, Univ. of Toronto, Canada, [2]ICFO, Spain.* We report our experimental progress observing time-revolved fourth order optical interference with a narrow-band, indistinguishable photon pair source from cavity enhancement. The required large dispersion is achieved by the electromagnetically induced transparency (EIT) effect.

JWA103

Measuring Atomic Oscillator Strengths by Single Atom Spectroscopy, *Jianwei Lee, Syed Abdullah Aljunid, Meng Khoon Tey, Brenda Chng, Gleb Maslennikov, Christian Kurtsiefer; Ctr. for Quantum Technologies, Natl. Univ. of Singapore, Singapore.* We propose a method for assessing the oscillator strengths of atomic transitions by measuring the AC Stark shift of atomic energy levels for the single atom trapped in an optical tweezer.

JWA104

A Narrow Rabi Frequency Window for Competition between Coherent Population Trapping and Raman Absorption, *Yi-Chi Lee[1], Ray-Yuan Chang[2], Zong-Syun He[2], Ming-Tsung Lee[2], Wei-Chia Fang[2], Hsiang-Chen Chui[1], Chin-Chun Tsai[1,2]; [1]Inst. of Electro-Optical Science and Engineering, Natl. Cheng-Kung Univ., Taiwan, [2]Dept. of Physics, Natl. Cheng-Kung Univ., Taiwan.* We demonstrate the competition mechanism between coherent population trapping and Raman absorption in ladder-type system. While Rabi frequency of probe exceeds decay rate, a decoherence created by probe field and Raman absorption dominates the process.

JWA105

Proposed Bell's Inequality Test Using Entangled Photon Holes, *Junlin Liang, James D. Franson, Todd B. Pittman; Univ. of Maryland, Baltimore County, USA.* We propose an experimental test of Bell's inequality using entangled photon holes rather than entangled photon pairs. The experiment involves feeding entangled photon holes into a time-bin based two-photon interferometer.

JWA106

Low-Bias Ultra-Fast Quantum Random Number Generator, *Michael A. Wayne, Paul G. Kwiat; Univ. of Illinois at Urbana-Champaign, USA.* We present a low-bias quantum random number generator based on the time interval between subsequent single-photon detections. Our cost-efficient and convenient implementation outputs data at rates in excess of 100 Mbit/s.

JWA107

Experimental Implementation of Time-Coding Quantum Key Distribution at Telecommunication Wavelength, *Olivier Morin, Simon Fossier, Thierry Debuisschert; Thales Res. and Technology, France.* A time-coding quantum key distribution protocol at telecommunication wavelength is investigated over a 25 km channel. Measured 98 % visibility and 2 % QBER enable 200 km security range and 1 kbit/sec secret key rates.

JWA108

Sub-Wavelengh Sized Optical Cavity Resonators with Fishnet, *Jingjing Li[1], Lars Thylen[1,2,3], Alex Bratkovski[1], Shih-Yuan Wang[1], Stanley Williams[1]; [1]Hewlett-Packard Res. Lab, USA, [2]KTH Dept of Microelectronics and Applied Physics, Royal Inst. of Technology, Sweden, [3]Joint Res. Ctr. of Photonics of the Royal Inst. of Technology and Zhejiang Univ., China.* An optical cavity resonator of deep sub-wavelength size is demonstrated numerically by inserting a single layer of "fishnet" structure of negative refractive index into a Fabry-Perot cavity composed of two gold films.

JWA109

Enhanced Birefringence of Inhomogeneous Slabs, *Sergey Sukhov[1], David P. Haefner[1], Girish Agarwal[2], Aristide Dogariu[1]; [1]CREOL and FPCE, College of Optics and Photonics, Univ. of Central Florida, USA, [2]Dept. of Physics, Oklahoma State Univ., USA.* We show that the presence of an interface changes the local field distributions in inhomogeneous materials. The loss of field symmetry leads to a significant surface-induced birefringence of an inhomogeneous medium.

JWA110

A Tool for Designing Realizable Hyperlenses, *Xingjie Ni, Zubin Jacob, Alexander Kildishev, Vladimir Shalaev, Evgenii E. Narimanov; Purdue Univ., USA.* We developed an on-line simulation tool which can facilitate designing experimentally realizable hyperlenses with cylindrical layered structures. A design working at 335.8nm with a resolution of quarter wavelength is presented.

JWA111

Effective Parameters For Anisotropic Metamaterials, *Christoph Menzel[1], Carsten Rockstuhl[1], Thomas Paul[1], Thomas Pertsch[2,3], Falk Lederer[1]; [1]Inst. of Condensed Matter Theory and Solid State Optics, Friedrich-Schiller Univ., Jena, Germany, [2]Inst. of Applied Physics, Friedrich Schiller Univ., Jena, Germany, [3]ZIK Ultra Optics, Germany.* We introduce a procedure to retrieve anisotropic effective parameters of metamaterials at oblique incidence. We show that such a homogenization fails near plasmonic resonances for all reasonable aspect ratios and discuss possible implications.

JWA112

Periodic Green's Functions for Linear Arrays in Free-Space and near Layered Media, *Derek A. Van Orden, Vitaliy Lomakin; Univ. of California at San Diego, USA.* We present a method for rapidly calculating the scalar and dyadic periodic Green's functions for a linear periodic array of sources both in free-space and near a layered medium.

JWA113

The Sign of Refractive Index of Surface Plasmons in Metal-Dielectric-Metal Structures, *Tian Yang, Kenneth B. Crozier; Harvard Univ., USA.* We have carefully examined the surface plasmon modes in the metal-dielectric-metal structures. By using the direction of energy decay to identify the sign of effective refractive index, we have obtained different results from previous reports.

JOINT

JWA114
High Aspect Ratio Metamaterials for Enhanced Tunability and Sensitivity, *Sher-Yi Chiam[1], Mohammed Bahou[2], Herbert O. Moser[2], Jianqiang Gu[3,4], Ranjan Singh[3], Weili Zhang[3], Jiaguang Han[1], Andrew A. Bettiol[1]; [1]Natl. Univ. of Singapore, Singapore, [2]Singapore Synchrotron Light Source, Singapore, [3]Oklahoma State Univ., USA, [4]Tianjin Univ., China.* Using a proton beam based lithography process, we fabricate and study high aspect ratio metamaterials, revealing distinct 3-dimensional resonances. Increased aspect ratio also leads to enhanced tunability and sensitivity for practical applications.

JWA115
Ultrafast Terahertz Probe of Spin-Density Wave Dynamics in Organic Conductor $(TMTSF)_2PF_6$, *Shinichi Watanabe, Ryusuke Kondo, Seiichi Kagoshima, Ryo Shimano; Univ. of Tokyo, Japan.* Photo-induced terahertz reflectivity change of the spin-density wave (SDW) gap in $(TMTSF)_2PF_6$ is observed. We find an ultrafast (~ps) increase of terahertz conductivity indicating a destabilization of the SDW states by a weak photo-excitation.

JWA116
Coherent Control of Quinquethiophene Photoluminescence, *Giovanni Cirmi[1], Daniele Brida[1], Alessio Gambetta[1], Giulio Cerullo[1], Guglielmo Lanzani[1], Laura Favaretto[2], Giovanna Barbarella[2]; [1]Politecnico di Milano, Italy, [2]ISO Consiglio Natl. delle Ricerche Bologna, Italy.* We observe torsional phonons of quinquethiophene in the time-domain and exploit the coherence for controlling the photoluminescence yield. We use the pump-dump scheme with visible femtosecond pulses, detecting the time-integrated photoluminescence versus pump-dump delay.

JWA117
Spin-Polarized Electron Transport in GaAs: Role of Holes, *Brian A. Ruzicka[1], Lalani K. Werake[1], Hui Zhao[1], Matt Mover[2], G. Vignale[2]; [1]Univ. of Kansas, USA, [2]Univ. of Missouri, USA.* Spin-polarized electron transport in GaAs is studied with emphasis on the role of holes. Sub-picosecond ac spin current pulses are produced and ambipolar spin diffusion are studied, both dominated by space charge field of holes.

JWA118
Stimulated Stokes and Anti-Stokes Raman Scattering Processes of Coherent G-Mode Vibrations in Single-Walled Carbon Nanotubes, *Ji-Hee Kim[1], Ki-Ju Yee[1], Erik Haroz[2], Yong-Sik Lim[3], Junichiro Kono[2]; [1]Chungnam Natl. Univ., Republic of Korea, [2]Rice Univ., USA, [3]Konkuk Univ., Republic of Korea.* Coherent G-mode vibrations in SWNTs were studied with spectrum-resolved pump-probe experiments. Detection wavelength dependence of G-mode amplitude was explained by SARS and SSRS. We could drive one process by controlling the dispersion of ultrashort pulses.

JWA119
Effective Hamiltonian Approach to Multiphonon Effects in Self Assembled Quantum Dots, *Matthias-René Dachner, Janik Wolters, Andreas Knorr, Marten Richter; Inst. für Theoretische Physik, Technische Univ. Berlin, Germany.* We present a perturbative approach to multiphonon assisted carrier relaxation and optical dephasing in self assembled quantum dots.

JWA120
A High-Optical Quality Supramolecular Assembly for Third-Order Nonlinear Optics, *Michelle L. Scimeca[1], Bweh Esembeson[1], Ivan Biaggio[1], Tsuyoshi Michinobu[2], François Diederich[2]; [1]Lehigh Univ., USA, [2]ETH Zurich, Switzerland.* We present an organic supramolecular assembly with a high off-resonant third-order susceptibility, easy fabrication into homogeneous thin films, and high-optical quality for ultra-fast all optical data processing.

JWA121
Optical Tweezers with Optically Resonant Particles, *Mark J. Kendrick, David H. McIntyre, Oksana Ostroverkhova; Dept. of Physics, Oregon State Univ., USA.* Optical tweezers are typically used on transparent dielectric particles. Particles with optical resonances should experience a larger trapping force near resonance. We present a numerical and experimental study of the trapping force on such particles.

JWA122
Synchronized Single-Photon Frequency Upconversion with a Pulsed Pump Source, *Xiaorong Gu, E. Wu, Yao Li, Ming Yan, Hanfeng Pan, Heping Zeng; East China Normal Univ., China.* A pulsed single-photon at 1.56 μm was converted to the visible region by sum-frequency mixing with a synchronized pump at 1.03 μm and the maximum conversion efficiency reached up to 31.2%.

JWA123
Thermodynamic Approach of Supercontinuum Generation in Photonic Crystal Fiber, *Bertrand Kibler[1], Benoît Barviau[1], Stéphane Coen[2], Alexandre Kudlinski[3], Arnaud Mussot[3], Guy Millot[1], Antonio Picozzi[1]; [1]Inst. Carnot de Bourgogne, Univ. de Bourgogne, France, [2]Univ. of Auckland, New Zealand, [3]Lab PhLAM, Univ. de Lille, France.* We show that the spectral broadening process inherent to supercontinuum generation may be described as a thermalization process, which results from the natural irreversible evolution of the optical field towards a thermodynamic equilibrium state.

JWA124
Spectral and Temperature Dependence of Nonlinear Absorption in InSb, *Peter D. Olszak[1], Claudiu M. Cirloganu[1], Scott Webster[1], Lazaro A. Padilha[1], Shekhar Guha[2], Srinivasan Krishnamurthy[3], David J. Hagan[1], Eric W. Van Stryland[1]; [1]CREOL and FPCE, The College of Optics and Photonics, Univ. of Central Florida, USA, [2]AFRL, USA, [3]SRI Intl., USA.* Temperature dependent two-photon and free-carrier absorption spectra of InSb are measured using a tunable picosecond source via temperature controlled Z-scan experiments and show good agreement with theoretical predictions. Three-photon absorption is also observed.

JWA125
Long-Period Oscillations of Dispersion-Managed Solitons, *Haldor Hartwig, Michael Böhm, Alexander Hause, Fedor Mitschke; Univ. Rostock, Germany.* Beyond the well known breathing of dispersion-managed solitons, a long-period oscillation has been reported. We identify the origin of this oscillation: These solitons are composite objects; the constituents can beat with each other.

JWA126
Ultra-Broadband Second-Harmonic Generation in Slant-Stripe-Type Periodically-Poled $RbTiOPO_4$, *Baigang Zhang, Pu Zhao, Yujie J. Ding; Lehigh Univ., USA.* We show that the retracing behavior based in slant-stripe-type periodically-poled $RbTiOPO_4$ can be used to efficiently achieve second-harmonic generation within an ultra-wide spectral range of 1.7-4.0 μm.

1:15 p.m.–3:15 p.m. ***PhAST* Market Focus Session: Biophotonics–Diagnostics,** *Exhibit Hall*

NOTES

NOTES

Rooms 321-323 / Rooms 324-326 — JOINT

1:30 p.m.–3:15 p.m.
JWB • Novel Light Sources I
Craig Siders; Lawrence Livermore Natl. Lab, USA, Presider

JWB1 • 1:30 p.m. Tutorial
AMO Research at the LCLS X-Ray Laser, *Philip H. Bucksbaum; Stanford Univ., USA.* This tutorial will explore the opportunities for novel AMO Physics at X-ray Free Electron Lasers such as LCLS, which begins operations in 2009.

Philip Bucksbaum is Professor of Physics, Applied Physics, and Photon science at Stanford University, and the Director of the Stanford PULSE Institute for Ultrafast Energy Science. He has previously worked at Lawrence Berkeley Laboratory, Bell Laboratories, and the University of Michigan. His research is in the area of ultrafast and strong field AMO physics.

1:30 p.m.–3:15 p.m.
JWC • Nanophotonics and Metamaterial Symposium I: Bulk Metamaterials
Nikolay Zheludev; Univ. of Southampton, UK, Presider

JWC1 • 1:30 p.m. Invited
'Trapped Rainbow' Schemes for Storing Light in Engineered Waveguides, *Kosmas L. Tsakmakidis, Ortwin Hess; Advanced Technology Inst., School of Electronics and Physical Sciences, Univ. of Surrey, UK.* We review recent progress in the realm of ultra-slow and stored light inside metamaterial waveguides. We elucidate a number of critical issues pertaining to the study of light propagation in various slow-light metamaterial structures.

