Ballroom A1 and A8 | Ballroom A2 and A7 | Ballroom A3 and A6 | Ballroom A4 and A5

QELS

8:00 a.m.–9:45 a.m.
QThA • Nonlinear Plasmonics
Harald Giessen; Univ. Stuttgart, Germany, Presider

QThA1 • 8:00 a.m.
Saturation of Second-Harmonic Generation in Plasmon-Coupled GaAs-Filled Hole Arrays, *Jingyu Zhang, Steve Brueck; Ctr. for High Technology Materials, USA.* Second harmonic generation (SH) based on the enhancement of localized fields confined in nanoscale periodic, GaAs-filled holes in a metal film is presented. The SH saturates for a fundamental peak power intensity > 20 GW/cm^2.

QThA2 • 8:15 a.m.
Enhanced Second-Harmonic Generation in an Array of Gold Nanocones, *Juha M. Kontio[1], Janne Simonen[1], Jukka Viheriälä[1], Markus Pessa[1], Hannu Husu[2], Brian K. Canfield[2], Martti Kauranen[2]; [1]Optoelectronics Res. Ctr., Tampere Univ. of Technology, Finland, [2]Inst. of Physics, Optics Lab, Tampere Univ. of Technology, Finland.* We present a centimeter-scale array of gold nanocones realized by nanoimprint lithography and e-beam evaporation. Field concentration at the tip of the cones is shown to enhance second-harmonic generation from the array significantly.

QThA3 • 8:30 a.m.
Gap-Dependent Nonlinear Optical Activity in Chiral Gold Nanodimers, *Hannu Husu[1], Brian K. Canfield[1], Martti Kauranen[1], Janne Laukkanen[2], Benfeng Bai[2], Markku Kuittinen[2], Jari Turunen[2]; [1]Tampere Univ. of Technology, Finland, [2]Univ. of Joensuu, Finland.* T-shaped gold nanodimers with nanogaps are chiral when their horizontal and vertical bars have non-orthogonal orientations. The resulting optical activity in second-harmonic generation exhibits unexpected gap dependence, which is explained by local-field effects.

8:00 a.m.–9:45 a.m.
QThB • Electromagnetically Induced Transparency
Presider to Be Announced

QThB1 • 8:00 a.m.
Probing the Dynamic of a Zeeman Coherence Grating Stored in a Cold Atomic Ensemble, *D. Moretti[1], N. Gonzalez[2], D. Felinto[1], José W. R. Tabosa[1]; [1]Univ. Federal de Pernambuco, Brazil, [2]Inst. de Ciències Fotòniques, ICFO, Brazil.* We report on the observation of collapse and revival of a spatial light grating stored into the Zeeman coherences of cold cesium atoms. Bragg diffraction is employed to probe the dynamic of the stored grating.

QThB2 • 8:15 a.m.
Topological Stability of Stored Optical Vortices, *Rami Pugatch[1,2], Moshe Shuker[2], Ofer Firstenberg[2], Amiram Ron[2], Nir Davidson[1]; [1]Weizmann Inst. of Science, Israel, [2]Technion - Israel Inst. of Technology, Israel.* We report an experiment in which an optical vortex is stored in Rb vapor. Because of its 2π phase twist, this mode is topologically stable and cannot unwind even under conditions of strong diffusion.

QThB3 • 8:30 a.m.
Four Wave Mixing (FWM) and Electromagnetically Induced Transparency (EIT) Based Coherent Image Storage in Hot Atomic Vapors, *Praveen K. Vudyasetu, Ryan M. Camacho, John C. Howell; Univ. of Rochester, USA.* We demonstrate storage of images carried by optical pulses in hot vapors using a combination of FWM and EIT and show that the images retrieved are robust to diffusion.

CLEO

8:00 a.m.–9:45 a.m.
CThA • High-Intensity Applications
Craig Siders; Lawrence Livermore Natl. Lab, USA, Presider

CThA1 • 8:00 a.m.
Polarization State Dynamics in Femtosecond Filaments, *Alexandre Trisorio[1], Christoph P. Hauri[2]; [1]Lab d'Optique Appliquée, Ecole Natl. Supérieure de Techniques Avancées, Ecole Polytechnique, France, [2]Paul Scherrer Inst., Switzerland.* We study polarization state dynamics, white-light generation and self-compression in femtosecond filaments for linear, circular and elliptically polarized input light. For elliptically polarized input laser light strong nonlinear elliptic polarization rotation is observed during filamentation.

CThA2 • 8:15 a.m.
Novel Ultra-Fast Broadband Laser Source at 910nm for Vulcan 10 PW OPCPA Laser System, *Yunxin Tang, Ian N. Ross, Cristina Hernandez-Gomez, Ian Musgrave, Oleg Chekhlov, Pavel Matousek, John Collier; Central Laser Facility, Science and Technology Facilities Council, Rutherford Appleton Lab, UK.* We have reported a jitter-free ultra-fast broadband OPA amplification in the sub-ps time domain at 1 kHz. A novel broadband laser source of ~180nm (FWHM) at ~910nm was demonstrated for Vulcan 10PW OPCPA laser.

CThA3 • 8:30 a.m.
Generation of a 12-fs Ultraviolet Optical Pulse Using Two Types of Coherent Molecular Rotations, *Yuichiro Kida, Shin-ichi Zaitsu, Totaro Imasaka; Kyushu Univ., Japan.* A 100-fs ultraviolet pulse is compressed to 12 fs using two types of coherent molecular rotations. Precise control of the time delay between the pulse and the molecular rotations reduced sub-pulses in the temporal profile.

8:00 a.m.–9:45 a.m.
CThB • Ultrafast Fiber Amplifiers
Ingmar Hartl; IMRA America, Inc., USA, Presider

CThB1 • 8:00 a.m.
31µJ, 220fs, 1MHz Fiber Chirped Pulse Amplification System, *Johan Boullet[1], Yoann Zaouter[1], Eric Cormier[1], Jens Limpert[2]; [1]Ctr. des Lasers Intenses et Applications, Unite Mixte de Recherche, Univ. Bordeaux 1, France, [2]Friedrich Schiller Univ. Jena, Germany.* We report on a fiber CPA system producing 31µJ energy pulses at a repetition rate of 1MHz, with pulse duration of 220fs, leading to a peak power up to 120MW.

CThB2 • 8:15 a.m.
Millijoule Pulse Energy High Repetition Rate Femtosecond Fiber CPA System, *Fabian Röser, Jan Rothhardt, Tino Eidam, Oliver Schmidt, Damian N. Schimpf, Jens Limpert, Andreas Tünnermann; Inst. of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany.* We report on an ytterbium-doped fiber CPA system delivering millijoule level pulse energy at repetition rates above 100 kHz corresponding to an average power of more than 100 W. The compressed pulses are 800 fs.

CThB3 • 8:30 a.m.
32 W Femtosecond Yb-Fiber CPA System Based on Chirped-Volume-Bragg-Gratings, *Guoqing Chang[1], Matthew Rever[1], Vadim Smirnov[2], Leon Glebov[3], Almantas Galvanauskas[1]; [1]Univ. of Michigan, USA, [2]Optigrate, USA, [3]CREOL, College of Optics and Photonics, Univ. of Central Florida, USA.* Femtosecond (~670 fs) fiber-CPA at 1.063 µm is demonstrated using broadband chirped-volume-Bragg-gratings for pulse stretching and compression. 32 W recompressed pulses are achieved corresponding to a 75% compression efficiency.

Room C1 and C2

QELS

8:00 a.m.–9:45 a.m.
QThC • Ultrafast Dynamics of Strongly Correlated Materials
Rohit P. Prasankumar; Los Alamos Natl. Lab, USA, Presider

QThC1 • 8:00 a.m.
Modulating Linear and Nonlinear Plasmonic Effects Using the Metal-Insulator Transition in Vanadium Dioxide, *Davon W. Ferrara, Eugene U. Donev, Leonard C. Feldman, R. Lopez, Jae Y. Suh, Kevin A. Tetz, Richard F. Haglund; Vanderbilt Univ., USA.* Linear and nonlinear nanoplasmonic effects, such as resonant absorption, second-harmonic generation and extraordinary optical transmission, are modulated in metallic nanostructures when the local dielectric environment is altered by the ultrafast metal-insulator transition in vanadium dioxide.

QThC2 • 8:15 a.m.
Ultrafast Pump-Probe Reflectance Study of Multiferroic $Eu_{0.75}Y_{0.25}$ MnO_3, *Diyar Talbayev[1], Antoinette J. Taylor[1], Richard D. Averitt[2], Chenglin Zhang[3], Sang-Wook Cheong[3]; [1]Los Alamos Natl. Lab, USA, [2]Boston Univ., USA, [3]Rutgers Univ., USA.* We measured the pump-probe reflectance relaxation time in multiferroic $Eu_{0.75}Y_{0.25}MnO_3$. The relaxation time can be tuned by magnetic field and follows the temperature dependence of the low-energy spectral weight that includes phonons and electro-active magnons.

QThC3 • 8:30 a.m. Invited
Time Resolved Photoemission of $Bi_2Sr_2CaCu_2O_{8+\delta}$, *Luca Perfetti, P. A. Loukakos, M. Lisowski, U. Bovensiepen, M. Wolf; Freie Univ. Berlin, Germany.* Time resolved photoemission is employed to study $Bi_2Sr_2CaCu_2O_{8+\delta}$. Photoexicted electrons dissipate their energy on two distinct timescales (110 fs and 2 ps). This is attributed to the generation and subsequent decay of non-equilibrium phonons, respectively.

Room C3 and C4

CLEO

8:00 a.m.–9:45 a.m.
CThC • CLEO Symposium on Integrated Optical Isolators and Magneto-Optical Phenomena I
Paul W. Juodawlkis; MIT Lincoln Lab, USA, Presider

CThC1 • 8:00 a.m. Invited
Integrated Waveguide Optical Isolators: Principles and History, *Tetsuya Mizumoto, Yuya Shoji; Tokyo Inst. of Technology, Japan.* Several approaches to realize the isolator integratable with active devices are described. The surface activated direct bonding technique is addressed as a key technology for integrating a magneto-optic material in III-V semiconductor based photonic circuits.

CThC2 • 8:30 a.m.
Semiconductor Waveguide Optical Isolators Incorporating Ferromagnetic Epitaxial Mn*X* (*X*=As or Sb), *Tomohiro Amemiya[1], Yusuke Ogawa[2], Hiromasa Shimizu[3], Masaaki Tanaka[4], Hiro Munekata[2], Yoshiaki Nakano[1]; [1]Res. Ctr. for Advanced Science and Technology, Univ. of Tokyo, Japan, [2]Imaging Science and Engineering Lab, Tokyo Inst. of Technology, Japan, [3]Dept. of Electrical and Electronic Engineering, Tokyo Univ. of Agriculture and Technology, Japan, [4]Dept. of Electronic Engineering, Univ. of Tokyo, Japan.* TM-mode waveguide optical isolators consisting of semiconductor waveguides with ferromagnetic Mn*X* (*X*=As, Sb) layers were developed. The device with a MnSb layer had an isolation ratio of 12 dB/mm in the wavelength range 1530-1555 nm.

Room B1 and B2

8:00 a.m.–9:45 a.m.
CThD • THz Techniques
Yujie J. Ding; Lehigh Univ., USA, Presider

CThD1 • 8:00 a.m.
Terahertz Detection Using Optical Parametric Upconversion and Geiger Mode Avalanche Photodiodes, *Jerry C. Chen, Mohammad J. Khan, Sumanth Kaushik; MIT Lincoln Lab, USA.* Terahertz radiation is nonlinearly upconverted to telecommunication wavelength. The resulting idler is coupled into fiber and detected with a photon counting receiver. Detection with 4.5 $pW/Hz^{1/2}$ noise equivalent power and nanosecond temporal resolution is demonstrated.

CThD2 • 8:15 a.m.
Phase Detection of Pulsed Narrowband THz-Wave Radiation with High Sensitivity, *Ruixiang Guo[1], Seigo Ohno[1], Hiroaki Minamide[1], Hiromasa Ito[1,2]; [1]RIKEN Sendai, Japan, [2]Graduate School of Engineering, Tohoku Univ., Japan.* We demonstrate highly sensitive coherent detection of a monochromatic THz-wave pulse at room temperature using the frequency up-conversion in $MgO:LiNbO_3$ combined with balanced homodyne detection. Both the intensity and phase of THz radiation are measured.

CThD3 • 8:30 a.m.
New Detection Scheme for THz Radiation—Photon Momentum Detector, *Ulrike Willer[1,2], Andreas Pohlkoetter[1], Wolfgang Schade[1,2], Alessandro Tredicucci[3]; [1]Inst. für Physik und Physikalische Technologien, Technische Univ. Clausthal, Germany, [2]LaserAnwendungsCentrum, Germany, [3]NEST, Italy.* The radiation of a QCL (2.8 THz) is modulated and focused onto one prong of a quartz tuning fork giving rise to a driven oscillation which is measured using the generated piezo current.

Room J2

8:00 a.m.–9:45 a.m.
CThE • Raman and Stimulated Scattering
Narasimha S. Prasad; NASA Langley Res. Ctr., USA, Presider

CThE1 • 8:00 a.m.
Optimization of the Brillouin Spectrum for Fiber Based Slow Light Systems, *Ronny Henker[1], Andrzej Wiatrek[1], Kai-Uwe Lauterbach[1], Thomas Schneider[1], Max J. Ammann[2], Andreas T. Schwarzbacher[2]; [1]Hochschule für Telekommunikation Leipzig, Germany, [2]Dublin Inst. of Technology, Ireland.* This article shows simulation results and first practical investigations of the optimization of a Brillouin spectrum with the natural bandwidth superimposed with two losses for fiber based slow light systems.

CThE2 • 8:15 a.m.
High-Precision Characterization of Dynamic Acoustic Grating Induced by Stimulated Brillouin Scattering in a High-Birefringence Optical Fiber, *Weiwen Zou, Zuyuan He, Kazuo Hotate; Univ. of Tokyo, Japan.* A novel experimental method is demonstrated to precisely characterize optical-frequency deviation within 4 MHz between orthogonal axes in a high-birefringence fiber arising from the SBS-induced dynamic acoustic-grating. This precision means a birefringence accuracy of 3×10^{-8}.

CThE3 • 8:30 a.m.
High Efficiency CARS Conversion in Silicon, *Prakash V. Koonath, Daniel R. Solli, Bahram Jalali; Univ. of California at Los Angeles, USA.* We experimentally demonstrate unprecedented wavelength conversion efficiency of 58% from coherent anti-Stokes Raman scattering (CARS) in a silicon waveguide. CARS is modeled by incorporating Raman scattering and free carrier effects into the nonlinear Schrödinger equation.

CLEO

Room J3

8:00 a.m.–9:45 a.m.
CThF • Mode-Locked Semiconductor Lasers I
Charles N. Ironside; Essient Photonics, Ltd., UK, Presider

CThF1 • 8:00 a.m.
Dynamic Simulation of Mode-Locked Quantum-Dot Lasers, *Alastair R. Rae, Mark G. Thompson, Richard V. Penty, Ian H. White; Univ. of Cambridge, UK.* A dynamic model of passive mode-locking in quantum-dot laser diodes is presented. It is found that in contrast with quantum-well lasers, rapid gain recovery is key for mode-locking of quantum-dot lasers.

CThF2 • 8:15 a.m.
Modeling and Direct Electric-Field Measurements of Passively Mode-Locked Quantum-Dot Lasers, *Nicholas G. Usechak[1], Youngchun Xin[2], Luke F. Lester[2], Daniel J. Kane[3], Vassilios Kovanis[1]; [1]AFRL, USA, [2]Ctr. for High Technology Materials, Univ. of New Mexico, USA, [3]Southwest Sciences Inc., USA.* A delay-differential equation model of a passively mode-locked quantum-dot laser reveals pulse asymmetry that is experimentally confirmed through direct electric-field measurements. This finding implies conventional autocorrelators obscure the underlying pulse structure.

CThF3 • 8:30 a.m.
Numerical Model of the Optical Stark Effect as a Mode-Locking Mechanism for Femtosecond Vertical-External-Cavity Surface-Emitting Semiconductor Lasers, *Zakaria Mihoubi, Geoffrey F. Daniell, Keith G. Wilcox, Anne C. Tropper; Univ. of Southampton, UK.* A pulse is shortened by repeated transits of a quantum well absorber in which the band-edge is detuned to higher energy. The calculated effect is consistent with the experimentally observed formation of 448-fs transform-limited pulses.

Marriott San Jose Salon 1 and 2

8:00 a.m.–9:45 a.m.
CThG • Deep Tissue Imaging
James Tunnell; Univ. of Texas at Austin, USA, Presider

CThG1 • 8:00 a.m. Invited
Photoacoustic Tomography, *Lihong V. Wang; Washington Univ. at St. Louis, USA.* A pulsed laser produces a rapid small temperature rise in biological tissue, which leads to emission of ultrasonic waves due to thermoelastic expansion. The short-wavelength ultrasonic waves are then detected to form high-resolution tomographic images.

CThG2 • 8:30 a.m. Invited
Quantitative Blood Flow Measurements with Multi-Exposure Speckle Contrast Imaging, *Andrew K. Dunn, Ashwin B. Parthasarathy; Univ. of Texas at Austin, USA.* We present a new Multi-Exposure Speckle Imaging instrument and a new speckle model to predict correlation times of flow consistently (within 10% deviation) in the presence of static scatterers such as a thinned skull.

Marriott San Jose Salon 3

8:00 a.m.–9:45 a.m.
CThH • All-Optical Signal Processing
Scott A. Hamilton; MIT Lincoln Lab, USA, Presider

CThH1 • 8:00 a.m.
Novel Scheme for Code Preserving Regenerative NRZ-DPSK Wavelength and Format Conversion, *Marco Presi, Nicola Calabretta, Giampiero Contestabile, Ernesto Ciaramella; Scuola Superiore Sant'Anna, Italy.* We propose a novel code-preserving NRZ-DPSK wavelength and format converter. It is based on optical filtering and a bi-stable device. It can be applied both to continuos and packet/burst traffic. Regenerative capability is also demonstrated.

CThH2 • 8:15 a.m.
Nonlinear Recovery of Noise-Hidden Signals via Modulation Instability, *Dmitry V. Dylov, Jason W. Fleischer; Princeton Univ., USA.* We demonstrate a spatial, all-optical version of steganography in a nonlinear medium. After hiding a coherent image in spatially-incoherent noise, we recover the signal by seeding modulation instability in a self-focusing photorefractive crystal.

CThH3 • 8:30 a.m.
Characterization of Wavelength Conversion by Four Wave Mixing in Silicon Waveguides, *Walid Mathlouthi, Haisheng Rong, Mario Paniccia; Intel Corp., USA.* We characterize a silicon based wavelength converter using a commercial semiconductor amplifier based wavelength converter as a benchmark. Results show that silicon achieves -5.5dB efficiency, offers broader conversion bandwidth, higher OSNR and negligible channel crosstalk.

Marriott San Jose Salon 4

8:00 a.m.–9:45 a.m.
CThI • Characterization of New Nonlinear Optical Materials
Presider to Be Announced

CThI1 • 8:00 a.m.
Large Optical Nonlinearities of Conjugated Porphyrin Polymers in the Near Infrared, *Joel M. Hales[1], Matteo Cozzuol[1], Thomas E. O. Screen[2], Harry L. Anderson[2], Joseph W. Perry[1]; [1]Georgia Tech, USA, [2]Univ. of Oxford, UK.* The optical nonlinearities of porphyrin polymers were investigated in the telecommunications band: large values, slow kinetics in solutions revealed efficient optical limiting while large values, fast kinetics in films suggested ultrafast applications should be possible.

CThI2 • 8:15 a.m.
Nonlinear Optical Properties of Conjugated Polymer Charge Transfer Composites, *San-Hui Chi, Matteo Cozzuol, Joel M. Hales, Charles Ochoa, Madison Fitzpatrick, Xuan Zhang, Zesheng An, Seth R. Marder, Joseph W. Perry; Georgia Tech, USA.* Processing methods for optical-quality conjugate polymer charge-transfer composite films have been investigated. These materials exhibited strong energy-suppression characteristics in the near infrared regime for nanosecond pulses and show potential as efficient limiters for sensor protection.

CThI3 • 8:30 a.m.
Excited State Absorption Cross-Sections of an Asymmetric Pentaazadentate Porphyrin-Like Manganese (II) Complex, *Timothy M. Pritchett[1], Andrew G. Mott[1], David M. Mackie[1], Qun Zhao[2], Gary M. Gray[2]; [1]ARL, USA, [2]Univ. of Alabama at Birmingham, USA.* Absorption cross-sections of the first excited singlet and triplet states of an asymmetric pentaazadentate porphyrin-like manganese complex have been measured using Z-scans employing both 7.1-ns and 30-ps pulse widths, each at multiple pulse energies.

Marriott San Jose
Salon 5 and 6

CLEO

8:00 a.m.–9:45 a.m.
CThJ • Photonic Crystal Lasers and Functional Devices
Philippe Fauchet; Univ. of Rochester, USA, Presider

CThJ1 • 8:00 a.m.
GaN Defect Photonic Crystal Membrane Laser, *Cheng-Hung Lin, Kun-Ching Shen, Dong-Ming Yeh, Cheng-Yen Chen, Zen-Da Mu, Lung-Han Peng, C. C. Yang; Natl. Taiwan Univ., Taiwan.* We report the lasing behaviors of a GaN defect photonic crystal membrane structure. The high Q factor and low threshold condition show the effective photon confinement with the full photonic band gap structure.

CThJ2 • 8:15 a.m.
Photonic Crystal Heterostructure Cavity Lasers, *Antonios V. Giannopoulos, Christopher Long, Kent D. Choquette; Univ. of Illinois at Urbana-Champaign, USA.* We demonstrate the lasing characteristics of a photonic crystal heterostructure cavity. Feedback to slow Bloch modes using a heterostructure confinement design produces single mode lasing at 1551 nm.

CThJ3 • 8:30 a.m.
Anisotropy Light Extraction with High Polarization Ratio from Photonic Crystal Light-Emitting Diodes, *Chun-Feng Lai[1], Hao-Chung Kuo[1], Tien-Chang Lu[1], Shing-Chung Wang[1], Chia-Hsin Chao[2], H. T. Hsueh[2], J.-F. T. Wang[2], W. Y. Yeh[2], J. Y. Chi[2]; [1]Dept. of Photonics and Inst. of Electro-Optical Engineering, Natl. Chiao-Tung Univ., Taiwan, [2]Industrial Technology Res. Inst., Taiwan.* The azimuthal anisotropy of GaN photonic crystal light-emitting diode is investigated using an annular structure. The extracted light distribution has P/S ratio of 5.5 for light propagating in ΓX direction and 2.1 for ΓM direction.

NOTES

Ballroom A1 and A8 | **Ballroom A2 and A7** | **Ballroom A3 and A6** | **Ballroom A4 and A5**

QELS

CLEO

QThA • Nonlinear Plasmonics—Continued

QThA4 • 8:45 a.m.
Nonlinear Optical Response of Metal Nanoantennas, *Barbara Wild, Jörg Merlein, Tobias Hanke, Alfred Leitenstorfer, Rudolf Bratschitsch; Univ. Konstanz, Germany.* We have excited bowtie-shaped metal nanoantennas fabricated with colloidal lithography by picosecond light pulses. The spectrum emitted by the nanoantennas consists of a broadband continuum overlapped with a narrowband second harmonic signal.

QThA5 • 9:00 a.m.
Tensorial Inhomogeneities in the Nonlinear Responses of an Array of Gold Nanoparticles, *Martti Kauranen[1], Hannu Husu[1], Brian K. Canfield[1], Juha Kontio[1], Jukka Viheriälä[1], Tuomo Rytkönen[1], Tapio Niemi[1], Eric Chandler[2], Alex Hrin[2], Jeff A. Squier[2]; [1]Tampere Univ. of Technology, Finland, [2]Colorado School of Mines, USA.* We use nonlinear microscopy to measure second- and third-harmonic generation from gold nanodots in an array. The polarization-dependent responses exhibit strong variations between individual dots, providing evidence of tensorial inhomogeneities in the nonlinearity.

QThA6 • 9:15 a.m.
Observation of Plasmonic Field-Enhancement of the Nonlinear Response of Gold Thin Films, *Alessandro Salandrino[1], Lazaro A. Padilha[1], Scott Webster[1], Canek Fuentes-Hernandez[2], Bernard Kippelen[2], David J. Hagan[1,3], Eric W. Van Stryland[1,3]; [1]CREOL, College of Optics and Photonics, Univ. of Central Florida, USA, [2]Ctr. for Organic Photonics and Electronics, School of Electrical and Computer Engineering, Georgia Tech, USA, [3]Dept. of Physics, Univ. of Central Florida, USA.* We investigate the nonlinear optical response of gold thin films of different thicknesses. Field enhancement effects lead to counterintuitive results which we interpret in terms of the excitation of plasmonic resonances at the metal-dielectric interfaces.

QThA7 • 9:30 a.m.
Wave Propagation in a Sub-Wavelength Waveguide Array: Superluminal Lattice Solitons and Bands' Cutoff, *Or Peleg[1], Mordechai Segev[1], Guy Bartal[2], Demetri Christodoulides[3], Nimrod Moiseyev[1]; [1]Technion, Israel, [2]Univ. of California at Berkeley, USA, [3]Univ. of Central Florida, USA.* We present the formulation of wave propagation in arrays of subwavelength waveguides with sharp index contrasts. We demonstrate the collapse of the bands into evanescent modes, and propagation of lattice solitons with superluminal phase velocity.

QThB • Electromagnetically Induced Transparency—Continued

QThB4 • 8:45 a.m.
Squeezing and Entanglement of Optical Fields Transmitted through a Thick Atomic Medium, *Arturo Lezama[1], Paulo Valente[2], Horacio Failache[1], Marcelo Martinelli[2], Paulo Nussenzveig[2]; [1]Inst. de Física, Facultad de Ingeniería, Univ. de la República, Uruguay, [2]Inst. de Física, Univ. de Sao Paulo, Brazil.* Propagation of a quantized optical field through a thick sample of two-level atoms, considering the complete Zeeman sublevel structure, is theoretically investigated. Squeezing and entanglement between orthogonal polarization components is predicted for the transmitted field.

QThB5 • 9:00 a.m.
Generation of Biphotons with Controllable Temporal Length, *Chinmay Belthangady, Shengwang Du, Pavel Kolchin, Guang-Yu Yin, Stephen E. Harris; Stanford Univ., USA.* We report the generation of time-energy entangled paired photons with subnatural linewidths and controllable temporal lengths. The photons are generated using EIT and slow light in a high optical depth two-dimensional MOT.

QThB6 • 9:15 a.m.
Observation of Double-EIT in a Four-Level Tripod Atomic System, *Hai Wang, Shujing Li, Xudong Yang, Xuemin Cao, Changde Xie; State Key Lab of Quantum Optics and Quantum Optics Devices, Inst. of Opto-Electronics, Shanxi Univ., China.* We present an experimental observation of simultaneous EIT for probe and trigger fields (double EIT) in a four-level tripod EIT system in ^{87}Rb atoms D1 line.

QThB7 • 9:30 a.m.
Electromagnetically Induced Transparency in Rubidium-Filled Kagome HC-PCF, *Philip S. Light[1,2], F. Benabid[1,2], Milan Maric[2], Andre Luiten[2], Francois Couny[1]; [1]Univ. of Bath, UK, [2]Univ. of Western Australia, Australia.* Electromagnetically induced transparency is observed in rubidium-filled kagomé structure hollow-core PCF with polymer-coated core. We show that the 6 MHz transparency linewidth is below that expected from a bare fiber.

CThA • High-Intensity Applications—Continued

CThA4 • 8:45 a.m. Tutorial
History of High-Intensity Interactions: Physics of the Power Scaling of the 2.9 Angstrom Xe(L) X-Ray Amplifier to the Multi-Petawatt Level, *A. B. Borisov[1], P. Zhang[1], E. Racz[1,2], J. C. McCorkindale[1], S. F. Khan[1], S. Poopalasingam[1], J. Zhao[1], Charles K. Rhodes[1]; [1]Univ. of Illinois at Chicago, USA, [2]KFKI Res. Inst. for Particle and Nuclear Physics, EURATOM Association, Hungary.* The 2.9 Angstrom Xe(L) X-ray amplifier characteristics determine an optimal scaling of the peak power. Experimental findings demonstrate that powers greater than 1 PW are clearly within the scaling limits of the Xe(L) system.

Charles Kirkham Rhodes is the Albert A. Michelson Professor of Physics and Director of the Laboratory for X-Ray Microimaging and Bioinformatics in the Department of Physics at the University of Illinois at Chicago. He is also a Foreign Member of the Russian Academy of Engineering, and a recipient of the Inventor of the Year Award (2000) at the University of Illinois at Chicago for the development of a patented concept for multikilovolt X-ray amplification.

CThB • Ultrafast Fiber Amplifiers—Continued

CThB4 • 8:45 a.m.
High-Energy Direct Amplification of Femtosecond Pulses in the Nonlinear Regime, *Dimitrios N. Papadopoulos[1], Marc Hanna[1], Frederic Druon[1], Patrick Georges[1], Yoann Zaouter[2], Eric Cormier[2], Eric Mottay[3]; [1]Lab Charles Fabry de l'Inst. d'Optique, Ctr. Natl. de la Recherche Scientifique, Univ. Paris-Sud, France, [2]Ctr. Lasers Intenses et Applications, Univ. de Bordeaux 1, France, [3]Amplitude Systèmes, France.* We report on direct amplification of femtosecond pulses in large-mode area fibers, where nonlinear effects dominate over dispersion. Careful compression allows the generation of μJ sub-80 fs pulses with good temporal pulse quality.

CThB5 • 9:00 a.m.
High Energy Femtosecond Fiber Chirped Pulse Amplification System with Adaptive Phase Control, *Fei He[1], Hazel S. S. Hung[1], Nikita K. Daga[1], Naveed Naz[1], Jerry Prawiharjo[1], Jonathan H. V. Price[1], David C. Hanna[1], David P. Shepherd[1], David J. Richardson[1], Jay W. Dawson[2], Craig W. Siders[2], Christopher P. J. Barty[2]; [1]Optoelectronics Res. Ctr., Univ. of Southampton, UK, [2]Lawrence Livermore Natl. Lab, USA.* We demonstrate threefold increased autocorrelation peak from Yb-fiber CPA system operating with strong self-phase modulation by pre-shaping the pulse spectral-phase. The adaptive control-loop used feedback from the output autocorrelation. High-quality 800fs, 65μJ pulses were produced.

CThB6 • 9:15 a.m.
Seed Pulse Optimization for Saturated Fiber-Amplifiers, *Damian N. Schimpf[1], Jens Limpert[1], Andreas Tünnermann[1], Francois Salin[2]; [1]Inst. of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany, [2]EOLITE, France.* The optimum seed pulse-profile for a desired output pulse-profile in saturated ns-pulsed fiber-amplifiers is determined with an analytical solution for the amplification process. It can be regarded as an inverse Frantz-Nodvik-equation for the seed photon-density.

CThB7 • 9:30 a.m.
Picosecond Pulse Amplification in Semiconductor Optical Amplifiers: A Multiple-Scale Analysis, *Malin Premaratne[1], Govind P. Agrawal[2]; [1]Advanced Computing and Simulation Lab (AXL), Monash Univ., Australia, [2]Inst. of Optics, Univ. of Rochester, USA.* We propose a systematic way for analyzing gain-recovery dynamics in semiconductor optical amplifiers using a multiple-scale analysis and show that the resulting analytical solution for the amplified pulse agrees well with numerical solutions.

10:00 a.m.–10:30 a.m., Coffee Break, *Exhibit Hall*

10:00 a.m.–4:00 p.m., Exhibit Hall Open

Room C1 and C2

QELS

QThC • Ultrafast Dynamics of Strongly Correlated Materials—Continued

QThC4 • 9:00 a.m.
Time-Resolved Spectroscopy of the Charge-Transfer Gap in $Sr_2CuO_2Cl_2$, *J. Steven Dodge[1], Andreas B. Schumacher[2], Lance L. Miller[3], Daniel S. Chemla[2,4]; [1]Simon Fraser Univ., Canada, [2]E. O. Lawrence Berkeley Natl. Lab, USA, [3]Ames Lab and Dept. of Physics, Iowa State Univ., USA, [4]Univ. of California at Berkeley, USA.* We present energy- and time-resolved pump-probe spectroscopy near the charge-transfer gap in the undoped copper oxide $Sr_2CuO_2Cl_2$. The photoinduced response relates simply to the thermal response, indicating a common boson-mediated origin.

QThC5 • 9:15 a.m.
Ultrafast Magnetostriction in the Itinerant Ferromagnet $SrRuO_3$ Studied by Femtosecond X-Ray Diffraction, *Clemens von Korff Schmising[1], Matias Bargheer[1], Anders Harpoeth[1], Nikolai Zhavoronkov[1], Zunaira Ansari[1], Michael Woerner[1], Thomas Elsaesser[1,2], Ionela Vrejoiu[2], Dietrich Hesse[2], Marin Alexe[2]; [1]Max-Born-Inst., Germany, [2]Max-Planck-Inst. für Mikrostrukturphysik, Germany.* The ultrafast buildup of optically induced stress in ferromagnetic nanolayers of a $SrRuO_3$/$SrTiO_3$ superlattice is analyzed by femtosecond X-ray diffraction. Below the Curie temperature, magnetoelastic contractive stress reduces the expansive anharmonic phonon stress.

QThC6 • 9:30 a.m.
Ultrafast Gigantic Photo-Response in Charge-Ordered Organic Salt $(EDO\text{-}TTF)_2PF_6$ on 10-fs Time Scales, *Jiro Itatani[1,2], Matteo Rini[1], Andrea Cavalleri[3], Ken Onda[2,4], Tadahiko Ishikawa[4], Sho Ogihara[4], Shin-ya Koshihara[2,4], XiangFeng Shao[2,5], Hideki Yamochi[2,5], Gunzi Saito[5], Robert W. Schoenlein[1]; [1]Lawrence Berkeley Natl. Lab, USA, [2]Japan Science and Technology Agency, Japan, [3]Univ. of Oxford, UK, [4]Tokyo Inst. of Technology, Japan, [5]Kyoto Univ., Japan.* The initial dynamics of photo-induced phase transition in $(EDO\text{-}TTF)_2PF_6$ was investigated using 10-fs laser pulses. We observed sub-20-fs gigantic photo-responses (DR/R>100%) and a clear signature of a structural bottleneck (~60 fs) for the first time.