JWC2 • 2:00 p.m.
Bulk Metamaterial with Hyperbolic Dispersion, *M. A. Noginov[1], Yu. A. Barnakov[1], G. Zhu[1], T. Tumkur[2,3], Li Heng[1], E. E. Narimanov[3]; [1]Norfolk State Univ., USA, [2]Summer Res. Program, Ctr. for Materials Res., Norfolk State Univ., USA, [3]Purdue Univ., USA.* We have demonstrated bulk (51 μm thick) photonic metamaterial based on anodized alumina membranes filled with silver. The material is highly anisotropic and follows the hyperbolic dispersion law at λ>0.84 μm.

JWC3 • 2:15 p.m.
Optical Nonlocalities and Additional Waves in Epsilon-near-Zero Metamaterials, *Viktor A. Podolskiy[1], Robert J. Pollard[2], Anthony Murphy[2], William R. Hendren[2], Paul R. Evans[2], Ron Atkinson[2], Gregory Wurtz[2], Anatoly V. Zayats[2]; [1]Oregon State Univ., USA, [2]Queen Univ. of Belfast, UK.* We present experimental evidence of excitation of additional wave in nanorod metamaterials in ENZ regime. Analytical description of the phenomenon is developed and the effect on the optical response of the system is discussed.

Room 314 — IQEC

1:30 p.m.–3:15 p.m.
IWA • Coherence and Control
Ulrich Höfer; Philipps-Univ. Marburg, Germany, Presider

IWA1 • 1:30 p.m.
Room Temperature Degenerate Four-Wave Mixing Due to Ultrafast Radiative Decay of Confined Excitons, *Masayoshi Ichimiya[1,2], Masaaki Ashida[1,2], Hideki Yasuda[1,2,3], Hajime Ishihara[1,3], Tadashi Itoh[1,2]; [1]CREST-JST, Japan, [2]Graduate School of Engineering Science, Osaka Univ., Japan, [3]Graduate School of Engineering, Osaka Prefecture Univ., Japan.* Degenerate four-wave mixing spectrum and the temperature dependence are investigated in a CuCl thin film with high crystalline quality. The signal at room temperature is firstly observed.

IWA2 • 1:45 p.m.
Interference-Induced Slow and Fast Light in Bulk Semiconductors, *Baijie Gu[1], Nai H. Kwong[1], Rolf Binder[1], Arthur L. Smirl[2]; [1]College of Optical Sciences, Univ. of Arizona, USA, [2]Univ. of Iowa, USA.* The interference between the two exciton polaritons in semiconductors is predicted to give a time delay for traversing light pulses that is unrelated to the polaritons' group velocities.

IWA3 • 2:00 p.m.
Picosecond Coherent Control of Dressed States in a Single Quantum Dot, *Stephen J. Boyle[1], Andrew J. Ramsay[1], Albert P. Heberle[2,3], Mark Hopkinson[4], Mark Fox[1], Maurice S. Skolnick[1]; [1]Univ. of Sheffield, UK, [2]Univ. of Pittsburgh, USA, [3]R&D Ctr., Corning Inc., USA, [4]EPSRC Natl. Ctr. for III-V Technologies, Univ. of Sheffield, UK.* We demonstrate picosecond control of dressed states in a single quantum dot. The Rabi oscillations of the dressed states are directly resolved in the time domain through beating of the Autler-Townes doublet.

IWA4 • 2:15 p.m.
Coherent Control of Shift Currents in GaAs Using Chirped Optical Pulses, *Ana Maria Racu, Shekhar Pryiadarshi, Uwe Siegner, Mark Bieler; Physikalisch-Technische Bundesanstalt, Germany.* We demonstrate coherent control of shift currents in GaAs by adjusting the relative phase between two orthogonally polarized, chirped optical pulses. The novel technique allows us to control the shape of the generated current transients.

Room 315

IQEC

1:30 p.m.–3:15 p.m.
IWB • Fundamental Nonlinear Processes
Roberto Morandotti; INRS-EMT, Canada, Presider

IWB1 • 1:30 p.m.
Impulsive Alignment of N_2 with a Train of 8 Pulses, *Ryan N. Coffee[1], James P. Cryan[1,2], Phil H. Bucksbaum[1,2]; [1]SLAC Natl. Accelerator Lab, USA, [2]Stanford Univ., USA.* We demonstrate a scheme that exploits the time periodicity of rigid rotors by breaking a single strong alignment pulse into an eight pulse train. Our results show $\cos^2$>0.6 in nitrogen gas at 1ATM, 300K.

IWB2 • 1:45 p.m.
Detection of Momentum Transfer from the Emission of Raman Photons, *Satish Rao[1], Stefan Balint[1,2], Pal Lovhaugen[1,3], Mark Kreuzer[1], Dmitri Petrov[1,4]; [1]ICFO, Spain, [2]Dept. of Biophysics, Univ. of Pavol Jozef Safárik, Slovakia, [3]Dept. of Physics and Technology, Univ. of Tromso, Norway, [4]ICREA, Spain.* The momentum transfer to a scatterer from Raman photons was detected using an optical system that permits one to simultaneously measure the radiation forces exerted on, and the Raman emission from the scatterer.

IWB3 • 2:00 p.m.
Nonlinear Terahertz Excitations of Optically Dark Para Excitons in Cu_2O, *Johannes T. Steiner[1], Mackillo Kira[1], Stephan W. Koch[1], Silvan Leinss[2], Rupert Huber[2], Alfred Leitenstorfer[2], Tobias Kampfrath[3], Konrad von Volkmann[3], Martin Wolf[3]; [1]Dept. of Physics, Philipps Univ., Germany, [2]Dept. of Physics, Univ. of Konstanz, Germany, [3]Free Univ. of Berlin, Germany.* A microscopic theory is applied to describe nonlinear terahertz excitations of optically-dark excitons in Cu_2O. The theory is quantitatively compared to recent experiments. Signatures of Rabi flopping and ponderomotive contributions are discussed and disentangled.

IWB4 • 2:15 p.m.
Nonlinear Optics of Three-Level, Inhomogeneously-Broadened Atoms in an Optical Cavity, *Julio Gea-Banacloche, Haibin Wu, Min Xiao; Univ. of Arkansas, USA.* We study theoretically and experimentally the strongly-coupled, nonlinear regime of a hot vapor of three-level atoms in an optical cavity. Interesting effects include lasing without inversion and polariton peak splittings.

Room 316

CLEO

1:30 p.m.–3:15 p.m.
CWA • Eye-Safe Wavelength Lasers I
Joe Alford; Lockheed Martin Coherent Technologies, USA, Presider

CWA1 • 1:30 p.m.
High-Power, Widely-Tunable, Continuous-Wave Polycrystalline Cr^{2+}:ZnS Laser, *Igor S. Moskalev, Vladimir V. Fedorov, Sergey B. Mirov; Univ. of Alabama at Birmingham, USA.* We present 10W room-temperature, pure CW, polycrystalline Cr^{2+}:ZnS laser, broadly tunable over 1940-2780nm, with maximum output power of 7.4W at 2410nm, and above 5W over 2120-2590nm.

CWA2 • 1:45 p.m.
Room Temperature Power Scalability of the Diode-Pumped Er:YAG Eye-Safe Laser, *Igor Kudryashov[1], Alex Katsnelson[1], Nikolay Ter-Gabrielyan[2], Mark Dubinskii[2]; [1]Princeton Lightwave Inc., USA, [2]US ARL, USA.* Laser performance of the Er:YAG resonantly end-pumped by a high-brightness InGaAsP/InP 10-bar stack is reported. Achieved 80 W power is believed to be the highest CW power ever reported from diode-pumped room-temperature Er:YAG laser.

CWA3 • 2:00 p.m. Invited
High Power Eye-Safe Lasers, *Scott D. Setzler; BAE Systems, USA.* Abstract not available.

Room 317

1:30 p.m.–3:15 p.m.
CWB • Topics in Optical Metrology I
Masataka Nakazawa; Tohoku Univ., Japan, Presider

CWB1 • 1:30 p.m.
Dual Comb Electric Field Cross-Correlation, *Fahmida Ferdous[1], Chen-Bin Huang[2], Daniel E. Leaird[1], Andrew M. Weiner[1]; [1]School of Electrical and Computer Engineering, Purdue Univ., USA, [2]Inst. of Photonics Technologies, Natl. Tsing Hua Univ., Taiwan.* We present a novel technique for electric field cross-correlation using two frequency combs. This technique is for characterization of optical arbitrary waveforms and allows independent control of phase and group delay without a mechanical stage.

CWB2 • 1:45 p.m.
Coherent Pulse Synthesis between a Femtosecond Optical Parametric Oscillator and Its Pump Laser: Towards Isolated Attosecond Optical Pulses, *Jinghua Sun, Derryck T. Reid; Heriot-Watt Univ., UK.* We demonstrate coherent synthesis between pulses from an optical parametric oscillator and its Ti:sapphire pump laser with a mutual timing-jitter of 30 attoseconds in 20 milliseconds, sufficient for attosecond waveform synthesis.

CWB3 • 2:00 p.m.
Wide-Range Spectral Shearing Interferometry, *Hajime Nishioka, Hitoshi Tomita; Inst. for Laser Science, Univ. of Electro-Communications, Japan.* A new scheme of spectral shearing interferometer providing a wide observation window has been demonstrated. Few-cycle pulse has been measured with a temporal observation/resolution ratio of $>10^3$ and a dynamic range of $>10^8$.

CWB4 • 2:15 p.m.
100× Frequency Magnification Using a Time-Lens-Based Spectral Imaging System, *Yoshitomo Okawachi, Reza Salem, Mark A. Foster, Amy C. Turner-Foster, Michal Lipson, Alexander L. Gaeta; Cornell Univ., USA.* We demonstrate frequency magnification by a factor of 105 using a spectral imaging system with two four-wave mixing based time-lenses. We achieve a 1-GHz frequency resolution.

Room 336

IQEC

1:30 p.m.–3:15 p.m.
IWC • Entangled Photons I
Franco N. Wong; MIT, USA, Presider

IWC1 • 1:30 p.m.
Multiple-Qubit Quantum State Visualization, *Joseph B. Altepeter[1], Evan R. Jeffrey[2], Milja Medic[1], Prem Kumar[1]; [1]Northwestern Univ., USA, [2]Leiden Inst. of Physics, Netherlands.* We present a method for graphically visualizing any two-qubit quantum state. This tool, based on the Poincaré sphere, provides an unambiguous, intuitive, and useful compliment to photonic state tomography.

IWC2 • 1:45 p.m.
Near-Field Correlations in the Two-Photon Field, *Martin P. van Exter, Henrique Di Lorenzo Pires; Leiden Univ., Netherlands.* We experimentally demonstrate intriguing fine structures in the two-photon field that reflect the (near-field) spatial correlations within the SPDC-generated photon pairs. These structures exhibit among others a surface-enhanced two-photon yield and spatial antibunching.

IWC3 • 2:00 p.m.
Change of Entanglement of Light on Propagation, *Hoda Hossein-Nejad, Rene Stock, Daniel F. V. James; Univ. of Toronto, Canada.* We demonstrate that entanglement of photons emitted in a large solid angle can change on propagation.

IWC4 • 2:15 p.m.
Spatial Entanglement Characterization in a Biphoton Beam, *Dietmar Korn, Dirk Puhlmann, Carsten Henkel, Robert Elsner, Martin Ostermeyer; Inst. for Physics and Astronomy, Univ. of Potsdam, Germany.* Spatial entanglement is investigated for applications in quantum imaging relying on multi-photon absorption. A product of variances in space and momentum shows strong violation of the classical correlation bound.

Room 337

CLEO

1:30 p.m.–3:15 p.m.
CWC • OPO I
Narasimha S. Prasad; NASA Langley Res. Ctr., USA, Presider

CWC1 • 1:30 p.m.
Study of a Narrowband Optical Parametric Oscillator at Degeneracy with a Transversely Chirped Bragg Grating, *Nicky Thilmann[1], Björn Jacobsson[1], Valdas Pasiskevicius[1], Fredrik Laurell[1], Eugeniu Rotari[2], Vadim Smirnov[2], Leonid Glebov[2]; [1]Laser Physics, KTH, Royal Inst. of Technology, Sweden, [2]OptiGrate, USA.* We investigate the energy and spectral properties of a narrowband (0.9 nm) optical parametric oscillator, tunable around the degeneracy point from 1055 to 1066 nm, by usage of a transversely chirped volume Bragg grating.

CWC2 • 1:45 p.m.
Single Frequency and Tunable Operation of a Continuous Intracavity Frequency Doubled Singly Resonant Optical Parametric Oscillator, *Thu Hien My, Oussama Mhibik, Cyril Drag, Fabien Bretenaker; Lab Aimé Cotton, Univ. Paris Sud, France.* A continuous intracavity-frequency-doubled singly resonant OPO is described. It provides 485 mW of single-frequency orange radiation and is tunable between 585 and 678 nm. Its frequency is stabilized within 4 MHz over 20 minutes.

CWC3 • 2:00 p.m.
Spectral Properties of a Mirrorless Optical Parametric Oscillator, *Gustav Strömqvist, Valdas Pasiskevicius, Carlota Canalias; Royal Inst. of Technology, KTH, Sweden.* In this work we show how the spectral properties of the pump are transferred to signal and idler in a mirrorless optical parametric oscillator and that the idler properties strongly depend on the grating vector.

CWC4 • 2:15 p.m.
High Efficient kHz Repetition Rate Injection Seeded Picosecond Optical Parametric Generator in LBO, *Tobias Traub, Felix Ruebel, Johannes L'Huillier; Technische Univ. Kaiserslautern, Germany.* We report on a high efficient kHz repetition rate ps OPG in LBO with total conversion efficiencies of >50% in the near infrared. Injection seeding reduced the spectral bandwidth from typically 40nm to 0.4nm.

Room 338

1:30 p.m.–3:15 p.m.
CWD • Large Mode Area and Bend Insensitive Fiber
Jesper Lægsgaard; Technical Univ. of Denmark, Denmark, Presider

CWD1 • 1:30 p.m.
Multi-Core Leakage-Channel Fibers with up to 26000 µm² Combined Effective Mode-Field Area, *Ingmar Hartl, H. A. McKay, A. A. Marcinkevičius, L. Dong, M. E. Fermann; IMRA America, Inc., USA.* Hexagonally stacked all-glass multi-core leakage-channel fibers consisting of seven fused silica cores of up to 100µm in diameter were fabricated. Simultaneous fundamental mode propagation in all cores and their active coherent combination was demonstrated.

CWD2 • 1:45 p.m.
Mode Control in Large-Mode-Area Fiber Lasers via Gain Filtering, *John R. Marciante, Richard G. Roides; Univ. of Rochester, USA.* Gain filtering of higher-order modes in large-mode-area fibers is experimentally demonstrated. While the beam quality degrades with pumping level in conventional fiber lasers, it remains constant in confined-gain fiber lasers due to gain filtering.

CWD3 • 2:00 p.m.
Optimizing Injection into Large-Mode-Area Photonic Crystal-Fiber Amplifiers by Spatially Resolved Spectral Interferometry, *Jake Bromage, Christophe Dorrer, Milton J. Shoup III, Jonathan D. Zuegel; Univ. of Rochester, USA.* Spatially-resolved spectral interferometry is used to measure the mode content of a Yb-doped photonic crystal-fiber amplifier having a 2300-µm² mode area. The impact of misalignment at signal injection on the relative mode powers is quantified.

CWD4 • 2:15 p.m.
Characterizing the Modes of a Core-Pumped, Large-Mode Area Er Fiber Using Spatially and Spectrally Resolved Imaging, *Jeff Nicholson, J. Jasapara, A. Desantolo, E. Monberg, F. Dimarcello; OFS Labs, USA.* Higher-order-modes of a 70-µm core-diameter, Er-doped-fiber are characterized over a broad wavelength range using a supercontinuum with spatially and spectrally resolved imaging. Pumping the Er-doped-fiber with 1480-nm in the fundamental mode decreases the higher-order-mode content.

Room 339

1:30 p.m.–3:15 p.m.
CWE • Nonlinear Microscopy
Brian E. Applegate; Texas A&M Univ., USA, Presider

CWE1 • 1:30 p.m.
Miniaturized Epi-Third Harmonic Generation Microscope with a Sub-Micron Spatial Resolution and a Video Rate, *Shih-Hsuan Chia[1], Nai-Chia Cheng[1], Tzu-Ming Liu[1], Ming-Che Chan[1], I-Hsiu Chen[1], Chi-Kuang Sun[1,2]; [1]Dept. of Electrical Engineering and Graduate Inst. of Photonics and Optoelectronics, Taiwan, [2]Res. Ctr. for Applied Sciences, Academia Sinica, Taiwan.* With a 2-D scanning MEMS mirror, we demonstrate a miniaturized epi-third-harmonic-generation microscope with a video rate and a 0.7µm transverse resolution. *In vivo* THG imaging of human skin is demonstrated.

CWE2 • 1:45 p.m.
Enhanced Axial Confinement of Sum Frequency Generation in a Temporal Focusing Setup, *Adam Straub, Michael Durst, Chris Xu; Cornell Univ., USA.* We demonstrate enhanced axial confinement in a temporal focusing setup using a shaped spectrum and a narrow emission filter, achieving 10x reduction of out-of-focus background when compared to conventional two-photon microscopy.

CWE3 • 2:00 p.m.
Real-Time Studies of Muscle Cell Contractions with Second Harmonic Generation Microscopy, *Nicole Prent[1], Richard Cisek[1], Catherine Greenhalgh[1], Arkady Major[2], Bryan Stewart[3], Virginijus Barzda[1]; [1]Deptartment of Physics and Inst. for Optical Sciences, Univ. of Toronto, Canada, [2]Dept. of Electrical and Computer Engineering, Univ. of Manitoba, Canada, [3]Deptartment of Biology, Univ. of Toronto Mississauga, Canada.* Real-time second harmonic generation microscopy of live myocytes was achieved with a femtosecond diode-pumped $Yb:KGd(WO_4)_2$ laser. Negligible absorption allows for prolonged imaging during muscle contractions with no significant phototoxic effects or signal degradation.

CWE4 • 2:15 p.m.
Enhancement of Intra-Tissue Refractive Index Shaping (IRIS) of the Cornea by Two-Photon Absorption, *Li Ding, Lana J. Nagy, Lisen Xu, Jack C-H Chang, Jennifer Swanton, Wayne H. Knox, Krystel R. Huxlin; Univ. of Rochester, USA.* Nanojoule femtosecond laser pulses were used to modify the refractive index of living corneas. By doping with Sodium Fluorescein to increase two-photon absorption, laser scanning speed could be greatly increased while inducing large RI modifications.

Room 340 / Room 341 — CLEO

1:30 p.m.–3:15 p.m.
CWF • High-Power Semiconductor Lasers
S. David Roh; Coherent Inc., USA, Presider

CWF1 • 1:30 p.m. Invited
Coherently Combined Diode Laser Arrays and Stacks, *Robin K. Huang[1], Bien Chann[1], Leo J. Missaggia[1], Steven J. Augst[1], Michael K. Connors[1], George W. Turner[1], Antonio Sanchez-Rubio[1], Joseph P. Donnelly[1], John L. Hostetler[2], Carl Miester[2], Friedhelm Dorsch[2]; [1]MIT, USA, [2]TRUMPF Photonics, USA.* We have coherently combined up to 7.2 W CW using an individually addressable 10-element-array of 960-nm Slab-Coupled Optical Waveguide Lasers (SCOWLs). We are currently scaling the phase-locked output power to 100 W using SCOWL stacks.

CWF2 • 2:00 p.m.
1060-nm Multi Quantum Well Diode Lasers with Narrow Vertical Divergence Angle of 8° and High Internal Efficiency, *Agnieszka Pietrzak, Paul Crump, Frank Bugge, Hans Wenzel, Götz Erbert, Günther Tränkle; Ferdinand-Braun-Inst. für Höchstfrequenztechnik, Germany.* MQW 1060 nm structures with extremely thick 8.6µm waveguide resulting in 8° angle of vertical divergence have been grown and tested. The measurements of uncoated lasers promise high optical power operation with nearly circular beam-shape.

CWF3 • 2:15 p.m.
High-Power GaN-Based Blue-Violet Laser Diodes, *Shingo Kameyama, Y. Kunoh, K. Inoshita, D. Inoue, Y. Murayama, Y. Bessho, T. Goto, T. Kunisato, Y. Nomura; SANYO Electric Co., Ltd, Japan.* We have succsessfully developed blue-violet laser diodes having the world's highest output power of 450mW by introducing a novel facet coating structure, reducing the internal loss in devices, and making a cavity length long.

1:30 p.m.–3:15 p.m.
CWG • THz Plasmonics
Richard D. Averitt; Boston Univ., USA, Presider

CWG1 • 1:30 p.m.
Scattering-Probe-Imaging of the Field Confinement on Tapered Metal-Wire Waveguides, *Victoria Astley, Hui Zhan, Rajind Mendis, Daniel M. Mittleman; Rice Univ., USA.* Using a recently developed scattering-probe-imaging technique, we observe strong confinement of the THz electric field at the end of a tapered metal-wire waveguide compared to an un-tapered wire. This confinement agrees well with FEM simulations.

CWG2 • 1:45 p.m.
Planar Plasmonic Terahertz Guided-Wave Devices, *Wenqi Zhu, Amit Agrawal, Ajay Nahata; Univ. of Utah, USA.* We describe the realization of planar plasmonic THz guided-wave devices, including straight waveguides, Y-splitters and 3dB-couplers, using periodically perforated metal films. These perforated films behave as effective media whose waveguiding properties can be broadly engineered.

CWG3 • 2:00 p.m.
Funneling of Terahertz Electromagnetic Waves through Nanogap Device, *M. A. Seo[1], H. R. Park[1], J. S. Kyoung[1], S. M. Koo[1], N. K. Park[1], O. K. Suwal[2], S. S. Choi[2], D. S. Kim[1]; [1]Seoul Natl. Univ., Republic of Korea, [2]Sun Moon Univ., Republic of Korea.* We show that terahertz waves transmit through a $\lambda/30{,}000$ nanogap separating two conducting planes. The field enhancement responsible for this light funneling has a $1/f$ dependence, which originates from the charging time of the gap.

CWG4 • 2:15 p.m.
Ultrafast Optical Control of Terahertz Surface Plasmon Polariton in Subwavelength Hole-Arrays at Room Temperature, *Abul K. Azad[1], Zhen Tian[2], Hou-Tong Chen[1], Xinchao Lu[2], Satish R. Kasarla[1], Weili Zhang[2], Antoinette J. Taylor[1], John F. O'Hara[1]; [1]Los Alamos Natl. Lab, USA, [2]School of Electrical and Computer Engineering, Oklahoma State Univ., USA.* We demonstrate ultrafast optical control of terahertz surface plasmon resonance in subwavelength metallic hole arrays. The transient photoconductivity of the substrate allows modulation of the THz resonance amplitude with a time scale of ~10 ps.

Rooms 328-329 — PhAST

1:15 p.m.–3:15 p.m.
PWA • Defense Applications of Lasers and Electro-Optics Technology
Timothy Carrig; Lockheed Martin, USA, Presider

PWA1 • 1:15 p.m. Invited
Chemical-Biological Detection Overview, *Cindy Swim, Richard Vanderbeek, Darren Emge; Edgewood Chemical Biological Ctr., USA.* State-of-the-art sensors and emerging technologies are under development for chemical and biological agent defense. Spectroscopic approaches such as differential scattering, depolarization, and Raman will be discussed.

PWA2 • 1:45 p.m. Invited
Coarse-to-Fine: A Layered Sensing Approach to Situational Awareness, *Edward Watson; AFRL, USA.* Future military operations will require sophisticated information gathering and exploitation tools. We highlight electro-optical technologies being developed. The approach to sensor implementation and the types of sensors being developed will be overviewed.

PWA3 • 2:15 p.m. Invited
HEL-JTO Programs in Directed Energy, *Don Seeley[1], Mark Neice[1], Jack Slater[2], Siya Mani[2]; [1]High Energy Laser Joint Technology Office (HEL-JTO), USA, [2]Schafer Corp., USA.* The HEL-JTO was established to coordinate, advocate and communicate the development of HEL technology. The office manages a portfolio of HEL technology programs. The goals and status of these efforts are reported.

JOINT — Rooms 321-323

JWB • Novel Light Sources I—Continued

JWB2 • 2:30 p.m.
Activation of a 1.1 Petawatt Hybrid, OPCPA-Nd: Glass Laser, *Erhard W. Gaul, Mikael Martinez, Joel Blakeney, Martin Ringuette, Doug Hammond, Axel Jochmann, Ramiro Escamilla, Ted Borger, Gilliss Dyer, Todd Ditmire; Univ. of Texas at Austin, USA.* We report on the activation of the 1.1 Petawatt Laser (190 J, 170 fs) based on optical parametric chirped pulse amplification (OPCPA) and mixed Nd: glass amplification.

JWB3 • 2:45 p.m.
A Multi-TW Few-Cycle Optical Parametric Chirped Pulse Amplifier, *Laszlo Veisz[1], Daniel Herrmann[1], Raphael Tautz[1], Franz Tavella[2], Alexander Buck[1], Karl Schmid[1,3], Vladimir Pervak[3], Michael Scharrer[4], Philip Russell[4], Ferenc Krausz[1,3]; [1]Max-Planck-Inst. für Quantenoptik, Germany, [2]HASYLAB/DESY, Germany, [3]Ludwig-Maximilians-Univ. München, Germany, [4]Univ. of Erlangen-Nuremberg, Germany.* We report on the generation of 8 fs, 125 mJ pulses in a noncollinear optical parametric chirped pulse amplifier with a temporal contrast reaching 10 orders of magnitude at 5 ps before the main pulse.

JWB4 • 3:00 p.m.
Precise Alignment of Large-Aperture Compressor Gratings for High-Power Lasers by Using Diffraction Interferometry, *Vladimir Chvykov, Victor Yanovsky; Univ. of Michigan, USA.* We introduce novel method of precise compressor alignment for Petawatt-scale CPA lasers. The method is using compressor gratings as gratings of diffraction interferometer. It meets accuracy requirements (~10^{-5}) and allows simple procedures of alignment.

JOINT — Rooms 324-326

JWC • Nanophotonics and Metamaterial Symposium I: Bulk Metamaterials—Continued

JWC4 • 2:30 p.m.
Bulky Nanowire Metamaterials for Negative Refraction at Broadband Frequencies from Visible to NIR, *Zhaowei Liu[1,2], Jie Yao[1], Yongmin Liu[1], Yuan Wang[1], Cheng Sun[1], Guy Bartal[1], Angelica Stacy[1], Xiang Zhang[1,3]; [1]Univ. of California at Berkeley, USA, [2]Univ. of California at San Diego, USA, [3]Lawrence Berkeley Natl. Lab, USA.* We report the first bulk metamaterials at visible frequencies that shows intriguing negative refraction for all incident angles. The metamaterial is realized by growing silver nanowire in a porous alumina template.

JWC5 • 2:45 p.m.
Super-Resolution Imaging Using Spatial Fourier Transform Infrared Spectroscopy, *Leonid Alekseyev[1,2], Evgenii Narimanov[2], Jacob Khurgin[3]; [1]Princeton Univ., USA, [2]Purdue Univ., USA, [3]Johns Hopkins Univ., USA.* We describe a scheme for far-field subwavelength spectroscopy and imaging in the mid-IR and THz. This approach relies on scattering from an acoustic grating and recovers both the amplitude and the phase of incident field.