Room C3 and C4

CLEO

CThC • CLEO Symposium on Integrated Optical Isolators and Magneto-Optical Phenomena I—Continued

CThC3 • 8:45 a.m.
Integrable Semiconductor Optical Isolators toward Larger Optical Isolation Utilizing Nonreciprocal Phase Shift, *Hiromasa Shimizu, Shunta Yoshida; Tokyo Univ. of Agriculture and Technology, Japan.* We have theoretically estimated optical isolation of larger than 30dB in Co-InGaAsP semiconductor active optical isolators based on nonreciprocal phase shift. The length of the nonreciprocal phase shifting region is as short as 1.3mm.

CThC4 • 9:00 a.m. Invited
Low-Loss, InP-Based Integrated Optical Isolators, *Wouter Van Parys[1], D. Van Thourhout[1], R. Baets[1], B. Dagens[2], J. Decobert[2], O. Le Gouezigou[2], D. Make[2], R. Vanheertum[3], L. Lagae[3]; [1]Dept. of Information Technology (INTEC), Ghent Univ.-Interuniversitair Micro Electronica Centrum (IMEC), Belgium, [2]Alcatel Thales III-V Lab, France, [3]Interuniversitair Micro Electronica Centrum (IMEC), Belgium.* We discuss the development of a monolithically integratable optical isolator. The device is a semiconductor optical amplifier with a magnetized ferromagnetic metal contact. 12.7dB of isolation combined with optical transparency has been demonstrated.

CThC5 • 9:30 a.m.
Study of Magneto-Optical Effect in (Al,Ga)As Optical Waveguide with Embedded Micro-Sized Fe Pillar for Non-Volatile Optical Memory Applications, *Vadym Zayets, Koji Ando; Natl. Inst. of Advanced Industrial Science and Technology, Japan.* Dependence of waveguiding loss on magnetization of Fe pillar embedded into AlGaAs optical waveguide was studied. For reading of magnetization direction, the signal-to-noise ratio of 4.8 dB was demonstrated for pillar area of 12 µm².

Room B1 and B2

CThD • THz Techniques—Continued

CThD4 • 8:45 a.m.
Concealed Object Detection by Sensing the Objects' Acoustic Phase with Terahertz Radiation, *Federico F. Buersgens, Guillermo P. Acuna, Roland Kersting; LMU Univ. Munich, Germany.* We present a novel terahertz technique for detecting concealed objects by sensing their individual acoustic phase lags when they perform a minute oscillation. The technique is sensitive to virtually all materials.

CThD5 • 9:00 a.m.
Sub-THz Photonic-Transmitters Based on GaAs/AlGaAs Uni-Traveling Carrier Photodiode and Micromachined Circular Disk Monopole Antenna for Ultra-Wideband Communication, *Yu-Tai Li[1], Ci-Ling Pan[1], J.-W. Shi[2], Cheng-Yu Huang[2], Nan-Wei Chen[2], Shu-Han Chen[2], J.-I. Chyi[2]; [1]Dept. of Photonics, Natl. Chaio Tung Univ., Taiwan, [2]Dept. of Electrical Engineering, Natl. Central Univ., Taiwan.* By incorporating GaAs/AlGaAs based uni-traveling-carrier photodiodes with broadband micromachined monopole antennas, the demonstrated photonic-transmitter can radiate strong sub-THz pulses (20mW peak-power) with a wide bandwidth (100~250GHz), which was measured by another photonic-receiver for ultra-wideband communication.

CThD6 • 9:15 a.m.
Aspheric Lenses for Terahertz Imaging, *Yat Hei Lo, Rainer Leonhardt; Physics Dept., Univ. of Auckland, New Zealand.* We present novel lens designs for Terahertz imaging. Kirchhoff's diffraction theory and experimental results show that the achievable resolution depends critically on the lens shape, and a resolution of close to $\lambda/2$ can be achieved.

CThD7 • 9:30 a.m.
Triangular Surface-Relief Grating for Reduction of Reflection from Silicon Surface in the 0.1-3 Terahertz Region, *Shin-ichi Kuroo[1,2], Kazuo Shiraishi[1], Hiroyuki Sasho[1], Hidehiko Yoda[1], Koichi Muro[1]; [1]Utsunomiya Univ., Japan, [2]Tochigi Nikon Co., Japan.* A triangular surface-relief grating is proposed to reduce reflection from a silicon surface for the light in the terahertz frequency region. Optimum structural parameters of the grating have been numerically determined and confirmed experimentally.

Room J2

CThE • Raman and Stimulated Scattering—Continued

CThE4 • 8:45 a.m.
Raman Amplification of Low Divergent Radiation in Barium Nitrate, *Victor A. Lisinetskii[1], Valentin A. Orlovich[1], Hanjo Rhee[2], Xin Wang[2], Hans J. Eichler[2]; [1]B. I. Stepanov Inst. of Physics, NAS of Belarus, Belarus, [2]Inst. für Optik und Atomare Physik, TU Berlin, Germany.* The efficient Raman amplification (amplification was up to 1600) of low divergent first Stokes radiation was demonstrated. The amplified pulse energy was up to 63 mJ at pump energy of 208 mJ.

CThE5 • 9:00 a.m.
Continuous-Wave Phase-Matched Generation of Raman Sidebands in a Dispersion-Managed Optical Cavity, *Shin-ichi Zaitsu[1], Hirotomo Izaki[1], Totaro Imasaka[1,2]; [1]Dept. of Applied Chemistry, Graduate School of Engineering, Kyushu Univ., Japan, [2]Ctr. for Future Chemistry, Kyushu Univ., Japan.* We demonstrate highly efficient continuous-wave-based four-wave mixing beyond a small signal approximation. This is achieved in a high-finesse cavity with controlled dispersion for phase-matched interaction.

CThE6 • 9:15 a.m.
Coherent Raman Micro-Spectroscopy with a Mode-Locked Ti:Sapphire Oscillator, *Jiahui Peng, Dmitry Pestov, Marlan O. Scully, Alexei V. Sokolov; Inst. for Quantum Studies and Depts. of Physics and Chemical Engineering, Texas A&M Univ., USA.* We demonstrate a simple, femtosecond-oscillator-based system for CARS microscopy, wherein impulsive Raman excitation is combined with narrow-band time-delayed, and therefore, background-free probing.

CThE7 • 9:30 a.m.
Generation of Ultrashort Optical Pulses Using Multiple Coherent Anti-Stokes Raman Scattering in $LiNbO_3$, *Eiichi Matsubara[1,2], Taro Sekikawa[1,2], Mikio Yamashita[1,2]; [1]Dept. of Applied Physics, Hokkaido Univ., Japan, [2]Core Res. for Evolutional Science and Technology, Japan Science and Technology Agency, Japan.* We demonstrate Fourier synthesis of multiple coherent anti-Stokes Raman-scattering signals in a single crystal of $LiNbO_3$ at room temperature. Isolated pulses with 25-fs duration and 640-780-nm wavelength range are generated without any active chirp compensator.

10:00 a.m.–10:30 a.m., Coffee Break, *Exhibit Hall*

10:00 a.m.–4:00 p.m., Exhibit Hall Open

Room J3	Marriott San Jose Salon 1 and 2	Marriott San Jose Salon 3	Marriott San Jose Salon 4

CLEO

CThF • Mode-Locked Semiconductor Lasers I—Continued

CThF4 • 8:45 a.m.
Hybrid Modelocking in High Power (220 mW) Electrically Pumped Semiconductor Lasers, *Faisal R. Ahmad, Farhan Rana; Cornell Univ., USA.* We have obtained optical pulses via hybrid modelocking in monolithic slab coupled optical waveguide lasers with average powers exceeding 220 mW at a wavelength of 1550 nm.

CThF5 • 9:00 a.m.
Mode Locked 1550 nm VECSEL Using a Two Quantum Wells GaInNAs Saturable Absorber, *Aghiad Khadour[1], S. Bouchoule[1], G. Aubin[1], J. P. Tourrenc[1], A. Miard[1], J. C. Harmand[1], J. Decobert[2], J. L. Oudar[1]; [1]Lab de Photonique et de Nanostructures, France, [2]Alcatel III-V Lab, France.* We report a 2GHz mode locked vertical external cavity surface emitting laser using a hybrid metal-metamorphic Bragg mirror on the gain structure with a resonant two quantum wells GaInNAs SEmiconductor Saturable Absorber Mirror (SESAM).

CThF6 • 9:15 a.m.
Passively Mode-Locked Semiconductor Disk Laser Generating Sub-300-fs Pulses, *Peter Klopp[1], Florian Saas[1], Uwe Griebner[1], Martin Zorn[2], Markus Weyers[2]; [1]Max-Born-Inst., Germany, [2]Ferdinand-Braun-Inst., Germany.* We report the shortest pulses (290 fs) obtained directly from semiconductor lasers. These were achieved using a passively mode-locked semiconductor disk laser with a graded-gap barrier design in the gain section operating near 1036 nm.

CThF7 • 9:30 a.m.
Interband Optical Pulse Injection Locking of a Quantum Dot Mode-Locked Semiconductor Laser, *Jimyung Kim, Peter J. Delfyett; CREOL, Univ. of Central Florida, USA.* We demonstrate that the slave laser oscillating on the ground state (GS) or excited state (ES) transitions can be locked through the injection of optical pulses generated via the opposite transition bands (ES or GS).

CThG • Deep Tissue Imaging—Continued

CThG3 • 9:00 a.m.
A Self-Calibrating Fiber-Optic Probe for Tissue Optical Spectroscopy, *Bing Yu, Henry Fu, Torre Bydlon, Janelle Bender, Nimmi Ramanujam; Duke Univ., USA.* Calibration of diffuse reflectance spectrum for instrument response and time-dependent fluctuation is complicated, time-consuming and potentially inaccurate. We demonstrate a novel fiber optic probe with real-time, self-calibration capability that can be used for tissue spectroscopy.

CThG4 • 9:15 a.m.
A Neural Interface Microsystem with All Optical Telemetry for Brain Implantable Neuroengineering Application, *Yoon-Kyu Song[1], William R. Patterson[1], Christopher W. Bull[1], David A. Borton[1], Arto V. Nurmikko[1,2], John D. Simeral[3,4], John P. Donoghue[3]; [1]Div. of Engineering, Brown Univ., USA, [2]Dept. of Physics, Brown Univ., USA, [3]Dept. of Neuroscience, Brown Univ., USA, [4]Dept. of Veterans Affairs Medical Ctr., USA.* We have developed a prototype cortical neural interface device for brain implantable neuroengineering application, featuring fiber optic guided all optical telemetry for neural data transmission as well as power/clock delivery to the implantable unit.

CThG5 • 9:30 a.m.
Two-Photon Luminescence Imaging Using a MEMS-Based Miniaturized Probe, *Christopher L. Hoy[1], Nicholas Durr[1], Pengyuan Chen[1], Danielle K. Smith[1], Timothy Larson[1], Wibool Piyawattanametha[2], Hyejun Ra[2], Brian Korgel[1], Konstantin Sokolov[1], Olav Solgaard[2], Adela Ben-Yakar[1]; [1]Univ. of Texas at Austin, USA, [2]Stanford Univ., USA.* We present two-photon luminescence (TPL) imaging of cancer cells through a 10 × 15 × 40 mm^3 miniaturized probe employing a two-axis MEMS scanning mirror and an air-core photonic crystal fiber.

CThH • All-Optical Signal Processing—Continued

CThH4 • 8:45 a.m.
Tunable Optical Delay with Signal Regeneration Using Cross-Absorption Modulation Wavelength Conversion and Chromatic Dispersion, *Mable P. Fok, Chester Shu; Chinese Univ. of Hong Kong, Hong Kong.* We demonstrate a compact tunable delay scheme with simultaneous signal regeneration using an electro-absorption modulator and a chirped fiber Bragg grating. Over 580-ps delay range is obtained with 2-dB improvement in the receiver sensitivity.

CThH5 • 9:00 a.m.
Simultaneous Optical Delay and NRZ-RZ Format Conversion via Cross-Polarization Modulation and Pulse Pre-Chirping, *Bill Ping Piu Kuo, P. C. Chui, Kenneth Kin Yip Wong; Univ. of Hong Kong, Hong Kong.* We demonstrate a tunable optical delay with NRZ-RZ format conversion capability by using cross polarization modulation and pulse pre-chirping. Continuous delay up to 8.6 ns with -1 dB power penalty was achieved using this scheme.

CThH6 • 9:15 a.m.
40 Gb/s Packet Reshaping with No Wavelength Shift Using SOA Cross Gain Compression, *Giampiero Contestabile, Roberto Proietti, Sumanta Gupta, Marco Presi, Ernesto Ciaramella; Scuola Superiore Sant'Anna, Italy.* We experimentally demonstrate a scheme for reshaping 40 Gb/s packets that is wavelength-preserving. The scheme, based on cross-gain-compression in an SOA, is polarization-independent and does not suffer from any transient effect at packet edges.

CThH7 • 9:30 a.m.
All-Optical Label Swapping Using Bistable Semiconductor Ring Laser, *Kornkamol Thakulsukanant[1], Bei Li[1], Siyuan Yu[1], Sandor Furst[2], Marc Sorel[2]; [1]Univ. of Bristol, UK, [2]Univ. of Glasgow, UK.* A semiconductor ring laser all-optical flip-flop is used to realize all-optical label swapping. Old address is erased by blocking the switching optically and new address is inserted by modulating the output from SRL.

CThI • Characterization of New Nonlinear Optical Materials—Continued

CThI4 • 8:45 a.m.
Quasi-Phase-Matched Wavelength Converter with Adhered Ridge Waveguide for Hybrid Silicon Photonics, *Rai Kou[1,2], Toru Okubo[1,2], Sunao Kurimura[1,2], Hirochika Nakajima[2], Junichiro Ichikawa[3], Katsutoshi Kondou[3]; [1]Natl. Inst. for Materials Science, Japan, [2]Waseda Univ., Japan, [3]Sumitomo Osaka Cement Co. Ltd., Japan.* A Mg:$LiNbO_3$-based adhered ridge waveguide was fabricated by dry etching on a silicon platform. Efficient QPM-SHG (normalized efficiency: 450%/W) and -DFG (efficiency: -9.8 dB for pump power 38 mW) were achieved in the telecommunication band.

CThI5 • 9:00 a.m.
Improved Degenerate Four Wave Mixing for Measuring Complex $\chi^{(3)}$, *Weilou Cao, Yi-Hsing Peng, Chi H. Lee, Warren N. Herman, Julius Goldhar; Lab for Physical Sciences, Univ. of Maryland at College Park, USA.* We report improvements on a technique for measuring the complex $\chi^{(3)}$ of nonlinear polymers using a 2-D phase grating and degenerate four wave mixing. These improvements produce a factor of 100 increase in the S/N.

CThI6 • 9:15 a.m.
Nonlinear Refraction and Absorption in Highly Transmissive One-Dimensional Metal-Organic Photonic Bandgap Structures, *Canek Fuentes-Hernandez[1], Lazaro A. Padilha[2], Daniel Owens[1], Shuo-Yen Tseng[1], Scott Webster[2], Jian-Yang Cho[1], David J. Hagan[2], Eric W. VanStryland[2], Seth R. Marder[1], Bernard Kippelen[1]; [1]Georgia Tech, USA, [2]Univ. of Central Florida, USA.* We report on the optical properties of a metal-organic photonic bandgap structure showing a peak transmission ~44 % and that enhances the nonlinear optical properties of bulk Copper by up to an order of magnitude.

CThI7 • 9:30 a.m.
Nonlinear Refractive Index of BiB_3O_6, *Sabine Miller[1], Frank Noack[1], Vladimir Panyutin[1], Valentin Petrov[1], Fabian Rotermund[2], Guibao Xu[3]; [1]Max-Born-Inst., Germany, [2]Ajou Univ., Republic of Korea, [3]Lehigh Univ., USA.* The nonlinear refractive index of the monoclinic biaxial nonlinear crystal BiB_3O_6 was measured at 1064 nm and strong anisotropy was observed with about two times larger value for *E*//*Z*-axis in comparison to *E*//*X*-axis.

10:00 a.m.–10:30 a.m., Coffee Break, *Exhibit Hall*

10:00 a.m.–4:00 p.m., Exhibit Hall Open

Marriott San Jose
Salon 5 and 6

CLEO

CThJ • Photonic Crystal Lasers and Functional Devices—Continued

CThJ4 • 8:45 a.m.
All-Optical On-Chip Memory Based on Ultra High Q InGaAsP Photonic Crystal Nanocavity, *Akihiko Shinya[1], Shinji Matsuo[2], Yosia Yosia[1,3], Takasumi Tanabe[1], Eiichi Kuramochi[1], Tomonari Sato[2], Takaaki Kakitsuka[2], Masaya Notomi[1]; [1]NTT Basic Res. Labs, Japan, [2]NTT Photonics Labs, Japan, [3]Nanyang Technological Univ., Singapore.* We demonstrate all-optical memory with 1.3Q-InGaAsP photonic crystal nanocavities based on carrier-induced nonlinearity. The minimum bias power for bistability is a few tens of µW and the switching energy is only 30 fJ.

CThJ5 • 9:00 a.m.
Demonstration of a Photonic Crystal Directional Coupler Switch with Ultra Short Switching Length, *Jun-ichiro Sugisaka[1,2], Noritsugu Yamamoto[2], Makoto Okano[2], Kazuhiro Komori[2], Masahide Itoh[1]; [1]Inst. of Applied Physics, Univ. of Tsukuba, Japan, [2]AIST, Photonics Res. Inst., Japan.* We evaluated the effect of a flat band in photonic crystal directional coupler optical switch for shortening the switching length. And we experimentally demonstrated that the flat band shortened the switching length by 29 times.

CThJ6 • 9:15 a.m.
Two-Dimensional Photonic Crystal Microcavity Sensor for Single Particle Detection, *Mindy R. Lee[1], Benjamin L. Miller[2], Philippe M. Fauchet[3]; [1]Inst. of Optics, Univ. of Rochester, USA, [2]Dept. of Dermatology, Univ. of Rochester, USA, [3]Dept. of Electrical and Computer Engineering, Univ. of Rochester, USA.* We theoretically and experimentally demonstrate a compact silicon photonic crystal microcavity sensor capable of detecting *in vivo* a single particle of size comparable to a virus.

CThJ7 • 9:30 a.m.
Reconfigurable Microfluidic Photonic Crystal Cavities, *Christian Karnutsch[1], Cameron L. C. Smith[1], Darran K. C. Wu[1], Snjezana Tomljenovic-Hanic[1], Michael W. Lee[1], Christelle Monat[1], Christian Grillet[1], Ross McPhedran[1], Benjamin J. Eggleton[1], Darren Freeman[2], Steve Madden[2], Barry Luther-Davies[2]; [1]Univ. of Sydney, Australia, [2]Australian Natl. Univ., Australia.* We demonstrate reconfigurable microfluidic photonic crystal double-heterostructure cavities by local fluid infiltration of select air holes. Properties of the microfluidic cavities are experimentally studied by evanescent coupling and analyzed by numerical simulations.

10:00 a.m.–10:30 a.m.
Coffee Break, *Exhibit Hall*

10:00 a.m.–4:00 p.m.
Exhibit Hall Open

NOTES

Ballroom A1 and A8 | Ballroom A2 and A7 | Ballroom A3 and A6 | Ballroom A4 and A5

QELS

10:30 a.m.–12:15 p.m.
QThD • Nano-Optics
Victor I. Klimov; Los Alamos Natl. Lab, USA, Presider

QThD1 • 10:30 a.m.
Cathodoluminescence Readout of High-Density Nanoparticle Phase Change Memory, *Andrey I. Denisyuk, Kevin F. MacDonald, Nikolay I. Zheludev; Univ. of Southampton, UK.* For the first time we demonstrate that information can be written in the structural phase of gallium nanoparticles within an array by a focused electron beam and read-out via measurements of cathodoluminescent emission.

QThD2 • 10:45 a.m.
A Molecular Spectroscopic View of Surface Plasmon Enhanced Resonance Raman Scattering (SERRS), *Anne M. Kelley; Univ. of California at Merced, USA.* Surface plasmon enhancement of molecular resonance Raman scattering is developed by treating the molecule-metal interaction as transition dipole coupling between the electronic transitions of the molecule and the metal nanoparticle via a density matrix treatment.

QThD3 • 11:00 a.m.
Nanoscale Optical Microscopy in the Vectorial Focusing Regime, *Keith A. Serrels, Euan Ramsay, Richard J. Warburton, Derryck T. Reid; Heriot Watt Univ., UK.* By using extreme numerical-aperture solid-immersion microscopy at 1553nm we demonstrate, under certain circumstances, polarization-sensitive imaging with resolution values approaching 100nm which substantially surpass the classical scalar diffraction-limit embodied by Sparrow's resolution criterion.

QThD4 • 11:15 a.m.
Breakdown of the Dipole Approximation for Large Quantum Dot Emitters Coupled to an Interface, *Søren Stobbe[1], Jeppe Johansen[1], Andreas Löffler[2], Sven Höfling[2], Alfred Forchel[2], Jørn Märcher Hvam[1], Peter Lodahl[1]; [1]COM•DTU, Technical Univ. of Denmark, Denmark, [2]Technische Physik, Univ. Würzburg, Germany.* We measured time-resolved photoluminescence from large quantum dots near a semiconductor-air interface. Far from the interface our data are consistent with dipole theory, but near the interface they question the validity of the dipole approximation.

10:30 a.m.–12:15 p.m.
QThE • Quantum Degenerate Gases
Michael Chapman; Georgia Tech, USA, Presider

QThE1 • 10:30 a.m.
Long Phase Coherence Times in the Microcavity Polariton Condensate, *A. P. D. Love[1], D. N. Krizhanovskii[1], D. M. Whittaker[1], R. Bouchekioua[1], D. Sanvitto[2], S. Al Rizeiqi[1], M. S. Skolnick[1], P. R. Eastham[3], R. André[4], Le Si Dang[4]; [1]Sheffield Univ., UK, [2]Dept. Fisica de Materiales, Univ. Autonoma de Madrid, Spain, [3]Condensed Matter Theory Group, Imperial College, UK, [4]Inst. Neel, CNRS and Univ. J. Fourier, France.* We observe high coherence times of polariton condensates up to 200 ps and build up of second order coherence. Interactions between the condensate and the thermal reservoir of polaritons determine the coherence properties.

QThE2 • 10:45 a.m.
Interaction and Cooling of the Indirect Excitons in Elevated Traps, *Alexander A. High[1], Aaron T. Hammack[1], Leonid V. Butov[1], Leonidas Mouchliadis[2], Alexie Ivanov[2], Micah Hanson[3], Arthur C. Gossard[3]; [1]Univ. of California at San Diego, USA, [2]Cardiff Univ., UK, [3]Univ. of California at Santa Barbara, USA.* We present studies of 2-D indirect excitons in an in-plane trap created by a laterally modulated gate voltage. We demonstrate evaporative cooling and study localized and delocalized exciton states.

QThE3 • 11:00 a.m.
Excitons and Cavity Polaritons for Cold-Atoms in an Optical Lattice, *Hashem Zoubi, Helmut Ritsch; Inst. for Theoretical Physics, Innsbruck Univ., Austria.* We investigate collective electronic excitations for ultracold atoms in an optical lattice in the Mott insulator. When the optical lattice are placed within a cavity the excitons and the photons get coupled to form polaritons.

QThE4 • 11:15 a.m.
Experiments on the 3-D Disordered Bose-Hubbard Model, *Matthew White, Matthew Pasienski, David McKay, Brian DeMarco; Univ. of Illinois at Urbana-Champaign, USA.* An optical speckle field is used to add fine-grained disorder to a 3-D optical lattice. We have begun to constrain the disordered Bose-Hubbard phase diagram by studying Bose-Einstein condensates in a disordered lattice.

CLEO

10:30 a.m.–12:15 p.m.
CThK • Pulse Characterization
Fiorenzo Omenetto; Tufts Univ., USA, Presider

CThK1 • 10:30 a.m. Invited
Visualizing Ultrafast Nonlinear Dynamics with X-FROG, *Anatoly Efimov; Los Alamos Natl. Lab, USA.* Cross-correlation FROG is a versitile tool for observing complex nonlinear dynamics in waveguides. Structures ranging from femtosecond solitons to continuous waves to supercontinua as well as their interactions can be visualized in time-frequency simultaneously.

CThK2 • 11:00 a.m.
Measuring Very Complex Ultrashort Pulses Using Frequency-Resolved Optical Gating (FROG), *Lina Xu, Erik Zeek, Rick Trebino; Georgia Tech, USA.* For very complex pulses (TBP ~ 100), the XFROG, PG FROG and SHG FROG pulse-retrieval algorithms converged for 100%, 99% and 80%, respectively, of the pulses tried in our simulations, which included noise.

CThK3 • 11:15 a.m.
Fully Automated, Phase Corrected Long Crystal SPIDER for the Characterization of Broadband Pulses, *Gero Stibenz[1], Peter Staudt[1], Christian Lukas[1], Simon-Pierre Gorza[2], Ian A. Walmsley[3]; [1]APE GmbH, Germany, [2]Service OPERA-Photonique, Univ. Libre de Bruxelles, Belgium, [3]Oxford Univ., UK.* We present an optimized and automated implementation of the compact Long-Crystal-SPIDER design. The integrated phase-corrections allow for precise pulse reconstruction up to bandwidths of 17 THz and linear chirp detection at bandwidths exceeding 40 THz.

10:30 a.m.–12:15 p.m.
CThL • Fiber Lasers and Amplifiers
Jesper Laegsgaard; DTU Technical Knowledge Ctr., Denmark, Presider

CThL1 • 10:30 a.m.
105 kHz, 85 ps, 3 MW Microchip Laser Fiber Amplifier System for Micro-Machining Applications, *Dirk Nodop, O. Schmidt, J. Limpert, A. Tünnermann; Inst. of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany.* We report on a fiber amplified passively Q-switched microchip-laser delivering 85ps, 3MW pulses with 105kHz repetition rate. An all-optical synchronization technique reducing the mean pulse jitter to 40ps is applied to the microchip laser.

CThL2 • 10:45 a.m.
Embedded-Mirror Side Pumping of Double-Clad Fiber Lasers and Amplifiers, *Sean W. Moore, Jeffrey P. Koplow, Andrea Hansen, Georg Wien, Dahv A. V. Kliner; Sandia Natl. Labs, USA.* Embedded-mirror side pumping enables fabrication of compact, efficient fiber sources using a variety of pump sources. It is the only method capable of employing the output of an unformatted diode bar. We discuss recent progress.

CThL3 • 11:00 a.m.
Ultralow-Threshold Room-Temperature Continuous-Wave Double-Clad Cr^{4+}:YAG Crystal Fiber Laser, *Chien-Chih Lai[1], Kuang-Yao Huang[2], Hann-Jong Tsai[2], Zhi-Wei Lin[2], Kuan-Dong Ji[2], Sheng-Lung Huang[1,3]; [1]Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Inst. of Electro-Optical Engineering, Natl. Sun Yat-Sen Univ., Taiwan, [3]Dept. of Electrical Engineering, Natl. Taiwan Univ., Taiwan.* We report the lasing characteristics of a room-temperature continuous-wave double-clad Cr^{4+}:YAG crystal fiber laser with a record-low threshold of 0.7 mW, more than 500 times lower than any previously reported Cr^{4+}:YAG lasers.

CThL4 • 11:15 a.m.
Temperature Sensitivity of Ytterbium Fiber Amplifiers, *Xiang Peng[1], Liang Dong[2]; [1]Raydiance, USA, [2]IMRA America Inc., USA.* We demonstrated a method of characterizing temperature sensitivity of ytterbium-doped fiber amplifiers based on deriving Stark parameters from measured emission and absorption spectra. Temperature sensitivity is found to be mainly determined by P_{out}/P_{pump}, when $P_{out}/P_{pump}>0.4$.

Room C1 and C2

QELS

10:30 a.m.–12:15 p.m.
QThF • Ultrafast Dynamics in Magnetic Materials
Luca Perfetti; Freie Univ. Berlin, Germany, Presider

QThF1 • 10:30 a.m.
Ultrafast Phase-Transition Induced by Selective Vibrational Excitation in a Magnetoresistive Manganite, *Matteo Rini[1], Ra'anan Tobey[2], Simon Wall[2], Nicky Dean[2], Jiro Itatani[1,3], Yasuhide Tomioka[4], Yoshinori Tokura[4], Robert W. Schoenlein[1], Andrea Cavalleri[2]; [1]Lawrence Berkeley Natl. Lab, USA, [2]Univ. of Oxford, UK, [3]ERATO Non-Equilibrium Dynamics Project, Japan Science and Technology Agency, Japan, [4]Correlated Electron Res. Ctr., Japan.* We show that selective excitation of a phonon mode induces an insulator-metal phase transition in a magnetoresistive manganite. The dynamics of such phase transformation are studied by optical pump-probe, transport and X-ray absorption measurements.

QThF2 • 10:45 a.m.
Ultrafast Magnetization Dynamics in Cobalt Nanoparticles Studied with Femtosecond Laser Pulses, *Abdelghani Laraoui, Valérie Halté, Leandro H. F. Andrade, Jean-Yves Bigot; Inst. de Physique et Chimie des Matériaux de Strasbourg, Univ. Louis Pasteur, France.* We study the trajectory of the magnetization in cobalt nanoparticles using femtosecond pulses. We show that the initial pathway of the magnetization vector is mostly determined by the magnetic anisotropy of the assembly of nanoparticles.

QThF3 • 11:00 a.m.
Ultrafast Demagnetization Dynamics in TbFeCo High-Density Magneto-Optical Recording Films, *Tianshu Lai[1], Xiaodong Liu[1], Haining Hu[2], Ruixin Gao[1], Shiming Zhou[2]; [1]State-Key Lab of Optoelectronic Materials and Technologies, Dept. of Physics, Zhongshan Univ., China, [2]State-Key Lab for Advanced Photonic Materials Devices, Dept. of Physics, Fudan Univ., China.* Ultrafast demagnetization processes of TbFeCo films are studied. Dynamic hysteresis loops measured at different pump-probe delayed times show that the ultrafast demagnetization originates from electron spin relaxation instead of electron-lattice heat exchange.

QThF4 • 11:15 a.m.
The Normal Incidence Goos-Hänchen Shift, *Thomas Dumelow[1,2], Francinete Lima[2,3], José A. P. da Costa[4], Eudenilson L. Albuquerque[2]; [1]Univ. do Estado do Rio Grande do Norte, Brazil, [2]Univ. Federal do Rio Grande do Norte, Brazil, [3]Escola Agrícola de Jundaí, Brazil, [4]Univ. Federal do Ceará, Brazil.* We predict a lateral shift of the reflected beam when an electromagnetic beam is normally incident on an antiferromagnet in the presence of an external field. This shift is confirmed using simulations for Gaussian beams.

Room C3 and C4

CLEO

10:30 a.m.–12:15 p.m.
CThM • CLEO Symposium on Integrated Optical Isolators and Magneto-Optical Phenomena II
Yoshiaki Nakano; Univ of Tokyo, Japan, Presider

CThM1 • 10:30 a.m.
Magneto-Optical Pump-Probe Imaging, *Jean-Yves Bigot, Abdelghani Laraoui, Mircea Vomir, Michèle Albrecht; Inst. de Physique et Chimie des Matériaux de Strasbourg, Ctr. Natl. de la Recherche Scientifique, Univ. Louis Pasteur, France.* We present a new technique for imaging magnetic domains with a confocal optical resolution. It is based on a Magneto-Optical Pump-Probe Imaging (MOPPI) using femtosecond laser pulses. Its efficiency on various magnetic structures is demonstrated.

CThM2 • 10:45 a.m.
Polarisation Mode Converter Monolithically Integrated within a Semiconductor Laser, *Josef J. Bregenzer, Steven McMaster, Marc Sorel, Barry M. Holmes, David C. Hutchings; Univ. of Glasgow, UK.* A monolithically integrated, compact, polarisation mode converter is incorporated within a Fabry-Perot semiconductor laser diode. The predominant polarisation states of the optical output from each facet are observed to be orthogonal.

CThM3 • 11:00 a.m. Invited
Use of Polarization in InP-Based Integrated Optics, *J. J. G.M. van der Tol, L. M. Augustin, A. A. M. Kok, U. Khalique, M. K. Smit; Eindhoven Univ. of Technology, Netherlands.* The development of integrated polarization manipulating devices opens the perspective on the use of polarization as a new design dimension in InP-based integrated optics. Examples will be given of how this results in additional functionalities.

Room B1 and B2

10:30 a.m.–12:15 p.m.
CThN • Terahertz Imaging
Martin Koch; Technische Univ. Braunschweig, Germany, Presider

CThN1 • 10:30 a.m.
A Single-Pixel Terahertz Camera, *Wai Lam Chan, Kriti Charan, Dharmpal Takhar, Kevin K. Kelly, Richard G. Baraniuk, Daniel M. Mittleman; Rice Univ., USA.* We describe a single-pixel, pulsed terahertz camera which uses random patterns to enable high-speed image acquisition. Our method requires no raster scanning of objects, nor detection using a focal-plane array.

CThN2 • 10:45 a.m.
A Real-Time Terahertz Wave Imager, *Jingzhou Xu, Gyu Cho; IMRA America Inc., USA.* We demonstrate a terahertz wave imager with an acquisition speed at 3 frames-per-second by implementing a scanning mirror. Moving neither object nor terahertz source opens the possibility of a large area scanning at video rate.

CThN3 • 11:00 a.m.
Terahertz Time-Domain Reflectometry Applied to the Investigation of Hidden Mural Paintings, *J. Bianca Jackson[1], Marie R. Mourou[1], John F. Whitaker[1], Irl N. Duling, III[2], Steve L. Williamson[2], Michel Menu[3], Gerard Mourou[4]; [1]Univ. of Michigan, USA, [2]Picometrix, Advanced Photonics, Inc., USA, [3]Ctr. for Res. and Restoration, Louvre Museum, France, [4]ENSTA - Ecole Polytechnique, France.* Terahertz time-domain reflectometry has been used to investigate hidden layers of mural paintings. Images of graphite underdrawings and dielectric paint patterns have been resolved through plaster. The reflectivity of several historical paint pigments were compared.