JWC6 • 3:00 p.m.
Impact of Disorder on Surface Plasmons in Two-Dimensional Arrays of Metal Nanoparticles , *Jacob B. Khurgin[1], Greg Sun[2]; [1]Johns Hopkins Univ., USA, [2]Univ. of Massachusetts at Boston, USA.* We study the impact of on the properties of surface plasmons (SP) in the metal nanoparticles arrays and develop analytical expressions enabling us to ascertain degree of localization and mixing between the SP states.

IQEC — Room 314

IWA • Coherence and Control—Continued

IWA5 • 2:30 p.m.
Spin Hall Effect of Light in a Semiconductor, *Jean-Michel Menard[1], Adam Mattacchione[1], John E. Sipe[1], Arthur L. Smirl[2], Henry M. van Driel[1]; [1]Univ. of Toronto, Canada, [2]Lab for Photonics and Quantum Electronics, Univ. of Iowa, USA.* We demonstrate the spatial separation of right and left circularly polarized components of a linear polarized beam non-normally incident at an air-GaAs interface through the transverse separation of optically injected up- and down-spin electrons.

IWA6 • 2:45 p.m.
All-Optical Injection, Control, and Detection of Ballistic Spin and Charge Currents in Group IV Semiconductors, *Arthur L. Smirl[1], Eric J. Loren[1], Brian A. Ruzicka[2], Lalani K. Werake[2], Hui Zhao[2], Henry M. van Driel[3]; [1]Univ. of Iowa, USA, [2]Univ. of Kansas, USA, [3]Univ. of Toronto, Canada.* Ballistic charge currents are injected into Ge and Si and pure spin currents into Ge using quantum interference techniques and are spatially and temporally resolved for the first time.

IWA7 • 3:00 p.m.
Ultrafast Coherent Control of Nonlinear Optical Processes in Plasmonic Nanostructures, *Tobias Utikal[1,2], Mark I. Stockman[1,3], Albert P. Heberle[1], Markus Lippitz[1,2], Harald Giessen[1]; [1]4th Physics Inst., Univ. of Stuttgart, Germany, [2]Max Planck Inst. for Solid State Res., Germany, [3]Dept. of Physics and Astronomy, Georgia State Univ., USA.* We present a new technique to coherently control ultrafast nonlinear processes in a plasmonic nanostructure on a femtosecond timescale. By using a four-photon process our detection provides full information about the coherence in the system.

3:15 p.m.–4:45 p.m. Coffee Break and Exhibit-Only Time, *Exhibit Hall*

3:45 p.m.–5:00 p.m. *PhAST* Market Focus Session: Biophotonics–Therapy, *Exhibit Hall*

NOTES

Room 315 | Room 316 | Room 317

IQEC | **CLEO**

IWB • Fundamental Nonlinear Processes—Continued

IWB5 • 2:30 p.m.
Spatial and Temporal Interferences between Four-Wave Mixing and Six-Wave Mixing Channels, *Utsab Khadka, Yanpeng Zhang, Blake Anderson, Min Xiao; Univ. of Arkansas, USA.* Spatial and temporal interferences between four-wave mixing and six-wave mixing signals are observed by using phase-control between these nonlinear optical processes in a four-level atomic system. Atomic coherence is the key to observe such phenomenon.

IWB6 • 2:45 p.m.
Anti-Stokes Photoluminescence from *n*-type Free-Standing GaN Based on Competing Two-Photon Absorption and Phonon-Assisted Absorption, *Suvranta K. Tripathy, Yujie J. Ding; Lehigh Univ., USA.* Mechanisms for anti-Stokes photoluminescence observed at room temperature from *n*-type free-standing GaN have been attributed by us to the competition between two-photon absorption and phonon-assisted absorption.

IWB7 • 3:00 p.m.
Surface and Bulk Contributions to the Second-Order Nonlinearity of Gold, *Fu Xiang Wang[1], Francisco J. Rodriguez[1], Martti Kauranen[1], Willem M. Albers[2], Risto Ahorinta[3], John E. Sipe[4]; [1]Dept. of Physics, Tampere Univ. of Technology, Finland, [2]VTT Microtechnology and Sensors, Finland, [3]Optoelectronics Res. Ctr., Tampere Univ. of Technology, Finland, [4]Dept. of Physics and Inst. for Optical Sciences, Univ. of Toronto, Canada.* We use two-beam second-harmonic generation to separate the surface and bulk contributions to the second-order nonlinearity of gold. The results provide direct evidence of bulk contributions, nevertheless, surface-like contributions dominate the measured signals.

CWA • Eye-Safe Wavelength Lasers I—Continued

CWA4 • 2:30 p.m.
High-Power Resonantly-Diode-Pumped CW Er^{3+}:YAG Laser, *Marc Eichhorn; French-German Res. Inst. of Saint-Louis, France.* Using high-brightness laser diodes for resonantly pumping a 1.64 µm Er:YAG laser, 9 W output power is achieved at 64.3 % intrinsic slope with up to 95 % mode-fill efficiency.

CWA5 • 2:45 p.m.
Total-Internal-Reflection-Pumped CW Er^{3+}:YAG Rod Laser with Crystalline Fiber Geometry, *Marc Eichhorn; French-German Res. Inst. of Saint-Louis, France.* Experimental results on a 1.2 mm diameter 60 mm long, TIR-pumped Er^{3+}:YAG laser and its thermal lens effects are presented. Up to 9.4 W output power are achieved.

CWA6 • 3:00 p.m.
Er:YAG is a 2.5-Level Laser at 300°K, *Jeffrey O. White; ARL, USA.* We propose the "level parameters" l_0 and l_1 to quantify the concept of two-, three- and four-level laser, for comparing different laser media, operating temperatures, and choices of pump and laser transitions.

CWB • Topics in Optical Metrology I—Continued

CWB5 • 2:30 p.m.
Stability of an Acetylene Frequency Reference inside Kagome Structured Hollow-Core Photonic Crystal Fiber, *Kevin Knabe[1], Jinkang Lim[1], Karl Tillman[1], Rajesh Thapa[1], Francois Couny[2], Philip S. Light[2], Jeffrey W. Nicholson[3], Brian R. Washburn[1], Fetah Benabid[2], Kristan L. Corwin[1]; [1]Kansas State Univ., USA, [2]Univ. of Bath, UK, [3]OFS Labs, USA.* A continuous-wave laser has been stabilized to an acetylene transition inside kagome photonic crystal fiber. Stability as measured with a carbon nanotube fiber laser frequency comb is better than $1x10^{-11}$ at 10 s.

CWB6 • 2:45 p.m.
Full Nonlinear Conversion of a 200-nm Comb Produced by Multiple Four-Wave Mixing in a Highly Nonlinear Fiber, *Flavio C. Cruz, Jorge D. Marconi, Arismar Cerqueira S. Jr, Hugo L. Fragnito; UNICAMP, Brazil.* A 100-nm comb of optical frequencies spaced by 400 GHz at 790 nm was obtained by second harmonic generation of an optical frequency comb produced by multiple four-wave-mixing in a highly nonlinear optical fiber.

CWB7 • 3:00 p.m.
Widely Tunable, Phase-Locked CW-THz Radiation by Photomixing of Two CW Lasers Locked to Two Independent Fiber Combs, *Takeshi Yasui[1], Hisanari Takahashi[2,3], Yutaka Iwamoto[2,3], Hajime Inaba[2], Kaoru Minoshima[2,3]; [1]Osaka Univ., Japan, [2]AIST, Japan, [3]Tokyo Univ. of Science, Japan.* Arbitrary single-frequency CW-THz-wave generator based on two-independent femtosecond fiber combs is presented. Continuous tuning of a 120-GHz CW wave was demonstrated across several MHz, which is limited by electric bandwidth of THz-spectrum analyzer for evaluation.

3:15 p.m.–4:45 p.m. Coffee Break and Exhibit-Only Time, *Exhibit Hall*

3:45 p.m.–5:00 p.m. *PhAST* Market Focus Session: Biophotonics–Therapy, *Exhibit Hall*

NOTES

Room 336

IQEC

IWC • Entangled Photons I—Continued

IWC5 • 2:30 p.m.
Entanglement Distillation of Two-Photon Polarization Qubits Using Tunable Local Filters, *Hee Su Park, Heonoh Kim, Sang-Kyung Choi; Korea Res. Inst. of Standards and Science, Republic of Korea.* A tunable entanglement distiller for arbitrary two-photon polarization qubits is demonstrated using novel tunable local filters constructed with rotatable birefringent prisms. The distillation is confirmed by comparing the concurrences of the two-photon states.

IWC6 • 2:45 p.m.
Two-Photon Interference for Quantum Cryptography with a Non-Maximally Entangled Photon Pair, *Kaoru Shimizu, Hiroki Takesue, Kiyoshi Tamaki; NTT Basic Res. Labs, NTT Corp., Japan.* This paper proposes a novel scheme of quantum cryptography with two-photon interference of a non-maximally entangled photon pair. The security is based on impossibility of local unitary transformation between the certain non-maximally entangled states.

IWC7 • 3:00 p.m.
Entanglement-Based Free Space Quantum Cryptography in Full Daylight, *Ilja Gerhardt, Matthew P. Peloso, Caleb Ho, Antia Lamas-Linares, Christian Kurtsiefer; Ctr. for Quantum Technologies, Natl. Univ. of Singapore, Singapore.* Many free space quantum key distribution systems are restricted to operation at night. Implementing spectral, spatial and temporal filtering techniques, we were able to establish a secure key transmission over several days using entangled photons.

Room 337

CLEO

CWC • OPO I—Continued

CWC5 • 2:30 p.m.
1-GHz Femtosecond Optical Parametric Oscillator Pumped by a 76-MHz Ti:sapphire Laser, *Omid Kokabee[1], Adolfo Esteban Martin[1], Konstantinos Moutzouris[2], Majid Ebrahim-Zadeh[1,3]; [1]ICFO - Inst. de Ciencies Fotoniques, Mediterranean Technology Park, Spain, [2]Technological Educational Inst.ion of Athens, Greece, [3]Institucio Catalana de Recerca i Estudis Avancats (ICREA), Spain.* We demonstrate a ~1 GHz femtosecond optical parametric oscillator synchronously pumped by a 76-MHz Ti:sapphire laser using a cavity longer than the fundamental synchronous cavity length. Near-transform-limited pulses with average durations of 227-fs are generated.

CWC6 • 2:45 p.m.
Tunable Phase-Stabilized Infrared High Power Parametric Source, *Leng Yuxin, Zhang Chunmei, Wang Jianliang, Song Liwei, Li Chuang, Li Ruxin, Xu Zhizhan; Shanghai Inst. of Optics and Fine Mechanics, China.* Tunable self-phase-stabilized femtosecond pulses are generated from an optical parametric amplifier. The output pulse wavelength is tunable from 1.3μm to 2.3μm. The maximum pulse energy at 1.8μm is ~1.2mJ/1kHz, with carrier-envelope-phase fluctuation of ~0.15rad.

CWC7 • 3:00 p.m.
Single Longitudinal Mode, 3 MHz Frequency Stable, 11mJ, Type II Doubly Resonant OPO/OPA for CO_2 DIAL, *Myriam Raybaut[1], Antoine Berrou[1], Antoine Godard[1], Ajmal K. Mohamed[1], Michel Lefebvre[1], Axel Bohman[2], Peter Geiser[2], Peter Kaspersen[2]; [1]ONERA - The French Aerospace Lab, France, [2]Norsk Elektro Optikk A/S (NEO), Norway.* For CO_2 differential-absorption LIDAR, the single-mode output of a type-II PPLN entangled-cavity nanosecond doubly-resonant OPO emitting at 2.05 μm is amplified to 11 mJ, with 3 MHz rms frequency stability and a $M^2 < 1.9$.

Room 338

CWD • Large Mode Area and Bend Insensitive Fiber—Continued

CWD5 • 2:30 p.m.
Bend-Induced Changes in Group Delay and Comparison with S^2 Mode-Content Measurements, *John M. Fini, Jeffrey W. Nicholson; OFS Labs, USA.* Calculations show qualitative changes in relative index and group delay induced by typical coiling of fiber. Comparison with S^2 measurement shows excellent agreement in relative group delay.

CWD6 • 2:45 p.m. Invited
What Are the Essential Technical Requirements for the New Bend Insensitive Fiber? *David Z. Chen; Verizon, USA.* Bandwidth requirements for residential customers have justified fiber penetration into buildings. Macro-bend-loss was identified as a major barrier in such small-dense-tight scenarios, in which copper was typically the choice. We present the requirements for deployment.

Room 339

CWE • Nonlinear Microscopy—Continued

CWE5 • 2:30 p.m.
A Femtosecond Yb:KGd$(WO_4)_2$ Laser for Biological Imaging of Yellow Fluorescent Protein, *Daaf Sandkuijl[1], Arkady Major[2], Richard Cisek[1], Guri Grang[1], Jaideep Mathur[3], Bryan Stewart[1], Virginijus Barzda[1]; [1]Univ. of Toronto, Canada, [2]Univ. of Manitoba, Canada, [3]Univ. of Guelph, Canada.* Real time multiphoton excitation fluorescence microscopy of enhanced yellow fluorescent protein was performed with low photobleaching using a femtosecond Yb:KGd$(WO_4)_2$ laser. Using a conventional Ti:S laser this was previously unfeasible due to low excitation efficiency.

CWE6 • 2:45 p.m.
Fiber-Optic Multiphoton *in vivo* Flow Cytometry, *Yu-Chung Chang, Jing Yong Ye, Thommey Thomas, Zhengyi Cao, Alina E. Kotlyar, James R. Baker Jr., Theodore B. Norris; Univ. of Michigan, USA.* We demonstrate the use of a double-clad fiber probe to conduct two-photon excited flow cytometry *in vivo*. High detection efficiency of GFP-expressing cells is demonstrated, and the initial dynamics of injected circulating cells is observed.

CWE7 • 3:00 p.m.
Nonlinear Optical Imaging with Sub-12fs Pulses, *Yair Andegeko, Dmitry Pestov, Kyle E. Sprague, Vadim V. Lozovoy, Marcos Dantus; Michigan State Univ., USA.* Transform limited ultrashort pulses are used in a laser-scanning two-photon microscope for imaging of various biological specimens, demonstrating the importance of dispersion-free imaging system. Pulse characterization, qualitative and quantitative data are presented.

3:15 p.m.–4:45 p.m. Coffee Break and Exhibit-Only Time, *Exhibit Hall*

3:45 p.m.–5:00 p.m. *PhAST* Market Focus Session: Biophotonics–Therapy, *Exhibit Hall*

NOTES

Room 340 | Room 341 | Rooms 328-329

CLEO | PhAST

CWF • High-Power Semiconductor Lasers—Continued

CWF4 • 2:30 p.m.
Two-Electrode Tapered Laser at 1060 nm with Record-High (19 W/A) Modulation Efficiency at 700 Mbps, *Myke Ruiz[1], Helena Odriozola[2], Owen Kwok[3], Nicolas Michel[1], M. Calligaro[1], M. Lecomte[1], O. Parillaud[1], Michel Krakowski[1], J. M. Tijero[2], I. Esquivias[2], R. V. Penty[3], I. H. White[3]; [1]Alcatel-Thales 3-5 lab, France, [2]ETSI Telecomunicación, Univ. Politécnica de Madrid, Spain, [3]Ctr. for Photonic Systems, Electrical Engineering Div., Engineering Dept., Univ. of Cambridge, UK.* We have obtained a high power of 3W CW, 57% maximum wall-plug efficiency, a record-high modulation efficiency of 19 W/A at 700 Mb/s, more than 1.6 W optical modulation amplitude and 19 dB extinction ratio.

CWF5 • 2:45 p.m.
Two Distinct Types of Dark-Line Defects in a Failed InGaAs/AlGaAs Strained Quantum Well Laser Diode, *Brendan Foran, Nathan Presser, Yongkun Sin, Maribeth Mason, Steven C. Moss; Aerospace Corp., USA.* TEM characterization of accelerated life-test failed InGaAs/AlGaAs quantum well 980nm laser diodes, by FIB sampling following EBIC, found two distinct types of dark-line defects providing insight for physics of failure models.

CWF6 • 3:00 p.m.
Wide Temperature Range High Power Broad Area 975nm DFB Lasers, *Christoph M. Schultz, Paul Crump, Hans Wenzel, Olaf Brox, Frank Bugge, Götz Erbert; Ferdinand-Braun-Inst. für Höchstfrequenztechnik, Germany.* 100µm stripe 975nm DFB lasers are shown to operate with spectral width <0.35nm to 100°C. Narrow (14°) vertical far field and reasonable conversion efficiency (39,5%) were achieved. A comparison with reference FP lasers is presented.

CWG • THz Plasmonics—Continued

CWG5 • 2:30 p.m.
Optical Coupling between Antionding Film Plasmon Modes and Perpendicularly Polarized Light, *J. W. Lee, T. H. Park, Peter Nordlander, Daniel M. Mittleman; Rice Univ., USA.* We demonstrate the spectral properties of resonant transmission induced by perpendicularly polarized light through an individual hole in a thin metallic film, using time-domain terahertz spectroscopy.

CWG6 • 2:45 p.m.
Magnetic Dependent Terahertz Propagation in a Random Metamaterial, *Corey A. Baron, Abdulhakem Y. Elezzabi; Univ. of Alberta, Canada.* We present an externally and actively tuneable metamaterial composed of random subwavelength elements that is experimentally shown to alter the propagation direction of terahertz pulses by an amount adjustable via an external magnetic field.

CWG7 • 3:00 p.m.
Terahertz Spectroscopy of Plasmonic Fractals, *Amit K. Agrawal[1], Tatsunosuke Matsui[2], Wenqi Zhu[1], Z. Valy Vardeny[3], Ajay Nahata[1]; [1]Dept. of Electrical and Computer Engineering, Univ. of Utah, USA, [2]Dept. of Electrical and Electronic Engineering, Mie Univ., Japan, [3]Physics Dept., Univ. of Utah, USA.* Transmission properties of subwavelength aperture arrays having deterministic and stochastic fractal morphologies were studied using THz-TDS. We find that transmission enhancement decreases with increasing array size. These observations are explained using density-density correlation function model.

PWA • Defense Applications of Lasers and Electro-Optics Technology—Continued

PWA4 • 2:45 p.m. Invited
Airborne Laser Program Overview, *Steve Post; Missile Defense Agency, USA.* An overview of the Airborne Laser (ABL) system will be presented, including a short description of the ABL and a review of mission objectives, weapon system elements, program progression, and program accomplishments.

3:15 p.m.–4:45 p.m. Coffee Break and Exhibit-Only Time, *Exhibit Hall*

3:45 p.m.–5:00 p.m. *PhAST* Market Focus Session: Biophotonics–Therapy, *Exhibit Hall*

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NOTES

Rooms 321-323 | Rooms 324-326 | Room 314

JOINT

IQEC

4:45 p.m.–6:30 p.m.
JWD • Novel Light Sources II
Jonathan Zuegel; Univ. of Rochester, USA, Presider

JWD1 • 4:45 p.m. Invited

Laser Based Synchrotron Light Sources, *Heinrich Schwoerer[1], Hans-Peter Schlenvoigt[2], Kerstin Haupt[1], Fabian Budde[2], Erich Rohwer[1], Jordan Gallacher[3], Dino Jaroszynski[3]; [1]Laser Res. Inst., Stellenbosch Univ., South Africa, [2]Inst. für Optik und Quantenelektronik, Friedrich-Schiller-Univ., Germany, [3]Univ. of Strathclyde, UK.* We report on the generation of synchrotron radiation from laser accelerated relativistic electrons propagating through an undulator. We discuss the necessary steps towards a tuneable, ultrafast, coherent, UV light source.

JWD2 • 5:15 p.m.

Characterization and Applications of a Bright, Tunable, MeV Class Compton Scattering γ-Ray Source, *Felicie Albert, Scott G. Anderson, Gerald A. Anderson, Shawn M. Betts, David J. Gibson, Christian A. Hagmann, Micah S. Johnson, Mike J. Messerly, Miroslav Y. Shverdin, Aaron M. Tremaine, Fred V. Hartemann, Brian Rusnak, Craig W. Siders, Dennis P. McNabb, Christopher P. J. Barty; Lawrence Livermore Natl. Lab, USA.* We report detailed spectral and spatial characterization of a 0.1 MeV-0.8 MeV tunable ultra-bright laser-based Compton scattering source. Nuclear Resonance Fluorescence experiments with the source are also presented.

JWD3 • 5:30 p.m.

Production of Infrared Pulses from a Laser Wakefield Electron Accelerator, *Chih-Hao Pai[1], Li-Chung Ha[2], Ming-Wei Lin[2], Jih-Ming Lin[2], Jyhpyng Wang[2], Szu-yuan Chen[2], Hsu-Hsin Chu[3], Jiunn-Yuan Lin[4]; [1]Natl. Taiwan Univ., Taiwan, [2]Academia Sinica, Taiwan, [3]Dept. of Physics, Natl. Central Univ., Taiwan, [4]Dept. of Physics, Natl. Chung Cheng Univ., Taiwan.* Production of intense infrared pulses with 250-microjoule pulse energy from a laser wakefield accelerator is demonstrated. It is strongly correlated with the production of self-injected monoenergetic electron beam.

4:45 p.m.–6:30 p.m.
JWE • Nanophotonics and Metamaterials Symposium II: Advances in Plasmonics
Nikolay Zheludev; Univ. of Southampton, UK, Presider

JWE1 • 4:45 p.m. Invited

Negative Radiation-Pressure Response of a Left-Handed Plasmonic Metamaterial, *Henri Lezec[1], Kenneth J. Chau[1,2]; [1]NIST, USA, [2]School of Engineering, Univ. of British Columbia, Canada.* We present the design, fabrication and opto-mechanical characterization of a left-handed plasmonic metamaterial which exhibits a negative photon-pressure response in the visible frequency range.

JWE2 • 5:15 p.m.

Planar Lenses Based on Nanoscale Slit Arrays in a Metallic Film, *Lieven Verslegers, Peter B. Catrysse, Zongfu Yu, Justin S. White, Edward S. Barnard, Mark L. Brongersma, Shanhui Fan; Stanford Univ., USA.* We experimentally demonstrated planar lenses based on nanoscale slit arrays in a metallic film. Electromagnetic simulations of lens designs and confocal measurements on manufactured structures show excellent agreement, but deviate from simple theory.

JWE3 • 5:30 p.m.

Photonic Metamaterials by Direct Laser Writing, *Michael S. Rill[1], Christine E. Kriegler[1], Michael Thiel[1], Erich Müller[2], Andreas Frölich[1], Georg von Freymann[3], Stefan Linden[3], Sabine Essig[4], Kurt Busch[4], Dagmar Gerthsen[2], Horst Hahn[3], Martin Wegener[1]; [1]Inst. für Angewandte Physik and Ctr. for Functional Nanostructures, Univ. Karlsruhe (TH), Germany, [2]Lab für Elektronenmikroskopie and Ctr. for Functional Nanostructures, Univ. Karlsruhe (TH), Germany, [3]Inst. für Nanotechnologie, Forschungszentrum Karlsruhe in der Helmholtz-Gemeinschaft, Germany, [4]Inst. für Theoretische Festkörperphysik and Ctr. for Functional Nanostructures, Univ. Karlsruhe (TH), Germany.* We present a planar magnetic metamaterial fabricated using 3-D direct laser writing and silver chemical vapor deposition as well as a negative-index bi-anisotropic metamaterial metallized via silver shadow evaporation. Calculations and experiments show good agreement.

4:45 p.m.–6:30 p.m.
IWD • Photon-Lattice Interactions
Jacob B. Khurgin; Johns Hopkins Univ., USA, Presider

IWD1 • 4:45 p.m.

Ultrafast Optical Measurements of Coherent Acoustic Phonon Attenuation in Silicon, *Brian C. Daly[1], Kwangu Kang[2], David G. Cahill[2]; [1]Vassar College, USA, [2]Univ. of Illinois at Urbana-Champaign, USA.* We report measurements of the attenuation of ~100 GHz coherent acoustic phonons in silicon and results are compared with existing theory. The results have implications for nanoscale thermal transport models and novel acoustic imaging schemes.

IWD2 • 5:00 p.m.

Mechanism of the Multiple Raman Sidebands Generation in Diamond Pumped by Two Femtosecond Pulses, *Eiichi Matsubara[1,2], Kensuke Fukayama[1], Taro Sekikawa[1,2], Mikio Yamashita[1,2]; [1]Hokkaido Univ., Japan, [2]CREST, Japan Science and Technolgy Agency, Japan.* Detailed angle resolved spectroscopy reveals that intense multiple Raman-Nath like CARS signals (350-720 nm) are generated in diamond under pumping of two-phonon Raman peak by two-color femtosecond pulses.

IWD3 • 5:15 p.m.

Observation of Anti-Stokes Fluorescence from GaN Film Grown on Si (111) Substrate, *Suvranta K. Tripathy[1], Guibao Xu[1], Xiaodong Mu[1], Yujie J. Ding[1], Muhammad Jamil[1], Ronald A. Arif[1], Nelson Tansu[1], Jacob B. Khurgin[2]; [1]Lehigh Univ., USA, [2]Johns Hopkins Univ., USA.* Phonon-assisted anti-Stokes fluorescence has been observed in GaN film grown on Si (111) substrate. The donor-acceptor pairs and bound excitons have played primary roles in the generation of anti-Stokes fluorescence.

IWD4 • 5:30 p.m.

Coherent Optical and Acoustic Phonons Coupled with the Charge-Ordering Phase Transition in $La_{1/4}Pr_{3/8}Ca_{3/8}MnO_3$, *Kyeong-Jin Jang[1], Jongseok Lim[1], Jihee Kim[2], Ki-Ju Yee[2], Jai Seok Ahn[3], Jaewook Ahn[1]; [1]KAIST, Republic of Korea, [2]Chungnam Natl. Univ., Republic of Korea, [3]Pusan Natl. Univ., Republic of Korea.* Ultrafast pump-probe spectroscopy is used to investigate $La_{1/4}Pr_{3/8}Ca_{3/8}MnO_3$. Coherent optical and acoustic phonons are observed strongly coupled with the charge-ordering phase transition. Phonon characteristics are well understood in a hypothesis related with charge-ordering gap opening.

IQEC

4:45 p.m.–6:30 p.m.
IWE • Optomechanical Effects
Tal Carmon; Univ. of Michigan, Ann Arbor, USA, Presider

IWE1 • 4:45 p.m. Tutorial
Cavity Optomechanics, *Kerry Vahala; Caltech, USA.* Cavity enhancement of optical fields is providing a new way to couple light and mechanical motion. Its application to mechanical cooling and amplification, example implementations, and prospects for new science and technology are reviewed.

Kerry Vahala is the Ted and Ginger Jenkins Professor of Information Science and Technology and Professor of Applied Physics at Caltech. His research on micro-cavities has led to wafer-based devices operating in the Q regime above 100 million, enabling micro-scale Raman and Parametric sources as well as cavity QED on-a-chip systems. His current research is focused on cavity optomechanical phenomena associated with radiation pressure in microresonators. Vahala has received the IEEE Sarnoff Award for his work on quantum-well laser dynamics, was the first recipient of the Richard P. Feynman Hughes Fellowship and has also received an Alexander Von Humboldt Research Award. He is a Fellow of The Optical Society, was program co-chair for CLEO 99, General Chair for CLEO 2001 and has also served as associate editor on several journals.

CLEO

4:45 p.m.–6:30 p.m.
CWH • Eye-Safe Wavelength Lasers II
Mark Dubinskii; ARL, USA, Presider

CWH1 • 4:45 p.m.
Thulium Fiber Laser 4-Pass End-Pumped High Efficiency 2.09-µm Ho:YAG Laser, *Xiaodong Mu, Helmuth E. Meissner, Huai-Chuan Lee; Onyx Optics, Inc., USA.* Slope efficiency as high as 80% has been achieved in Tm:fiber laser end-pumped adhesive free bonded (AFB) YAG/Ho:YAG/YAG laser composite. 18.7-W output power at 2.09 µm has been achieved at pump power of 24.3 W.