CThN4 • 11:15 a.m.
Real-Time THz-TDS Line Scanner for Moving Object, *Takeshi Yasui, Ken-ichi Sawanaka, Atsushi Ihara, Tsutomu Araki; Osaka Univ., Japan.* We propose a real-time, line-field THz-TDS imaging system. The proposed system functions as a color scanner in the terahertz spectral region with fast line-scanning and has been successfully used to image moving objects.

Room J2

10:30 a.m.–12:15 p.m.
CThO • Frequency Conversion
Majid Ebrahim-Zadeh; ICFO, Spain, Presider

CThO1 • 10:30 a.m.
From Frequency Doubling to Efficient Generation of High-Order Harmonics of Fourier-Transform-Limited CO_2 Laser at 10.6 µm from GaSe Crystals, *Yi Jiang, Yujie J. Ding; Lehigh Univ., USA.* Coherent ns pulses for 2nd, 3rd and 4th harmonics of CO_2 laser frequency were efficiently generated from GaSe crystals, with corresponding output peak powers as high as 443 W, 23 W and 2 W, respectively.

CThO2 • 10:45 a.m.
Efficient Upconversion of Coherent Radiation at 10.26 µm, *Yi Jiang, Yujie J. Ding; Lehigh Univ., USA.* Upconversion of laser beam at 10.26 µm to 1.187 µm was achieved in a GaSe crystal via difference-frequency generation with the highest conversion efficiency measured to be 19%. Saturation due to pump depletion was evidenced.

CThO3 • 11:00 a.m.
Difference Frequency Generation at 2.5-2.9 µm in GaAs Microdisks, *Alessio Andronico[1], Ivan Favero[1], Sara Ducci[1], Pascale Senellart[2], Aristide Lemaitre[2], Giuseppe Leo[1]; [1]Univ. Paris Diderot, France, [2]Lab de Photonique et Nanostructures, Ctr. Natl. de la Recherche Scientifique, France.* We propose a triply-resonant GaAs microdisk for difference-frequency generation in the 2.5-2.9 µm band. Its performances are first numerically studied, in terms of phase-matching condition, conversion efficiency and tolerances. Preliminary devices are then fabricated and characterized.

CThO4 • 11:15 a.m.
High-Power, High-Repetition-Rate Femtosecond Pulses Tunable in the Ultraviolet, *Masood Ghotbi[1], Adolfo Esteban-Martin[1], Majid Ebrahim-Zadeh[1,2]; [1]Inst. de Ciencies Fotonique, Spain, [2]Inst. Catalana de Recerca i Estudis Avancats, Spain.* Efficient femtosecond pulse generation across 250-355 nm in the ultraviolet is reported by internal doubling of a visible optical parametric oscillator. An average power of 225 mW in 132-fs pulses at 76 MHz is demonstrated.

CLEO

Room J3

10:30 a.m.–12:15 p.m.
CThP • Mode-Locked Semiconductor Lasers II
Luke F. Lester; Ctr. for High Technology Materials, Univ. of New Mexico, USA, Presider

CThP1 • 10:30 a.m.
Dark Pulse Diode Laser, *Mingming Feng[1,2], Steven T. Cundiff[1,2], Richard P. Mirin[1], Kevin L. Silverman[1]; [1]NIST, USA, [2]Dept. of Physics, Univ. of Colorado at Boulder, USA.* A dark pulse train is generated by an external cavity quantum dot diode laser, which is passively controlled by a saturable Bragg reflector. The 92 ps dark pulses have a 400 MHz repetition rate.

CThP2 • 10:45 a.m.
Subpicosecond Pulse Generation at 245 GHz Using a Quantum-Dash-Based Passive Mode-Locked Laser Emitting at 1.53 µm, *Kamel Merghem[1], Akram Akrout[1], Anthony Martinez[1], François Lelarge[2], Benjamin Rousseau[2], F. Poingt[2], Lionel Legouezigou[2], Odile Legouezigou[2], Alain Accard[2], Frederic Pommereau[2], Guang-Hua Duan[2], Guy Aubin[1], Abderrahim Ramdane[1]; [1]Lab de Photonique et Nanostructures, Ctr. Natl. de la Recherche Scientifique, France, [2]Alcatel-Thalès III-V Lab, France.* We demonstrate ~590 fs pulse generation at a 245 GHz repetition rate using a one-section Fabry-Perot quantum-dash-based laser. A time-bandwidth product of 0.41 and average output power in excess of 20 mW are achieved.

CThP3 • 11:00 a.m.
Characterization of Pulse Timing Jitter of Actively Stabilised 1-GHz Vertical-External-Cavity Surface-Emitting Semiconductor Laser Producing 500-fs Pulses, *Adrian H. Quarterman, Keith G. Wilcox, Zakaria Mihoubi, Stephen P. Elsmere, Anne C. Tropper; Univ. of Southampton, UK.* The rms timing jitter of 500-fs optical pulses from a passively mode-locked, actively stabilised vertical-external-cavity surface-emitting laser was determined by the Von der Linde method to be 350 fs over 500 Hz-500 KHz.

CThP4 • 11:15 a.m.
External-Cavity Mode-Locked Quantum-Dot Lasers for Low Repetition Rate, Sub-Picosecond Pulse Generation, *Mo Xia, Mark G. Thompson, Richard V. Penty, Ian H. White; Univ. of Cambridge, UK.* External-cavity mode-locking of a quantum-dot laser is demonstrated with record-low repetition-rates of 310MHz, and harmonic repetition-rates up to 4GHz. Fourier-limited 930fs pulse generation is achieved. The pulse-energy of ~0.45pJ is independent of operating conditions.

Marriott San Jose Salon 1 and 2

10:30 a.m.–12:15 p.m.
CThQ • Lab-on-a-Chip for Biophotonic Applications I
Seok-Hyun (Andy) Yun; Harvard Univ., USA, Presider

CThQ1 • 10:30 a.m. Tutorial
Optofluidics for Biosensing, *Steve Quake; Stanford Univ., USA.* Abstract, biography and photo not available.

Marriott San Jose Salon 3

10:30 a.m.–12:15 p.m.
CThR • Radio-over-Fiber and Optical Signal Generation
Natasha M. Litchinitser; Univ. of Michigan, USA, Presider

CThR1 • 10:30 a.m.
Characterisation of Millimetre Wave Multimode Radio-over-Fibre Systems, *Bilal A. Khawaja, Martin J. Cryan; Univ. of Bristol, UK.* Millimetre wave radio-over-fibre links using both singlemode and multimode fibres are demonstrated over a 0-50GHz bandwidth operating at 1550nm. Results show that good link gain can be achieved with both single mode and multimode detectors.

CThR2 • 10:45 a.m.
Photonic Active Integrated Antennas (PhAIAs) Using Lossless Matching For 2.4-GHz Wireless-over-Fibre Systems, *Vitawat Sittakul, Martin J. Cryan; Univ. of Bristol, UK.* Lossless matching circuits are integrated into PhAIAs used in a 2.4GHz wireless-over-fibre link. The system uses a 220m in-building multi-mode-fibre and results show a greater than 10dB improvement in signal strength and improved throughput.

CThR3 • 11:00 a.m.
Correlation Detection of Photonically Generated Ultra-Wideband Radio-Frequency Waveforms over Wireless Link, *Ingrid S. Lin, Andrew M. Weiner; Purdue Univ., USA.* We report correlation measurements of ultra-wideband radio-frequency signals dispersion pre-compensated for transmission over a short antenna link. Experimental auto- and cross-correlations of up-chirped and down-chirped electrical waveforms demonstrate high contrast.

CThR4 • 11:15 a.m. Invited
Fiber-Wireless Networks and Radio-over-Fibre Techniques, *Ken-ichi Kitayama[1], Toshiaki Kuri[2], J. J. Vegas Olmos[1], Hiroyuki Toda[3]; [1]Osaka Univ., Japan, [2]Natl. Inst. of Information and Communications Technology, Japan, [3]Doshisha Univ., Japan.* Dense WDM access network of co-existing analog radio over fiber and digital FTTH systems is presented, by focusing on enabling techniques including optical frequency interleaving, super-continuum light source and optical channel allocation for wireless services.

Marriott San Jose Salon 4

10:30 a.m.–12:15 p.m.
CThS • Quantum Dots
Nelson Tansu; Lehigh Univ., USA, Presider

CThS1 • 10:30 a.m.
Reducing the Oscillator Strength in Semiconductor Quantum Dots with a Lateral Electric Field, *Amelia R. Bloom, Richard P. Mirin, Kevin L. Silverman; NIST, USA.* We modulate the oscillator strength of self-assembled quantum dots embedded in a semiconductor ridge waveguide by applying an electric field with two coplanar contacts. We estimate a 20 % reduction at 40 V.

CThS2 • 10:45 a.m.
Fabrication of Site-Controlled, Highly Uniform and Dense InGaN Quantum Dots, *Luke K. Lee, Taeil Jung, P. C. Ku; Univ. of Michigan, USA.* We report fabrication of site-controlled, highly uniform and dense (>=1e10/cm^2) InGaN multiple stacks of quantum dots using selective area epitaxy in MOCVD. The dot height and lateral dimension are 3 nm and 30 nm, respectively.

CThS3 • 11:00 a.m. Invited
Single Quantum Dot Spectroscopy in a Cavity, *Galina Khitrova; Univ. of Arizona, USA.* A photonic crystal slab nanocavity with a single InAs quantum dot in a field antinode is a promising system for cavity QED because of the cavity's small volume and the dot's stationary position.

Marriott San Jose Salon 5 and 6 — CLEO

10:30 a.m.–12:15 p.m.
CThT • Slot and High Confinement Waveguides
Qianfan Xu; Hewlett-Packard Labs, USA, Presider

CThT1 • 10:30 a.m.
Multi-Slot Silicon Optical Waveguides, *Shun H. Yang, Prabhakar R. Bandaru, Michael L. Cooper, Jung S. Park, Shayan Mookherjea; Univ. of California at San Diego, USA.* We describe, fabricate and demonstrate multi-slotted silicon nanophotonic waveguides, comprised of four low index slots etched longitudinally along the waveguide. The computed modal profiles are well described by supermode theory.

CThT2 • 10:45 a.m.
Slot Waveguide Cavities for Electrically-Pumped Silicon-Based Light Sources, *Kyle Preston, Jacob T. Robinson, Michal Lipson; Cornell Univ., USA.* We fabricate horizontal slot waveguides and resonators using layers of polycrystalline and single crystalline silicon. We demonstrate waveguide propagation losses of 7.3 dB/cm and ring resonators with an intrinsic quality factor of 76,000.

CThT3 • 11:00 a.m.
Low-Loss Si-SiO_2 8nm Slot Waveguides, *Robert M. Pafchek, Jinjin Li, Ravi S. Tummidi, Thomas L. Koch; Lehigh Univ., USA.* Quasi-TM-mode propagation loss of 1.83dB/cm at λ = 1.565 µm is achieved in horizontal Si(amorphous)-SiO_2-Si(crystalline) slot waveguides with 8.3nm slots fabricated on silicon-on-insulator. Waveguide loss is measured using a ring resonator with Q ~ $3x10^5$.

CThT4 • 11:15 a.m.
Photon Confinement in Multi-Slot Waveguides, *Yijing Fu[1], Han G. Yoo[2], Daniel B. Riley[3], Philippe M. Fauchet[1,2,3]; [1]Inst. of Optics, Univ. of Rochester, USA, [2]Dept. of Physics and Astronomy, Univ. of Rochester, USA, [3]Dept. of Electrical and Computer Engineering, Univ. of Rochester, USA.* We present a multi-layer waveguide that can confine light in low refractive index layers. M-line measurement verified our simulation results. This structure can be used for silicon light emission device because free-carrier losses are avoided.

PhAST Room 1 — PhAST

10:30 a.m.–12:30 p.m.
PThA • Laser Applications in the Photovoltaic Market I
Andreas Grohe; Fraunhofer Inst. for Solar Energy Systems, Germany, Presider

PThA1 • 10:30 a.m. Invited
The Role of Laser-Based Manufacturing Processes in Driving the Solar Industry Roadmap, *Finlay Colville; Coherent Inc., USA.* Widespread solar energy adoption at the consumer level demands that a variety of industry roadmap objectives are satisfied over the next 5 to 10 years. These include: higher cell efficiencies, increased yields on thinner and larger wafer sizes, lower operating costs, the use of more environmentally friendly production equipment, and supply chain consolidation consisting of industry-qualified suppliers. This talk will address the requirements on laser-based processes within solar manufacturing today, and the increasingly important role lasers will play in allowing industry roadmap targets to be met successfully in the future.

PThA2 • 11:00 a.m. Invited
Leveraging IC and Flat Panel Display Technologies to Scale Photovoltaics, *Peter Borden; Applied Materials, USA.* This talk will explore how scaling combined with the enormous investment already made in IC and FPD technologies can lead to significant reductions in PV cost/watt. Wafer-based silicon PV has already benefited from 30 years of scaling, bringing module costs to attractive levels in some regions. We will discuss the potential of planar IC processes and laser patterning to further this progress. In parallel, thin-film silicon on glass is a technology that transfers directly from the FPD industry. We will discuss how this enables leveraging of FPD technology to achieve attractive panel manufacturing cost.

PhAST Room 2

10:30 a.m.–12:30 p.m.
PThB • Lasers in Manufacturing III
Friedhelm Dorsch; TRUMPF Photonics, Inc., USA, Presider

PThB1 • 10:30 a.m. Keynote
KEYNOTE: Innovative Laser Fabrication—From Macro, Micro to Nano Scales, *Lin Li; Univ. of Manchester, UK.* Laser fabrication has been widely applied in industry for over 40 years for cutting, drilling and micro-machining of a variety of engineering materials. Challenges still remain for the improvement of capability, quality and efficiency of materials processing using high power lasers. This paper reports some of the recent work carried out in the Laser Processing Research Centre (LPRC) at the University of Manchester to advance laser fabrication technologies from macro, micro to nano scales.

PThB2 • 11:00 a.m. Invited
High-Power Multi kW Diode Lasers, Structure and Applications, *Klaus Kleine; Laserline Inc., USA.* This presentation will introduce power scaling methods for fiber coupled diode lasers up to a power level of 8000W. Applications like laser cladding, hardening, welding and brazing, which use the high output power capabilities of diode lasers, are discussed.

PhAST Room 3

10:30 a.m.–12:30 p.m.
PThC • Inorganic Solar Cell Technology and Economics
Yong-hang Zhong; Arizona State Univ., USA, Presider

PThC1 • 10:30 a.m. Invited
Overview of the DOE Solar America Initiative, *Scott Stephens; US Dept. of Energy, USA.*

PThC2 • 10:50 a.m. Invited
Si Solar Cells and Their Future, *Bobby Ram; SunPower Corp., USA.*

PThC3 • 11:10 a.m. Invited
Thin Film Solar I (CIGS), *Terry Schuyler; DayStar Technologies, Inc., USA.*

Ballroom A1 and A8	Ballroom A2 and A7	Ballroom A3 and A6	Ballroom A4 and A5

QELS (Ballroom A1 and A8, Ballroom A2 and A7) — **CLEO** (Ballroom A3 and A6, Ballroom A4 and A5)

QThD • Nano-Optics—Continued

QThD5 • 11:30 a.m. Invited

Optical Transitions in Monolayer and Bilayer Graphene, *Feng Wang[1], Yuanbo Zhang[1], Chuanshan Tian[1], Caglar Girit[1,2], Alex Zettl[1,2], Y. Ron Shen[1,2]; [1]Univ. of California at Berkeley, USA, [2]Lawrence Berkeley Natl. Lab, USA.* Optical transitions in grapheme are studied by infrared spectroscopy. The interband transitions in graphene monolayers show a relatively flat spectrum, while those in bilayers are dominated by a van-Hove singularity.

QThD6 • 12:00 p.m.

Microdrop Raman Laser and Plasmon Enhancement Effects, *Rachit Sharma, Jessica P. Mondia, Jan Schäfer, Z. H. Lu, L. J. Wang; Inst. of Optics, Information and Photonics, Max-Planck Res. Group, Germany.* We report room-temperature Raman lasing in electrodynamically levitated pure glycerin microdrops. The possibility of lowering the lasing threshold through surface Plasmon enhanced scattering in glycerin microdrops doped with Ag nanoparticles is also demonstrated.

QThE • Quantum Degenerate Gases—Continued

QThE5 • 11:30 a.m.

Measuring Relative Atom Number Fluctuations in a Coherently Split Bose Einstein Condensate, *Marcius H. T. Extavour[1], Jason McKeever[1], Thorsten Schumm[2], Lindsay J. LeBlanc[1], Alma B. Bardon[1], Dylan Jervis[1], Alan Stummer[1], Joseph H. Thywissen[1]; [1]Dept. of Physics, Univ. of Toronto, Canada, [2]Atominst. d. Österr. Univ., Austria.* We report direct measurements of number fluctuations between two BECs. A single BEC is dynamically and coherently split in two. Fluctuations in the relative atom number in repeated trials are evaluated against binomial random fluctuations.

QThE6 • 11:45 a.m.

Control of Decoherence of Many-Body Excitations in a Bose-Einstein Condensate, *Nir Bar-Gill, Eitan Rowen, Rami Pugatch, G. Kurizki, Nir Davidson; Weizmann Inst. of Science, Israel.* We measure the effects of reservoir engineering on the decay of a coherent, many-body excitation in a BEC loaded into an optical lattice. We show both enhancement and suppression of decoherence vs. lattice depth.

QThE7 • 12:00 p.m.

Vortex-Antivortex Labyrinth Wavefunction, *Alexey Y. Okulov; A.M. Prokhorov General Physics Inst., Russian Acad. of Sciences, Russian Federation.* The vortex-antivortex optical trapping arrays are shown to transfer angular orbital momentum to support "antiferromagnet-like" matter waves. The wavefunction's phase gradient field associated with the field of classical velocities via Madelung transformation forms labyrinth-like structure.

CThK • Pulse Characterization—Continued

CThK4 • 11:30 a.m.

High Performance Wavelet-Based Phase Reconstruction of Ultrashort Laser Pulses, *Jens Bethge, Günter Steinmeyer; Max Born Inst., Germany.* We demonstrate a wavelet-based strategy for precise and rapid phase retrieval in SPIDER and spectral interferometry. Our method outperforms traditional Takeda phase tracking, both in terms of speed and precision.

CThK5 • 11:45 a.m.

Polarization State Characterization of Ultrafast Laser Pulses by Self-Referenced Tomographic Reconstruction, *Philip Schlup[1], Omid Masihzadeh[1], Lina Xu[2], Rick Trebino[2], Randy A. Bartels[1]; [1]Colorado State Univ., USA, [2]Georgia Tech, USA.* We demonstrate a self-referenced method for characterizing of the polarization state of an ultrashort laser pulse field. It can be used with any existing measurement technique that measures intensity and phase of a single polarization.

CThK6 • 12:00 p.m.

Measuring the Spatio-Temporal Electric Field of Tightly Focused Ultrashort Pulses, *Pamela Bowlan[1], Ulrike Fuchs[2], Pablo Gabolde[1], Rick Trebino[1], Uwe D. Zeitner[2]; [1]School of Physics, Georgia Tech, USA, [2]Fraunhofer-Inst. für Angewandte Optik und Feinmechanik, Germany.* We demonstrate a spectral interferometer with NSOM probes for measuring focusing ultrashort pulses with high spatial and temporal resolution. We measure a 0.26 NA focus and, for the first time, we observe the forerunner pulse.

CThL • Fiber Lasers and Amplifiers—Continued

CThL5 • 11:30 a.m.

Single Mode Lasing in Gain-Guided Index Anti-Guided Diode End Pumped Fiber, *Timothy S. McComb[1], Vikas Sudesh[1], Ying Chen[1], Michael Bass[1], Martin Richardson[1], John Ballato[2], Anthony E. Siegman[3]; [1]CREOL, College of Optics and Photonics, Univ. of Central Florida, USA, [2]School of Materials Science and Engineering, Ctr. for Optical Materials Science and Engineering Technologies, Clemson Univ., USA, [3]Ginzton Lab, Stanford Univ., USA.* Single mode oscillation in a 200µm core diameter gain guided index anti-guided fiber laser is demonstrated. Single mode oscillation is maintained for pumping of up to four times laser threshold, limited by available pump power.

CThL6 • 11:45 a.m.

Numerical Simulations of Yb^{3+}-Doped, Pulsed Fiber Amplifiers: Comparison with Experiment, *Roger L. Farrow, Sean W. Moore, Paul E. Schrader, Arlee V. Smith; Sandia Natl. Labs, USA.* We have developed a numerical simulation of cw-pumped Yb^{3+}-doped fiber amplifiers seeded by pulses at 1064 nm. Results compare well to measurements of longitudinal upper-level ion populations and of output pulse energy versus pump power.

CThL7 • 12:00 p.m.

Simple Multiwavelength Time-Division Multiplexed Laser for H_2O Absorption Measurements, *Thilo Kraetschmer, Scott T. Sanders; Univ. of Wisconsin at Madison, USA.* We present a multiwavelength, time-division multiplexed laser that continuously cycles through 10 stable, tunable and spectrally narrow wavelengths at 30 kHz for absorption measurements in the R-branch of the ν1+n3 band of H_2O (1330-1380 nm).

12:15 p.m.–1:00 p.m., Lunch Break *(concessions available in the Exhibit Hall)*

NOTES

Room C1 and C2 — QELS

QThF • Ultrafast Dynamics in Magnetic Materials—Continued

QThF5 • 11:30 a.m.
Ultrafast Coercivity and Magnetization Dynamics in GaMnAs, *Kimberley C. Hall[1], Jeremy P. Zahn[1], Samuel March[1], Xinyu Liu[2], Jacek Furdyna[2]; [1]Dalhousie Univ., Canada, [2]Univ. of Notre Dame, USA.* Using time-resolved magneto-optical Kerr effect spectroscopy, the magnetization and coercivity dynamics in GaMnAs are investigated. A subpicosecond ferromagnetic to paramagnetic phase transition is observed, followed by coercivity enhancement on longer time scales.

QThF6 • 11:45 a.m.
Ultrafast Photoinduced Ferromagnetic Phase Enhancement in Ion Implanted GaMnAs, *Ingrid Cotoros[1,2], Jigang Wang[2], Peter Stone[1,2], Oscar Dubon[1,2], Daniel Chemla[1,2]; [1]Univ. of California at Berkeley, USA, [2]Lawrence Berkeley Natl. Lab, USA.* We report on the dramatic ultrafast photo-enhancement of ferromagnetism on a 100-picosecond timescale in ion-implanted semiconductor GaMnAs via photoexcited transient carriers. This non-thermal, transient cooperative magnetic process surprisingly quenches at low temperatures, significantly bellow T_C.

QThF7 • 12:00 p.m.
Asynchronous Optical Probing of Coherent Magnetic Excitations from Picoseconds to Nanoseconds, *Vladimir A. Stoica, Yu-Miin Sheu, David A. Reis, Roy Clarke; FOCUS Ctr., Dept. of Physics, Univ. of Michigan, USA.* Thermoreflectance and coherent spin dynamics in Fe films are measured using asynchronous optical sampling at kilohertz rates. We observe ultrafast laser-induced time dependence of spin precession frequencies that is attributed to thermal relaxation.

Room C3 and C4 — CLEO

CThM • CLEO Symposium on Integrated Optical Isolators and Magneto-Optical Phenomena II—Continued

CThM4 • 11:30 a.m. Invited
Growth of Magneto-Optic Garnet Waveguides and Polarizers for Optical Isolators, *Sang-Yeob Sung, Xiaoyuan Qui, Bethanie J. H. Stadler; Univ. of Minnesota, USA.* YIG waveguides and polarizers were integrated monolithically onto semiconductors. The waveguide losses were 1.55 dB/mm with Faraday rotations of 0.2dB/mm. Birefringence was minimized by optimized etching. Photonic crystal polarizers and biasing films completed the isolator.

CThM5 • 12:00 p.m.
Effect of the Foreign Phases on the Crystallization and Growth of Magnetooptic Garnets Films, *Michael V. Zaezjev[1], Manda Chandra Sekhar[1], Marcello Ferrera[1], Luca Razzari[1], Alain Pignolet[1], Roberto Morandotti[1], Barry Holmes[2], Marc Sorel[2], David Hutchings[2]; [1]Enérgie, Matériaux et Télécommunications, Inst. Natl. de la Res. Scientifique, Canada, [2]Univ. of Glasgow, UK.* The crystallization of magnetooptic iron garnets $Y_3Fe_5O_{12}$ (YIG) and $Ce_1Y_2Fe_5O_{12}$ (Ce-YIG) in thin films has been investigated. The parasitic phases were shown to have a negative impact on the crystalline structure.

Room B1 and B2 — CLEO

CThN • Terahertz Imaging—Continued

CThN5 • 11:30 a.m.
THz Interferometric Imaging Using Subwavelength Plastic Fiber Based THz Endoscopes, *Ja-Yu Lu[1], Chung-Chiu Kuo[2], Chui-Min Chiu[2], Hung-Wen Chen[2], Ci-Ling Pan[3], Chi-Kuang Sun[2]; [1]Graduate Inst. of Electro-Optical Science and Engineering, Natl. Cheng Kung Univ., Taiwan, [2]Dept. of Electrical Engineering and Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [3]Graduate Inst. of Electro-Optical Engineering, Natl. Chiao-Tung Univ., Taiwan.* We demonstrate a continuous-wave THz fiber-endoscopy by utilizing low-loss THz subwavelength plastic fibers. The reconstructed 3-D images not only reflect the depth variation of the object surface, but also reveal the molecular distribution of samples.

CThN6 • 11:45 a.m.
Laser Terahertz Emission Microscopy toward High-Resolution Imaging, *Sunmi Kim, Hironaru Murakami, Masayoshi Tonouchi; Inst. of Laser Engineering, Osaka Univ., Japan.* For high resolution, we employed a solid immersion lens in Laser THz emission microscope system. The terahertz emission images of line-and-space structure on InP were obtained with a spatial resolution better than 1.5 µm.

CThN7 • 12:00 p.m.
Time-Domain Terahertz Mapping of Thickness and Degradation of Aircraft Turbine Blade Thermal Barrier Coatings, *Jeffrey White[1], G. Fichter[1], A. Chernovsky[1], David A. Zimdars[1], John F. Whitaker[2], D. Das[2], Tresa M. Pollock[2]; [1]Picometrix, Inc., USA, [2]Univ. of Michigan, USA.* Time domain terahertz (TD-THz) non destructive evaluation (NDE) imaging is used to two-dimensionally map the thickness of yttria stabilized zirconia (YSZ) thermal barrier coatings (TBC) on aircraft engine turbine blades.

Room J2 — CLEO

CThO • Frequency Conversion—Continued

CThO5 • 11:30 a.m.
Deep-UV Harmonic Generation and Applications, *Chuangtian Chen[1], Shuntaro Watanabe[2], Zuyan Xu[3]; [1]Technical Inst. of Physics and Chemistry, Chinese Acad. of Sciences, China, [2]Inst. for Solid State Physics, Univ. of Tokyo, Japan, [3]Inst. of Physics, Chinese Acad. of Sciences, China.* Using 2.3mm thick $KBe_2BO_3F_2$ crystal optically contacted with CaF_2 in prism-coupled device we obtained an average output-power nearly 360mW at 200nm; an output-power of 50mW with a narrow spectral width of 0.007 pm at 193.5nm.

CThO6 • 11:45 a.m.
Ultra-Low-Power Parametric Frequency Conversion of High Data Rates On-Chip, *Amy C. Turner, Mark A. Foster, Alexander L. Gaeta, Michal Lipson; Cornell Univ., USA.* We demonstrate ultra-low-power parametric frequency conversion of 5-Gbit/s data in a silicon photonic structure via microcavity-enhanced four-wave mixing. Our modeling predicts high conversion efficiency up to 0-dB is possible through GVD-engineering and free-carrier lifetime reduction.

CThO7 • 12:00 p.m.
Ultra-Low-Power Frequency Conversion in High-Index Glass Micro Ring Resonators, *Marcello Ferrera[1], Luca Razzari[1], David Duchesne[1], Roberto Morandotti[1], Zhenshan Yang[2], Marco Liscidini[2], John E. Sipe[2], Brent Little[3], David J. Moss[4]; [1]Enérgie, Matériaux et Télécommunications, Inst. Natl. de la Res. Scientifique, Canada, [2]Dept. of Physics, Univ. of Toronto, Canada, [3]Infinera Ltd., USA, [4]Ctr. for Ultrahigh Bandwith Devices for Optical Systems, School of Physics, Univ. of Sydney, Australia.* We present the first demonstration of ultra-low power four-wave-mixing in a high-index glass micro-ring resonator (47.5 µm radius). By using a mW-level CW pump power we obtained an appreciable wavelength conversion in the C-band.

12:15 p.m.–1:00 p.m., Lunch Break *(concessions available in the Exhibit Hall)*

NOTES

Room J3 | Marriott San Jose Salon 1 and 2 | Marriott San Jose Salon 3 | Marriott San Jose Salon 4

CLEO

CThP • Mode-Locked Semiconductor Lasers II—Continued

CThP5 • 11:30 a.m.
Injection Locked Mode-Locked Laser with Long-Term Feedback Stabilization, *Charles G. Williams, Franklyn Quinlan, Peter J. Delfyett; Univ. of Central Florida, USA.* A semiconductor based, CW injection stabilized, 2.46 GHz harmonically mode-locked laser using a feedback loop for long term stabilization is demonstrated. Optical supermode suppression of 36dB and significant timing and amplitude noise reduction are observed.

CThP6 • 11:45 a.m.
40MHz Pulse Train Based on a Temporally Demultiplexed 2.56GHz SCOWA Low Noise Mode-Locked Laser, *Dimitrios Mandridis[1], Shinwook Lee[1], Franklyn Quinlan[1], Peter J. Delfyett[1], Jason J. Plant[2], Paul W. Juodawlkis[2]; [1]CREOL, College of Optics and Photonics, Univ. of Central Florida, [2]MIT Lincoln Lab, USA.* An alternative to the sub-100MHz repetition rate laser source is explored. A low noise SCOWA-based harmonically mode-locked laser is developed and temporally demultiplexed to twice the cavity fundamental resulting in a 40MHz pulse train.

CThP7 • 12:00 p.m.
Tunable Semiconductor Hybrid Mode-Locked Laser Using a Tapered Amplifier as Gain Medium, *Andreas U. Velten, Andreas Schmitt-Sody, Ye Liu, Ladan Arissian, Jean-Claude Diels; Univ. of New Mexico, USA.* A semiconductor laser, using only a tapered amplifier as gain medium, is mode-locked with a multiple quantum well saturable absorber and RF modulation, generating 0.5 ps pulses without dispersion compensation.

CThQ • Lab-on-a-Chip for Biophotonic Applications I—Continued

CThQ2 • 11:30 a.m.
Flow-Dependent Optofluidic Particle Trapping, *J. Thomas Blakely, David Sinton, Reuven Gordon; Univ. of Victoria, Canada.* Interactions between optical and hydrodynamic forces enable selective particle trapping and control inside a planar optofluidic chip. The unique flow-dependent nature of the traps allows for active particle sorting with extensions to immiscible microfluidic systems.

CThQ3 • 11:45 a.m.
Optical Trapping Platform Based on Highly Confining Silicon Waveguiding Structures with Microfluidics, *Bradley Schmidt, Sasikanth Manipatruni, Allen H. J. Yang, David Erickson, Michal Lipson; Cornell Univ., USA.* We demonstrate strongly enhanced optical trapping forces on sub-micron-diameter dielectric spheres within a pressure-driven microfluidic flow of several hundred microns/s using the evanescent field of the light in silicon waveguides.

CThQ4 • 12:00 p.m.
Compact, Rapid Cell Deformability Measurements Using Diode Laser Bar Optical Trapping in Microfluidics, *Robert W. Applegate Jr., Jeff Squier, Tor Vestad, John Oakey, David W. M. Marr; Colorado School of Mines, USA.* We present a simple, compact, microfluidic system that easily facilitates diode laser bar optical trapping for cell stretching measurements and particle sorting within flowing microfluidic systems for the first time.

CThR • Radio-over-Fiber and Optical Signal Generation—Continued

CThR5 • 11:45 a.m.
Optical Vector Signal Generation Using Double Sideband with Carrier Suppression and Frequency Multiplication, *C. T. Lin[1], W. J. Jiang[1], E. Z. Wong[1], J. Chen[1], P. T. Shih[1], P. C. Peng[2], S. Chi[1,3]; [1]Inst. of Electro-Optical Engineering, Natl. Chiao Tung Univ., Taiwan, [2]Dept. of Applied Materials and Optoelectronic Engineering, Natl. Chiao Tung Univ., Taiwan, [3]Dept. of Electrical Engineering, Yuan Ze Univ., Taiwan.* This work experimentally demonstrates optical vector signal generation using frequency multiplication based on double sideband with carrier suppression. After transmission over 50-km SMF, the power penalty of 15-GHz 1.25-Gb/s RF signals is less than 0.2-dB.

CThR6 • 12:00 p.m.
Complete Performance Analysis of a 3.5 ps Pulse Source Consisting of a Gain-Switched Laser Diode Followed by a Nonlinearly Chirped Grating, *Robert D. Maher, Prince M. Anandarajah, Liam P. Barry; Dublin City Univ., Ireland.* The authors demonstrate the performance of an optimized gain-switched pulse source that generates 3.5ps pulses. The transform limited pulses perform excellently when employed in an 80Gb/s OTDM set-up and a 10Gb/s 40km transmission experiment.

CThS • Quantum Dots—Continued

CThS4 • 11:30 a.m.
Photoluminescence Enhancement from Colloidal Quantum Dots in a Flexible Microcavity, *Matthew Luberto[1], Nikesh Valappil[1], Subhasish Chatterjee[2], Vinod M. Menon[1,2]; [1]Queens College CUNY, USA, [2]Graduate Ctr., CUNY, USA.* We report enhanced photoluminescence from InGaP/ZnS core/shell quantum dots embedded in a one dimensional flexible microcavity realized via spin coating alternating layers of polymers. Tunability of emission wavelength by bending the microcavity is also demonstrated.

CThS5 • 11:45 a.m.
Investigating High-Speed Modulation Characteristics of Quantum Dots in Red Emitting Quantum Dot-Light Emitting Diodes, *Fan Zhang, Chunfeng Zhang, Zhanao Tan, Ting Zhu, Jian Xu; Penn Sate Univ., USA.* We investigate the high-speed modulation characteristics of quantum dots in red emitting quantum dot-light emitting diodes, in which the -3dB cutoff frequency for 6-mm^2 device is 1.5 MHz under optimized conditions.

CThS6 • 12:00 p.m.
PbS Quantum Dot Photoluminescence Quenching Induced by an Applied Bias, *Liangfeng Sun, Adam Bartnik, Byung-Ryool Hyun, Frank Wise, Jason C. Reed, Jason D. Slinker, George Malliaras, Yu-wu Zhong, Lei Bao, Hector Abruna; Cornell Univ., USA.* We demonstrate that a DC voltage applied on a PbS quantum dot embedded organic light emitting diode can partially quench the quantum dot photoluminescence and propose a way to avoid this quenching.

12:15 p.m.–1:00 p.m., Lunch Break *(concessions available in the Exhibit Hall)*

Marriott San Jose Salon 5 and 6	*PhAST* Room 1	*PhAST* Room 2	*PhAST* Room 3
CLEO	*PhAST*		

CThT • Slot and High Confinement Waveguides—Continued

CThT5 • 11:30 a.m.
A Novel High-Q Resonator Using High Contrast Subwavelength Grating, *Ye Zhou, Michael Moewe, Johannes Kern, Michael C. Y. Huang, Connie J. Chang-Hasnai; Univ. of California at Berkeley, USA.* We present a novel high-Q resonator using high contrast subwavelength grating. The simulated Q-factor of the resonator can be as high as ~500,000. A Q-factor of 14,000 is experimentally measured in fabricated devices.

CThT6 • 11:45 a.m.
15 dB Cross Loss Modulation by CW Pump Injection of mW-Class in 1.5-mm Long Nano-Wire Waveguide, *Redouane Katouf, Atsushi Kanno, Naokatsu Yamamoto, Norihiko Sekine, Tak Keung Liang, Kiyotaka Sasagawa, Kouichi Akahane, Toshiro Isu, Hideyuki Sotobayashi, Masahiro Tsuchiya; Natl. Inst. of Information and Communications Technology, Japan.* GaAs nano-wire waveguides were successfully fabricated on a SiO_2/Si substrate for the first time. 15 dB cross loss modulation was achieved by a few mW continuous-wave pump power within a 1.5 mm-long waveguide.

CThT7 • 12:00 p.m.
Demonstration of Low Power, Thermally Stable Second-Order Microring Resonators, *Reja Amatya, Charles W. Holzwarth, Henry I. Smith, Rajeev J. Ram; MIT, USA.* Thermal tuning with an efficiency of 40uW/GHz/ring is demonstrated in silicon-rich silicon nitride second-order microring resonators. Open-loop thermal stability of the resonant frequency is measured to be within 400MHz for these resonators.

PThA • Laser Applications in the Photovoltaic Market I—Continued

PThA3 • 11:30 a.m. Invited
Laser Concepts and Processes for Industrial Photovoltaic Production, *Roland Mayerhofer[1], Michael Nardozzi[1], Claudia Finck[2], Ludger Muellers[2], Richard Hendel[2]; [1]Rofin Sinar Inc., USA, [2]Rofin/Baasel Lasertech, Germany.* The laser as an industrial tool is an essential part of today's solar cell production. For some of the processing steps the use of lasers is now state of the art. Intensive research is done on substituting further conventional processing steps. The presentation will give an overview on suitable laser concepts, their fundamentals regarding laser beam-material-interaction and their applications in industrial manufacturing.

PThA4 • 12:00 p.m. Invited
Recent Advances in the Use of Lasers and Motion Systems for Manufacturing of Large Area Thin Film Photovoltaic Panels, *David Clark; Newport/Spectra-Physics, USA.* Two main types of solar cells are widely deployed: crystalline Silicon-based structures and thin film (amorphous silicon, or cadmium telluride, or copper indium diselenide, CIS or copper indium gallium diselenide, CIGS)-based structures. The thin film solar cells on glass substrates offer tremendous potential for cost reduction since they use automated manufacturing techniques and infrastructure similar to those used in the flat panel display industry. If cell manufacturers can leverage this technology successfully, it should be possible to make large area PV panels at very low costs. Lasers and motion platforms play a key role in manufacturing of these thin film solar cells by precise scribing of the interconnect pattern at each layer. This paper will discuss the laser scribing characteristics of each of the thin film solar cell layers and how system integrators might achieve faster scribing speeds and less dead space between scribes when manufacturing of thin film solar cells.

PThB • Lasers in Manufacturing III—Continued

PThB3 • 11:30 a.m. Invited
New High-Power Diode Lasers and Their Use as Machine Tools, *Nels Ostrom; Coherent Inc., USA.* The results of the latest high power diode laser development at Coherent DDS will be discussed. The basis for these advancements, as it relates to new direct diode systems and their applications, will also be reviewed.

PThB4 • 12:00 p.m. Invited
Using Lasers to Improve Security in Documents of Value, *John Herslow; CompoSecure, USA.* The ability of lasers to unalterably subsurface mark plastics has led to an escalating demand for its use in national ID cards and passports. This talk will examine the history and trends for the future.

PThC • Inorganic Solar Cell Technology and Economics—Continued

PThC4 • 11:30 a.m. Invited
Thin Film Solar II (CdTe), *David Eaglesham; First Solar Inc., USA.*

PThC5 • 11:50 a.m. Invited
Utility Perspective of Different PV Technologies, *Herb Hayden; APS, USA.*

PThC6 • 12:10 p.m. Invited
Solar Value Chain and Markets, *Eric Wesoff; Greentech Media, USA.*

12:15 p.m.–1:00 p.m., Lunch Break *(concessions available in the Exhibit Hall)*

JOINT

1:00 p.m.–2:30 p.m.
JThA • CLEO/QELS Poster Session III

JThA1
The Effect of Injection Barrier Thickness and Doping Level on a λ ~ 8 μm Quantum Cascade Structure, *Scott S. Howard[1], Daniel P. Howard[1,2], Tiffany Ko[1], Deborah L. Sivco[3], Claire F. Gmachl[1]; [1]Princeton Univ., USA, [2]Univ. of Dayton, USA, [3]Alcatel-Lucent, USA.* For a high-performance quantum cascade laser structure, a 50% reduction in doping level and 33% reduction in injection barrier thickness yields 5 times stronger luminescence, 20% smaller optical transition width, and improved current-voltage characteristics.

JThA2
Tunable Slow Light in Quantum Well Vertical-Cavity Surface-Emitting Laser at 40 GHz, *Peng-Chun Peng[1], Fang-Ming Wu[1], Chun-Ting Lin[2], Jyehong Chen[2], Po Tsung Shih[2], Wei-Che Kao[2], Wen-Jr Jiang[2], Hao-chung Kuo[2], S. Chi[2,3]; [1]Natl. Chi Nan Univ., Taiwan, [2]Natl. Chiao Tung Univ., Taiwan, [3]Yuan Ze Univ., Taiwan.* This investigation experimentally demonstrates tunable slow light in a quantum well vertical-cavity surface-emitting laser at 40 GHz. Tunable optical delays are achieved by adjusting the bias current and wavelength detuning.

JThA3
GaAs-Based Buried Heterostructure Laser Incorporating an InGaP Opto-Electronic Confinement Layer, *Kristian M. Groom[1], Ryan R. Alexander[1], David T. D. Childs[1], Andrey B. Krysa[1], John S. Roberts[1], Amr S. Helmy[2], Richard A. Hogg[1]; [1]Univ. of Sheffield, UK, [2]Univ. of Toronto, Canada.* We demonstrate a novel process for fabrication of GaAs-based single lateral mode buried heterostructure lasers using a single epitaxial overgrowth in which an n-doped InGaP layer is utilized for both electrical and optical confinement.

JThA4
Continuous Tuning of an Extented-Cavity Diode Laser with a Translated Varied Line-Space Grating as an External Coupler, *Gilles Fortin, Nathalie McCarthy; COPL, Univ. Laval, Canada.* An extended-cavity diode laser is tuned without mode hop by simply translating a varied line-space grating. This original technique has produced a continuous wavelength tuning range as wide as 12 nm at 1550 nm.

JThA5
Novel Heat Removal Waveguide Structure for High Performance Quantum Cascade Lasers, *Muhammad A. Talukder[1], Fow-Sen Choa[1], Curtis R. Menyuk[1], Kale J. Franz[2], Scott S. Howard[2], Claire F. Gmachl[2]; [1]Univ. of Maryland, Baltimore County, USA, [2]Princeton Univ., USA.* We study the heat removal capability of different core structures in quantum cascade lasers. We find that due to non-isotropic conductivity, core structures with higher depth dissipate heat faster than the conventional higher-width structures.

JThA6
Longitudinal Mode Selection in a Fiber-Coupled Microlensed Microchip VECSEL, *Nicolas Laurand, Chee Leong Lee, Erdan Gu, Stephane Calvez, Martin D. Dawson; Inst. of Photonics, Univ. of Strathclyde, UK.* We demonstrate spectral control of a 1.055μm fiber-coupled microlensed microchip VECSEL by using a coupled-cavity effect. The coupled-cavity created between the fiber and the microchip output coupler facilitates single-mode operation with fiber-coupled power above 18mW.

JThA7
Coherence in Optics and Transport in Terahertz Quantum Cascade Lasers, *Carsten Weber, Andreas Wacker; Mathematical Physics, Lund Univ., Sweden.* Coherence in optics and transport is investigated for quantum cascade lasers. While coherence provides oscillations in the gain recovery if the tunnel coupling surpasses the broadening, incoherent hopping transport can fail in the opposite case.

JThA8
Polarization Controlled High Single Mode Output Wafer Fused Long-Wavelength VCSELs with Sub-Wavelength Shallow Gratings, *Vladimir Iakovlev[1,2], Alexei Syrbu[2], Alexandru Mereuta[2], Andrei Caliman[2], Kiril Atlasov[2], Andrei Mircea[2], Benjamin Dwir[2], Eli Kapon[2]; [1]BeamExpress S.A., Switzerland, [2]Lab of Physics of Nanostructures, Ecole Polytechnique Fédérale de Lausanne, Switzerland.* Polarization stable, wafer-fused 1310 nm VCSELs employing sub-wavelength shallow gratings on their top DBR and emitting 1.5 mW single mode output power in the 20°C-75°C temperature range are demonstrated.

JThA9
Excited-State Absorption in High-Power Mid-Infrared Quantum Cascade Lasers, *Yamac Dikmelik[1], Jacob B. Khurgin[1], Anthony J. Hoffman[2], Scott S. Howard[2], Kale J. Franz[2], Claire F. Gmachl[2]; [1]Johns Hopkins Univ., USA, [2]Princeton Univ., USA.* The loss due to excited-state absorption into the continuum was calculated for high-power mid-infrared quantum cascade lasers. We find this loss to be a significant fraction of the gain at the laser wavelength.

JThA10
Power-Scaling of a 1060nm Semiconductor Disk Laser with a Diamond Heatspreader, *Alexander J. Maclean, Alan J. Kemp, David Burns; Inst. of Photonics, Univ. of Strathclyde, UK.* Power scaling by increasing the pump spot area is shown to be intrinsically limited in semiconductor disk lasers with diamond heatspreaders. An output power of 9W is reported for a 1060 nm device.

JThA11
Self-Pulsation Clock Sources Based on Two-Section DFB Lasers with Built-in Shift Layer, *Jer-Shien Chen[1], San-Liang Lee[2], Hong-Chang Kung[3], Hen-Wai Tsao[4], Kuo-Chin Jong[4]; [1]Dept. of Electronic Engineering, Graduate Inst. of Communication Engineering, Natl. Taiwan Univ., Taiwan, [2]Dept. of Electronic Engineering, Natl. Taiwan Univ. of Science and Technology, Taiwan, [3]Electrical Engineering Dept., Tung Nan Inst. of Technology, Taiwan, [4]Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan.* We propose a novel model for estimating the self-sustained pulsation frequency (s.p.f), the model considers all the important factors in multi-sections DFB laser architecture, and the measured s.p.f. is matched the estimated s.p.f.

JThA12
Modulation Property of Multi-Spatial-Mode Semiconductor Mode-Locked Lasers, *Weiguo Yang; Western Carolina Univ., USA.* Modulation response of multi-spatial-mode semiconductor mode-locked lasers is studied by using coupled multi-mode rate equations and the analysis agrees well with previous experimental results that show the modulation response well beyond the relaxation-oscillation-resonance limit.

JThA13
Influence of Class-B to Class-A Transition on Relative Intensity Noise in Semiconductor Lasers, *Ghaya Baili[1], Thierry Malherbe[1], Mehdi Alouini[1], Fabien Bretenaker[2], Daniel Dolfi[1], Isabelle Sagnes[3]; [1]Thales Res. and Technology, France, [2]Lab Aimé Cotton, France, [3]Lab Photonique et Nanostructures, France.* The transitional regime from class-B to class-A dynamics in semiconductor lasers presents a non-resonant second order filtering behaviour. Compared to the transitional regime, class-A operation provides a very effective noise filtering especially at low frequencies.

JThA14
EBIC and HR-TEM Study of Catastrophic Optical Damaged High Power Multi-Mode InGaAs-AlGaAs Strained Quantum Well Lasers, *Yongkun Sin, Nathan Presser, Brendan Foran, Steven C. Moss; Aerospace Corp., USA.* We report our investigation of catastrophic optical damaged high power multi-mode InGaAs-AlGaAs strained quantum well (QW) lasers using electron beam induced current (EBIC), focused ion beam (FIB), and high-resolution transmission electron microscope (HR-TEM) techniques.

JThA15
Catastrophic Optical Damage in High-Power Diode Lasers Monitored by Real-Time Imaging, *Mathias Ziegler[1], Jens W. Tomm[1], Thomas Elsaesser[1], Clemens Matthiesen[2], Marwan Bou Sanayeh[3], Peter Brick[3]; [1]Max-Born-Inst., Germany, [2]Dept. of Physics, Cavendish Lab, Cambridge Univ., UK, [3]OSRAM Opto Semiconductors GmbH, Germany.* Combined thermal and near-field imaging monitors the catastrophic optical damage dynamics in diode lasers. Red-emitting high-power lasers display a very rapid and spatially confined catastrophic process with re-absorption as the key-mechanism of device degradation.

JThA16
Carrier Leakage in GaInNAsSb Quantum Well Lasers, *James W. Ferguson[1], Peter M. Smowton[1], Peter Blood[1], James A. Gupta[2], Geoffrey C. Aers[2]; [1]Cardiff Univ., UK, [2]Inst. for Microstructual Sciences, Natl. Res. Council of Canada, Canada.* We assess the non-radiative recombination mechanisms in GaInNAsSb structures by comparing p-doped, n-doped and un-doped material. Our results indicate a contribution from thermally activated leakage in 1.55μm GaInNAsSb Quantum well lasers at elevated temperatures.

JThA17
Detuning Characteristics of the Linewidth Enhancement Factor of a Mid-Infrared Quantum Cascade Laser, *Naoki Kumazaki[1], Yohei Takagi[1], Mikito Ishihara[1], Kenichi Kasahara[1], Atsushi Sugiyama[2], Naota Akikusa[2], Tadataka Edamura[2]; [1]Ritsumeikan Univ., Japan, [2]Central Res. Lab, Hamamatsu Photonics K.K., Japan.* The linewidth enhancement factor of a 5.2-μm distributed-feedback quantum cascade laser above the threshold current caused by detuning from the gain peak was investigated. We clearly observed different values for the linewidth enhancement factor.

JThA18
Wavelength Polarization Switching and Bistability in a 1550nm-VCSEL Subject to Orthogonal Optical Injection, *Antonio Hurtado, Ian D. Henning, Michael J. Adams; Univ. of Essex, UK.* We report the first experimental observation of different forms of wavelength polarization switching and bistability with a 1550nm-VCSEL operated just above threshold and subject to orthogonally-polarised optical injection.

JThA19
Polarization Bistability in 1550 nm Wavelength Single-Mode Vertical-Cavity Surface-Emitting Lasers Subject to Orthogonal Optical Injection, *Angel Valle, Marcos Gomez-Molina, Luis Pesquera; Inst. de Fisica de Cantabria, CSIC-Univ. Cantabria, Spain.* Pure frequency-induced polarization bistability of 1550nm single-mode VCSELs subject to orthogonal optical injection is observed. Hysteresis widths become constant for injection powers greater than a transition value. Power-induced polarization bistability is found near that value.

JThA20
Design and Fabrication of a λ/4 Phase-Shifted 1310 nm Laterally Coupled Distributed-Feedback Laser, *Ronald R. Millett[1], Hazem Awad[1], Maxime Poirier[2], Valery I. Tolstikhin[3], Trevor Hall[1], Karin Hinzer[1], Henry Schriemer[1]; [1]Univ. of Ottawa, Canada, [2]CMC Microsystems, Queen's Univ., Canada, [3]OneChip Photonics Inc., Canada.* We describe the design and fabrication of a λ/4 phase-shifted laterally-coupled distributed-feedback laser. The third-order grating for distributed-feedback is fabricated without regrowth using stepper lithography, a process that is amenable to high-yield, low-cost manufacturing.

JThA21
Group-IV Quantum Cascade Laser Operating in the L-Valleys, *Greg Sun[1], Jacob B. Khurgin[2], Jose Menéndez[3], Richard A. Soref[4]; [1]Univ. of Massachusetts, Boston, USA, [2]Johns Hopkins Univ., USA, [3]Arizona State Univ., USA, [4]AFRL, USA.* We design a lattice-matched $Ge/Ge_{0.76}Si_{0.19}Sn_{0.05}$ quantum cascade laser emitting at 49μm. This particular alloy composition gives a "clean" conduction band offset of 150meV at L-valleys with all other energy valleys sitting higher in energy.

JThA22
InGaAs Diode Laser System for the Generation of 480 fs Long Pulses with 340 W Peak Power, *Thorsten Ulm, Florian Harth, Johannes A. L'huillier, Richard Wallenstein; Technical Univ. of Kaiserslautern, Germany.* 480 fs long pulses with 340 W peak power are generated with an InGaAs diode laser MOPA system and a grating compressor, without stretching the pulses before amplification as required in commonly used CPA systems.

1:00 p.m.–2:30 p.m.
JThA • CLEO/QELS Poster Session III

JThA23
Passively Mode-locked 832-nm Vertical-External-Cavity Surface-Emitting Semiconductor Laser Producing 15.3-ps Pulses at 1.9-GHz Repetition Rate, *Keith G. Wilcox[1], Zakaria Mihoubi[1], Stephen P. Elsmere[1], Adrian H. Quarterman[1], Hannah D. Foreman[2], Anne C. Tropper[1]; [1]School of Physics and Astronomy, Univ. of Southampton, UK, [2]Inst. of Photonics, Univ. of Strathclyde, UK.* We report the first passively mode-locked 830-nm vertical-external-cavity surface-emitting laser. A semiconductor saturable absorber mirror with carrier recovery time governed by surface recombination was used to demonstrate pulses of 15.3 ps duration.

JThA24
Efficient Coherent Combining and Wavelength Stabilization of Tapered Lasers with a Volume Bragg Grating, *David Paboeuf[1], Olivier Braun[1], Gaëlle Lucas-Leclin[1], Nicolas Michel[2], Michel Krakowski[2], Patrick Georges[1]; [1]Inst. d'Optique, CNRS, Univ. Paris Sud, France, [2]Alcatel-Thales III-V Lab, France.* We describe the coherent combining and the wavelength stabilization of 10 tapered lasers in an external Talbot cavity. The use of a volume Bragg grating as feedback element to narrow the spectrum is demonstrated.

JThA25
Theoretical Analysis of High Speed Semiconductor Optical Amplifier Using Tunneling Injection Structure, *Kosuke Fujimoto, Tomoyuki Miyamoto, Yasutaka Higa, Hiroshi Nakajima, Fumio Koyama; Microsystem Res. Ctr., Tokyo Inst. of Technology, Japan.* We propose a SOA with a tunnel injection structure and analyze the operation properties. High-speed carrier recovery was suggested in the tunnel-injection SOA. The results indicate tunnel-injection SOAs have a potential of high-speed operation.

JThA26
***In situ* Active Region Temperature Measurement for THz Quantum Cascade Lasers,** *Saeed Fathololoumi[1], Dayan Ban[1], Hui Luo[2], Emmanuel Dupont[2], Sylvain R. Laframboise[2], Abderraouf Boucherif[2], Hui C. Liu[2]; [1]Univ. of Waterloo, Canada, [2]Natl. Res. Council of Canada, Canada.* The active region temperature of THz quantum cascade lasers during continuous-wave operation was measured using interband photoluminescence technique. The active region was found to be ~40K above heat sink temperature at maximum THz power output.

JThA27
Square-Root Law Thermal Response in VCSELs: Experiment and Theoretical Model, *Andreas Hangauer[1,2], Jia Chen[1,2], Markus C. Amann[2]; [1]Siemens AG, Germany, [2]Walter Schottky Inst., Technical Univ. of Munich, Germany.* A simple theoretical model is used to derive closed form expressions for the FM response of VCSELs. These match measurement results very well and give a significant improvement over the usually assumed first order model.

JThA28
A Facetless Laser Suitable for Monolithic Integration, *Diarmuid C. Byrne[1], Qiaoyin Lu[1], Wei-Hua Guo[1], John F. Donegan[1], Brian Corbett[2], Brendan Roycroft[2], Paul Lambkin[2], Jan P. Engelstaedter[2], Frank Peters[2]; [1]Semiconductor Photonics Group, Ireland, [2]Tydall Natl. Inst., Ireland.* A novel facetless laser diode is proposed and demonstrated. The facetless laser is realised by etching deep slots into the mirror sections of a multi-section semiconductor laser which provide the feedback for laser operation.

JThA29
Dissipative Solitons of the Ginzburg-Landau Equation in Normal-Dispersion Fiber Lasers, *William H. Renninger, Andy Chong, Frank W. Wise; Cornell Univ., USA.* Fiber lasers modelocked by filtering of a chirped pulse are analyzed with the Ginzburg-Landau equation. A range of experimental pulse shapes are predicted remarkably well by an exact analytical solution, and constitute dissipative temporal solitons.

JThA30
Efficient Output at 4600 nm in Dy:Chalcogenide Glass Fiber Laser with Cascade Lasing, *R. S. Quimby[1], L. B. Shaw[2], J. S. Sanghera[2], I. D. Aggarwal[2]; [1]Worcester Polytechnic Inst., USA, [2]NRL, USA.* The output power at 4600 nm in a Dy:chalcogenide glass fiber laser is found through numerical simulations to be significantly enhanced with simultaneous lasing at 3300 nm.

JThA31
Optimization of Yb^{3+}:ZBLANP Fiber Structure for Laser Cooling, *Galina Nemova, Raman Kashyap; Ecole Polytechnique de Montréal, Canada.* We propose an optimized fiber structure for laser cooling. It is shown that a long fiber with a small core can be more beneficial for laser cooling than a short fiber with a large core.

JThA32
Power Dependence of Brillouin Linewidths in a Silica Fiber, *Guanshi Qin, Takenobu Suzuki, Yasutake Ohishi; Res. Ctr. for Advanced Photon Technology, Toyota Technological Inst., Japan.* We report the dependence of Brillouin linewidths on the pump power below the threshold of Brillouin lasing in a silica fiber and explain these experimental results by the distributed fluctuating source model.

JThA33
Intermodal Interference in Two-Mode Air-Silica Microstructure Fibers, *Yuling Ji[1,2], Hou Lantian[1], Zhou Guiyao[1], Li Shuguang[1]; [1]Yanshan Univ., China, [2]Shanxi Normal Univ., China.* Characteristics of modal interference in two-mode air-silica microstructure fibers are discussed. The theoretical result agrees well with the experiment measurement. Furthermore, the fine structure of modal interference is predicted.

JThA34
Monolithic Ytterbium All-Single-Mode Fiber Laser with Direct Fiber-End Delivery of nJ-Level Femtosecond Pulses, *Dmitry Turchinovich; Dept. of Communications, Optics and Materials, Technical Univ. of Denmark, Denmark.* We demonstrate a monolithic, i.e. without any free-space coupling, all-single-mode passively modelocked Yb-fiber laser, with direct fiber-end delivery of 364-405 fs pulses of 4 nJ pulse energy using a low-loss hollow-core photonic crystal fiber compression.

JThA35
Nanostructured Optical Fiber Obtained by the Sol-Gel Process in the SiO_2-ZrO_2 System Doped with Erbium Ions, *Gurvan Brasse, Christine Restoin, Jean-Louis Auguste, Stéphanie Hautreux, Jean-Marc Blondy; XLIM, Unite Mixte de Recherche, Ctr. Natl. de la Recherche Scientifique, France.* We present experimental results concerning the first silica-zirconia nanostructured optical fiber doped with erbium ions obtained by the sol-gel process. The microstructure and the optical properties of the fiber are characterized.

JThA36
Widely Tunable Picosecond Fiber Ring Laser Mode-Locked by a Single-Wall Carbon Nanotube (SWNT)-Polycarbonate Composite Film Saturable Absorber, *Frank Wang, Richard V. Penty, Ian H. White, Zhipei Sun, Alex Rozhin, Vittorio Scardaci, Andrea C. Ferrari; Univ. of Cambridge, UK.* A widely tunable fiber ring laser, utilising a SWNT/polycarbonate film mode-locker and a 3-nm tunable filter, has been realized. 2.3ps pulse generation over 27nm spectral range is achieved for a constant pump power of 25mW.

JThA37
Two-Color Fiber Amplifier for Mid-Infrared Generation, *Ruben Romero Alvarez, Donna Strickland; Univ. of Waterloo, Canada.* 20µW of average power at ~18µm is generated by difference frequency mixing the 300mW, two-color output of a Yb:fiber amplifier. The mid-infrared power was not limited by two-photon absorption allowing it to be scaled.

JThA38
All Fiber Wavelength Tunable Bandpass Filter for Optical Inter-Connections, *Woojin Shin[1], K. Oh[2], B.-A. Yu[1], Y. L. Lee[1], T. J. Eom[1], Y.-C. Noh[1], D.-K. Ko[1], J. Lee[1]; [1]Advanced Photonics Res. Inst., Gwangju Inst. of Science and Technology, Republic of Korea, [2]Yonsei Univ., Republic of Korea.* We propose an all-fiber wavelength tunable bandpass filter with multi-mode to single-mode converting property via serially concatenated structure of a helicoidal long-period fiber grating (HLPFG), a hollow optical fiber (HOF), and a multimode fiber (MMF).

JThA39
Long Period Fiber Gratings Made in Active Fibers: Rigorous Analysis and Its Experimental Verification, *David Krcmarik[1,2], Radan Slavik[1], Miroslav Karasek[1], Mykola Kulishov[3]; [1]Inst. of Photonics and Electronics, Acad. of Sciences of the Czech Republic, Czech Republic, [2]Faculty of Electrical Engineering, Czech Technical Univ., Czech Republic, [3]HTA Photomask Inc., USA.* The presented novel and rigorous analysis, which includes grating-assisted diffraction of amplified spontaneous emission generated along the entire grating structure, predicts accurately performance of the studied devices in terms of both the amplitude and phase.

JThA40
Tunable Millimeter Wave Generation Using a Dual-Band Fiber Bragg Grating, *Youngjae Kim, Alexandre D. Simard, Philippe Chrétien, Sophie LaRochelle; Ctr. d'Optique, Photonique et Lasers, Dept. of Electrical and Computer Engineering, Univ. Laval, Canada.* We demonstrate a compact millimeter wave signal generator based on a phase-modulated laser and a dual-band FBG. Two optical sidebands of a phase-modulated spectrum propagate through two transmission windows temporarily open in a chirped FBG.

JThA41
Dual-Concentric-Core Microstructured Optical Fiber with Selective Filling of Hole for Chromatic Dispersion Compensation, *Marcos A. R. Franco[1,2], Valdir A. Serrão[1], Francisco Sircilli[1]; [1]Inst. de Estudos Avançados, Brazil, [2]Inst. Tecnológico de Aeronáutica, Brazil.* We propose three designs of microstructured optical fibers for chromatic dispersion compensation. Dispersion of – 3500, – 25000 and – 135000 ps/nm/km were obtained with FWHM of ~30 nm, ~6 nm and ~2 nm, respectively.

JThA42
Switchable Single-Longitudinal-Mode Dual-Wavelength Fiber Ring Laser Using Hybrid Gain Medium, *Shilong Pan, Xiaofan Zhao, Caiyun Lou; Tsinghua Univ., China.* We propose and demonstrate a novel single-longitudinal-mode dual-wavelength erbium-doped fiber ring laser incorporating a semiconductor optical amplifier. The dual-wavelength output with 40-GHz wavelength spacing is switchable in the range of 1533 nm-1565 nm.

JThA43
Tandem Fiber Laser: Injected Laser versus Double Pass Amplifier, *Ramatou Bello Doua[1,2], François Salin[1], Eric Freysz[3]; [1]Eolite, France, [2]Alphanov, France, [3]Univ. Bordeaux 1, France.* We coupled two laser fibers to provide two 6.7 ns, coherent, synchronized, adjustable, diffraction limited, Q-switched laser pulses with up to 120 kW peak power at repetition rates between 10 and 100 kHz.

JThA44
The Study of Embedded Reflection Gratings for Distributively Pumped Ytterbium-Doped Fiber Lasers, *Chun-Lin Chang[1], Dong-Yo Jheng[1], Chieh-Wei Huang[1], Kuang-Yu Hsu[1], Jia-Yin Lin[1], Seth Tsau[2], Chieh Hu[2], Jibin Horng[2], Sheng-Lung Huang[1,3]; [1]Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Laser Application Technology Ctr., Industrial Technology Res. Inst. South, Taiwan, [3]Inst. of Electro-Optical Engineering, Natl. Sun Yat-Sen Univ., Taiwan.* Embedded reflection gratings for distributed pumping by LD bar in fiber lasers are studied. The efficiencies of 92% and 82% are for binary and blazed gratings. Fabrication and alignment tolerances are analyzed at 915 nm.

JThA45
Full C-Band Tunable Laser Based on Electro-holography in the g44 Configuration, *Noam Sapiens, Assaf Bitman, Aharon J. Agranat; Hebrew Univ., Israel.* An electrically tunable laser covering the entire C-band is presented. The laser tuning device is an electrohologram in the g44 configuration implemented in a potassium lithium tantalate niobate crystal.

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JThA46
Fluorine-Doped Silica Fiber with High Transparency and Resistivity to Deep Ultra Violet Light, *Madoka Ono-Kuwahara, Akio Koike, Kaname Okada, Tomonori Ogawa; Asahi Glass Co. Ltd., Japan.* Transmittance exceeding 92 μm^{-1} at 266 nm and its permanence after 4 G pulses of laser irradiation are realized in fluorine-doped silica fiber due to the optimized fiber-manufacturing processes such as perform-fabrication and fiber-drawing.

JThA47
Ultra-Broadband Gain from a Bismuth-Doped Glass Waveguide Fabricated Using Ultrafast Laser Inscription, *Nicholas D. Psaila[1], Robert R. Thomson[1], Henry T. Bookey[1], Ajoy K. Kar[1], Yasushi Fujimoto[2], Masahiro Nakatsuka[2], Nicola Chiodo[3], Roberto Osellame[3], Giulio Cerullo[3]; [1]Heriot-Watt Univ., UK, [2]Osaka Univ., Japan, [3]Politecnico di Milano, Italy.* Waveguides were fabricated inside a Bi-doped silica glass using ultrafast laser inscription. When optically pumped at 980 nm, ultra-broadband gain was measured from the waveguides, paving the way for compact ultra-broadband optical amplifiers.

JThA48
Higher Order Mode Photonic Bandgap Fibers for Dispersion Control, *Zoltan Varallyay[1], Julia Fekete[2], Robert Szipocs[2]; [1]Furukawa Electric Inst. of Technology Ltd., Hungary, [2]Res. Inst. for Solid State Physics and Optics, Hungary.* We investigate the dispersion properties of solid core and hollow core photonic bandgap fibers and propose a novel, partial reflector layer around the core for dispersion control of femtosecond optical pulses.

JThA49
Temperature Dependence of Oxygen Sensitive Transducer, *Sean B. Pieper, Santanos Mestas, Zhong Zhong, Kenneth F. Reardon, Kevin L. Lear; Colorado State Univ., USA.* Photoluminescence emission power and lifetime temperature dependence for an oxygen sensitive ruthenium complex is investigated in sparged water and gas surroundings. From near freezing to 40°C studies show a negative linear response to temperature.

JThA50
Adaptive Detection of Doppler Frequency Shift Using ac Non-Steady-State Photo-EMF Effect, *Pedro Moreno Zarate[1], Ponciano Rodriguez[1], Sebastian Koeber[2], Klaus Meerholz[2], Svetlana Mansurova[1]; [1]Inst. Natl. de Astrofísica, Optica y Electrónica, Mexico, [2]Inst. für Physikalische Chemie, Germany.* Adaptive velocimeter based on the ac non-steady state photo-EMF effect induced by oscillating interference pattern has been investigated. The possibility to detect very low velocities (micrometer per second) using photoconductive polymer based detector was demonstrated.

JThA51
Experimental Phase Detection at the Quantum Limit with Coherent State Interferometry, *Juan F. Hodelin[1], Dirk Bouwmeester[1], Luca Pezze[2], Augusto Smerzi[2]; [1]Univ. of California at Santa Barbara, USA, [2]Univ. of Trento, Italy.* We experimentally demonstrate phase sensitivity at the standard quantum limit independent of phase using Bayesian phase estimation. This technique is unbiased and saturates the Cramer-Rao lower bound representing the optimum technique using coherent states.

JThA52
Advanced Length Metrology Exploiting the Frequency Comb of a Femtosecond Laser, *Young-Jin Kim, Jonghan Jin, Yunseok Kim, Sangwon Hyun, Seung-Woo Kim; Korea Advanced Inst. of Science and Technology, Republic of Korea.* The frequency comb of a femtosecond laser is exploited as the wavelength ruler for length metrology. This permits absolute distances to be precisely measured with uncertainty directly traceable to the atomic clock of time standard.

JThA53
Frequency Scanning Spectroscopy of Optical Frequency Comb with High-Resolution on an Absolute Frequency Axis, *Tatsutoshi Shioda, Takayoshi Mori, Kenichiro Fujii, Yosuke Tanaka, Takashi Kurokawa; Tokyo Univ. of Agriculture and Technology, Japan.* We propose high-resolution spectroscopy based on single-sideband optical modulator and optical frequency comb, which performed 1MHz resolution and >1THz measurement range on absolute frequency axis.