CWH2 • 5:00 p.m.
Q-Switched Tm^{3+}:YAG Rod Laser with Crystalline Fiber Geometry, *Marc Eichhorn, Christelle Kieleck, Antoine Hirth; French-German Res. Inst. of Saint-Louis, France.* We present experimental results on TIR-pumped Q-switched Tm^{3+}:YAG lasers pumped at 804 nm. Up to 5.6 mJ pulse energy is achieved (25.9 kW peak power at 216 ns pulse width).

CWH3 • 5:15 p.m.
Efficient Fiber-Laser-Pumped Ho:YLF Oscillator and Amplifier Utilizing the Transmitted Pump Power of the Oscillator, *Hencharl J. Strauss, Wayne Koen, Christoph Bollig, M. J. Daniel Esser, Dieter Preussler, Kwanele Nyangaza, Cobus Jacobs; Council for Scientific and Industrial Res., South Africa.* We present a novel scheme for a compact and robust pulsed fiber-laser-pumped Ho:YLF oscillator and amplifier system, where the pump power transmitted by the oscillator is utilized to pump the amplifier.

CWH4 • 5:30 p.m.
1.88 µm InGaAsP Pumped, Room Temperature Ho:LuAG Laser, *Norman P. Barnes[1], Farzin Amzajerdian[1], Donald J. Reichle[1], George Busch[2], Paul Leisher[3]; [1]NASA Langley Res. Ctr., USA, [2]Science Application Intl., USA, [3]nLight, USA.* A room temperature, directly diode pumped Ho:LuAG laser oscillated for the first time. Direct pumping of the Ho upper laser manifold maximizes efficiency, minimizes heating, and eliminates Ho:Tm energy sharing. Design and performance are presented.

4:45 p.m.–6:30 p.m.
CWI • Topics in Optical Metrology II
Jason Jones; Univ. of Arizona, USA, Presider

CWI1 • 4:45 p.m. Invited
Optical Interferometers with Reduced Sensitivity to Thermal Noise, *H. Jeff Kimble[1], Benjamin L. Lev[2], Jun Ye[3]; [1]Caltech, USA, [2]Univ. of Illinois, USA, [3]Univ. of Colorado, USA.* Thermal phase noise in optical interferometry can be compensated by exploiting coherence for underlying stochastic displacements and strains. The phase upon reflection from a fluctuating mirror's surface can thereby have reduced sensitivity to thermal noise.

CWI2 • 5:15 p.m.
Measurements of the Group Delay Dispersion in High Finesse Optical Cavities, *T.J. Hammond, Arthur K. Mills, David J. Jones; Univ. of British Columbia, Canada.* We present a simple method for determining the group delay dispersion of a high finesse optical cavity by measuring the dependence of the cavity's optical path length on frequency.

CWI3 • 5:30 p.m.
Effect of Structural Distortion on Fabry-Perot Temperature Response, *Richard W. Fox; NIST, USA.* Low expansion glass cavities with optically contacted mirrors can exhibit structural distortions at the mirrors which significantly shift the temperature at which dv/dT = 0. An analytical analysis that incorporates finite element modeling is given.

Room 336

IQEC

4:45 p.m.–6:30 p.m.
IWF • Entangled Photons II
Prem Kumar; Northwestern Univ., USA, Presider

IWF1 • 4:45 p.m.
Interferometry with a Photon-Number Resolving Detector, *Christoph F. Wildfeuer[1,2,3], Aaron Pearlman[2], Jun Chen[2,3], Jingyun Fan[2,3], Alan Migdall[2,3], Jonathan P. Dowling[1]; [1]Hearne Inst. for Theoretical Physics, Louisiana State Univ., USA, [2]Optical Technology Div., NIST, USA, [3]Joint Quantum Inst., Univ. of Maryland, USA.* With photon-number resolving detectors, we show compression of interference fringes with increasing photon number for both Michelson and Fabry-Pérot interferometers. We also theoretically show supersensitivity for nonclassical light.

IWF2 • 5:00 p.m.
Tomography of a Heralded N00N State with Losses, *Nicholas L. Thomas-Peter, Brian J. Smith, Ian A. Walmsley; Clarendon Lab, Univ. of Oxford, UK.* We fully characterize a heralded two-photon N00N state in the presence of losses, including the one-photon and vacuum components. Reconstruction shows large vacuum and one-photon components.

IWF3 • 5:15 p.m.
On the Practicality of Quantum Interferometry Using Photonic N00N States, *Gerald Gilbert, Yaakov S. Weinstein; MITRE, USA.* We show that attenuated *N00N* states lead to a worse phase estimate than an equally attenuated *N* separable state unless the transmittance of the medium is very high.

IWF4 • 5:30 p.m.
Heralded Generation of a Three-Photon N00N State, *Heonoh Kim, Hee Su Park, Sang-Kyung Choi; Korea Res. Inst. of Standards and Science, Republic of Korea.* A heralded three-photon N00N state is generated from two pairs of photons produced by spontaneous parametric down-conversion (SPDC). The measured four-photon coincidences reveal fringes three times finer than single-photon interference.

Room 337

CLEO

4:45 p.m.–6:30 p.m.
CWJ • OPO II
Takunori Taira; Laser Res. Ctr. for Molecular Science, Insti, Japan, Presider

CWJ1 • 4:45 p.m.
GaS_xSe_{1-x} Compounds for Nonlinear Optics, *Vladimir L. Panyutin[1], Alexander I. Zagumennyi[2], Abdelmounaime F. Zerrouk[3], Frank Noack[1], Valentin Petrov[1]; [1]Max-Born-Inst., Germany, [2]General Physics Inst. of the Russian Acad. of Sciences, Russian Federation, [3]Zecotek Photonics Singapore Pte Ltd, Singapore.* We measure the nonlinearity and transparency of mixed GaS_xSe_{1-x} crystals and show that $GaS_{0.4}Se_{0.6}$ is a promising nonlinear material for mid-IR (>5 µm) OPO operation without two-photon absorption for a pump wavelength of 1064 nm.

CWJ2 • 5:00 p.m.
OP-GaAs OPO Pumped by a Q-switched Tm,Ho:silica Fiber Laser, *Christelle Kieleck[1], Marc Eichhorn[1], Antoine Hirth[1], David Faye[2], Eric Lallier[2], Stuart D. Jackson[3]; [1]French-German Res. Inst. of Saint-Louis (ISL), France, [2]Thales Res. and Technology, France (TRT), France, [3]Optical Fiber Technology Ctr., Univ. of Sydney, Australia.* We report on the first OP-GaAs OPO directly pumped by a 2.09 µm fiber laser. Up to 0.6 W average output power was achieved at 20 kHz repetition rate in the mid-infrared range.

CWJ3 • 5:15 p.m.
Achromatic Double-Pass Configuration in a Single Longitudinal Mode Doubly Resonant OPO, *Bertrand Hardy, Sylvain Guilbaud, Antoine Berrou, Myriam Raybaut, Antoine Godard, Michel Lefebvre; ONERA, The French Aerospace Lab, France.* We present a new, low threshold, narrow linewidth, entangled cavity scheme for nanosecond OPO. Thanks to this compact design, open loop single longitudinal mode operation is achieved over hours with 5 MHz short term stability.

CWJ4 • 5:30 p.m.
Fiber-Laser-Pumped CW OPO for Red, Green, Blue Laser Generation, *Shoutai Lin, Yen-Yin Lin, Rong Yu Tu, Tsong-Dong Wang, Yen Chieh Huang; Natl. Tsing Hua Univ., Taiwan.* We report a cw-RGB laser based on an Yb-fiber-laser pumped OPO with intra- and extra-cavity wavelength converters. At 25-W pump power, the laser generated 5, 0.5, and 0.01-W at 633, 532, and 450 nm, respectively.

Room 338

4:45 p.m.–6:30 p.m.
CWK • High-Power Ultrafast Fiber Sources
Axel Ruehl; IMRA America, Inc., USA, Presider

CWK1 • 4:45 p.m.
Peak Power Scaling towards Ultrashort Pulses at High Repetition Rates, *Steffen Hädrich[1], Jan Rothhardt[1], Tino Eidam[1], Damian N. Schimpf[1], Fabian Röser[1], Jens Limpert[1], Andreas Tünnermann[1,2]; [1]Friedrich Schiller Univ. Jena, Germany, [2]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* We present two scaling concepts for fiber based system. Ultrashort pulses with high peak power are generated while maintaining the advantages of fiber laser systems such as high repetition rate and good beam quality.

CWK2 • 5:00 p.m.
100W, Fiberised, Linearly-Polarized, Picosecond Ytterbium Doped Fiber MOPA, *Kangkang Chen, Shaif-ul Alam, Dejiao Lin, Andrew Malinowski, David J. Richardson; Optoelectronic Res. Ctr., Univ. of Southampton, UK.* We report a PM, fully-fiberised, picosecond fiber MOPA delivering 20 ps pulses at repetition rates up to 970 MHz and at average powers of up to 100 W.

CWK3 • 5:15 p.m.
45 Watts Average Power, 3 ps, 1.3-GHz Repetition Rate Yb-Fiber Amplification System, *Dimitre G. Ouzounov, Heng Li, Bruce Dunham, Charles Sinclair, Frank W. Wise; Cornell Univ., USA.* Pulses from harmonically-mode-locked fiber laser were amplified in Yb-fiber to average power of 45 watts in good-quality 3-ps-pulses, at 1.3-GHz repetition rate in a near diffraction-limited-beam. 15-watts-average-power at 520 nm is produced by second-harmonic generation.

CWK4 • 5:30 p.m.
Sub-50 fs Pulse Generation from a High Power Yb-Doped Fiber Amplifier, *Yujun Deng, Ching-Yuan Chien, Bernard G. Fidric, James D. Kafka; Spectra-Physics, Newport Corp., USA.* We demonstrate the generation of 48 fs, 226 nJ pulses from an Yb-doped fiber amplifier with 18 W of average power. Gain fiber length and pump wavelength are chosen to achieve this optimum result.

Room 339

4:45 p.m.–6:30 p.m.
CWL • Parametric Amplification
Todd Ditmire; Univ. of Texas at Austin, USA, Presider

CWL1 • 4:45 p.m.
Strong Bandwidth and Efficiency Improvement by Passive Pulse Shaping in Cavity-Enhanced OPCPA, *Aleem M. Siddiqui, Jeffrey Moses, Kyung-Han Hong, Franz X. Kärtner; MIT, USA.* An enhancement cavity can optimally reshape the small-signal gain across the interacting pulses of a chirped-pulse parametric amplifier, increasing the gain bandwidth dramatically while simultaneously boosting the conversion efficiency.

CWL2 • 5:00 p.m.
Multi-Stage Optimization of Ultrabroadband High-Energy Optical Parametric Chirped Pulse Amplification, *Jeffrey Moses[1], Cristian Manzoni[2], Shu-Wei Huang[1], Giulio Cerullo[2], Franz X. Kärtner[1]; [1]MIT, USA, [2]Politecnico di Milano, Italy.* We present a procedure for simultaneous optimization of efficiency-bandwidth product and super-fluorescence noise suppression in ultrabroadband high-energy optical parametric chirped pulse amplification. Gain dependence of parameters makes stage-by-stage signal chirp optimization necessary in multi-stage amplification.

CWL3 • 5:15 p.m.
15-fs, 1-µJ, 100-kHz Pulses by Direct Seeding of a NOPA and Its Fiber Pump by a CEP Stabilized Ti-Sapphire Oscillator, *Julien Nillon, Sebastien Montant, Johann Boullet, Rudy Desmarchelier, Yoann Zaouter, Eric Cormier, Stéphane Petit; Univ. de Bordeaux 1-CNRS-CEA, CELIA, France.* We report on the direct seeding of a 7-fs Ti:sapphire oscillator into a fiber amplifier at 100-kHz repetition rate used for pumping a NOPA. 1-µJ pulses have been then recompressed down to 15-fs.

CWL4 • 5:30 p.m.
High-Power, Few-Cycle, Phase-Stabilized 2.2-µm Optical Parametric Chirped Pulse Amplifier, *Shu-Wei Huang[1], Jeffrey Moses[1], Kyung-Han Hong[1], Edilson L. Falcão-Filho[1], Andrew Benedick[1], Jeremy Bolger[2], Benjamin Eggleton[2], Franz X. Kärtner[1]; [1]MIT, USA, [2]Univ. of Sydney, Australia.* We demonstrate a high-peak-power, 1-kHz, 2.2-µm OPCPA for long-wavelength-driven high harmonic generation that produces 9-GW, 3-optical-cycle, CEP-stabilized pulses, allowing tunneling-ionization-threshold intensity with low Guoy phase shift.

Room 340

IQEC

4:45 p.m.–6:30 p.m.
IWG • Applications of Cold Atoms
Alberto Marino; NIST, USA, Presider

IWG1 • 4:45 p.m.
Accuracy of a High Sensitivity Atomic Gravimeter, *Nicola Malossi, Quentin Bodart, Sebastian Merlet, André Clairon, Arnaud Landragin, Franck Pereira Dos Santos; Lab Natl. de Métrologie et d'Essais--Système de Références Temps-Espace (LNE-SYRTE), France.* Systematic effects on the stability (1.4×10^{-8}g at 1s) and accuracy of a compact cold atoms gravimeter at SYRTE-LNE are studied with special emphasis on the effect due to light wave aberration of the Raman Lasers.

IWG2 • 5:00 p.m. Invited
Quantum Information Processing with Double-Well Optical Lattices, *Nathan Lundblad, James V. Porto; NIST, USA.* We demonstrate a technique to address a spatially dense field-insensitive qubit register composed of neutral atoms held in a double-well optical lattice. We robustly perform single-qubit rotation on qubits located at addressed lattice sites.