JThA54
Ti:Sapphire Comb Laser Devised for Direct Frequency Comb Spectroscopy, *Tsung-Han Wu, Chien-Ming Wu, Wang-Yau Cheng; Inst. of Atomic and Molecular Science, Academia Sinica, Taiwan.* We built up, for the first time to our knowledge, a Ti:sapphire comb laser directly referring to cesium 822.5 nm two-photon transition. The novel devices were designed for the flexibility of direct frequency comb spectroscopy.

JThA55
Predicting Amplitude and Phase Noise of Modelocked Lasers from the Pump Noise Power Spectrum, *Theresa D. Mulder, Ryan P. Scott, Brian H. Kolner; Univ. of California at Davis, USA.* From a measurement of the noise power spectral density of the pump laser, we predict and verify the amplitude and phase noise of a modelocked laser using the noise transfer function method.

JThA56
Number-Resolving, Single Photon Detection with No Deadtime, *Aaron J. Pearlman[1], Sergey V. Polyakov[1,2], Alan Migdall[1,2], Sae Woo Nam[3]; [1]Optical Technology Div., NIST, USA, [2]Joint Quantum Inst., Univ. of Maryland at College Park, USA, [3]Optoelectronics Div., NIST, USA.* We present a new scheme of a photon-resolving measurement with a superconducting microbolometer. Based on known "instrumental function" of the microbolometer, we convert its analog output into a digitized record of photon detections without deadtime.

JThA57
Fibre Transfer of High Stability Microwave References with Optical Frequency Combs, *Giuseppe Marra, Stephen Lea, Helen Margolis, Patrick Gill; Natl. Physical Lab, UK.* The 100 MHz repetition rate of a mode-locked erbium-doped fibre laser has been transmitted over 100 km of spooled fibre. With only passive dispersion compensation, short-term frequency instability below 4×10^{-14} has been demonstrated.

JThA58
Using Electromagnetically Induced Transparency to Assign the Hyperfine Transitions, *Yi-Chi Lee[1], Hsiang-Chen Chui[1], Zong-Syun He[2], 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.* Here, we propose a new method of identifying the unknown hyperfine transitions without a wavemeter, by the electromagnetically induced transparency. EIT is a phenomenon of quantum interference between two propagating electromagnetic radiations.

JThA59
Development of Re-Entrant Cavity Ringdown or Multi-Pass Absorption Spectroscopy for Measurement of Gas Properties, *Jérémie Courtois[1], Ajmal Mohamed[1], Daniele Romanini[2]; [1]Office Natl. d'Études et de Recherches Aérospatiales, France, [2]Lab de Spectrométrie Physique, Ctr. Natl. de la Recherche Scientifique, France.* We present two long-path absorption systems, one based on Cavity Ring Down and another on a Herriott cell, both with a re-entrant configuration to enhance spectral resolution and setup easiness, to measure weak absorption coefficients.

JThA60
Wavefront Measurements with Large Dynamic Range on High-Power Diode Lasers, *Yu-Kuan Lu[1], Shyh-Tsong Lin[2], Szu-Ming Yeh[1], Wood-Hi Cheng[1]; [1]Inst. of Electro-Optical Engineering, Natl. Sun Yat-Sen Univ., Taiwan, [2]Dept. of Electro-Optical Engineering, Natl. Taipei Univ. of Technology, Taiwan.* Wavefront measurements with large dynamic range (π/2 to -π/2) are demonstrated. The result of this study may provide an accuracy method for measuring the wavefront distributions of the laser light sources with large divergence angles.

JThA61
Long-Term CEP Stabilization of a Grating-Based High-Power Femtosecond Laser by the Direct Locking Method, *Jae-hwan Lee[1], Yong Soo Lee[1], Juyun Park[1], Tae Jun Yu[2], Chang Hee Nam[1]; [1]Dept. of Physics and Coherent X-Ray Res. Ctr., KAIST, Republic of Korea, [2]Advanced Photonics Res. Inst., GIST, Republic of Korea.* CEP of a high-power femtosecond laser was stabilized using the direct locking method. CEP stabilization was maintained for several hours with phase jitter of 180 mrad by adjusting the grating separation of a pulse compressor.

JThA62
A New Kind of Laser Microphone Using High Sensitivity Pulsed Laser Vibrometer, *Chen-Chia Wang[1], Sudhir Trivedi[1], Feng Jin[1], V. Swaminathan[2], Narasimha S. Prasad[3]; [1]Brimrose Corp. of America, USA, [2]Armament Res., Development and Engineering Ctr., Res., Development & Engineering Command, US Army, USA, [3]NASA Langley Res. Ctr., USA.* We demonstrate experimentally a new laser microphone using a highly sensitive pulsed laser vibrometer. By using the photo-electromotive-force (photo-EMF) sensors, we present data indicating the real-time detection of surface displacements as small as 4 pm.

JThA63
Paired Electromagnetically Induced Transparency with Dual Mode Laser: A Step toward EIT-Comb, *S. M. Iftiquar; Indian Inst. of Science, India.* Coupled electromagnetically induced transparency (EIT) has been observed with a dual mode control laser. The technique can be used for generating EIT-comb from optical frequency comb.

JThA64
Reduced Blue Shift in Screening the Quantum-Confined Stark Effect of an InGaN/GaN Quantum Well with the Prestrained Growth of a Light-Emitting Diode, *Chih-Feng Lu, Chi-Feng Huang, C. C. Yang; Natl. Taiwan Univ., Taiwan.* We demonstrate the reduced spectral blue shift in increasing injection current of an InGaN/GaN quantum-well light-emitting diode with prestrained growth and show that this effect is stronger when the prestained GaN barrier layer is thinner.

JThA65
High Enhancement in Light Output of InGaN-Based Micro-Hole Array LEDs by Photoelectrochemical (PEC) Oxidation, *Fang-I Lai[1], S. G. Lin[2], C. E. Hsieh[2], H. C. Kuo[2], T. C. Lu[2], S. C. Wang[2]; [1]Dept. of Electrical Engineering, Yuan-Ze Univ., Taiwan, [2]Inst. of Electro-Optical Engineering and Dept. of Photonics, Natl. Chiao Tung Univ., Taiwan.* InGaN micro-hole-array LEDs (μ-LEDs) with and without oxide-film on it were fabricated. Compared with conventional LED, output power of μ-LEDs without and with oxide film have enhancement of 38% and 82% at 20 mA, respectively.

JThA66
Effects of Gamma Irradiation on Optical Properties of CdSe/ZnS Colloidal Quantum Dots, *Nathan J. Withers[1], Krishnaprasad Sankar[1], Brian A. Akins[1], Tosifa A. Memon[1], Tingyi Gu[1,2], Jiangjiang Gu[1,2], Gennady A. Smolyakov[1], Marek Osinski[1]; [1]Univ. of New Mexico, USA, [2]Shanghai Jiao Tong Univ., China.* Effects of ^{137}Cs gamma irradiation on photoluminescent properties of CdSe/ZnS colloidal quantum dots are reported. Optical degradation was evaluated by measuring dependence of photoluminescence intensity on irradiation dose. CdSe/ZnS quantum dots show poor radiation hardness.

JThA67
Photosensitizer-Doped Organic Light-Emitting Diodes for Near Infrared to Visible Optical Upconversion, *Qihuang Gong, Zhijian Chen, Lixin Xiao, Yuan Zheng, Jiashu Lu; Peking Univ., China.* The optical upconversion of infrared light to visible light has been achieved in infrared photosensitizer-doped organic light-emitting diodes. This work brought forth a prototype design for novel flexible organic optical upconversion device.

JThA68
Enhancing the Light Extraction of InGaN Light-Emitting Diodes by Patterning the Dicing Streets, *Hung Cheng Lin[1], Yen Chun Tseng[1], Jen Inn Chyi[1,2,3], Chia Ming Lee[4]; [1]Dept. of Electrical Engineering, Natl. Central Univ., Taiwan, [2]Dept. of Optics and Photonics, Natl. Central Univ., Taiwan, [3]Res. Ctr. for Applied Sciences, Academia Sinica, Taiwan, [4]Tekcore Co. Ltd., Taiwan.* Patterning the dicing streets technology was used to define the high extraction efficiency region of InGaN-GaN multiple-quantum-well light-emitting diodes (LEDs). The external quantum efficiency (EQE) of the LEDs at 20 mA increased by 12.9%.

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JThA69
Bright and Color-Saturated Emission from Blue Light Emitting Diodes Based on Solution-Processed Colloidal Nanocrystal Quantum Dots, *Zhanao Tan, Fan Zhang, Ting Zhu, Jian Xu, Suzanne E. Mohoney, Jerzy Ruzyllo; Pennsylvania State Univ., USA.* We report a bright and color-saturated blue light-emitting-diode based on colloidal core/shell-CdS/ZnS quantum-dots. Broad-band, long-wavelength emission from the deep-traps in QDs is, for the first time, minimized to less than 5% of the total emission.

JThA70
Optical Anisotropy in InGaN/GaN Quantum-Well Light-Emitting Diodes with a General Crystal Orientation, *S.-H. Park[1], Doyeol Ahn[2], J. E. Oh[3,4]; [1]Catholic Univ. of Daegu, Republic of Korea, [2]Univ. of Seoul, Republic of Korea, [3]Hanyang Univ., Republic of Korea, [4]Wooree LST Corp., Republic of Korea.* We have studied the crystal orientation effect on optical anisotropy in InGaN/GaN quantum-well light-emitting diodes. The absolute value of the anisotropy is found to increase rapidly with increasing crystal angle.

JThA71
Degradation of Organic Light-Emitting Diodes: Dependence on Deposition Rate, *Shun-Wei Liu[1,2], Chih-Chien Lee[3], Guo-Jun Huang[3], Jiun-Haw Lee[1], Chin-Ti Chen[2], Juen-Kai Wang[4,5]; [1]Graduate Inst. of Photonics and Optoelectronics and Dept. of Electrical Engineering, Natl. Taiwan Univ., Taiwan, [2]Inst. of Chemistry, Academia Sinica, Taiwan, [3]Dept. of Electronic Engineering, Natl. Taiwan Univ. of Science and Technology, Taiwan, [4]Ctr. for Condensed Matter Sciences, Natl. Taiwan Univ., Taiwan, [5]Inst. of Atomic and Molecular Sciences, Academia Sinica, Taiwan.* The dependence of device degradation of organic light-emitting diodes (OLEDs) on film deposition rate is presented. The OLEDs made by lower deposition rates exhibit short device lifetime, which is attributed to the formed ordered aggregates.

JThA72
InGaN Light Emitters: A Comparison of Quantum Dot and Quantum Well Based Devices, *Yuh-Renn Wu[1], Yih-Yin Lin[2], Jasprit Singh[2]; [1]Graduate Inst. of Photonics and Optoelectronics and Dept. of Electrical Engineering, Natl. Taiwan Univ., Taiwan, [2]Dept. of Electrical Engineering and Computer Science, Univ. of Michigan, USA.* Optoelectronic properties of InGaN based quantum dots are studied including strain and piezoelectric polarization effects. The electron-hole overlap and effective bandgap with different dot sizes are studied and compared with quantum well cases.

JThA73
High Extraction Efficiency GaN Light-Emitting Diode with Photonic Crystal Patterns and Angled Sidewall Deflectors, *Joonhee Lee, Donguk Kim, Sihan Kim, Sungmo Ahn, Heonsu Jeon; Dept. of Physics and Astonomy, Seoul Natl. Univ., Republic of Korea.* We integrated into GaN LEDs both two-dimensional photonic crystal patterns and angled sidewall deflectors. The resultant devices exhibited about three-fold enhancement in vertical emission intensity when compared with the planar reference LED device.

JThA74
Crystal Fiber Based White Light Source Using Ce,Sm:YAG as the Active Medium, *Yen-Sheng Lin[1], Cheng-Nan Tsai[2], Po-Jui Liao[1], Dong-Yo Jheng[1], Sheng-Lung Huang[1,3]; [1]Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Inst. of Electro-Optical Engineering, Natl. Sun Yat-Sen Univ., Taiwan, [3]Dept. of Electrical Engineering, Natl. Taiwan Univ., Taiwan.* White light source using double-clad Ce,Sm:YAG crystal fiber was fabricated for the first time. The color-rendering index and color temperature are estimated to be 75 and 4610 K, respectively.

JThA75
Controlling the Radiative Rate of Electrophosphorescent Organometallic Complexes by Engineering the Singlet-Triplet Splitting, *Stephan Haneder[1], Enrico Da Como[1], Jochen Feldmann[1], John M. Lupton[2], Christian Lennartz[3], Peter Erk[3], Evelyn Fuchs[3], Oliver Molt[3], Ingo Muenster[3], Christian Schildknecht[3], Gerhard Wagenblast[3]; [1]Ludwig-Maximilians Univ. München, Germany, [2]Dept. of Physics, Univ. of Utah, USA, [3]BASF AG, Germany.* We address the role of singlet-triplet splitting in controlling the radiative rate for deep-blue electrophosphorescent metal complexes. An enhanced radiative rate correlates with a small splitting, highlighting the road map to efficient electrophosphorescence.

JThA76
Enhanced Vertical Extraction Efficiency from a Thin-Film InGaN/GaN Photonic Crystal Light-Emitting Diodes, *Chun-Feng Lai[1], H. W. Huang[1], C. H. Lin[1], H. C. Kuo[1], T. C. Lu[1], S. C. Wang[1], Chia-Hsin Chao[2]; [1]Natl. Chiao-Tung Univ., Taiwan, [2]Industrial Technology Res. Inst., Taiwan.* An InGaN/GaN thin-film light-emitting diode with the photonic crystal (PhC) on the surface and a TiO_2/SiO_2 omnidirectional reflector on the bottom was fabricated and found the line-width emission spectrum of 5 nm by the PhC.

JThA77
Role of Carrier Diffusion and Recombination in Photonic Crystal Nanocavity Optical Switches, *Takasumi Tanabe, Hideaki Taniyama, Masaya Notomi; NTT Basic Res. Labs, NTT Corp., Japan.* We studied the spatio-temporal behavior of the carriers in photonic crystal nanocavities and showed that diffusion enables fast switching, which is the advantage of nanocavity switches over other larger optical switches.

JThA78
Effect of Loss on Slow-Light Enhanced Absorption in Liquid-Infiltrated Photonic Crystals, *Jesper Pedersen, Sanshui Xiao, Niels Asger Mortensen; Technical Univ. of Denmark, Denmark.* We study slow-light enhancement of absorption measurements in photonic crystals composed of lossy dielectrics. We find that the material loss has an unexpected limited drawback and may even increase the bandwidth for low-index contrast systems.

JThA79
Nonlinear Dispersion in Silicon Photonic Wires, *Nicolae C. Panoiu[1], Xiaoping Liu[2], Richard M. Osgood[2]; [1]Dept. of Electronic and Electrical Engineering, Univ. College London, UK, [2]Dept. of Electrical Engineering, Columbia Univ., USA.* We present the first full theoretical and numerical analysis of the influence of the waveguide geometry and intrinsic material frequency dispersion of the nonlinearity, on the Si wires effective third-order nonlinearity and its frequency dispersion.

JThA80
Optimization of SiNx Planar Microdisk High Q Resonators for Chipscale Visible Integrated Photonics, *Ehsan Shah Hosseini, Siva Yegnanarayanan, Mohammad Soltani, Ali Adibi; Georgia Tech, USA.* Ultra-high Q (>5x10e[5]) microdisk resonators are demonstrated in a SiNx platform at 650nm with integrated in-plane coupling waveguides on a Si substrate. Critical coupling to first-order radial-mode is demonstrated using pedestal layer to control coupling.

JThA81
Enhanced Radiative Energy Transfer in Single Glycerol/Water Microdroplets on a Superhydrophobic Surface, *Alper Kiraz, Sultan Doğanay, Adnan Kurt, Adem Levent Demirel; Koç Univ., Turkey.* Up to 10 times enhancement in the energy transfer rate from donor to acceptor molecules is demonstrated at wavelengths resonant with a whispering gallery mode of a glycerol/water microdroplet standing on a superhydrophobic surface.

JThA82
Reducing Mode-Transition Loss in Silicon-on-Insulator Strip Waveguide Bends, *Hao Shen[1], Maroof Hkan[1], Shijun Xiao[2], Minghao Qi[1]; [1]Purdue Univ., USA, [2]NIST, USA.* Mode-transition loss in silicon-on-insulator strip waveguides is reduced from 0.019dB/transition to 0.0046dB/transition for a bending radius of 4.5 micrometer, by adding a gradual-transition curved waveguide to connect the bend section and straight section.

JThA83
Polarization Controlled Diffraction and Near-Field Hot-Spots in a Quasiperiodic Nanohole Array in a Gold Film, *Pramodha Marthandam, Reuven Gordon; Univ. of Victoria, Canada.* Quasicrystal arrays show a rotationally symmetric diffraction pattern that can be oriented with the polarization. A comprehensive electromagnetic theory agrees with the observed transmission spectrum and diffraction, and it shows near-field hot-spots.

JThA84
Designing Randomness—The Impact of Textured Surfaces on the Efficiency of Thin-Film Solar Cells, *Thomas Beckers[1], Karsten Bittkau[1], Reinhard Carius[1], Stephan Fahr[2], Carsten Rockstuhl[2], Falk Lederer[2]; [1]Inst. für Energieforschung 5, Forschungszentrum Jülich GmbH, Germany, [2]Inst. für Festkörpertheorie und -Optik, Friedrich-Schiller-Univ. Jena, Germany.* We analyze experimentally and theoretically light localization at randomly textured ZnO surfaces and light absorption in thin-film amorphous Si deposited conformal on it. Guidance is provided to tailor such surfaces for optimizing the absorption.

JThA85
Stimulated Emission of Laser Dyes in Opal-Like Matrix (Photonic Crystal) under Nanosecond Pulsed Laser Excitation, *Yurii V. Orlovskii, Tasoltan T. Basiev, Olimkhon K. Alimov; General Physics Inst. RAS, Russian Federation.* Transformation of fluorescence to stimulated emission in synthetic opals with voids filled by ethanol solutions of organic dyes is studied. Simultaneous shift of fluorescence and laser spectra maxima because of Bragg reflection is observed.

JThA86
Demonstration of L-Band Lasing in an Integrated Microsphere Plus Coupler Device, *Sile Nic Chormaic[1,2], Jonathan M. Ward[2,3]; [1]Univ. College Cork, Ireland, [2]Tyndall Natl. Inst., Ireland, [3]Cork Inst. of Technology, Ireland.* We explore thermal effects in a rare-earth doped glass microsphere resonator arising from internal heating of the cavity via pump intensity. This has facilitated the fabrication of an integrated coupler plus source for L-band lasing.

JThA87
Surface-Normal Fano Filters Based on Transferred Silicon Nanomembranes on Glass Substrates, *Hongjun Yang[1], Zexuan Qiang[1], Huiqing Pang[2], Zhenqiang Ma[2], Weidong Zhou[1], Mingyu Lu[1], Richard A. Soref[3]; [1]Univ. of Texas at Arlington, USA, [2]Univ. of Wisconsin, Madison, USA, [3]AFRL, USA.* Surface-normal optical filters based on Fano resonance were demonstrated in patterned single crystalline silicon nanomembranes on glass. Measured transmission agrees well with the design. High Q filters are feasible with design and process optimizations.

JThA88
Elliptic Optical Filters with All-Positive Couplings Based on the Double-Microring Ladder Architecture, *Ashok P. Masilamani, Hai Ling Liew, Vien Van; Univ. of Alberta, Canada.* Compact elliptic optical filter architectures based on arrays of parallel-cascaded microring doublets are proposed. These devices can realize general filter transfer functions with imaginary transmission zeros using only synchronously-tuned microrings with non-negative couplings.

JThA89
Large Spectral Tuning of Liquid Microdroplets Using the Optical Scattering Force, *Alper Kiraz, Saime Çiğdem Yavuz, Yasin Karadağ, Adnan Kurt, Alphan Sennaroglu, Hüseyin Çankaya; Koç Univ., Turkey.* By exerting optical scattering force at 1064 nm on glycerol/water microdroplets situated on a superhydrophobic surface, we have observed large spectral tuning of the whispering gallery modes up to 29.5 nm near 590 nm.

JThA90
Broadband Wide-Angle Polarization Converter, *Chang-Ching Tsai, Shin-Tson Wu; CREOL, Univ. of Central Florida, USA.* A novel polarization converter using reflective metallic gratings and broadband polarization beam splitter is developed. This device converts an unpolarized light to linear polarization with over 85% efficiency.

JThA91
Direct Observation of Higher-Order Whispering-Gallery Modes in a Defect-Free Surface Micro-Structure VCSEL, *Chih-Yao Chen[1], Yuan-Yao Lin[1], Chen-Ye Shen[2], Kuo-Yu Tang[2], Hung-Pin D. Yang[3], Tsin-Dong Lee[2], Ray-Kuang Lee[1]; [1]Inst. of Photonics Techologies, Natl. Tsing-Hua Univ., Taiwan, [2]Graduate School of Optoelectronics, Natl. Yunlin Univ. of Science and Technology, Taiwan, [3]Nanophotonic Ctr., Industrial Technology Res. Inst., Taiwan.* We demonstrate 23rd azimuthal order whispering-gallery modes in vertical cavity surface emitting lasers at room temperature by embedding a defect-free a surface micro-structure. Various modes are identified in experiments as well as numerical simulations.

JThA • CLEO/QELS Poster Session III—Continued

JThA92

High Efficiency White LEDs with 2-D Photonic Quasi-Crystal and Patterned Sapphire Substrate, *ChingHua Chiu[1], Bo Shiao Cheng[1], H. C. Kuo[1], T. C. Lu[1], S. C. Wang[1], H. W. Huang[2], C. C. Yu[2], C. H. Lin[2]; [1]Dept. of Photonics and Inst. of Electro-Optical Engineering, Natl. Chiao-Tung Univ., Taiwan, [2]Mesophotonics, Taiwan.* A high emitting efficiency GaN-based white LED with 2-D PQC on surface and PSS were successfully fabricated. After packaging, 21% enhancement in emitting luminous flux was achieved under the driving current 20 mA.

JThA93

Design and Fabrication of a Mid Infra-Red Photonic Crystal Defect Laser in Indium Antimonide, *Jonathan R. Pugh[1], Peter J. Heard[1], Geoff R. Nash[1,2], Tim Ashley[2], John G. Rarity[1], Martin J. Cryan[1]; [1]Univ. of Bristol, UK, [2]QinetiQ, UK.* This paper presents 2-D FDTD modelling and prototype fabrication of a mid-infrared photonic crystal defect laser. The device is fabricated using a two stage Focused Ion Beam process which results in improved hole profiles.

JThA94

Measurement of Mid-Infrared AlInSb Light-Emitting Diodes with Surface Patterning, *Ian J. Buss[1], Ben I. Mirza[1], Geoff R. Nash[1,2], C. Storey[2], L. Buckle[2], S. D. Coomber[2], M. T. Emeny[2], John G. Rarity[1], Martin J. Cryan[1]; [1]Photonics Res. Group, Dept. of Electrical and Electronic Engineering, Univ. of Bristol, UK, [2]QinetiQ, UK.* 3-D FDTD modelling is employed to design a surface pattern for mid-IR LEDs. Measured enhancement factors over an un-patterned device of 8% and 14% are found at 300K and 25K respectively.

JThA95

Matrix-Free Plane Wave Modal Expansion Approach for Robust Design of Photonic Structures, *Vivek Krishnamurthy, Matthias Messer, Janet Allen, Benjamin Klein; Georgia Tech, USA.* Fourier operator is used in the vectorial Helmholtz's equation for the calculation of layer modes in a 2d slice of a photonic device. The slice modes are then propagated throughout the device via scattering matrices.

JThA96

Blue and Yellow Electroluminescence of MOSLED Made on Si-Rich SiO_x Grown by PECVD with Detuning Buried Si Nanoclusters Size, *Chung-Hsiang Chang, Gong-Ru Lin; Graduate Inst. of Electro-Optical Engineering, Natl. Taiwan Univ., Taiwan.* Blue and yellow electroluminescence of MOSLEDs made on Si-rich SiO_x with buried Si nanocrystals of different sizes controlled with minimum hydrogen passivation are demonstrated by PECVD at different N_2O/SiH_4 ratio and total fluence.

JThA97

High Noise Rejection Filter Using Complementary Ring Resonators on Silicon-on-Insulator, *Karthik Narayanan, Zhaolin Lu, Stefan F. Preble, M. A. G. Abushagur; Rochester Inst. of Technology, USA.* We propose a high noise rejection filter using complementary ring resonators. The device has a much higher signal/noise ratio than a single ring resonator and can be used as a low noise electro-optic modulator.

JThA98

Electrically Controlled Silicon Photonic Crystal-Based Chromatic Dispersion Compensator with Ultra Low Power Consumption, *C. E. Png[1], G. H. Park[1], S. T. Lim[1], E. P. Li[1], A. J. Danner[2], M. B. Yu[3], K. Ogawa[4], Y. T. Tan[4]; [1]Inst. of High Performance Computing, A*Star, Singapore, [2]Dept. of Electrical and Computer Engineering, Natl. Univ. of Singapore, Singapore, [3]Inst. of Microelectronics, A*Star, Singapore, [4]Optics and Electronics Lab, Fujikura Ltd., Japan.* We demonstrate 3-D simulation and fabrication of a novel silicon photonic crystal chromatic dispersion compensator with ultra low power consumption, by exploiting a device structure where optical and electrical properties can be individually designed.

JThA99

Bistability and Ultrafast Mode Switching in Microlasers, *Sergei V. Zhukovsky[1], Dmitry N. Chigrin[1], Andrei V. Lavrinenko[2], Johann Kroha[1]; [1]Inst. of Physics, Univ. of Bonn, Germany, [2]COM-DTU and Nano DTU, Technical Univ. of Denmark, Denmark.* General theoretical principles for bistability in microlasers are formulated. Bistable lasing is reported between modes with similar spatial intensity profiles in coupled microcavities, allowing wavelength switching by several nanometers on an ultrafast, picosecond time scale.

JThA100

Mechanical Dissipation in Optical Microresonators, *Georg Anetsberger, Albert Schliesser, Rémi Rivière, Olivier Arcizet, Tobias J. Kippenberg; Max-Planck-Inst. of Quantum Optics, Germany.* We present a detailed understanding of mechanical dissipation in toroidal microresonators enabling the design of novel structures that combine ultra-high optical Q($>10^8$) and mechanical Q exceeding 50,000 at frequencies above 20 MHz at room temperature.

JThA101

Decay Control via Discrete-Continuum Modulation in Optical Waveguides, *Felix Dreisow[1], Alexander Szameit[1], Matthias Heinrich[1], Thomas Pertsch[1], Stefan Nolte[1], Andreas Tünnermann[1,2], Stefano Longhi[3]; [1]Friedrich Schiller Univ. Jena, Germany, [2]Fraunhofer Inst. of Appied Optics and Precision Engineering, Germany, [3]Dept. di Fisica and Inst. di Fotonica e Nanotecnologie del CNR, Politecnico di Milano, Italy.* We report on fractional decay suppression as well as decay deceleration and acceleration of an unstable quantum mechanical state. The decay is directly observed in a system of optical waveguides.

JThA102

Coherent Control of ac-Stark Allowed Transitions, *Gennady A. Koganov, Reuben Shuker; Ben Gurion Univ. of the Negev, Israel.* We show that nitially dipole-forbidden atomic transitions can be effectively controlled by bichromatic laser fields. Such transitions become dynamically allowed due to ac-Stark effect. Gain, dispersion and spectral properties of these transitions are discussed.

JThA103

Design of Photonic Crystal Microcavities in Diamond Films for Quantum Information, *Janine Riedrich-Möller, Christine Kreuzer, Roland Albrecht, Elke Neu, Christoph Becher; Univ. des Saarlandes, Germany.* We design photonic crystal microcavities in diamond films for applications in quantum information yielding high quality factors $Q>66000$ and small mode volume $V\approx1.1(\lambda/n)^3$. The calculated quality factors show a strong dependence on material absorption.

JThA104

Observation of Fidelity Saturation in a δ-Kicked Rotor Potential, *Saijun Wu, Alexey Tonyushkin, Mara G. Prentiss; Dept. of Physics, Harvard Univ., USA.* We experimentally investigate the effect of atomic δ-kicked rotor potentials on the mutual coherence between wavepackets in an atom interferometer, and demonstrate fidelity saturation in phase-space displacement echoes at quantum resonance.

JThA105

Toward a Scalable Dipole-Trapping Scheme for Neutral Atoms, *Lukas Brandt, Cecilia Muldoon, Edouard Brainis, Axel Kuhn; Univ. of Oxford, UK.* We present a new scheme for trapping single atoms in separate dipole-traps and manipulating them individually. It relies on a spatial light-modulator to create the traps and will find applications in cavity-QED.

JThA106

Frequency Comb Referenced Diode Laser System for Coherent Molecular Spectroscopy, *Klaus Doeringshoff[1], Ingo Ernsting[1], Stephan Schiller[1], Andreas Wicht[1], Rolf-Hermann Rinkleff[2]; [1]Univ. Düsseldorf, Germany, [2]Univ. Hannover, Germany.* We report on a low-noise diode laser system for coherent precision spectroscopy of individual rovibrational molecular states. A 10-fold reduction of frequency-noise of our diode laser with respect to grating stabilized diode lasers is presented.

JThA107

Excitation Dependence of Non-Markovian Dynamics in a Dense Potassium Vapor, *Xingcan Dai, Steven T. Cundiff; JILA, Univ. of Colorado and NIST, USA.* The transient four-wave mixing signal from a dense potassium vapor, which displays non-Markovian dynamics, depends on the excitation strength. Theoretical fits reveal the excitation dependence of the parameters employed in a two-time correlation function.

JThA108

Switching of Absorption in Coherently Driven Media, *Katrin Dahl[1,2], Luca Spani Molella[1,2], Rolf-Hermann Rinkleff[1,2], Karsten Danzmann[1,2]; [1]Max-Planck-Inst. für Gravitationsphysik, Albert-Einstein-Inst., Germany, [2]Inst. für Gravitationsphysik, Leibniz Univ. Hannover, Germany.* A system usually characterized by electromagnetically induced absorption was investigated with a probe and a coupling laser. Properly tuning the laser polarizations and intensities, first measurements showing inversions in the lasers absorption profiles were obtained.

JThA109

Comparative Study of Index of Refraction: The Strongly Driven and the Degenerate Two-Level Systems, *Rolf-Hermann Rinkleff[1,2], Lucca Spani Molella[1,2], Alessandra Rocco[2], Andreas Wicht[2], Karsten Danzmann[1,2]; [1]Inst. für Gravitationsphysik, Leibniz Univ. Hannover, Germany [2]Max-Planck-Inst. für Gravitationsphysik, Albert-Einstein-Inst., Germany.* Negative dispersion and transparency in strongly driven two-level system in calcium and positive dispersion and transparency or anomalous dispersion and enhanced absorption in closed degenerate two-level systems in caesium have been observed using pump-probe spectroscopy.

JThA110

Continuous-Variable Entanglement in a Two-Mode Three-Level Cascade Laser with a Parametric Amplifier, *Eyob Alebachew Sete; New Mexico State Univ., USA.* We analyze squeezing and entanglement properties of light produced by a two-mode three-level laser with parametric amplifier employing master equation. It turns out that the two-mode light is in a highly squeezed and entangled state.

JThA111

Polarization Control in Silicon-on-Insulator Waveguides Using Gap Plasmon Polaritons, *Ivan Avrutsky; Wayne State Univ., USA.* Resonant coupling to highly confined plasmonic modes in a metal-dielectric nanoscale multilayer on top of a silicon guiding core is proposed for polarization control in silicon-on-insulator waveguides.

JThA112

Numerical Design of Bidirectional Surface Plasmonic Polaritons Wave Coupler, *Zhan Fu[1,2], Qiaoqiang Gan[2], Kailu Gao[1], Gongtao Wang[1], Zhongqi Pan[1], Filbert J. Bartoli[2]; [1]Univ. of Louisiana at Lafayette, USA, [2]Lehigh Univ., USA.* We have investigated the Bragg gratings for surface plasmonic polaritons modes in the metal-dielectric-air waveguide and proposed a bidirectional coupler which is capable to guide the incident light at different wavelengths along two predetermined directions.

JThA113

Electric Field Enhancing Properties of the V-Shaped Optical Resonant Antennas, *Jiasen Zhang, Jing Yang, Qihuang Gong; State Key Lab for Mesoscopic Physics and Dept. of Physics, Peking Univ., China.* Both dipolar and quadrupolar modes are proved to be effectively excited and strong field enhancement is found in the gap of the V-shaped optical resonant antenna by using FDTD simulations.

JThA114

Nonlinear Optics of Magnetic Nanoparticles, *Irina Kolmychek[1], Tatyana Murzina[1], Stijn Fourier[2], Jelle Wouters[2], Thierry Verbiest[2], Oleg Aktsipetrov[1]; [1]Moscow State Univ., Russian Federation, [2]Katholieke Univ. Leuven, Belgium.* Nonlinear magneto-optical properties of magnetic core (shell) γ-Fe_2O_3(Au) and Fe_3O_4 (magnetite) nanoparticles are studied. Nonlinear magneto-optical Kerr effect in hyper-Rayleigh scattering at the second harmonic wavelength is about 10-20% for both types of nanoparticles.

JThA • CLEO/QELS Poster Session III—Continued

JThA115
Surface Plasmons in Periodically Coupled Gold Nanoparticles: A Semi-Analytical Model, *Tian Yang, Kenneth B. Crozier; Harvard Univ., USA.* The surface plasmon coupling between gold nanoparticles in a periodic array is theoretically modeled. The calculated dispersion relation and loss properties of an array of chains at air/glass interface agree well with FDTD simulation results.

JThA116
Loss Analysis of Non-Symmetrical Splitters in Subwavelength Plasmonic Waveguides, *Zhong Shi, Roman Ostroumov, Vladimir Kochergin; Luna Innovations, Inc., USA.* Losses were analyzed for non-symmetrical metal-dielectric-metal (MDM) splitters in subwavelength plasmonic waveguides. The simulation results show non-symmetrical MDM splitters have very high transmission and very close power splitting ratios among output ports at 1.5μm wavelength.

JThA117
Coupling Surface Plasmons: Index Matching and Dielectric Pillar Arrays, *Michiel J. A. de Dood[1], Eduard F. C. Driessen[1], Daniel Stolwijk[1], Marc A. Verschuurem[2], Gert W. 't Hooft[2], Martin P. van Exter[1]; [1]Huygens Lab, Leiden Univ., Netherlands, [2]Philips Res., Netherlands.* We study coupling between surface plasmons in metal-hole arrays. We observe avoided crossings in the measured transmission spectra for metal-hole arrays with a dielectric pillar in each hole and for arrays in index matching liquid.

JThA118
Trapping Across PCFs: A Numerical Study, *Peter Domachuk, Mark Cronin-Golomb, Fiorenzo G. Omenetto; Tufts Univ., USA.* We numerically examine the trapping efficiency of an optical beam transmitted transversely through a hollow-core, water filled photonic crystal fiber. The trapping beam retains its structure and trapping efficiency despite the fiber microstructure.

JThA119
Characterization of Plasmonic Bragg Reflectors with Implementation in Isolation Applications, *Brian C. Claus, Qiao Min, Pramodha Marthandam, Reuven Gordon; Univ. of Victoria, Canada.* Integrated plasmonic devices may be isolated using plasmonic Bragg reflectors (PBRs). Systematic experimental characterization shows optimal reflection for three PBR layers, 45 nm deep. Isolation between series of nanohole array structures using PBRs is demonstrated.

JThA120
Compact Node for Selective Surface Plasmon Coupling to Orthogonal Planar Metallic Wires, *Michael C. Quong, Abdulhakem Y. Elezzabi; Univ. of Alberta, Canada.* A node for coupling surface plasmons onto planar layers of metallic nanowires is studied via numerical calculations. Coupling to orthogonal arms of wires can be switched by interfering differently-polarized beams incident upon the node.

JThA121
Volume Holographic Phase Conjugation through a Sub-Wavelength Hole, *Felix Kalkum, Sebastian Broch, Karsten Buse; Inst. of Physics, Univ. of Bonn, Germany.* Holographic phase conjugation is used to focus light onto sub-wavelength holes in a gold film directly on top of a photorefractive lithium niobate crystal. This could lead to a high-numerical-aperture-focusing system.

JThA122
Enhanced Photoluminescence Excitation in Surface Plasmon Coupling with an InGaN/GaN Quantum Well, *Yen-Cheng Lu, Cheng-Yen Chen, Kun-Ching Shen, Dong-Ming Yeh, Tsung-Yi Tang, C. C. Yang; Natl. Taiwan Univ., Taiwan.* We observe the enhancement of photoluminescence excitation through the coupling of an InGaN/GaN quantum well (QW) with surface plasmons which are generated on an Ag nanostructure deposited on the SiN-coated QW epitaxial sample.

JThA123
Intensity and Polarization Nano-Patterns in a 2-D System of Interacting Dipoles, *S. N. Volkov, A. E. Kaplan; Johns Hopkins Univ., USA.* We demonstrated that predicted by us phenomenon of sub-wavelength nano-stratification of local field is feasible not only for 1-D, but also for 2-D structures, where it can produce huge field enhancement via size-related resonances.

JThA124
Nanophotonic Gate Operation Using Near-Field Energy Transfer between InAs Quantum Dots, *Kazuhiro Nishibayashi[1], Takumi Yamamoto[1], Tadashi Kawazoe[1], Kouichi Akahane[2], Naokatsu Yamamoto[2], Motoichi Ohtsu[1]; [1]Univ. of Tokyo, Japan, [2]Natl. Inst. of Information and Communications Technology, Japan.* We demonstrated nanophotonic gate operation of coupled InAs quantum dots using the pump-and-probe micro-photoluminescence measurement. The result indicates that we can select either AND- or NOT-gate operation by controlling the pulse intensity.

JThA125
Artifacts in Near-Field Scanning Optical Microscope Spectroscopy and Imaging of Nanoparticles, *Shih-Hui Chang, Yun-Chorng Chang; Inst. of Electro-Optical Science and Engineering, Natl. Cheng-Kung Univ., Taiwan.* NSOM spectroscopy and imaging of nanoparticles in both illumination and collection mode were studied. The artifacts of red-shifting in NSOM spectra and polarization dependent dark fringe patterns associated with each scattering resonant peak were explained.

JThA126
Atomic Fluorescence Emitted into an Optical Nanofiber: Coupling Efficiency and Spectrum, *Daniel Gleeson[1,2], Vladimir G. Minogin[2,3,4], Michael Morrissey[2,4], Kieran Deasy[2,4], Thejesh Bandi[2,4], Silé Nic Chormaic[1,2]; [1]Physics Dept., Univ. College Cork, Ireland, [2]Photonics Ctr., Tyndall Natl. Inst., Ireland, [3]Inst. of Spectroscopy, Russian Acad. of Sciences, Russian Federation, [4]Dept. of Applied Physics and Instrumentation, Cork Inst. of Technology, Ireland.* We present an analysis of fuorescence emitted by optically excited atoms and coupled to an optical fiber. We show frequency-position selectivity and asymmetry of the spectral emission line. Theoretical analysis is compared with experimental data.

JThA127
Active Near-Field Optical Microscopy, *Gaëlle Le Gac[1], Adel Rahmani[1], Christian Seassal[1], Emmanuel Picard[2], Emmanuel Hadji[2], Ségolène Callard[1]; [1]Inst. des Nanotechnologies de Lyon, Ecole Centrale de Lyon, France, [2]Dept. de Recherche Fondamentale sur la Matière Condensée, CEA Grenoble, France.* Near-field probe was used to tune the resonance wavelength of a linear cavity. Theorical and experimental study are presented to show the effect of the probe material on the cavity resonance.

JThA128
Ultrafast Surface Plasmon Pulses and Their Limitations Using Prism Coupling Excitation, *Sibel Ebru Yalcin, Yanzhen Wang, David Ouellette, Marc Achermann; Univ. of Massachusetts at Amherst, USA.* We characterize femtosecond surface plasmon pulses that are excited through conventional prism coupling on metal films. The resonant excitation mechanism causes spectral narrowing and phase changes that result in temporal broadening of ultrafast plasmon pulses.

JThA129
Nanophotonic Energy Converter Using ZnO Quantum Dots, *Takashi Yatsui[1], Hyung Su Jeong[2], Tadashi Kawazoe[2], Motoichi Ohtsu[2,1]; [1]Japan Science and Technology Agency, Japan, [2]Univ. of Tokyo, Japan.* Two sizes of ZnO quantum dots with resonant energy levels were mixed to confirm the energy transfer and resultant energy conversion using time-resolved photoluminescence spectroscopy. The energy transfer time was found to be 130 ps.

JThA130
Near-Field Optical Spectroscopy of Ga Nanoparticles for Plasmonics, *Antonio Llopis[1], Jie Lin[1], Arup Neogi[1], Jihoon Lee[2], Zhiming Wang[2], Gregory Salamo[2]; [1]Univ. of North Texas, USA, [2]Inst. of Nanoscale Science and Engineering, Univ. of Arkansas, USA.* Near-field optical spectroscopy of nanoscale Ga droplets on GaAs exhibits quenching of photoluminescence emission due to coupling with surface plasmon. Ga droplets exhibit antenna like behavior associated with a red-shift in the near-field photoluminescence emission.

JThA131
Toward Silicon-Compatible Modulation of Plasmonic Waveguides, *Thomas E. Furtak[1], Charles Durfee[1], Ali Sabbah[1], Reuben Collins[1], Russel Hollingsworth[2]; [1]Colorado School of Mines, USA, [2]ITN Energy Systems, USA.* We have modeled plasmonic waveguides that support low-loss modes using configurations compatible with metal-oxide-semiconductor devices. Our experimental verification with visible wavelength analogs demonstrates that silicon-based plasmonic modulators are possible.

JThA132
Surface Plasmon Polaritons Mediated by ITO at Near Infrared Wavelength, *M. Y. C. Xu, M. Z. Alam, A. J. Zilkie, K. Zeaiter, J. S. Aitchison; Univ. of Toronto, Canada.* ITO supports surface plasmon polaritons above 2.28 μm wavelength in symmetric glass-ITO-glass waveguides. Here, we report the dispersion relationship and experimental findings.

JThA133
Subwavelength Imaging Opportunities with a Non-Magnetic Slab Lens, *Huikan Liu, Shivanand Shivanand, Kevin J. Webb; Purdue Univ., USA.* We describe the imaging properties of a non-magnetic slab lens without restrictions on material parameters. The best performance appears to be with an anisotropic slab that converts evanescent fields to propagating waves.

JThA134
Nano-Stratification of Local Field and Atomic Bistability in Low Dimensional Structures, *A. E. Kaplan, S. N. Volkov; Johns Hopkins Univ., USA.* Nano-scale strata due to broken uniformity of local field in strongly self-interacting low dimensional structures are predicted. They result in giant field resonances and atomic optical bistability, including ultimate case of two coupled atoms.

JThA135
Interference of Light Emitted by a Slit and a Groove Coupled by Surface Plasmons, *Shigehiko Mori, Jonas Söderholm, Keisuke Hasegawa, Toshiya Segawa, Shuichiro Inoue; Inst. of Quantum Science, Nihon Univ., Japan.* We report on a method to generate an interference pattern from a slit-groove structure. Although we have not used a double-slit, a Young like interference pattern is observed due to the effect of surface plasmons.

Ballroom A1 and A8 | Ballroom A2 and A7 | Ballroom A3 and A6 | Ballroom A4 and A5

QELS

2:30 p.m.–4:15 p.m.
QThG • Nonlinear Photonic Lattice
Viktor A. Podolskiy; Oregon State Univ., USA, Presider

QThG1 • 2:30 p.m.
Delocalization of Localized Modes in Nonlinear Disordered Waveguide Lattices, *Yoav Lahini[1], Assaf Avidan[1], Francesca Pozzi[2], Mark Sorel[2], Roberto Morandotti[3], Demetrios N. Christodoulides[4], Yaron Silberberg[1]; [1]Weizmann Inst. of Science, Israel, [2]Dept. of Electrical and Electronic Engineering, Univ. of Glasgow, UK, [3]Inst. Natl. de la Recherche Scientifique, Canada, [4]College of Optics and Photonics, CREOL, Univ. of Central Florida, USA.* We present direct experimental measurements of localized eigenmodes in disordered one-dimensional waveguide arrays. In the nonlinear regime we observe delocalization of localized states, exhibiting different features in the limits of weak and strong disorder.

QThG2 • 2:45 p.m.
Wavepacket Expansion in Nonlinear Disordered Lattices, *Yoav Lahini[1], Assaf Avidan[1], Francesca Pozzi[2], Mark Sorel[2], Roberto Morandotti[3], Demetrios N. Christodoulides[4], Yaron Silberberg[1]; [1]Weizmann Inst. of Science, Israel, [2]Dept. of Electrical and Electronic Engineering, Univ. of Glasgow, UK, [3]Inst. Natl. de la Recherche Scientifique, Canada, [4]College of Optics and Photonics, CREOL, Univ. of Central Florida, USA.* We present experimental and numerical results of wavepacket expansion in one-dimensional disordered nonlinear waveguide arrays. We show that in 1-D there is a direct transition from ballistic expansion to localization, which is accelerated by nonlinearity.

QThG3 • 3:00 p.m.
Nonlinear Light Propagation in Rotating Waveguide Arrays, *Shu Jia, Jason W. Fleischer; Princeton Univ., USA.* We experimentally and theoretically study nonlinear propagation in a rotating waveguide array, created by propagating a self-rotating vortex lattice inside a self-defocusing photorefractive crystal. Non-inertial effects on discrete diffraction and soliton formation are observed.

2:30 p.m.–4:15 p.m.
QThH • Atom Interferometry and Atom Based Measurements
Presider to Be Announced

QThH1 • 2:30 p.m.
Perfect Coherence Preservation in an Atom Interferometer Perturbed by Optical Standing Wave Pulses Acting as a Kicked Rotor, *Alexey Tonyushkin[1], Saijun Wu[2], Mara Prentiss[1]; [1]Harvard Univ., USA, [2]NIST, USA.* We experimentally studied the effect of standing wave pulses on an atom interferometer. Despite the external field perturbations the coherence is perfectly preserved for the conditions similar to quantum resonances of a quantum kicked rotor.

QThH2 • 2:45 p.m.
Atom Interferometry Using Beam Splitters Based on Multi-Photon Bragg Diffraction: A Tool for Precision Measurements, *Sven Herrmann[1], Sheng-Wey Chiow[1], Holger Müller[1], Steven Chu[2]; [1]Stanford Univ., USA, [2]Lawrence Berkeley Natl. Lab, USA.* We apply multi-photon beam splitters based on Bragg diffraction in atom interferometers transferring up to 24 photon momenta in a single process. Ultimately, this may lead to atom interferometric measurements of increased precision.

QThH3 • 3:00 p.m.
Single Laser System for Onboard Atomic Interferometry, *Olivier Carraz, Fabien Lienhart, Nassim Zahzam, Yannick Bidel, Alexandre Bresson; ONERA, France.* We propose a compact and robust laser system for onboard Rubidium atomic interferometry useful for atomic inertial sensors. Our system is based on the second harmonic generation of a telecom fiber bench at 1560 nm.

CLEO

2:30 p.m.–4:15 p.m.
CThU • Carrier Envelope Phase Systems
Presider to Be Announced

CThU1 • 2:30 p.m.
Carrier-Envelope Stabilization of High-Average-Power Ultrafast Laser Amplifier Systems, *Daisy A. Raymondson[1], Sterling Backus[2], Dirk Mueller[2], Etienne Gagnon[1], Ming-Chang Chen[1], Paul Arpin[1], Margaret M. Murnane[1,2], Henry C. Kapteyn[1,2]; [1]JILA and Dept. of Physics, Univ. of Colorado, USA, [2]Kapteyn-Murnane Labs Inc., USA.* We report results from thorough characterization of a high average-power, cryogenically cooled, carrier-envelope phase (CEP) stabilized ultrafast laser system. We also discuss the effect of signal averaging on measured RMS noise in CEP.

CThU2 • 2:45 p.m.
Stabilizing Carrier-Envelope Phase by Controlling Grating Separation of Compressor, *Chengquan Li, Hiroki Mashiko, Eric Moon, He Wang, Steve Gilbertson, Zenghu Chang; J.R. Macdonald Lab, Dept. of Physics, Kansas State Univ., USA.* The carrier-envelope phase of amplified laser pulses was stabilized to 230 mrad by controlling compressor grating separation. This technique can be used to synthesize two amplified laser pulses.

CThU3 • 3:00 p.m.
Common-Path Interferometer for Incorruptible Detection of the Carrier-Envelope Phase Drift, *Christian Grebing, Sebastian Koke, Bastian Manschwetus, Günter Steinmeyer; Max-Born-Inst., Germany.* We propose and demonstrate a novel quasi-common-path variant of the *f*-to-2*f* interferometer that widely removes undesired residual phase drift from femtosecond pulse trains and improves the utility of stabilization schemes in frequency metrology and attophysics.

2:30 p.m.–4:15 p.m.
CThV • Novel Fiber Designs
John M. Fini; OFS Labs, USA, Presider

CThV1 • 2:30 p.m.
Polarization Maintaining Hybrid TIR/Bandgap All-Solid Photonic Crystal Fiber, *Jens K. Lyngsø[1,2], Brian J. Mangan[1], Peter J. Roberts[2]; [1]Crystal Fibre A/S, Denmark, [2]Dept. of Communications, Optics and Materials, Technical Univ. of Denmark, Denmark.* We report on fabricated all-solid fibers which guide by a combination of bandgap and TIR mechanisms. The fibers show high birefringence and possess a dispersion characteristic similar to the pure bandgap guiding form.

CThV2 • 2:45 p.m.
A New Kind of PM Fiber, Using Cylindrical Vector Beams, *Siddharth Ramachandran, Man F. Yan; OFS Labs, USA.* We generate radially polarised beams, attractive for many scientific and technological applications, as stable eigenmodes in optical fiber. This yields a new class of fibers that are polarization-maintaining even though they are strictly cylindrically symmetric.

CThV3 • 3:00 p.m.
Efficient Excitation of Polarization Vortices in a Photonic Bandgap Fiber with Ultrashort Laser Pulses, *Amiel A. Ishaaya[1], Bonggu Shim[1], Christopher J. Hensley[1], Samuel E. Schrauth[1], Alexander L. Gaeta[1], Karl W. Koch[2]; [1]Cornell Univ., USA, [2]Corning Inc., USA.* We experimentally investigate the excitation of radially and azimuthally polarized modes in a hollow-core photonic bandgap fiber. With radially-polarized ultrashort pulses, we achieve 91% total transmission through the fiber, including coupling losses.

Room C1 and C2

QELS

2:30 p.m.–4:15 p.m.
QThI • Exciton Dynamics I
Chih-Wei Lai; Michigan State Univ., USA, Presider

QThI1 • 2:30 p.m.
Spontaneous Coherence, Interaction and Kinetics of Macroscopically Ordered Exciton State, *Sen Yang[1], A. T. Hammack[1], A. V. Mintsev[1], M. M. Fogler[1], L. V. Butov[1], L. S. Levitov[2], B. D. Simons[3], A. C. Gossard[4]; [1]Dept. of Physics, Univ. of California at San Diego, USA, [2]Dept. of Physics, Ctr. for Materials Sciences and Engineering, MIT, USA, [3]Cavendish Lab, UK, [4]Materials Dept., Univ. of California at Santa Barbara, USA.* The macroscopically ordered exciton state (MOES) appears in the external exciton rings in GaAs/(Al,Ga)As coupled quantum wells below a few Kelvin. Here, we report on the experimental study of coherence, interaction and kinetics of MOES.

QThI2 • 2:45 p.m.
Kinetics of Excitons in an Optically Induced Exciton Trap, *Aaron T. Hammack[1], Leonid V. Butov[1], Leonidas Mouchliadis[2], A. L. Ivanov[3], Art C. Gossard[3]; [1]Univ. of California at San Diego, USA, [2]Cardiff Univ., UK, [3]Univ. of California at Santa Barbara, USA.* We report on the kinetics of a low-temperature gas of indirect excitons in an optically-induced exciton trap. The loading time of excitons to the trap center is ~40 ns.

QThI3 • 3:00 p.m.
Terahertz Coherent Control of the Internal Quantum State of Dark Excitons in Cu_2O, *Silvan Leinß[1], Tobias Kampfrath[2], Konrad von Volkmann[2], Martin Wolf[2], Dietmar Fröhlich[3], Alfred Leitenstorfer[1], Rupert Huber[1]; [1]Dept. of Physics, Univ. of Konstanz, Germany, [2]Dept. of Physics, Freie Univ. Berlin, Germany, [3]Dept. of Physics, Univ. of Dortmund, Germany.* Intense multi-terahertz fields of order MV/cm coherently promote 70% of the quasiparticles of an optically dark, dense, and cold 1s-para exciton gas in Cu_2O into the 2p state via a partial internal Rabi oscillation.

Room C3 and C4

JOINT

2:30 p.m.–4:15 p.m.
JThB • High-Energy Short-Pulse Lasers and Technology
Craig Siders; Lawrence Livermore Natl. Lab, USA, Presider

JThB1 • 2:30 p.m. Invited
The OMEGA EP High-Energy, Short-Pulse Laser System, *Leon J. Waxer, Mark J. Guardalben, John H. Kelly, Brian E. Kruschwitz, Jie Qiao, I. A. Begishev, J. Bromage, C. Dorrer, J. L. Edwards, L. Folnsbee, S. D. Jacobs, R. Jungquist, T. J. Kessler, R. W. Kidder, S. J. Loucks, J. R. Marciante, D. N. Maywar, R. L. McCrory, D. D. Meyerhofer, S. F. B. Morse, A. V. Okishev, J. B. Oliver, G. Pien, J. Puth, A. L. Rigatti; Lab for Laser Energetics, Univ. of Rochester, USA.* OMEGA EP (Extended Performance) is a petawatt-class addition to the existing 30-kJ, 60-beam OMEGA Laser Facility at the University of Rochester. Activation of the OMEGA EP Laser is near completion and results will be described.

JThB2 • 3:00 p.m.
Commissioning the Astra Gemini Petawatt Ti:Sapphire Laser System, *Chris J. Hooker, Steven Blake, Oleg Chekhlov, Rob J. Clarke, John L. Collier, Edwin J. Divall, Klaus Ertel, Peta S. Foster, Steven J. Hawkes, Paul Holligan, Brian Landowski, Bill J. Lester, David Neely, Bryn Parry, Rajeev Pattathil, Matthew Streeter, Brian E. Wyborn; Science and Technology Facilities Council, Rutherford Appleton Lab, UK.* Astra Gemini is a dual-beam petawatt Ti:Sapphire laser at the Rutherford Appleton Laboratory in the UK. We report measurements characterising the laser beam quality, pulse energy and pulse duration of the first beam line.

Room B1 and B2

CLEO

2:30 p.m.–4:15 p.m.
CThW • Visible and Ultraviolet Laser Systems
Eric Honea; Aculight Corp., USA, Presider

CThW1 • 2:30 p.m. Tutorial
Fundamental Mechanisms and Advances in Crystaline Up-Conversion Lasers, *Ernst Heumann; Univ. of Hamburg, Germany.* Excitation mechanisms and requirements on materials, and pump sources for crystalline up-conversion lasers will be discussed. Using suitable pump and resonator arrangements, significant improvements of existing results concerning room temperature up-conversion lasers could be achieved.

Ernst Heumann received his diploma degree and Ph.D. in Physics from the University Jena, Germany in 1968 and 1971, respectively. His thesis work involved the experimental study of stimulated Raman-scattering and self focusing in liquids and gases. From 1971 until 1990 he was with the nonlinear optics group of the Physics Department of the University Jena. Since 1991 he has been with the Institute of Laser-Physics of University of Hamburg, Germany. In 1998 he became a professor of Physics. His recent research activity includes development and characterization of materials for visible and UV solid state lasers, intracavity frequency doubling and up-conversion lasers. He is a member of the European Physical Society.

Room J2

2:30 p.m.–4:15 p.m.
CThX • Harmonic Generation
Takunori Taira; Laser Res. Ctr. for Molecular Science, Inst. for Molecular Science, Japan, Presider

CThX1 • 2:30 p.m. Invited
All-Optical Quasi-Phase Matching Techniques in High-Harmonic Generation, *Oren Cohen, Amy L. Lytle, Tenio Popmintchev, Henry Kapteyn, Margaret M. Murnane; JILA and Univ. of Colorado, USA.* Weak counter-propagating pulse trains or multiple quasi-cw waves can induce complex amplitude and phase modulated structures in the high-harmonic field. These "photonic" structures can be used for quasi-phase-matching the high-harmonic generation process.

CThX2 • 3:00 p.m.
3-D Optical Data Storage Using Third-Harmonic Generation in Silver Zinc Phosphate Glass, *Matthieu Bellec[1], Lionel Canioni[1], Arnaud Royon[1], Bruno Bousquet[1], Thierry Cardinal[2]; [1]Ctr. de Physique Moléculaire Optique et Hertzienne, Univ. Bordeaux 1, France, [2]Inst. de Chimie de la Matière Condensée de Bordeaux, Ctr. Natl. de la Recherche Scientifique, Univ. Bordeaux 1, France.* We demonstrate the possibility of 3-D optical data storage inside a zinc phosphate glass containing silver by using third-harmonic generation imaging. Information is stored inside the glass below the refractive index modification threshold.

Room J3	Marriott San Jose Salon 1 and 2	Marriott San Jose Salon 3	Marriott San Jose Salon 4

CLEO

2:30 p.m.–4:15 p.m.
CThY • Low-Dimensional Gain Media
Ann Catrina Bryce; Univ. of Glasgow, UK, Presider

2:30 p.m.–4:15 p.m.
CThZ • Lab-on-a-Chip for Biophotonic Applications II
Changhuei Yang; Caltech, USA, Presider

2:30 p.m.–4:15 p.m.
CThAA • Optical Transmission Systems
Curtis Menyuk; Univ. of Maryland, Baltimore County, USA, Presider

2:30 p.m.–4:15 p.m.
CThBB • Advanced Materials and Methods
Presider to Be Announced

***PhAST* sessions will begin at 2:00 p.m. in the *PhAST* session rooms in Exhibit Halls 1 and 3.**

CThY1 • 2:30 p.m. Invited
Lasers with Nanopatterned Active Regions, *James J. Coleman; Univ. of Illinois, USA.* The structures, processing methods and challenges, experimental results, and spectral analyses for patterned quantum dot lasers and nanopore ordered array lasers are presented and compared with otherwise identical quantum well laser diodes.

CThY2 • 3:00 p.m.
Toward Polarization Insensitive Semiconductor Optical Amplifiers Using InAs/GaAs Columnar Quantum Dots, *Philipp Ridha[1], Lianhe Li[1], Andrea Fiore[1], Gilles Patriarche[2], Meletios Mexis[3], Peter M. Smowton[3], Janusz Andrzejewski[4], Grzegorz Sek[4], Jan Misiewicz[4]; [1]Ecole Polytechnique Fédérale de Lausanne, Switzerland, [2]Lab de Photonique et Nanostructures, Ctr. Natl. de la Recherche Scientifique, France, [3]Cardiff Univ., UK, [4]Wroclaw Univ. of Technology, Poland.* We report columnar quantum dots (CQDs) with extremely large aspect ratios, showing nearly polarization-insensitive electroluminescence. A systematic experimental and theoretical investigation of their polarization properties as a function of aspect ratio is also reported.

CThZ1 • 2:30 p.m.
Silk Fibroin-Based Active Optofluidics, *Brian Lawrence, Hannah Perry, Peter Domachuk, Mark Cronin-Golomb, Irene Georgakoudi, David L. Kaplan, Fiorenzo G. Omenetto; Tufts Univ., USA.* The ancient silk fiber finds resurgence in a new paradigm of highly functional optofluidic devices embodied by an active oxygenation sensor comprising a hemoglobin infused cast silk integrated diffraction grating for spectral analysis.

CThZ2 • 2:45 p.m.
Effect of Fluorescently Labeling Protein Probes on Kinetics of Protein-Ligand Reactions, *Yung-Shin Sun[1], James P. Landry[1], Yiyan Fei[1], Juntao Luo[2], Xiaobing Wang[2], Kit S. Lam[2], Xiangdong Zhu[1]; [1]Dept. of Physics, Univ. of California at Davis, USA, [2]Div. of Hematology and Oncology, Dept. of Internal Medicine, Univ. of California at Davis, USA.* We study the kinetic effect of extrinsic fluorescent labeling agents on protein-ligand binding affinity and find that the kinetics is related to the loss or change of protein function when proteins are fluorescent-labeled.

CThZ3 • 3:00 p.m.
Optical Biosensor Based on One-Dimensional Photonic Crystal in a Total-Internal-Reflection Geometry, *Yunbo Guo[1], Jingyong Ye[1,2], Charles Divin[1], Andrzej Myc[2], James R. Baker Jr.[2], Theodore B. Norris[1,2]; [1]Ctr. for Ultrafast Optical Science, Univ. of Michigan, USA, [2]Michigan Nanotechnology Inst. for Medicine and Biological Sciences, Univ. of Michigan, USA.* We report a novel sensor for label-free biomolecular assay using a one-dimensional photonic crystal in a total-internal-reflection geometry. This configuration creates a unique open biosensing interface for real-time detection with ultrahigh sensitivity.

CThAA1 • 2:30 p.m.
Uncompensated 10.7 Gb/s Transmission over a 470 km Hybrid Fiber Link with In-Line SOAs, *John D. Downie, Jason Hurley, Yihong Mauro; Corning Inc., USA.* We experimentally demonstrate uncompensated WDM transmission over a 470 km hybrid fiber link using two versions of duobinary and in-line SOA amplification. MLSE receiver technology partially mitigates the accumulated dispersion of approximately 3300 ps/nm.

CThAA2 • 2:45 p.m.
20-Gb/s PolDM Duobinary Transmission in a 575-km SSMF Link with Automatic Polarization Stabilization and Optical Dispersion Compensation, *Pierpaolo Boffi[1,2], Maddalena Ferrario[1], Lucia Marazzi[1], Paolo Martelli[1], Paola Parolari[1], Aldo Righetti[1], Rocco Siano[1], Mario Martinelli[1,2]; [1]CoreCom, Italy, [2]Dept. of Electronics and Information, Politecnico di Milano, Italy.* 20-Gb/s transmission exploiting duobinary modulation and polarization-division multiplexing is shown. Experimental performances are evaluated in presence of an automatic polarization stabilizer and a double-pass optical dispersion compensator over 575-km SSMF.

CThAA3 • 3:00 p.m.
NRZ-OOK Transmission of 16x40 Gb/s over 2800 km SSMF Using Asynchronous Phase Modulation, *Marco Forzati[1], Anders Berntson[1], Jonas Mårtensson[1], Erwan Pincemin[2], Paulette Gavignet[2]; [1]Acreo AB, Sweden, [2]France Télécom, France.* We use the cost-effective APM technique to increase the non-linear tolerance of NRZ-OOK, and we demonstrate, in a recirculating loop experiment, the transmission over 2800-km SSMF of 16 NRZ-OOK 40-Gb/s channels with 100~GHz spacing.

CThBB1 • 2:30 p.m.
Fabrication and Characterization of Single-Walled Carbon Nanotube Saturable Absorbers for Solid-State Laser Mode-Locking Near 1 µm, *Jong Hyuk Yim[1], Soonil Lee[1], Won Bae Cho[1], Yeong Hwan Ahn[1], Kihong Kim[1], Fabian Rotermund[1], Guenter Steinmeyer[2], Valentin Petrov[2], Uwe Griebner[2]; [1]Ajou Univ., Republic of Korea, [2]Max-Born-Inst., Germany.* Ultrafast single-walled carbon nanotube saturable absorbers were fabricated and optimized for mode-locking solid-state lasers near 1 µm. Their typical modulation depth and recovery time were measured to be < 0.3% and ~ 750 fs, respectively.

CThBB2 • 2:45 p.m.
Measurement of the Optical Properties of Graphene from THz to Near-IR, *Jahan M. Dawlaty, Paul George, Jared Strait, Shriram Shivaraman, Mvs Chandrashekhar, Farhan Rana, Michael G. Spencer; Cornell Univ., USA.* We present experimental results on the optical properties of graphene from near-IR to THz frequencies. The interband absorption has a flat spectrum. At THz intraband absorption dominates and is well described by a plasmon model.

CThBB3 • 3:00 p.m.
Electrically Tunable Mid-Infrared Extraordinary Optical Transmission Gratings, *Daniel Wasserman[1], Eric A. Shaner[2], Jeff. G. Cederberg[2]; [1]Univ. of Massachusetts at Lowell, USA, [2]Sandia Natl. Labs, USA.* Active control over the resonant frequency of a surface plasmon excitation is demonstrated. Tunable semiconductor-based extraordinary optical transmission gratings were fabricated, designed for transmission between 7 and 10µm, showing a tuning range of over 25cm^{-1}.

Marriott San Jose Salon 5 and 6

CLEO

2:30 p.m.–4:15 p.m.
CThCC • Photonic Crystal High-Q Cavities
Steven Spector; MIT, USA, Presider

CThCC1 • 2:30 p.m.
Electrically Driven High-Q Quantum Dot-Micropillar Cavities, *Stephan Reitzenstein[1], Carolin Böckler[1], Caroline Kistner[1], Ralph Debusmann[1], Andreas Löffler[1], Julien Claudon[2], Laurent Grenouillet[3], Sven Höfling[1], Jean-Michel Gerard[2], Alfred Forchel[1]; [1]Technische Physik, Univ. Würzburg, Germany, [2]Dept. de Recherche sur la Matière Condensée, CEA/Ctr. Natl. de la Recherche Scientifique, Ecole Polytechnique, France, [3]CEA-Leti, Minatec, France.* We report on high quality electrically driven quantum dot micropillar cavities with Q-factors up to 16.000. The high Q-factors allow the observation of pronounced single dot resonance effects with a Purcell enhancement of about 10.

CThCC2 • 2:45 p.m.
Digital Resonance Tuning of High-Q/V_m Silicon Photonic Crystal Nanocavities by Atomic Layer Deposition, *Charlton Chen, Xiaodong Yang, Chad Husko, Chee Wei Wong; Columbia Univ., USA.* We propose and demonstrate the digital resonance tuning of high-Q/V_m silicon photonic crystal nanocavities using self-limiting atomic layer deposition. Control of resonances of 122 ± 18 pm per hafnium oxide atomic layer is achieved.

CThCC3 • 3:00 p.m.
Ultrahigh-*Q* Nanocavities Realized by Using a Very Narrow Photonic Crystal with Built-in Air Slots, *Eiichi Kuramochi, Takasumi Tanabe, Hideaki Taniyama, Akihiko Shinya, Masaya Notomi; NTT Basic Res. Labs, NTT Corp., Japan.* A new photonic crystal nanocavity combined with built-in air slots achieved an experimental *Q* of over 10^6 even when the photonic crystal on either side of the line defect had only a few lateral periods.

PhAST Room 1

PhAST

2:00 p.m.–4:00 p.m.
PThD • Laser Applications in the Photovoltaic Market II
Andreas Grohe; Fraunhofer Inst. for Solar Energy Systems, Germany, Presider

PThD1 • 2:00 p.m. Invited
Laser Process for Manufacturing High Efficiency Solar Cells at BP Solar, *Lian Zou, Carmen Morilla; BP Solar, USA.* Laser based processing techniques are used for the manufacturing of high efficiency solar cells at BP Solar. The Laser Grooved Buried Contact cell (LGBC) employs laser micromachining as a central tool in the manufacturing process, and laser isolation is becoming a standard for the screen-print technology. This work will review our experience in production with laser processing and other potential laser usage considered in BP Solar's roadmap.

PThD2 • 2:30 p.m. Invited
Overview of Laser Processes for Solar Cell Production, *Eric Schneiderlöchner, Frederik Bamberg, Holger Neuhaus; SolarWorld Industries USA, USA.* The paper will give a short overview on relevant laser beam applications in silicon wafer solar cell mass production. It will higlight some inherent advantages of laser technologies and also comment on possible challenges of possible future laser beam applications that are currently under investigation.

PThD3 • 3:00 p.m. Invited
Development of Laser Processes at UNSW for Innovative Photovoltaic Technology, *Stuart Wenham; Univ. of New South Wales, Australia.* The most exciting of the UNSW laser-based technologies is the laser-doped solar cell, which is currently the focus of commercialization initiatives. In this technology, laser energy is used in localized areas of the wafer surface to diffuse n-type dopants through an antireflection coating (ARC) and into the underlying silicon that is simultaneously melted. This simultaneously decomposes the ARC in these areas, thereby exposing the heavily doped silicon surface for subsequent self-aligned metal plating. The structure produced is close to ideal in terms of achieving high performance solar cells, while simultaneously being particularly simple and low cost to produce. In pilot production, these cells are achieving a performance increase of more than 10% compared with conventional screen-printed solar cells.