IWG3 • 5:30 p.m.
Ultra-Sensitive Faraday Rotation Measurements from an Atom-Light Quantum Interface, *Marco Koschorreck, Mario Napolitano, Brice Dubost, Morgan W. Mitchell; ICFO, Spain.* Highly sensitive Faraday rotation measurements are performed on an ensemble of ^{87}Rb. The deduced interaction strength is discussed in the context of spin-squeezing. We present a method for spin state tomography based on Faraday rotations.

Room 341

CLEO

4:45 p.m.–6:30 p.m.
CWM • THz Imaging
Takeshi Yasui; Osaka Univ., Japan, Presider

CWM1 • 4:45 p.m.
Mode Imaging and Dispersion Analysis in Terahertz Waveguides Using Terahertz Near-Field Microscopy, *Oleg Mitrofanov[1], Thomas Tan[1], Paul R. Mark[2], Bradley Bowden[2], James A. Harrington[2]; [1]Univ. College London, UK, [2]Rutgers Univ., USA.* Mode structure, transmission loss and dispersion are characterized in low-loss (~1dB/m) Terahertz (THz) dielectric-lined hollow metallic waveguides. THz near-field probe imaging and spectroscopy is applied for precise mode imaging and selective mode probing.

CWM2 • 5:00 p.m.
THz Subwavelength-Fiber-Based Near-Field Microscope, *Hung-Wen Chen[1], Chui-Min Chiu[1], Yu-Ru Huang[1], Chun-Chiu Kuo[1], Yuh-Jing Huang[2], Wen-Jeng Lee[3], Chi-Kuang Sun[4]; [1]Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Inst. of Astronomy and Astrophysics, Academia Sinica, Taiwan, [3]Natl. Taiwan Univ. Hospital, Taiwan, [4]Dept. of Electrical Engineering and Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., and Res. Ctr. for Applied Sciences, Academia Sinica, Taiwan.* We successfully established a compact all-THz fiber-scanning near-field microscope operating at room-temperature. This upright transmission-illumination microscope was applied for diagnosis of breast tumor biopsy samples with ~100% specificity and ~100% sensitivity.

CWM3 • 5:15 p.m.
New Approach for an Electro-Optic THz-Detector Array Using Photonic Mixing Device Camera, *Gunnar Spickermann, Peter Haring Bolívar; Siegen Univ., Germany.* We present a new 2-D electrooptical THz detector using a photonic mixing device (PMD) camera. This combination increases sensitivity drastically, enabling the use of non amplified fs laser sources for high resolution real-time THz imaging.

CWM4 • 5:30 p.m.
Time-Reversal and Model-Based Imaging in a THz Waveguide, *Malakeh A. Musheinesh, Charles J. Divin, Jeffrey A. Fessler, Theodore B. Norris; Univ. of Michigan, USA.* A substantial improvement in the reconstruction of time-reversed Thz fields is demonstrated by adapting a waveguide technique from ultrasound imaging. Furthermore, a model based reconstruction method is considered as an alternative to time-reversal THz imaging.

Rooms 328-329

PhAST

4:45 p.m.–6:45 p.m.
PWB • Lasers and Optics for Astronomy and Spacebased Sensing
Robert L. Byer; Stanford Univ., USA, Presider

PWB1 • 4:45 p.m. Invited
The Decadal Survey, *Berrien Moore; Climate Central, USA.* Two years ago, the National Research Council released a Decadal Survey that laid out recommendations for the next ten years of observing Earth from space. This paper discusses that report and the government's subsequent actions.

PWB2 • 5:15 p.m. Invited
Lasers and Electro-Optics for Ground-Based Astronomy, *Richard Dekany; Caltech, USA.* To expand their science reach, terrestrial observatories have long demanded innovative optical technologies. Today, photonics enabling the active control, compensation, and detection of astronomical light are once again opening new vistas on our Universe.

Rooms 321-323	Rooms 324-326	Room 314
JOINT		IQEC

JWD • Novel Light Sources II—Continued

JWD4 • 5:45 p.m.
Coherent Betatron Radiation from Laser-Wakefield Accelerated Bunches of Monoenergetic Electrons, *Stuart P. D. Mangles[1], Stefan Kneip[1], Christopher McGuffey[2], Stepan S. Bulanov[2], Vladimir Chvykov[2], Franklin Dollar[2], Y. Horovitz[2], C. Huntington[2], Galina Kalintchenko[2], Anatoly Maksimchuk[2], Takeshi Matsuoka[2], Charlotte Palmer[1], Kim Ta Phuoc[3], Pascal Rousseau[2], Victor Yanovsky[2], Karl Krushelnick[2], Zulfikar Najmudin[1]; [1]Imperial College London, UK, [2]Univ. of Michigan, USA, [3]Lab d'Optique Applique, France.* X-rays generated by 0.1-0.5 GeV electron beams generated using a 100 TW laser are shown to have a low emittance, be spatially coherent and have a peak brightness comparable to 3rd generation synchrotron sources.

JWD5 • 6:00 p.m.
Generation of a 1 Picosecond Soft X-Ray Laser Pulses from an Injection-Seeded Plasma Amplifier, *Yong Wang[1], Mark Berrill[1], Francesco Pedaci[1], M. M. Shakya[2], S. Gilbertson[2], Zenghu Chang[2], E. Granados[1], Brad Luther[1], M. A. Larotonda[1], Dave Alessi[1], Jorge Rocca[1]; [1]Colorado State Univ., USA, [2]Kansas State Univ., USA.* Phase-coherent 1.13±0.47 ps soft x-ray laser(SXRL) were generated by injection-seeding a solid-target Ne-like Ti plasma amplifier with high harmonic pulses. This is the shortest pulse duration reported to date from a table-top SXRL amplifier.

JWD6 • 6:15 p.m.
Infrared Multimillijoule Single-Filament Supercontinuum Generation, *Oliver D. Mücke[1], Aart J. Verhoef[1], Audrius Pugžlys[1], Andrius Baltuška[1], Skirmantas Ališauskas[2], Valerijus Smilgevičius[2], Jonas Pocius[3], Linas Giniūnas[3], Romualdas Danielius[3], Nicolas Forget[4]; [1]Vienna Univ. of Technology, Austria, [2]Vilnius Univ., Lithuania, [3]Light Conversion Ltd., Lithuania, [4]Fastlite, France.* Single 4-mJ supercontinuum filaments supporting 8-fs pulses are generated by focusing ultrashort pulses from a four-stage KTP-OPCPA into a noble-gas cell. The use of a 1.6-μm wavelength permits efficient energy scaling in the single-filament regime.

JWE • Nanophotonics and Metamaterials Symposium II: Advances in Plasmonics—Continued

JWE4 • 5:45 p.m.
Plasmon Resonance Variation from Strongly Interacting Gold Nanorods, *Moussa N'Gom[1], Theodore Norris[1], Rolf Erni[2]; [1]Univ. of Michigan at Ann Arbor, USA, [2]Lawrence Berkeley Natl. Lab, USA.* Electron-energy-loss-spectroscopy combined with spectral-imaging in a transmission-electron-microscope is used to probe-and-map the energy-distribution of the optical-frequency surface-plasmons of coupled gold nanorods. Local-field-enhancement and spectral-shift of the surface-plasmon-modes is observed when two nanoparticles are electromagnetically coupled.

JWE5 • 6:00 p.m.
Femtosecond Surface Plasmon Interferometry with Gold Nanostructures, *Vasily V. Temnov[1], Keith Nelson[1], Gaspar Armelles[2], Alfonso Cebollada[2], Tim Thomay[3], Alfred Leitenstorfer[3], Rudolf Bratschitsch[3]; [1]MIT, USA, [2]Inst. de Microelectrónica de Madrid, Spain, [3]Dept. of Physics and Ctr. for Applied Photonics, Univ. of Konstanz, Germany.* We measure ultrafast electron dynamics in gold via ultrafast surface plasmon interferometry. A new plasmonic microinterferometer with tilted slit-groove pair is used to unambiguously determine changes of real and imaginary parts of the dielectric function.

JWE6 • 6:15 p.m.
Surface Plasmon Waveguide Mode Hybridization and Lasing in Sub-wavelength Microdisks at 1.3μm, *Raviv Perahia, Thiago P. Mayer Alegre, Amir Safavi-Naeini, Oskar Painter; Caltech, USA.* Hybridization of surface-plasmon and waveguide modes, in sub-wavelength quantum well microdisks with a varying diameter top metal contact, is simulated and experimentally verified. Lasing is achieved in weakly hybridized optically pumped sub-wavelength disks at λ=1.3*μm*.

IWD • Photon-Lattice Interactions—Continued

IWD5 • 5:45 p.m.
Bias-Controlled Coherent Acoustic Phonon Generation in InGaN/GaN Multiple-Quantum-Wells Light Emitting Diodes, *Pei-Hsun Wang[1], Yu-Chieh Wen[1], Shi-Hao Guol[1], Hung-Cheng Lin[2], Peng-Ren Cheng[2], Jin-Wei Shi[2], Jen-Inn Chyi[2], Chih-Ming Lai[3], Chi-Kuang Sun[4,5]; [1]Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Dept. of Electrical Engineering, Natl. Central Univ., Taiwan, [3]Dept. of Electronic Engineering, Ming Chuan Univ., Taiwan, [4]Dept. of Electrical Engineering and Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [5]Res. Ctr. for Applied Sciences, Academia Sinica, Taiwan.* We demonstrate the control of coherent acoustic phonon generation by applying voltage across InGaN/GaN multiple-quantum-wells light emitting diodes (LEDs). The acoustic phonons oscillation can be switched off by increasing the reverse bias up to -25V.

IWD6 • 6:00 p.m.
Coherent Lattice Vibrations in Small Diameter Single-Walled Carbon Nanotubes, *Yong-Sik Lim[1], Jae-Geum Ahn[1], Taiha Joo[2], Ki-Ju Yee[3], E. H. Haroz[4], L. G. Booshehri[4], J. Kono[4]; [1]Dept. of Applied Physics, Konkuk Univ., Republic of Korea, [2]Dept. of Chemistry, Pohang Univ. of Science and Technology, Republic of Korea, [3]Dept. of Physics, Chungnam Natl. Univ., Republic of Korea, [4]Dept. of Electrical and Computer Engineering, Rice Univ., USA.* We report on coherent phonon oscillations of non-resonantly excited RBMs at the excitation as high as 300meV above the E_{11} transition level for (6,5) and (7, 3) tubes in isolated CoMoCAT SWNTs.

IWD7 • 6:15 p.m.
Phonon Interaction on a Single Quantum Dot Emission Line, *Erik Stock[1], Andreas Baumgartner[2], Matthias-Rene Dachner[3], Till Warming[1], Andrei Schliwa[1], Amalia Patanè[2], Laurence Eaves[2], Marten Richter[3], Andreas Knorr[3], Mohamed Henini[2], Dieter Bimberg[1]; [1]Berlin Inst. für Festkörperphysik, Technische Univ., Germany, [2]Univ. of Nottingham, UK, [3]Berlin Inst. für Theoretische Physik, Technische Univ., Germany.* We studied the coupling between the lattice vibrations and the electronic states of a single electrically pumped InAs/GaAs quantum dot. The experimental observed spectra agree excellent with theoretical modeling considering real QD structural parameters.

NOTES

Room 315

IQEC

IWE • Optomechanical Effects—Continued

IWE2 • 5:45 p.m.
Controlling Light Propagation via Radiation Pressure Optomechanical Coupling, *Olivier Arcizet[1], Albert Schliesser[1], Tobias Kippenberg[1,2]; [1]Max Planck Inst. for Quantum Optics, Germany, [2]École Polytechnique Fédérale de Lausanne, Switzerland.* We demonstrate experimentally for the first time the possibility of controlling the propagation properties of a light pulse using cavity assisted radiation pressure coupling to mechanical modes. Both pulse delay and advancement are observed.

IWE3 • 6:00 p.m.
Probing the Nonlinear Optical Response of Nanosuspensions, *Woei Ming Lee[1], Kishan Dholakia[1], Ewan M Wright[2], Ramy El-Ganainy[3], Demetrios Christodoulides[3]; [1]SUPA, School of Physics and Astronomy, Univ. of St Andrews, UK, [2]College of Optical Sciences, Univ. of Arizona, USA, [3]CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA.* We describe a fiber-based Z-scan experiment for probing the nonlinear optical response of nanosuspensions that will provide a platform for deciding between rival different theoretical models.

IWE4 • 6:15 p.m.
Strong Coupling between Optomechanical Resonators, *Gustavo S. Wiederhecker, Alexander A. Gondarenko, Michal Lipson; Cornell Univ., USA.* We demonstrate strong coupling between two stacked micro-optomechanical silicon nitride disks. The induced frequency splitting almost spans a full free-spectral range. Mechanical oscillations excited by repulsive/attractive gradient forces modulate the coupling modulation at several MHz.

Room 316

CLEO

CWH • Eye-Safe Wavelength Lasers II—Continued

CWH5 • 5:45 p.m.
Single Longitudinal Mode, High Repetition Rate, Q-Switched Ho:YLF Laser for Remote Sensing, *Yingxin Bai[1], Jirong Yu[2], Paul Petzar[3], Mulugeta Petros[4], Songsheng Chen[1], Bo Trieu[2], Hyung Lee[3], Upendra Singh[2]; [1]Science Systems and Applications, Inc., USA, [2]NASA Langley Res. Ctr., USA, [3]Natl. Inst. of Aerospace, USA, [4]Science and Technology Corp., USA.* An injection-seeded, Q-switched Ho:YLF laser has been developed for 13W pumping from a CW Tm:fiber laser, the energy and width of single longitudinal mode pulse are 5.5mJ and 50ns, respectively. The repetition rate is 1.25kHz.

CWH6 • 6:00 p.m.
Experimental Results on an Er^{3+}:YAG Solid-State Heat Capacity Laser, *Marc Eichhorn; French-German Res. Inst. of Saint-Louis, France.* Experimental results on an Er^{3+}:YAG solid-state heat-capacity laser are presented and compared to theory.