PhAST Room 2

2:00 p.m.–4:00 p.m.
PThE • Lasers in Manufacturing IV
Mikhail Zervas; SPI Lasers, UK, Presider

PThE1 • 2:00 p.m. Keynote
KEYNOTE: Applications of Yb Fiber Lasers in Microelectronics Fabrication, *William O'Neill, Kun Li; Cambridge Univ., UK.* The increasing scope of laser applications in the microelectronics sector demonstrates a need to increase our understanding of the characteristics of laser matter interactions on a range of electronic materials and length scales down to several hundred nm. Standard DPSS laser systems offer high beam qualities with wavelengths from the infrared at 1.5µm to the ultraviolet at 355nm. It has long been thought that the drive towards UV wavelengths was necessary in order to produce effective processing. This paper compares the laser matter interaction characteristics on a range of microelectronic materials when using a high brightness Yb fiber laser operating at 1µm and that produced with UV DPSS laser operating at 355nm.

PThE2 • 2:30 p.m. Invited
Benefits of Micro Processing with High Repetition Rate Pulsed Fiber Lasers, *Jack Gabzdyl; SPI Lasers, UK.* Traditional q-switched laser sources have been limited in pulse frequency and in overall control of pulse energy and length. A novel pulsed fibre laser capable of operation from cw through to 500kHz has provided a tool that has enabled a number of significant processing improvements from a greatly extended parameter window. The benefits of operating in the >100kHz regime, encompassing both quality and productivity, are evident in a broad range of applications such as marking of metals, plastics and IC packages, and also in micromachining, silicon processing and thin film patterning for solar and FPD applications. Clearly, applications that have low pulse energy thresholds can benefit most from operating in the high frequency regime.

PThE3 • 3:00 p.m. Invited
High-Power Industrial Applications of Fiber Lasers, *Bill Shiner; IPG Photonics, USA.* No abstract available.

PhAST Room 3

2:00 p.m. • 4:00 p.m.
PThF • New Solar Technology for Grid Parity
Yong-Hang Zhang; Arizona State Univ., USA, Presider

PThF1 • 2:00 p.m. Invited
High Efficiency Solar Cells for Space Applications, *John Merrill; AFRL, USA.*

PThF2 • 2:20 p.m. Invited
Multijunction Solar Cells and Their Applications, *Nasser Karam; Spectrolab, USA.*

PThF3 • 2:40 p.m. Invited
Concentrator Photovoltaic Systems and Their Economics, *Vahan Barboushian; Amonix, USA.*

PThF4 • 3:00 p.m. Invited
High Efficiency Hybrid Integrated Solar Cells, *Allen Barnett; Univ. of Delaware, USA.*

Ballroom A1 and A8 | Ballroom A2 and A7 | Ballroom A3 and A6 | Ballroom A4 and A5

QELS

QThG • Nonlinear Photonic Lattice—Continued

QThG4 • 3:15 p.m.
Nonlinear Hofstadter Butterfly and Its Optical Realization, *Ofer Manela[1], Mordechai Segev[1], Demetrios N. Christodoulides[2]; [1]Technion - Israel Inst. of Technology, Israel, [2]School of Optics, CREOL, Univ. of Central Florida, USA.* We study the extended modes of a nonlinear quasi-periodic system and show that the nonlinear spectra are deformed versions of the Hofstadter Butterfly. An optical realization of the Hofstadter Butterfly is proposed.

QThG5 • 3:30 p.m.
Optical Properties of PT Synthetic Structures, *Konstantinos Makris[1], Rami El-Ganainy[1], Demetrios Christodoulides[1], Ziad Musslimani[2]; [1]CREOL, College of Optics, Univ. of Central Florida, USA, [2]Florida State Univ., USA.* We investigate for the first time optical beam dynamics in parity-time (*PT*) synthetic structures. We show that *PT* symmetric systems can exhibit a host of intriguing characteristics such as non-reciprocal Bloch modes and power oscillations.

QThG6 • 3:45 p.m.
Complex Networks of Interacting Solitons: Noise-Enhanced Memory and Self-Synchronization, *Ido Kaminer, Mordechai Segev, Alfred M. Bruckstein, Yonina C. Eldar; Technion Israel, Israel.* We propose complex networks constructed from interacting vector solitons. Within soliton-based networks, we demonstrate memory effects that are greatly enhanced by noise, as well as spontaneous entire network self-synchronization effects.

QThG7 • 4:00 p.m.
Linear Guidance of Dipole Modes in an Optically Induced Ring Lattice with a Low-Index Core, *Jiandong Wang[1], Jianke Yang[1], Xiaosheng Wang[2], Simon Huang[2], Zhigang Chen[2,3]; [1]Univ. of Vermont, USA, [2]San Francisco State Univ., USA, [3]TEDA Applied Physics School, Nankai Univ., China.* Linear guidance of dipole modes in an optically induced ring lattice with a low-refractive-index core is demonstrated both theoretically and experimentally. Such modes are also obtained in the theoretical model.

QThH • Atom Interferometry and Atom Based Measurements—Continued

QThH4 • 3:15 p.m.
Atom Microscopy Beyond Diffraction Limit by Resonance Fluorescence Spectroscopy, *Jun-Tao Chang[1], Jörg Evers[2], Marlan Scully[1,3], Suhail Zubairy[1]; [1]Physics Dept., Texas A&M Univ., USA, [2]Max-Planck-Inst. für Kernphysik, Germany, [3]Princeton Inst. for Materials Res., Princeton Univ., USA.* We proposed an atom microscopy scheme measuring distance between two identical atoms placed in a standing-wave laser field by measuring fluorescence spectrum or g_2 function's spectrum. It has fractional-wavelength precision from about λ/550 to λ/2.

QThH5 • 3:30 p.m.
Subwavelength Imaging via Dark State, *Hebin Li[1], Vladimir Sautenkov[1], Michael M. Kash[2], George R. Welch[1], Yuri Rostovtsev[1], Marlan O. Scully[1]; [1]Inst. for Quantum Studies, Texas A&M Univ., USA, [2]Lake Forest College, USA.* Performing experiments in Rb vapor, we demonstrated spatial patterns being smaller than the length determined by the diffraction limit. This approach has applications to interference lithography and to coherent Raman spectroscopy for subwavelength resolution.

QThH6 • 3:45 p.m.
Phase Shift of the Retrieved Light Caused by Microwave Field, *Z. F. Hu, Y. Z. Wang; Key Lab of Quantum Optics, Shanghai Inst. of Optics and Fine Mechanics, Chinese Acad. of Science, China.* We have theoretically investigated the large phase rotation of the retrieved light field caused by a microwave field based on light storage with very low tensity of the microwave field.

QThH7 • 4:00 p.m.
Cesium Spin-Exchange-Relaxation-Free Magnetometer, *Igor M. Savukov[1], Micah Ledbetter[2], Victor Acosta[2], Dmitry Budker[2], Michael Romalis[3]; [1]Los Alamos Natl. Lab, USA, [2]Univ. of California at Berkeley, USA, [3]Princeton Univ., USA.* We have built and tested a Cs atomic magnetometer operating in the spin-exchange relaxation-free (SERF) regime at much lower temperature than a more conventional potassium SERF magnetometer developed at Princeton University.

CLEO

CThU • Carrier Envelope Phase Systems—Continued

CThU4 • 3:15 p.m.
Demonstration of Locking Carrier Envelope Offset by Using Low Pulse Eenergy, *Atsushi Ishizawa[1], Tadashi Nishikawa[1], Hidetoshi Nakano[1], Shinichi Aozasa[2], Atsushi Mori[2], Osamu Tadanaga[2], Masaki Asobe[2]; [1]NTT Basic Res. Labs, NTT Corp., Japan, [2]NTT Photonics Labs, NTT Corp., Japan.* We demonstrate a carrier-envelope-offset (CEO)-locked frequency comb with 230-pJ fiber coupling pulse energy by using a passive-modelocked Er-fiber amplifier laser. We succeeded in CEO stabilization at telecommunications wavelengths using the lowest fiber coupling pulse energy.

CThU5 • 3:30 p.m.
Coherent Control Using the Carrier-Envelope Phase, *Mark J. Abel[1,2], Thomas Pfeifer[1,2], Aurélie Jullien[1,2], Phillip M. Nagel[1,2], Justine Bell[1,2], Daniel M. Neumark[1,2], Stephen R. Leone[1,2]; [1]Univ. of California at Berkeley, USA, [2]Lawrence Berkeley Natl. Lab, USA.* Octave-spanning laser pulses enable a new coherent control scheme based on the carrier-envelope phase (CEP). Multiphoton ionization of Xe atoms demonstrates CEP control over the phases of photoelectron quantum states and therefore the photoelectron direction.

CThU6 • 3:45 p.m.
A Linear Optical Method for Measuring the Carrier Envelope Offset Phase, *Karoly Osvay[1], Mihály Görbe[2], Christian Grebing[1], Günter Steinmeyer[1]; [1]Max Born Inst., Germany, [2]Dept. of Optics, Univ. of Szeged, Hungary.* A linear optical method is demonstrated for extracting the carrier-envelope offset phase via the fringe visibility in a combined two-path multi-path interferometer. This method is applicable to a wider class of lasers than f-to-2f interferometry.

CThU7 • 4:00 p.m.
High Average Power Fs Frequency Comb from an Optically Injection Locked Amplification Cavity, *Justin Paul, James Johnson, Jane Lee, R. Jason Jones; College of Optical Sciences, Univ. of Arizona, USA.* We demonstrate a scalable approach for the generation of high average power fs pulse trains by optically injection locking an amplification cavity. Initial results generated 4.7 Watts average power and 70 fs pulses.

CThV • Novel Fiber Designs—Continued

CThV4 • 3:15 p.m.
Small Core Ultra High Numerical Aperture Fibers with Very High Nonlinearity, *Libin Fu, Brian K. Thomas, Liang Dong; IMRA America Inc., USA.* We demonstrated ultra-high NA fibers with core-diameters down to 1.2μm, low loss and high nonlinearity. Efficient supercontinuum generation is demonstrated in a 2μm core fiber. These fibers are spliced to conventional fibers with low loss.

CThV5 • 3:30 p.m.
Fabrication of Metre-Long Fibre Tapers, *Natasha Vukovic, Neil G. R. Broderick, Marco Petrovich, Gilberto Brambilla; Optoelectronics Res. Ctr., Univ. of Southampton, UK.* We report a novel fibre taper facility that allows tapering in the intermediate range of lengths of both standard and microstructured optical fibres. In particular, we examine issues related to the diameter fluctuations during tapering.

CThV6 • 3:45 p.m.
HAFs Having λ_0 in a 1.0μm Band and High Nonlinearity, *Ryo Miyaba, Kazunori Mukasa, Ryuichi Sugizaki, Takeshi Yagi; Fitel Photonics Lab, Furukawa Electric Co. Ltd., Japan.* We designed and fabricated simple-structure HAFs having λ_0 in a 1.0μm band as well as low confinement loss and single-mode operation over wide range of wavelengths. The developed HAFs showed high nonlinearity and good connectivity.

CThV7 • 4:00 p.m.
Suspended Core High Numerical Aperture Multimode Polymer Fiber, *Bertrand Gauvreau, Dhia Khadri, Ning Guo, Maksim Skorobogatiy; École Polytechnique de Montréal, Canada.* The transmission performances of a novel high numerical aperture polymer made multimode fiber are presented. The suspended core structure offers a low propagation loss in the visible and enables microfluidic capabilities.

4:15 p.m.–4:45 p.m., Coffee Break, *Concourse Level*

Room C1 and C2

QELS

QThI • Exciton Dynamics I—Continued

QThI4 • 3:15 p.m.
Thermal Distribution of Cu_2O Paraexcitons in a Strain-Induced Trap Probed by Excitonic Lyman Spectroscopy, *Eun Mi Chae, Kosuke Yoshioka, Takuro Ideguchi, Nobuko Naka, Makoto Kuwata-Gonokami; Univ. of Tokyo, Solution Oriented Research for Science and Technology, Core Research for Evolutional Science and Technology, Japan Science and Technology Agency, Japan.* We observe the signal of trapped paraexcitons in Cu_2O by using CW excitonic Lyman spectroscopy. The temperature dependence of the 1s-2p induced absorption of paraexcitons indicates the presence of a strain-induced trap.

QThI5 • 3:30 p.m.
Coherent Control of Resonant Two-Photon Excitation of Excitons in Cu_2O by Phase Modulated Pulses, *Takuro Ideguchi, Toshiyuki Sakamoto, Kosuke Yoshioka, Makoto Kuwata-Gonokami; Univ. of Tokyo, Core Res. for Evolutional Science and Technology (CREST), Japan.* By using a pulse shaping method, we control the resonant two-photon excitation probability of 1s orthoexcitons in Cu_2O and suppress the undesired three-photon interband transition which emerges at a high power excitation.

QThI6 • 3:45 p.m.
Quantum-Confined Stark Effect in Intersubband Transition in InAs/GaAs Quantum Dots, *Xuejun Lu; Univ. of Massachusetts at Lowell, USA.* Quantum-confined Stark effect (QCSE) in intersubband transition in InAs/GaAs quantum dots (QD) is reported. The QCSE induced linear shift of the absorption spectrum was observed and analyzed to be in good agreement with theoretical predication.

QThI7 • 4:00 p.m.
Tunable Terahertz Amplification in Optically Excited Biased Semiconductor Superlattices, *Dawei Wang[1], Aizhen Zhang[1], Lijun Yang[2], Marc M. Dignam[1]; [1]Queen's Univ. at Kingston, Canada, [2]Univ. of California at Irvine, USA.* We simulate the carrier dynamics of an optically-excited, updoped AlGaAs superlattice in the presence of a terahertz pulse. It exhibits large tunable terahertz gain due to excitonic effects, even with large numbers of unbound excitons.

Room C3 and C4

JOINT

JThB • High-Energy Short-Pulse Lasers and Technology—Continued

JThB3 • 3:15 p.m.
Optical Parametric Chirped-Pulse-Amplification Contrast Enhancement by Regenerative Pump Spectral Filtering, *Christophe Dorrer[1], Andrey V. Okishev[1], Ildar A. Begishev[1], Jonathan D. Zuegel[2], Vadim I. Smirnov[3], Leonid B. Glebov[4]; [1]Lab for Laser Energetics, Univ. of Rochester, USA, [2]Lab for Laser Energetics, USA, [3]OptiGrate, USA, [4]Univ. of Central Florida, USA.* A method for fundamentally improving the temporal contrast of optical parametric chirped-pulse-amplification (OPCPA) systems by using a volume Bragg grating to regeneratively filter the OPCPA pump spectrum is demonstrated for the first time.

JThB4 • 3:30 p.m.
Direct Amplification of 12 fs Pulses in a Terawatt Class CPA Laser System, *Abdolreza Amani Eilanlou[1,2,3], Yasuo Nabekawa[1], Kenichi L. Ishikawa[2,3], Hiroyuki Takahashi[2], Katsumi Midorikawa[1]; [1]RIKEN, Japan, [2]Univ. of Tokyo, Japan, [3]JST, Japan.* We have demonstrated the direct amplification of 12-fs pulses in a terawatt-class CPA system of Ti:Sapphire laser. Spectral narrowing during amplification is successfully compensated by regenerative pulse shaping featuring a specially designed partial mirror.

JThB5 • 3:45 p.m.
Realization of a Tiled-Grating Compressor for the OMEGA EP Petawatt Laser System, *Jie Qiao, Adam Kalb, David Canning, John H. Kelly; Lab for Laser Energetics, Univ. of Rochester, USA.* Eight tiled-grating assemblies (TGA's) have been developed for the OMEGA EP Petawatt Laser System. The methods and results for tiling individual TGA's and for optimizing the overall tiling performance of the compressors will be described.

JThB6 • 4:00 p.m.
Application of Phase Retrieval for Predicting a High-Intensity Focused Laser Field, *Seung-Whan Bahk, Jake Bromage, Jonathan D. Zuegel, James R. Fienup; Univ. of Rochester, USA.* Multiple-focal-plane spatial phase retrieval for a chirped-pulse-amplification laser is demonstrated for the first time. Advantages of this method are simplicity of setup, ability to measure angular dispersion, and potential integration into precision, on-shot focal-spot diagnostics.

Room B1 and B2

CLEO

CThW • Visible and Ultraviolet Laser Systems—Continued

CThW2 • 3:30 p.m.
Efficient Visible Laser Emission of GaN Laser Diode Pumped Pr-Doped Fluoride Crystals, *Francesco Cornacchia[1], Alberto Di Lieto[1], Mauro Tonelli[1], André Richter[2], Ernst Heumann[2], Günter Huber[2]; [1]Natl. Enterprise for nanoScience and nanoTechnology, Inst. Nazionale per la Fisica della Materia, Consiglio Nazionale delle Ricerche and Dept. di Fisica dell' Univ. di Pisa, Italy, [2]Inst. of Laser Physics, Univ. of Hamburg, Germany.* We report on the spectroscopy and laser results of diode pumped Pr-doped fluorides. We obtained efficient laser emission in the visible range with $LiYF_4$ $LiLuF_4$ and $LiGdF_4$ crystals.

CThW3 • 3:45 p.m.
Micro-Pulling Down Method Grown Ce:LiCAF as Ultraviolet Laser, *Marilou M. Cadatal[1,2], Minh Pham[1,2], Toshihiro Tatsumi[3], Ayumi Saiki[3], Yusuke Furukawa[3], Elmer Estacio[3], Nobuhiko Sarukura[3], Toshihisa Suyama[4], Kentaro Fukuda[4,5], Kyoung Jin Kim[5], Akira Yoshikawa[5], Fumio Saito[5]; [1]Inst. for Molecular Science, Japan, [2]Graduate Univ. for Advanced Studies, Japan, [3]Inst. of Laser Engineering, Osaka Univ., Japan, [4]Tokuyama Corp., Japan, [5]Tohoku Univ., Japan.* We report the first successful micro-pulling down method growth and ultraviolet emission from a Ce:LiCAF crystal. With two-side pumping configuration, 23% slope efficiency is obtained from the 290-nm emission of a 30mm-long, 2mm-wide Brewster-cut crystal.

CThW4 • 4:00 p.m.
All-Solid-State Sub-200-nm Pulsed Deep Ultraviolet Source, *Yushi Kaneda[1], N. Peyghambarian[1], Kenshi Miyazono[2], Hiroya Shimatani[2], Yoshiyuki Honda[2], Masashi Yoshimura[2], Yusuke Mori[2], Yasuo Kitaoka[2], Takatomo Sasaki[2]; [1]Univ. of Arizona, USA, [2]Osaka Univ., Japan.* Using a diode-pumped Q-switched Nd:YAG laser as the pump source, 198.5-nm was constructed. With 1.15 W of average power at 1064 nm, 12 mW of average output power was obtained at 198.5 nm.

Room J2

CThX • Harmonic Generation—Continued

CThX3 • 3:15 p.m.
Intra-Cavity Frequency Tripling in Actively Q-Switched Ceramic Nd:YAG Micro-Laser, *Koji Tojo[1], Naoya Ishigaki[1], Akiyuki Kadoya[1], Kazuma Watanabe[1], Katuhiko Tokuda[1], Yutaka Ido[1], Takunori Taira[2]; [1]Shimadzu Corp., Japan, [2]Laser Res. Ctr. for Molecular Science, Inst. for Molecular Science, Japan.* A compact UV-light source for MALDI/TOFMS based on an intra-cavity frequency tripled, actively Q-switched ceramic Nd:YAG micro-laser, with more than 55µJ pulse-energy and less than 5ns pulse-width up to 6kHz repetition, has been demonstrated.

CThX4 • 3:30 p.m.
Laser and Self-Doubling Operations in an Nd:YCOB Sphere, *Simon Joly[1], Yannick Petit[1], Patricia Segonds[1], Benoit Boulanger[1], Corinne Felix[1], Pierre Brand[1], Bertrand Menaert[1], Gérard Aka[2]; [1]Inst. Néel, Ctr. Natl. de la Recherche Scientifique, Univ. J. Fourier, France, [2]Ecole Natl. Supérieure de Chimie de Paris, France.* We report experimental results of a laser based on a Nd:YCOB crystal cut as a sphere inserted between two plane mirrors. It is being used as a unique tool for the direct characterization of self-doubling.

CThX5 • 3:45 p.m.
Second Harmonic Generation Using Axially Symmetric, Polarized Beams with Spatial Variation of Ellipticity, *Yuichi Kozawa, Shunichi Sato; Inst. of Multidisciplinary Res. for Advanced Materials, Tohoku Univ., Japan.* Transverse mode conversion by second harmonic generation is demonstrated using focused axially symmetric, polarized beams with spatial variation of ellipticity. Superposition of higher order transverse modes of Hermite-Gaussian or Laguerre-Gaussian beams forms peculiar intensity patterns.

CThX6 • 4:00 p.m.
Frequency Doubling of 300J/1ns Nd:Glass Laser Pulses, *Efim A. Khazanov, Grigory A. Luchinin, Michail A. Martyanov, Anatoly K. Poteomkin, Andrey A. Shaykin; Inst. of Applied Physics, Russian Federation.* Two types of interaction at second harmonic generation of Nd:glass laser are compared theoretically and experimentally. If beam depolarization >1%, ooe-interaction is preferable. A 72% efficiency has been obtained at the fundamental harmonic of 300J.

4:15 p.m.–4:45 p.m., Coffee Break, *Concourse Level*

Room J3	Marriott San Jose Salon 1 and 2	Marriott San Jose Salon 3	Marriott San Jose Salon 4

CLEO

CThY • Low-Dimensional Gain Media—Continued

CThY3 • 3:15 p.m.
Gain and Phase Dynamics of InAs/GaAs Quantum Dot Semiconductor Optical Amplifiers, *Ian O'Driscoll[1], Tomasz Piwonski[1,2], John Houlihan[1,3], Guillaume Huyet[1,2], Robert J. Manning[1], Brian Corbett[1]; [1]Tyndall Natl. Inst., Ireland, [2]Cork Inst. of Technology, Ireland, [3]Waterford Inst. of Technology, Ireland.* The gain/phase transients of InAs/GaAs quantum-dot semiconductor-optical-amplifiers are analysed using a 2-colour heterodyne pump-probe arrangement. Key processes highlighted include hole dynamics for the gain, and wetting-layer electron dynamics for the phase.

CThY4 • 3:30 p.m.
The Ordered Nanopore Array Diode Laser: Comparing Analysis with Experiment, *V. B. Verma, V. C. Elarde, J. J. Coleman; Univ. of Illinois at Urbana-Champaign, USA.* An analytical model describing the density of states and gain spectrum of the ordered nanopore array diode laser is presented. The theoretically predicted gain spectrum shows excellent agreement with experimental results.

CThY5 • 3:45 p.m.
An Investigation of Differences in Electron and Hole Confinement in InAs/InGaAsP Quantum Dash Lasers, *Susannah C. Heck[1], Sorcha B. Healy[1], Simon Osborne[1], David P. Williams[1], Robin Fehse[1], Eoin P. O'Reilly[1], Francois Lelarge[2], Francis Poingt[2], Alain Accard[2], Frederic Pommereau[2], Odile Le Gouezigou[2], Beatrice Dagens[2]; [1]Tyndall Natl. Inst., Ireland, [2]Alcatel Thales III-V Lab, France.* We calculate that strain and confinement effects lead to similar conduction and valence density of states in InGaAsP quantum dashes. Room temperature threshold remains dominated by non-radiative recombination, as in 1.5 µm quantum well lasers.

CThY6 • 4:00 p.m.
Extension of Quasi-Supercontinuum Generation in Multiple-Bandgap Semiconductor Quantum-Dash Laser, *Chee-Loon Tan[1], Hery Susanto Djie[2], Yang Wang[1], Dong Ning Wang[1], James C. M. Hwang[1], Boon Siew Ooi[1]; [1]Lehigh Univ., USA, [2]JDS Uniphase Corp., USA.* We demonstrate a viable approach for ultrabroad-stimulated emission in InAs/InAlGaAs quantum-dash laser. This method involves the integration of multiple diodes with respective bandgaps tuned to different energies along a single laser cavity using postgrowth-intermixing process.

CThZ • Lab-on-a-Chip for Biophotonic Applications II—Continued

CThZ4 • 3:15 p.m.
Vertically Emitting Distributed Feedback Laser for Active Label Free Biosensing, *Meng Lu, Steven Choi, Clark J. Wagner, J. Gary Eden, Brian T. Cunningham; Univ. of Illinois at Urbana-Champaign, USA.* A distributed feedback laser has been demonstrated as a label free biosensor. The stimulated emission wavelength changes with the refractive index variations on the sensor surface. The sensor exhibits high resolution and wide dynamic range.

CThZ5 • 3:30 p.m.
Nanoscale Optofluidic Sensor Arrays for Dengue Virus Detection, *Sudeep Mandal, Julie Goddard, David Erickson; Cornell Univ., USA.* The NOSA architecture's primary advantage is that it combines the sensitivity (mass limit of detection) of nanosensor devices with the parallelism of the microarray format. We demonstrate successful detection of a Dengue virus serotype.

CThZ6 • 3:45 p.m.
Incorporable DFB Dye Lasers for Micro-Flow-Channels on a Polymeric Chip, *Yu Yang[1], Shusaku Kataoka[1], Noriyuki Kamogawa[1], Hirofumi Watanabe[1], Kenichi Yamashita[2], Masaya Miyazaki[2], Yuji Oki[1]; [1]Graduate School of Information Science and Electrical Engineering, Kyushu Univ., Japan, [2]Natl. Inst. of Advanced Industrial Science and Technology, Japan.* Integration techniques of tunable film dye lasers on a plastic optical application chip were studied. We fabricated microflowcytometry chip integrated with DFB film lasers as a first example. Preliminary LIF experiment was also demonstrated.

CThZ7 • 4:00 p.m.
Electrokinetic Control of Single Molecules in Fused Silica Fluidic Nanochannels, *Brian K. Canfield, Xiaoxuan Li, William Hofmeister, Lloyd M. Davis; Univ. of Tennessee Space Inst., USA.* We discuss single-molecule detection of fluorescently-labeled proteins in solution within a nanochannel fabricated in fused silica. Confocal fluorescence microscopy and fluorescence correlation spectroscopy are employed to monitor the motion of single molecules under electrokinetic control.

CThAA • Optical Transmission Systems—Continued

CThAA4 • 3:15 p.m.
Impact of Rayleigh Backscattering on Stimulated Brillouin Scattering Threshold Evaluation for 10Gb/s NRZ-OOK Signals, *Maddalena Ferrario[1], Lucia Marazzi[1], Pierpaolo Boffi[1,2], Aldo Righetti[1], Mario Martinelli[1,2]; [1]CoreCom, Italy, [2]Dept. of Electronics and Information, Politecnico di Milano, Italy.* We experimentally verified a decrease of Stimulated Brillouin Scattering threshold for 10Gb/s NRZ-OOK signals with respect to theoretical predictions. We relate this reduction to Rayleigh Backscattering interaction with Stokes backscattered spectrum. BER curves are shown.

CThAA5 • 3:30 p.m.
A Waveplate Hinge Model for PMD in Installed Fibers, *Jinglai Li[1], Gino Biondini[2], William L. Kath[1]; [1]Northwestern Univ., USA, [2]SUNY Buffalo, USA.* We propose a waveplate hinge model to characterize anisotropic PMD effects. We compute outage probabilities and the non-compliant capacity ratio, and we show that there are significant differences between isotropic and anisotropic hinge models.

CThAA6 • 3:45 p.m.
Effective Amplification of Real WDM Burst Traffic Using Optical Gain Clamping, *Marcelo Zannin[1], Stefano Taccheo[1,2], Karin Ennser[1], Davide Careglio[3], Josep Solé-Pareta[3]; [1]Inst. of Advanced Telecommunications, Swansea Univ., UK, [2]Dept. di Fisica, Politecnico di Milano, Italy, [3]Univ. Politècnica de Catalunya, Spain.* Experimental studies of real optical burst traffic in WDM systems are performed with optical gain clamping for stabilizing the EDFA amplification. Impairments of power variation due to burst are shown to be negligible.

CThAA7 • 4:00 p.m.
High-Speed Chromatic Dispersion Monitoring of a Two-Channel WDM System Using a Single TPA Microcavity, *Krzysztof Bondarczuk[1], Paul J. Maguire[1], Liam P. Barry[1], John O'Dowd[2], Wei H. Guo[2], Michael Lynch[2], A. Louise Bradley[2], John F. Donegan[2]; [1]Dublin City Univ., Ireland, [2]Trinity College, Univ. of Dublin, Ireland.* Chromatic dispersion monitoring of two 160Gb/s wavelength channels using a TPA Microcavity is presented. As the microcavity exhibits a wavelength resonance characteristic, a single device could monitor a number of different WDM-channels sequentially.

CThBB • Advanced Materials and Methods—Continued

CThBB4 • 3:15 p.m.
Graded Index Optical Lens Using Inhomogeneous Metamaterials, *Svyatoslav Smolev, Steven R. J. Brueck; Ctr. for High Technology, Univ. of New Mexico, USA.* We numerically demonstrate a low loss optical lens (~1.55 µm) with inhomogeneous graded index metamaterials. Parametric studies are presented. For a $(64x64)\lambda^2$ sample f=3.2 mm, T=0.76. This structure can be fabricated with standard semiconductor processing.

CThBB5 • 3:30 p.m.
Two-Dimensional Dynamic Focusing and Optical Switching of Laser Light by Ferroelectric Devices, *Mahesh Krishnamurthi, Mariola Ramirez, Lili Tian, Venkatraman Gopalan; Pennsylvania State Univ., USA.* Two-dimensional dynamic focusing is demonstrated by using lens-shaped ferroelectric domain stacks. The devices were fabricated on Lithium Tantalate and tested at 633 nm. Novel designs and numerical simulations are presented for optical switching applications.

CThBB6 • 3:45 p.m.
MRF: Engineering Large-Scale Crystals for Improved Wavefront, *K. I. Schaffers, J. A. Menapace, A. J. Bayramian, P. J. Davis, C. A. Ebbers, J. E. Wolfe, J. A. Caird, C. P. J. Barty; Lawrence Livermore Natl. Lab, USA.* Magneto-rheological finishing techniques have been applied to Yb:S-FAP and Ti:sapphire crystals to compensate for submillimeter distortions, improving the transmitted wavefront (10x) and increasing the availability of large aperture parts (>10 cm).

CThBB7 • 4:00 p.m.
Solvent-Casting Deposition of Chalcogenide Glass for Photonic Applications, *Shanshan Song, Candice Tsay, Craig B. Arnold; Princeton Univ., USA.* A solvent casting method of depositing amorphous chalcogenide materials has been developed. Films are characterized and applied to the tuning of mid-infrared photonic structures and waveguide fabrication through a combination of soft-lithography and microfluidics.

4:15 p.m.–4:45 p.m., Coffee Break, *Concourse Level*

Marriott San Jose Salon 5 and 6 | *PhAST* **Room 1** | *PhAST* **Room 2** | *PhAST* **Room 3**

CLEO

CThCC • Photonic Crystal High-Q Cavities—Continued

CThCC4 • 3:15 p.m.
Local Tuning of Photonic Crystal Cavities Using Chalcogenide Glasses, *Andrei Faraon[1], Dirk Englund[1], Douglas Bulla[2], Barry Luther-Davies[2], Benjamin J. Eggleton[3], Nick Stoltz[4], Pierre Petroff[4], Jelena Vuckovic[5]; [1]Dept. of Applied Physics, Stanford Univ., USA, [2]Ctr. for Ultrahigh-Bandwidth Devices for Optical Systems, Laser Physics Ctr., Australian Natl. Univ., Australia, [3]Ctr. for Ultrahigh-Bandwidth Devices for Optical Systems, School of Physics, Univ. of Sydney, Australia, [4]Univ. of California at Santa Barbara, USA, [5]E. L. Ginzton Lab, Stanford Univ., USA.* We developed a method to locally tune refractive index in photonic crystals. The technique, based on photodarkening of chalcogenide glasses, enables 3nm resonance tuning of GaAs photonic crystal cavities operating at 940nm.

CThCC5 • 3:30 p.m.
Photonic Crystal Laser Cavities Optimized by the Geometric Projection Method, *Christopher M. Long[1], Walter R. Frei[2], Antonios V. Giannopoulos[1], Harley T. Johnson[1], Kent D. Choquette[1]; [1]Univ. of Illinois, USA, [2]COMSOL, USA.* We report the quality factor and spectral characteristics of a photonic crystal cavity laser optimized by the geometry projection method. Fabricated devices show 30% improvement in quality factor, consistent with a predicted two-fold increase.

CThCC6 • 3:45 p.m.
Strategies for Reducing Out-of-Plane Radiation in Photonic Crystal Double Heterostructure Resonant Cavities, *Adam Mock, John D. O'Brien; Univ. of Southern California, USA.* Directional dependence of optical radiation from photonic crystal double heterostructure resonant cavities is analyzed using the finite-difference time-domain method. Geometries that mitigate out-of-plane radiation loss with dielectric substrates are analyzed.

CThCC7 • 4:00 p.m.
Double-Layered Monolithic Silicon Photonic Crystals, *Shrestha Basu Mallick[1], Sora Kim[1], Sanja Hadzialic[2], Aasmund Sudbo[2], Olav Solgaard[1]; [1]Stanford Univ., USA, [2]Univ. of Oslo, Norway.* Double-layered, self-aligned, silicon photonic crystals are fabricated using directional and isotropic etches—a potential step toward 3-D PCs. One structure shows sharper resonances compared to corresponding single layer structure. Another shows high, broadband reflectivity.

PhAST

PThD • Laser Applications in the Photovoltaic Market II—Continued

PThD4 • 3:30 p.m. Invited
Laser Chemical Processing of Silicon Solar Cells, *Daniel Kray; Fraunhofer ISE, Germany.* The proprietary Laser Chemical Processing (LCP) combines a laser beam with a hair thin chemical liquid jet which acts as a light guide. A large variety of innovative and elegant microstructuring processes become possible.