CWH7 • 6:15 p.m.
Mid-IR Electroluminescence of Cr:ZnSe Crystals Co-Doped with Donor and Acceptor Impurities, *Changsu Kim, Jeremy Peppers, Vladimir V. Fedorov, Sergey B. Mirov; Dept. of Physics, Univ. of Alabama at Birmingham, USA.* Studies of divalent Chromium ions compensation in ZnSe crystals after thermo-diffusion of Al and Ag co-dopants are presented. We report 2-3μm Mid-IR electroluminescence in the Al:Cr:ZnS and Ag:Cr:ZnSe bulk samples.

Room 317

CWI • Topics in Optical Metrology II—Continued

CWI4 • 5:45 p.m.
Synchronously Pumped OPO with Two Pulses per Cavity for Intracavity Phase Measurements, *Andreas Schmitt-Sody, Andreas Velten, Jean-Claude Diels; Dept. of Physics and Astronomy, Univ. of New Mexico, USA.* Phase to frequency conversion is demonstrated with a synchronously mode-locked optical parametric oscillator, with a sensitivity of 16 MHz/radian, and a phase resolution of 9 x 10^{-8} radian.

CWI5 • 6:00 p.m.
Measurement of Photodiode Harmonic Distortion Using Optical Comb Sources and High-Resolution Optical Filtering, *Jason D. McKinney[1], Daniel E. Leaird[2], Andrew M. Weiner[2], Keith J. Williams[1]; [1]NRL, USA, [2]Purdue Univ., USA.* Optical combs and high-resolution optical filtering are utilized for high-fidelity measurements of photodiode harmonic distortion. This technique uses a single laser and phase modulation - alleviating requirements on laser frequency stabilization and modulator bias control.

CWI6 • 6:15 p.m.
Observing Angular Deviations in Specular Reflection of Light, *Michele Merano, Andrea Aiello, Martin P. van Exter, Johannes P. Woerdman; Leiden Univ., Netherlands.* We measure the direction of a TEM_{00} Gaussian beam reflected from an air-glass interface. We report experimental evidence of an angular deviation of the beam axis from the Reflection Law for a light ray.

NOTES

Room 336 | Room 337 | Room 338 | Room 339

IQEC | **CLEO**

IWF • Entangled Photons II—Continued

IWF5 • 5:45 p.m.
Spatial Super-Resolution with Triphoton N00N States, *Lee A. Rozema[1,2], Lynden K. Shalm[1,2], Aephraim M. Steinberg[1,2], Malcolm N. O'Sullivan[3], Robert W. Boyd[3]; [1]Dept. of Physics, Univ. of Toronto, Canada, [2]Ctr. for Quantum Information and Quantum Control and Inst. for Optical Sciences, Univ. of Toronto, Canada, [3]Inst. of Optics, Univ. of Rochester, USA.* The proposal that quantum entanglement can lead to sub-Rayleigh resolution in optics has received much attention lately. Here we present an experiment in which three entangled photons are used to demonstrate spatial super-resolution.

IWF6 • 6:00 p.m.
Observation of Nontrivial 3-Photon Correlation of Chaotic Thermal Light, *Yu Zhou, Jianbin Liu, Yanhua Shih; Dept. of Physics, Univ. of Maryland, Baltimore County, USA.* The reported experiment observed a nontrivial third-order temporal correlation ("three-photon bunching" effect) of chaotic-thermal light in the joint-detection of three individual photodetectors. In the view of quantum mechanics, "three-photon bunching" is a three-photon interference effect.

IWF7 • 6:15 p.m.
Exploring Energy-Time Entanglement Using Geometric Phase, *Anand K. Jha, Mehul Malik, Robert W. Boyd; Inst. of Optics, Univ. of Rochester, USA.* Using the photons produced by parametric down-conversion, we report an experimental observation of a violation of the Bell inequality for energy and time based purely on the geometric phases of the downconverted photons.

CWJ • OPO II—Continued

CWJ5 • 5:45 p.m.
Recent Advances in All-Epitaxial Growth and Properties of Orientation-Patterned Gallium Arsenide (OP-GaAs), *Peter G. Schunemann, Leonard A. Pomeranz, York E. Young, Lee Mohnkern, Alice Vera; BAE Systems, USA.* We report on all-epitaxial growth of large diameter (3-inch), large aperture (>1.5mm thick), low-loss (<0.005cm^{-1}) QPM GaAs grown at BAE Systems. 2-µm-laser-pumped OPO performance was comparable to that of $ZnGeP_2$.

CWJ6 • 6:00 p.m.
Generation of High Energy Sub-20-fs Pulses Tunable in the 250nm-310nm Region by Frequency Doubling of a High-Power Non-Collinear OPA, *Marcus Beutler[1], Masood Ghotbi[1], Frank Noack[1], Daniele Brida[2], Cristian Manzoni[2], Giulio Cerullo[2]; [1]Max-Born-Inst., Germany, [2]Natl. Lab for Ultrafast and Ultraintense Optical Science, Inst. for Photonics and Nanotechnologies, Italian Natl. Res. Council, Italy.* We report the generation of tunable DUV pulses with pulse durations below 20fs at 10µJ energy level. The pulses are generated by frequency doubling of a high-power non-collinear OPA and compressed to almost transform-limited duration.

CWJ7 • 6:15 p.m.
High Repetition Rate Optical Parametric Amplification Based on a Single Yb:Fiber Laser, *Yan-Wei Tzeng[1], Chen-Han Huang[1], Yen-Yin Lin[2], Jian-Ming Liu[1], Hsiang-Chen Chui[3], Hsiang-Lin Liu[4], James M. Stone[5], Jonathan C. Knight[5], Shi-Wei Chu[1]; [1]Dept. of Physics, Natl. Taiwan Univ., Taiwan, [2]Inst. of Photonics Technologies, Dept. of Electrical Engineering, Natl. Tsing-Hua Univ., Taiwan, [3]Inst. of Electro-Optical Science and Engineering, Natl. Cheng Kung Univ., Taiwan, [4]Dept. of Physics, Natl. Taiwan Normal Univ., Taiwan, [5]Ctr. for Photonics and Photonic Materials, Univ. of Bath, UK.* 700-1900-nm tunable single-pass optical-parametric-amplification was demonstrated. The pump was a frequency-doubled Yb-laser, and the residual Yb-laser was recycled to generate supercontinuum as seeding. Over 30% conversion efficiency was obtained with 10-nJ pump energy.

CWK • High-Power Ultrafast Fiber Sources—Continued

CWK5 • 5:45 p.m.
Mode-Locked Yb-Doped Fiber Laser with Watt-Level Average Power and Sub-100fs Pulse Duration, *Khanh Kieu, Will Renninger, Andy Chong, Frank W. Wise; Cornell Univ., USA.* We report a pulsed fiber laser that generates 31-nJ chirped pulses at 70-MHz repetition rate and 2.2 W average power. After dechirping outside the cavity, 80-fs pulses, with 200-kW peak power, are obtained.

CWK6 • 6:00 p.m.
Transform Limited 100 µJ Pulses Non-Linear Fiber CPA with Mismatched Stretchers and Compressor, *Yoann Zaouter[1,2], Johan Boullet[1], Eric Mottay[2], Eric Cormier[1]; [1]CELIA, France, [2]Amplitude Systèmes, France.* We report on a fiber CPA system producing 100 µJ energy pulses with quasi transform limited duration of 267 fs at a repetition rate of 300 kHz leading to a peak power of 345 MW.

CWK7 • 6:15 p.m.
Environmentally-Stable Nonlinear Chirped-Pulse Fiber Amplifier, *Shian Zhou[1,2], Tetsuji Takamido[2], Rakesh Bhandari[2], Frank W. Wise[1]; [1]Cornell Univ., USA, [2]SUNX Ltd., Japan.* A femtosecond fiber system based on nonlinear chirped-pulse amplification is investigated. The amplifier is completely integrated, which requires careful management of nonlinearity. High-quality 500-fs pulses with 5 µJ energy are generated.

CWL • Parametric Amplification—Continued

CWL5 • 5:45 p.m.
Design and Simulation of Few-Cycle Optical Parametric Chirped Amplification at Mid-IR Wavelengths, *Olivier Chalus[1], Philip Bates[1], Jens Biegert[1,2]; [1]ICFO, Spain, [2]ICREA, Spain.* We present a design for a novel carrier-envelope phase stable OPCPA source in the mid-infrared. The obtained results indicate pulses of 56fs duration, with pulse energies of 9.6µJ at a central wavelength of 3.3µm.

CWL6 • 6:00 p.m.
1 µJ from a High Repetition Rate Femtosecond Optical Parametric Chirped-Pulse Amplifier in the Mid-Infrared, *Clemens Heese, Christian Erny, Martin Haag, Lukas Gallmann, Ursula Keller; ETH Zurich, Switzerland.* We demonstrate a mid-infrared optical parametric chirped-pulse amplifier with a pulse energy of 1 µJ at 100 kHz repetition rate. Its output is compressed to 92 fs by a prism compressor and characterized by SHG-FROG.

CWL7 • 6:15 p.m.
Micro-Joule Energy, Mid-IR Pulses with 9-Cycle Duration from a 100 kHz OPCPA Source, *Olivier Chalus[1], Philip K. Bates[1], Mathias Smolarski[1], Jens Biegert[1,2]; [1]ICFO, Spain, [2]ICREA, Spain.* A novel mid-IR OPCPA source generates 9.0 cycle pulses (96fs, 3.2µm) with 1.2µJ energy at 100kHz, and is expected to be intrinsically CEP stable. The minimum fourier transform limited duration is 45fs, or 4.2 cycles.

NOTES

Room 340

IQEC

IWG • Applications of Cold Atoms—Continued

IWG4 • 5:45 p.m.
A Single Mode Optical Waveguide for Matter Waves, *Kenneth G. H. Baldwin, Sean S. Hodgman, Robert G. Dall, Mattias T. Johnsson, Andrew G. Truscott; Australian Natl. Univ., Australia.* We demonstrate single mode guiding of metastable helium atoms from a BEC confined in a far detuned optical potential. Multimode guiding is also shown and results in the creation of a matter wave speckle pattern.

IWG5 • 6:00 p.m.
Atom "Meta-Optics": Negative-Index Media for Matter Waves in the nm Wavelength Range, *Mehdi Hamamda, Gabriel Dutier, Mohammed Boustimi, Valja Bocvarski, Jules Grucker, Francisco Perales, Jacques Baudon, Martial Ducloy; Lab de Physique des Lasers, Inst. Galilée, Univ. Paris, France.* Meta-optics is extended to matter waves. "Co-moving" magnetic fields in Stern-Gerlach interferometers allows producing negative group velocity of atomic wave packets, resulting into a negative refraction of the matter wave and atom "meta-lenses".

IWG6 • 6:15 p.m.
Tracking Quasi-Classical Chaos in Bose-Einstein Condensates, *Maxence Lepers, Véronique Zehnlé, Jean-Claude Garreau; Lab de Physique des Lasers, Atomes, et Molécules, Univ. des Sciences et Technologies de Lille, France.* We study the dynamics of a Bose-Einstein condensate in a tilted optical lattice via the Gross-Pitaevskii equation.We track this behavior by using an easily measurable quantity, the condensate mean position.

Room 341

CLEO

CWM • THz Imaging—Continued

CWM5 • 5:45 p.m.
Observation of Semiconductor Test Circuits with Interconnect Defects Using Laser THz Emission Microscope, *Masatsugu Yamashita[1], Chiko Otani[1], Toru Matsumoto[2], Yoshihiro Midoh[3], Katsuyoshi Miura[3], Koji Nakamae[3], Masayoshi Tonouchi[3], Kiyoshi Nikawa[4]; [1]RIKEN, Japan, [2]Hamamatsu Photonics, Japan, [3]Osaka Univ., Japan, [4]NEC Electronics, Japan.* To evaluate the performance for non-contact testing of semiconductor circuits, we observed simple test circuits with interconnect defects using laser THz emission microscope, which detects THz wave emitted from circuits excited by focused fs laser.

CWM6 • 6:00 p.m.
Terahertz Imaging of Aircraft Composites, *Matthew J. Bohn[1], Christopher D. Stoik[1], James L. Blackshire[2]; [1]Air Force Inst. of Technology, USA, [2]AFRL, USA.* Damaged aircraft composites were prepared simulating voids, delaminations, puncture holes, burns and paint removal. Terahertz time domain spectroscopy in reflection configuration was assessed as a Non-Destructive Evaluation (NDE) technique and compared to traditional NDE techniques.

CWM7 • 6:15 p.m.
Efficient Distributed Self-Mixing in Silicon CMOS Transistors, *Alvydas Lisauskas[1], Diana Glaab[1], Hartmut G. Roskos[1], Ullrich Pfeiffer[2], Erik Öjefors[2]; [1]Goethe-Univ., Germany, [2]Univ. of Wuppertal, Germany.* A 645-GHz focal-plane array fabricated in a 0.25-μm CMOS process achieves a responsivity of up to 80 kV/W and a NEP of 300 pW/pHz. The mixing mechanism is analyzed. Heterodyne detection is also demonstrated.

Rooms 328-329

PhAST

PWB • Lasers and Optics for Astronomy and Spacebased Sensing—Continued

PWB3 • 5:45 p.m. Invited
The Coming Generation of Large Optical Telescopes, *Craig Foltz; NSF, USA.* Three challenging designs for astronomical telescopes with apertures of 20-30 meters range will be described. Employing adaptive optics, these telescopes will improve our light grasp and angular resolution by factors of ten and three, respectively.

PWB4 • 6:15 p.m. Invited
GeoEye-1, the World's Highest Resolution Commercial Satellite, *Michael Madden; GeoEye, USA.* GeoEye-1 is the world's most advanced commercial imaging satellite. This LEO satellite provides multi spectral imagery at 41 centimeter spatial resolution, from 681 kilometers in space. This talk will outline GE-1's system specifications and performance.

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