PThE • Lasers in Manufacturing IV—Continued

PThE4 • 3:30 p.m. Invited
High Speed Laser Machining with a Femtosecond Fiber Laser, *Lawrence Shah; IMRA America Inc., USA.* We review precision micromachining applications of high energy and high power femtosecond fiber lasers in metal, semiconductors and glasses. We highlight applications which require micron-level precision and rapid material removal.

PThF • New Solar Technology for Grid Parity—Continued

PThF5 • 3:20 p.m.
PANEL: Solar Deployment Roadmap, Infrastructure and Energy Demands

4:15 p.m.–4:45 p.m., Coffee Break, *Concourse Level*

Ballroom A1 and A8 | **Ballroom A2 and A7** | **Ballroom A3 and A6** | **Ballroom A4 and A5**

QELS

4:45 p.m.–6:30 p.m.
QThJ • Slow and Fast Light
Stephen Hughes; Queen's Univ., Canada, Presider

QThJ1 • 4:45 p.m.
Coupling into Slow-Light in Photonic Crystal Waveguides, *Solomon Assefa, Fengnian Xia, William M. J. Green, Yurii Vlasov; IBM T.J. Watson Res. Ctr., USA.* Coupling into the slow-light regime of photonic crystal waveguides is investigated for various taper lengths and terminations by utilizing an integrated Mach-Zehnder interferometer. Experimental results for coupling efficiency as a function of group-index are presented.

QThJ2 • 5:00 p.m.
Enhancement of Group Velocity in a Random Composite Metamaterial, *Kenneth J. Chau, Pouya Maraghechi, Abdulhakem Y. Elezzabi; Univ. of Alberta, Canada.* We demonstrate group velocity enhancement in a composite metamaterial consisting of ensembles of dielectric and metallic particles. This finding introduces another class of metamaterials that lack spatial order but nonetheless possess peculiar electromagnetic properties.

QThJ3 • 5:15 p.m.
Geometry-Enhanced Modulation of Group Velocity in Nano-Waveguides, *Viktor A. Podolskiy[1], Alexander A. Govyadinov[1,2]; [1]Oregon State Univ., USA, [2]Univ. of Pennsylvania, USA.* We demonstrate that modulation of geometry of nanoscale waveguides may dramatically enhance the modulation of group velocity in dispersive media and illustrate the developed formalism on examples of plasmonic nanorod and metamaterial photonic funnel.

QThJ4 • 5:30 p.m.
Observation of Slow Light in Coupled-Resonator-Induced Transparency, *Kouki Totsuka, Norihiko Kobayashi, Makoto Tomita; Shizuoka Univ., Japan.* We observed slow light in a coupled-resonator induced transparency in a tandem microsphere-fiber-taper system. Nearly Gaussian-shaped pulses propagated with a large positive delay of 6.2 ns and 78% transmission through a transparent frequency window.

4:45 p.m.–6:30 p.m.
QThK • Quantum Measurement
Julio Gea-Banacloche; Univ. of Arkansas, USA, Presider

QThK1 • 4:45 p.m.
Experimental Quantum State Estimation with Mutually Unbiased Bases, *Robert B. A. Adamson, Aephraim M. Steinberg; Physics Dept., Univ. of Toronto, Canada.* We present the first experiment in two-qubit quantum state tomography to take advantage of the power of mutually unbiased bases (MUBs). MUBs improve state estimation but require entangling measurements.

QThK2 • 5:00 p.m.
Near-Optimal Quantum State Discrimination of Optical Coherent States, *Christoffer Wittmann[1], Masahiro Takeoka[2,3], Katiuscia Cassemiro[4], Masahide Sasaki[2,3], Gerd Leuchs[1], Ulrik L. Andersen[1,5]; [1]Inst. für Optik, Information und Photonik; Max Planck Res. Group, Univ. Erlangen-Nürnberg, Germany, [2]Natl. Inst. of Information and Communications Technology, Japan, [3] Core Research for Evolutional Science and Technology, Japan Science and Technology Agency, Japan, [4]Inst. de Fìsica, Univ. de São Paulo, Brazil, [5]Dept. of Physics, Technical Univ. of Denmark, Denmark.* We experimentally demonstrate a new scheme for the discrimination of binary-encoded optical coherent states. We show that the error probability of our approach beats the ones obtained by standard receiver schemes for any signal amplitude.

QThK3 • 5:15 p.m.
Quantum Optical Adaptive Phase Estimation of Sidebands, *Trevor A. Wheatley[1], Elanor H. Huntington[1], Dominic W. Berry[2], Howard M. Wiseman[3], Timothy C. Ralph[4]; [1]Univ. College, Univ. of New South Wales, Australia, [2]Macquarie Univ., Australia, [3]Griffith Univ., Australia, [4]Univ. of Queensland, Australia.* We present experimental results of the use of continuous adaptive feedback in quantum optical measurement of phase of the sidebands on continuous-wave (cw) coherent light, consistent with theoretical predictions.

QThK4 • 5:30 p.m. **Invited**
Entanglement-Free, Heisenberg-Limited Phase Measurement, *Brendon L. Higgins[1], Howard W. Wiseman[1], Geoff J. Pryde[1], Dominic W. Berry[2], Stephen D. Bartlett[3]; [1]Griffith Univ., Australia, [2]Macquarie Univ., Australia, [3]Univ. of Sydney, Australia.* We demonstrate experimental Heisenberg-limited scaling of the variance in optical phase measurements. Our algorithm replaces entangled states—often thought essential for Heisenberg scaling—with single photons, multiple phase shift passes and adaptive measurement.

CLEO

4:45 p.m.–6:30 p.m.
CThDD • Ultrafast Pulse Shaping
Presider to Be Announced

CThDD1 • 4:45 p.m.
Theory of Rapid-Update Line-by-Line Pulse Shaping, *John T. Willits[1], Andrew M. Weiner[2], Steven T. Cundiff[1]; [1]Univ. of Colorado at Boulder, USA, [2]Purdue Univ., USA.* Pulse shaping theory is extended to include rapid waveform update for line-by-line pulse shaping. The fundamental trade-off between response speed and waveform fidelity is illustrated through simulation.

CThDD2 • 5:00 p.m.
Quartic-Phase Limited Grism-Based Ultrashort Pulse Shaper, *Jeffrey J. Field[1], Charles G. Durfee[1], Steve Kane[2], Jeff A. Squier[1]; [1]Colorado School of Mines, USA, [2]HORIBA Jobin Yvon, USA.* By using a grism in a pulse shaping apparatus, we show that it is possible to pre-compensate for large amounts of dispersion (>5000 fs^2), thus reserving the dynamic range of the pulse-shaper for active control.

CThDD3 • 5:15 p.m.
New Aspects of Temporal Dispersion in Virtually Imaged Phased Array (VIPA) Based Fourier Pulse Shapers, *V. R. Supradeepa, Ehsan Hamidi, Daniel E. Leaird, Andrew M. Weiner; Purdue Univ., USA.* We present new aspects of temporal dispersion in high resolution Fourier pulse shapers using VIPA based setups as a representative example. These effects should become significant in grating based setups when bandwidths approach an octave.

CThDD4 • 5:30 p.m.
Polarization, Phase and Amplitude Control of Ultrafast Laser Pulses With a Single Linear Spatial Light Modulator, *Omid Masihzadeh, Jesse W. Wilson, Philip Schlup, Randy A. Bartels; Colorado State Univ., USA.* Complete control over the polarization, phase and amplitude state of an ultrafast laser pulse is demonstrated using a single, linear spatial light modulator placed in a near-common-path, polarization-split Martinez stretcher.

4:45 p.m.–6:30 p.m.
CThEE • Photonic Band-Gap Fibers
Karl Koch; Corning, Inc. USA, Presider

CThEE1 • 4:45 p.m.
Cladding Modes in All-Solid Photonic Bandgap Fibers, *Feng Luan[1], Boris T. Kuhlmey[1], Libin B. Fu[1], Dong-Il Yeom[1], Benjamin J. Eggleton[1], Aimin Wang[2], Jonathan C. Knight[2]; [1]Ctr. for Ultrahigh Bandwith Devices for Optical Systems, School of Physics, Univ. of Sydney, Australia, [2]Ctr. for Photonics and Photonic Materials, Univ. of Bath, UK.* We present the first characterization of cladding modes of a low-index contrast all-solid photonic bandgap fiber using an acousto-optic long-period grating. Near field modal measurements and theoretical calculations reveal unique cladding mode properties.

CThEE2 • 5:00 p.m.
Decoupling and Asymmetric Coupling in a Triple-Core Photonic Crystal Fiber (PCFs), *Yan Yan[1], Jean Toulouse[1], Iavor Velchev[2], Slava V. Rotkin[1]; [1]Dept. of Physics, Lehigh Univ., USA, [2]Laser Ctr., Fox Chase Cancer Ctr., USA.* We simulate and measure decoupling in triple-core PCFs. We obtain the three supermodes and calculate the coupling parameters. The measured parameters agree well with the calculated ones. The inter-core coupling is found to be asymmetric.

CThEE3 • 5:15 p.m.
Observation of Anti-Crossing Events via Mode-Pattern Rotation in HC-PCF, *Philip S. Light[1], Peter J. Roberts[2], Patrick Mirault[1], Fetah Benabid[1]; [1]Ctr. for Photonics and Photonic Materials, Univ. of Bath, UK, [2]Dept. of Communications, Optics and Materials, Technical Univ. of Denmark, Denmark.* We observe the effects of anti-crossings between core and core interface guided modes of a HC-PCF, by monitoring the output of the fiber as the coupled laser is scanned in wavelength.

CThEE4 • 5:30 p.m.
Cavity Ring-Down in a Photonic Bandgap Fiber Gas Cell, *Adriaan van Brakel, César Jáuregui Misas, Trina T. Ng, Periklis Petropoulos, John P. Dakin, Christos Grivas, Marco N. Petrovich, David J. Richardson; Optoelectronics Res. Ctr., Univ. of Southampton, UK.* Cavity ring-down spectroscopy is demonstrated in a spliced photonic bandgap fiber cell with fs-laser-machined side micro-channels. The increase in ring-down time observed when the cell is filled with acetylene provides quantitative information on gas concentration.

Room C1 and C2

QELS

4:45 p.m.–6:30 p.m.
QThL • Exciton Dynamics II
Steven Cundiff, NIST, USA, Presider

QThL1 • 4:45 p.m.
Exciton Raman Coherence Revealed in Two-Dimensional Fourier Transform Spectroscopy of Semiconductors, *Tianhao Zhang[1], Lijun Yang[2], Alan D. Bristow[1], Shaul Mukamel[2], Steven T. Cundiff[1]; [1]JILA, Univ. of Colorado and NIST, USA, [2]Dept. of Chemistry, Univ. of California at Irvine, USA.* Raman coherence between heavy-hole and light-hole excitons in quantum wells is isolated in an alternative spectrum and contributions from single exciton and correlated two-exciton states are studied experimentally and theoretically by excitation with different polarizations.

QThL2 • 5:00 p.m.
Non-Equilibrium Many-Body Theory of Two-Dimensional Fourier Spectroscopy of Semiconductors, *Kuljit S. Virk, John Sipe; Univ. of Toronto, Canada.* A non-equilibrium Green functions formalism for two-dimensional Fourier spectroscopy of semiconductors is developed. Equations of motion are derived for various initial states including pre-exisitng plasmas. Diagram methods are developed for analysis.

QThL3 • 5:15 p.m.
Coherently Controlled Ballistic Currents in Single-Walled Carbon Nanotubes and Graphite, *Ryan W. Newson, Jean-Michel Ménard, Christian Sames, Markus Betz, Henry M. van Driel; Univ. of Toronto, Canada.* Phase-related 1.4 and 0.7 µm, 150 fs pulses induce directional charge motion in unaligned and aligned carbon nanotubes and graphite at 300 K. The THz radiation emission reveals peak currents of ~300 pA per nanotube.

QThL4 • 5:30 p.m.
Direct Measurement of Dark-Bright Exciton Splitting in Individual Single-Walled Carbon Nanotubes, *Ajit Srivastava[1], Junichiro Kono[1], Han Htoon[2], Victor I. Klimov[2]; [1]Rice Univ., USA, [2]Los Alamos Natl. Lab, USA.* We have performed low-temperature micro-photoluminescence studies on *individual* single-walled carbon nanotubes in magnetic fields up to 5 T and directly measured the dark-bright exciton splitting magnitude through the observation of *magnetic brightening*.

Room C3 and C4

JOINT

4:45 p.m.–6:30 p.m.
JThC • Ultrafast Laser Plasmas and Filaments
Jean-Claude Diels; Univ. of New Mexico, USA, Presider

JThC1 • 4:45 p.m.
Absolute Carrier-Envelope Phase Signature in THz Emission from a Femtosecond Filament in Argon, *Christoph P. Hauri[1], Ivan Medvedev[2], Jonathan Wheeler[2], Chris Roedig[2], Gilles Doumy[2], Louis F. DiMauro[2]; [1]Paul Scherrer Inst., Switzerland, [2]Ohio State Univ., USA.* We report on our investigation of THz emission from femtosecond filaments in argon and propose a single-shot scheme for determination of the absolute carrier envelope phase with a 2-π ambiguity.

JThC2 • 5:00 p.m.
Predicting the Filamentation of High-Powered Beams and Pulses without Numerical Integration, *Luat T. Vuong[1], Alexander L. Gaeta[1], Nir Gavish[2], Gadi Fibich[2]; [1]School of Applied and Engineering Physics, Cornell Univ., USA, [2]School of Mathematical Sciences, Tel Aviv Univ., Israel.* We present a new analytical method that predicts the initial filamentation dynamics of high-powered beams and pulses. We demonstrate the method with various input beams and pulses and show good agreement with numerical results.

JThC3 • 5:15 p.m.
OFI Rare-Gas Excimer Amplifier for Intense Sub-Picosecond VUV Pulse Generation, *Masanori Kaku[1], Yuta Taniguchi[1], Kazuyoshi Oda[1], Masahito Katto[1], Atsushi Yokotani[1], Shoichi Kubodera[1], Noriaki Miyanaga[2], Kunioki Mima[2]; [1]Univ. of Miyazaki, Japan, [2]Osaka Univ., Japan.* We report the Ar_2^* amplification with a gain-length product of 6 pumped by a high-intensity laser and the generation of subpicosecond seed pulses at 126 nm using harmonic radiation of an infrared Ti:Sapphire laser.

JThC4 • 5:30 p.m.
The Fine Structure of a Laser-Plasma Filament in Air, *Shmuel Eisenmann, Anatoly Pukhov, Arie Zigler; Racah Inst. of Physics, Hebrew Univ., Israel.* We probed the electron density variations of a controlled femtosecond plasma-filament. It exhibits rapid variations and a meter-long self-guided stage despite the fact that plasma alone cannot efficiently saturate nonlinear self-focusing.

Room B1 and B2

CLEO

4:45 p.m.–6:30 p.m.
CThFF • Ytterbium Lasers
Daniel J. Ripin; MIT Lincoln Lab, USA, Presider

CThFF1 • 4:45 p.m.
Multi-Millijoule, Diode-Pumped, Picosecond Regenerative Amplifier at 999-nm Wavelength with Cryogenically Cooled Yb^{3+}:$LuLiF_4$ Crystal, *Yutaka Akahane[1,2], Makoto Aoyama[1,2], Akira Sugiyama[1], Ryouichi Kubo[1], Kanade Ogawa[1,3], Koichi Tsuji[1], Koichi Yamakawa[1,2]; [1]Japan Atomic Energy Agency, Japan, [2]Core Research for Evolutional Science and Technology, Japan Science and Technology Agency, Japan, [3]Inst. of Laser Engineering, Osaka Univ., Japan.* A diode-pumped, cryogenically-cooled Yb^{3+}:$LuLiF_4$ regenerative amplifier has been developed for the first time to our knowledge, which generated ~6-mJ, 13-ps pulses at 999 nm wavelength without a pulse compressor.

CThFF2 • 5:00 p.m.
Tunable Laser Operation of Yb:$NaY(MoO_4)_2$, *Andreas Schmidt[1], Simon Rivier[1], Uwe Griebner[1], Valentin Petrov[1], Xiumei Han[2], Jose M. Cano-Torres[2], Alberto Garcia-Cortes[2], Carlos Zaldo[2]; [1]Max-Born-Inst., Germany, [2]Inst. de Ciencia de Materiales de Madrid, Consejo Superior de Investigaciones Cientificas, Spain.* CW laser operation of Yb^{3+} in the disordered flux-grown $NaY(MoO_4)_2$ is demonstrated. The maximum slope efficiency with Ti:sapphire and diode laser pumping is 57.5% and 38.6%, respectively. The tunability extends from 1005 to 1059 nm.

CThFF3 • 5:15 p.m.
Concentration-Dependent Laser Performance of Yb:YAG Ceramics, *Jun Dong[1], Ken-ichi Ueda[1], Hideki Yagi[2]; [1]Inst. for Laser Science, Univ. of Electro-Communications, Japan, [2]Konoshima Chemical Co. Ltd., Japan.* Laser performance of Yb:YAG ceramics and single-crystals doped with different Yb concentrations was investigated using two-pass pumping miniature laser configuration. Better laser performance was observed for heavy-doped Yb:YAG ceramic than single-crystal (C_{Yb} = 20 at.%).

CThFF4 • 5:30 p.m.
First Demonstration of Laser Emission from an Yb:YAG Single Crystal Fiber Grown by the Micro-Pulling Down Technique, *Damien Sangla[1,2], Nicolas Aubry[2,3], Julien Didierjean[1], Didier Perrodin[3], François Balembois[1], Kherredine Lebbou[2], Alain Brenier[2], Patrick Georges[1], Jean-Marie Fourmigue[3], Olivier Tillement[2]; [1]Lab Charles Fabry de l'Inst. d'Optique, France, [2]Lab de Physico-Chimie des Matériaux Luminescents, France, [3]Fibercryst, France.* We present the first laser demonstration obtained from an Yb:YAG single-crystal fiber directly grown by the micro-pulling-down technique, with 2.2-W of average output power at 1031-nm for 50-W of incident pump power at 940-nm.

Room J2

4:45 p.m.–6:30 p.m.
CThGG • Nonlinear Photonic Crystals
David Rockwell; Raytheon Corp., USA, Presider

CThGG1 • 4:45 p.m.
Optical Parametric Generation and Oscillation in a Two-Dimensional Nonlinear Photonic Crystal, *Hsi-Chun Liu[1,2], A. H. Kung[1,3]; [1]Academia Sinica, Taiwan, [2]Caltech, USA, [3]Natl. Chiao Tung Univ., Taiwan.* Anomalously high parametric gain and simultaneous generation of two signal beams are unique properties of an optical parametric oscillator based on a quasi-phase-matched photonic crystal with a tetragonal lattice structure.

CThGG2 • 5:00 p.m.
Trapping of Dispersive Waves by Solitons in Long Lengths of Tapered PCF, *J. C. Travers, S. V. Popov, J. R. Taylor; Femtosecond Optics Group, Physics Dept., Imperial College London, UK.* We numerically analyze supercontinuum generation in a long length of tapered PCF to understand the soliton trapping dynamics leading to the enhanced Blue/UV supercontinuum recently achieved experimentally in such fibers.

CThGG3 • 5:15 p.m.
Optical Interference in Nonlinear Photonic Crystals, *Chien-Jen Lai[1], Lung-Han Peng[2], A. H. Kung[1,3]; [1]Academia Sinica, Taiwan, [2]Natl. Taiwan Univ., Taiwan, [3]Natl. Chiao Tung Univ., Taiwan.* We report a generalized quantitative analysis of the origin of optical interference in two-dimensional nonlinear photonic crystals. The results are verified by a second harmonic generation experiment in a 2-D periodically-poled $LiNbO_3$ crystal.

CThGG4 • 5:30 p.m.
Critical Slowing Down in InGaAsP-InP Nonlinear Photonics Crystal Resonator, *Yosia Yosia[1,2], Akihiko Shinya[1], Takasumi Tanabe[1], Masaya Notomi[1], Lu Chao[3]; [1]NTT Basic Res. Labs, Nippon Telegraph and Telecommunication Corp., Japan, [2]School of Electrical Engineering, Network Technology Ctr., Nanyang Technological Univ., Singapore, [3]A*STAR, Inst. for Infocomm Res., Singapore.* Critical slowing down (CSD) phenomenon was observed experimentally in InGaAsP-InP nonlinear photonics crystal resonator. The hallmark of CSD is the occurrence of the output transmission in the unstable state for a long time before switching.

CLEO

Room J3

4:45 p.m.–6:30 p.m.
CThHH • Quantum Dot Lasers
Peter M. Smowton; Physx, Cardiff Univ., UK, Presider

CThHH1 • 4:45 p.m. Tutorial
Quantum Dot Lasers Physics and Applications to High Power and High Efficiency, *Dennis Deppe; CREOL, Univ. of Central Florida, USA.* Abstract, biography and photo not available.

Marriott San Jose Salon 1 and 2

4:45 p.m.–6:30 p.m.
CThII • Novel Spectroscopy and Microscopy Methods
Brian E. Applegate; Texas A&M Univ., USA, Presider

CThII1 • 4:45 p.m.
Coherent Anti-Stokes Raman Scattering (CARS) Microscopy for Three-Dimensional Flow Characterization in Microfluidics, *Dawn N. Schafer[1], Jeff Squier[1], Michiel Müller[2], Mischa Bonn[3], Jan Van Maarseveen[4]; [1]Colorado School of Mines, USA, [2]Swammerdam Inst. for Life Sciences, Univ. of Amsterdam, Netherlands, [3]Inst. for Atomic and Molecular Physics, Foundation for Fundamental Res. on Matter, Netherlands, [4]Van 't Hoff Inst. for Molecular Sciences, Univ. of Amsterdam, Netherlands.* The diffusion of mixing species inside of microchannels, as measured by CARS microscopy, is related to the flow field for the purpose of resolving non-symmetric velocity profiles.

CThII2 • 5:00 p.m.
Fourier Transform Coherent Anti-Stokes Raman Scattering (FTCARS) Microscopy, *Meng Cui, Joshua Skodack, Jennifer P. Ogilvie; Univ. of Michigan, USA.* We demonstrate FTCARS microscopy and show that an external field combined with the signal can overcome detector dark noise. We discuss conditions for obtaining shot-noise-limited detection and compare the S/N of FTCARS with other methods.

CThII3 • 5:15 p.m.
Single-Source Interferometric Multiplex Coherent Anti-Stokes Raman Scattering with a Photonic Crystal Fiber Light Source, *Charles H. Camp Jr., Ali A. Eftekhar, Ali Adibi; Georgia Tech, USA.* An interferometric multiplex coherent anti-Stokes scattering (iMCARS) system that utilizes the supercontinuum of a photonic crystal fiber as both the Stokes and local oscillator sources for broadband heterodyne detection is demonstrated.

CThII4 • 5:30 p.m.
An Optofluidic Microscope on a Chip Driven by DC Electrokinetics, *Lap Man Lee, Xiquan Cui, Xin Heng, Changhuei Yang; Caltech, USA.* The use of DC electrokinetics can ensure a uniform and pure translational motion of biological samples in an optofluidic microscope. Its ability to image a single ellipsoidal cell, *Chlamydomonas*, was demonstrated on-chip.

Marriott San Jose Salon 3

4:45 p.m.–6:30 p.m.
CThJJ • Coherent Detection and Signal Processing
Scott Hamilton; MIT Lincoln Lab, USA, Presider

CThJJ1 • 4:45 p.m.
Impact of Receiver Imperfections on the Performance of Coherent Intradyne DQPSK Receivers, *Constantinos S. Petrou[1], Ioannis Roudas[1], Lampros Raptis[2]; [1]Univ. of Patras, Greece, [2]Attica Telecommunications, Greece.* We theoretically investigate the impact of 90° optical hybrid and balanced detector imperfections on the performance of a coherent intradyne DQPSK system using feedforward frequency and phase estimation.

CThJJ2 • 5:00 p.m.
Receiver Sensitivity Improvement Using Decision-Aided Maximum Likelihood Phase Estimation in Coherent Optical DQPSK System with Nonlinear Phase Noise, *Shaoliang Zhang[1], Pooi Yuen Kam[1], Jian Chen[2], Changyuan Yu[1,2]; [1]Natl. Univ. of Singapore, Singapore, [2]Inst. for Infocomm Res., Agency for Science, Technology and Res., Singapore.* We propose a decision-aided maximum likelihood phase estimation receiver for a nonlinear-phase-noise-dominant coherent optical DQPSK system, which requires only linear computation and improves the receiver sensitivity by 3 dB compared to differential detection.

CThJJ3 • 5:15 p.m.
Cost Efficient Narrow Linewidth Laser Transmitter for Coherent Detection, *Aleksandra M. Kaszubowska-Anandarajah[1], Arvind Mishra[2], Andrew Ellis[2], Liam P. Barry[1], Prince M. Anandarajah[1], Philip Perry[1], Douglas Reid[1], James O'Gorman[3], Richard Phelan[3], Brian Kelly[3]; [1]Res. Inst. for Networks and Communications Engineering, Dublin City Univ., Ireland, [2]Photonic Systems Group, Tyndall Natl. Inst., Univ. College Cork, Ireland, [3]Eblana Photonics Ltd., Ireland.* Authors present a cost efficient narrow linewidth laser transmitter for future coherent detection systems. The spectral purity of the laser allows the phase modulation of data signals at bit rates as low as 155 Mb/s.

CThJJ4 • 5:30 p.m. Invited
Intradyne Receivers Using FPGA Processing, *Andreas Leven, Noriaki Kaneda, Young-Kai Chen; Bell Labs, Alcatel-Lucent, USA.* FPGA-based intradyne real-time receivers have received increasing attention because of ease of implementation. In this paper, we will review the progress that has been made over the last couple of years.

Marriott San Jose Salon 4

4:45 p.m.–6:30 p.m.
CThKK • Semiconductor Optoelectronics
Venkatraman Gopalan; Pennsylvania State Univ., USA, Presider

CThKK1 • 4:45 p.m.
Electronic Characterization of Silicon Doped Beyond the Solubility Limit via Femtosecond Laser Irradiation, *Mark T. Winkler, Eric Mazur; Harvard Univ., USA.* We have performed temperature-dependent resistivity measurements of silicon after doping with sulfur via femtosecond laser irradiation. Results are consistent with a theoretically predicted binding energy for sulfur donors of 100 meV below the conduction-band edge.

CThKK2 • 5:00 p.m.
High-Speed SiGe p-i-n W-Structure Photodetectors at Telecommunication Wavelengths Grown Directly on Si, *Dyan Ali[1], Phillip Thompson[2], Julius Goldhar[1], Joseph DiPasquale III[1], Christopher J. K. Richardson[1]; [1]Lab for Physical Sciences, Univ. of Maryland at College Park, USA, [2]NRL, USA.* We report on Si-rich SiGe p-i-n W-structure single-mode waveguide detectors of varying lengths, and found to have a responsivity of up to $489\mu AW^{-1}mm^{-1}$. The shortest tested devices exhibit a 1.74GHz bandwidth, and 173.5μA/W responsitivty at 1.3μm.

CThKK3 • 5:15 p.m.
Measurement of Spontaneous Emission Quantum Efficiency in InGaAs/GaAs Quantum Wells, *Ding Ding, Shane R. Johnson, Jiang-Bo Wang, Shui-Qing Yu, Yong-Hang Zhang; Arizona State Univ., USA.* The spontaneous emission quantum efficiency of molecular beam epitaxy grown InGaAs/GaAs quantum wells is determined using photoluminescence measurements. The quantum efficiency is inferred from the power law that links pump power and integrated photoluminescence signal.

CThKK4 • 5:30 p.m.
AlGaN/GaN Multiple Quantum Wells Grown by Atomic Layer Deposition, *Ming-Hua Lo, Shih-Wei Chen, Zhen-Yu Li, Tien-Chang Lu, Hao-Chung Kuo, Shing-Chung Wang; Dept. of Photonics and Inst. of Electro-Optical Engineering, Natl. Chiao Tung Univ., Taiwan.* Three-pair AlGaN/GaN multiple quantum well structure with superlattice was grown using metal-organic chemical vapor deposition system. The AlGaN barrier and GaN well of the MQW were grown by atmoic layer deposition and conventional growth, respectively.

Marriott San Jose
Salon 5 and 6

CLEO

4:45 p.m.–6:30 p.m.
CThLL • Plasmonics and Nanomanipulation

Michelle L. Povinelli; Stanford Univ., USA, Presider

CThLL1 • 4:45 p.m. Invited
Plasmonics-Based Design: Combining Surface-Enhanced Raman and IR Spectroscopies into the Same Structure, *Naomi J. Halas; Rice Univ., USA.* Plasmonic nanostructures are useful for providing high-intensity fields at metal surfaces for surface enhanced spectroscopies. Plasmon hybridization principles are used to design substrates that enhance both Raman and Infrared absorption spectroscopy on the same structure.

CThLL2 • 5:15 p.m.
Optical Waves on Nano-Particle Chains Coupled with Metal-Dielectric Surfaces, *Derek A. Van Orden, Yeshaiahu Fainman, Vitaliy Lomakin; Univ. of California at San Diego, USA.* Nano-particle metal chains coupled with a metal-dielectric surface support traveling waves of several types. These traveling waves can be used to guide fields along the chain or to radiate surface wave beams along the surface.

CThLL3 • 5:30 p.m.
Scanning Probe Optical Microscopy Using an Integrated Submicron Organic Photodetector, *Kwang Hyup An, Brendan O'Connor, Kevin P. Pipe, Yiying Zhao, Max Shtein; Univ. of Michigan, USA.* A high-resolution scanning optical microscopy technique is developed by fabricating an organic photodetector with sub-micron size on a scanning probe cantilever. Optical and topographic data are recorded simultaneously and demonstrate sub-micron resolution.

NOTES

Ballroom A1 and A8 | **Ballroom A2 and A7** | **Ballroom A3 and A6** | **Ballroom A4 and A5**

QELS

QThJ • Slow and Fast Light—Continued

QThJ5 • 5:45 p.m.
All-Optical Analogue to Electromagnetically Induced Transparency with Silicon Photonic Crystal Nanocavities, *Xiaodong Yang[1], Mingbin Yu[2], Dim-Lee Kwong[2], Chee Wei Wong[1]; [1]Columbia Univ., USA, [2]Inst. of Microelectronics, Singapore.* We observe experimentally all-optical analogue to electromagnetically induced transparency with silicon photonic crystal nanocavities having high intrinsic quality factor and small modal volume. This phenomenon is analyzed through coupled-mode formalism and three-dimensional finite-difference time-domain method.

QThJ6 • 6:00 p.m.
The Effect of Metamaterials on Anderson Localisation, *Ara A. Asatryan[1], Lindsay C. Botten[1], Michael A. Byrne[1], Valentin D. Freilikher[2], Sergey A. Gredeskul[3], Ilya V. Shadrivov[4], Ross C. McPhedran[5], Yuri S. Kivshar[4]; [1]Ctr. for Ultrahigh-Bandwidth Devices for Optical Systems (CUDOS), Univ. of Technology, Sydney, Australia, [2]Bar-Ilan Univ., Israel, [3]Ben Gurion Univ. of the Negev, Israel, [4]Australian Natl. Univ., Australia, [5]Univ. of Sydney, Australia.* We study 1-D stacks comprising alternating layers of normal and metamaterials, with disorder in both refractive index and layer thickness, and show strong suppression of localisation with only index disorder.

QThJ7 • 6:15 p.m.
Optical Transport Properties of Three-Dimensional Photonic Quasicrystals, *Alexandra Ledermann[1], Georg von Freymann[1], Costanza Toninelli[2], Diederik S. Wiersma[2], Ludovico Cademartiri[3], Geoffrey A. Ozin[3], Martin Wegener[4]; [1]Inst. of Nanotechnology, Forschungszentrum Karlsruhe, Germany, [2]European Lab for Nonlinear Spectroscopy, Italy, [3]Dept. of Chemistry, Univ. of Toronto, Canada, [4]Inst. für Angewandte Physik, Univ. Karlsruhe (TH), Germany.* We theoretically describe the optical properties of three-dimensional icosahedral photonic quasicrystals by means of a periodic approximant approach. Experimental findings that were previously ascribed to extrinsic effects are found to be intrinsic properties of quasicrystals.

QThK • Quantum Measurement—Continued

QThK5 • 6:00 p.m.
Experimental Quantum Detector Tomography, *Hendrik B. Coldenstrodt-Ronge[1], Jeff S. Lundeen[1], Kenny L. Pregnell[2], Alvaro Feito[2], Brian J. Smith[1], Christine Silberhorn[3], Jens Eisert[2], Martin Plenio[2], Ian A. Walmsley[1]; [1]Univ. of Oxford, UK, [2]Imperial College London, UK, [3]Max-Planck Res. Group, Germany.* We present the first quantum tomography of a detector, using as examples an avalanche photodiode and a photon-number resolving detector. The resulting POVM set agrees well with one derived from a model of the detector.

QThK6 • 6:15 p.m.
Demonstration of a Measurement-Based Quantum Nondemolition Interaction, *Jun-ichi Yoshikawa[1,2], Yoshichika Miwa[1,2], Alexander Huck[1,3,4], Ulrik L. Andersen[3,4], Peter van Loock[4], Akira Furusawa[1,2]; [1]Univ. of Tokyo, Japan, [2]Core Research for Evolutional Science and Technology, Japan Science and Technology Agency, Japan, [3]Technical Univ. of Denmark, Denmark, [4]Univ. Erlangen-Nürnberg, Germany.* We experimentally demonstrate a quantum nondemolition (QND) interaction, based upon offline-prepared, squeezed ancilla states and homodyne measurements with feedforward. The resulting QND gate is verified via the criteria for QND measurements of each conjugate quadrature.

CLEO

CThDD • Ultrafast Pulse Shaping—Continued

CThDD5 • 5:45 p.m.
Nonlinear Femtosecond Pulse Reshaping in Waveguide Arrays, *Darren D. Hudson[1], Thomas R. Schibli[1], Steven T. Cundiff[1], Kimberlee Shish[2], J. Nathan Kutz[2], Roberto Morandotti[3], Demetrious Christodoulides[4]; [1]JILA and Univ. of Colorado, USA, [2]Dept. of Applied Mathematics, Univ. of Washington, USA, [3]Inst. Natl. de la Recherche Scientifique, Univ. du Quebec, Canada, [4]College of Optics and Photonics, CREOL, Univ. of Central Florida, USA.* We observe nonlinear pulse reshaping of femtosecond pulses propagating in a waveguide array. The reshaping is due to nonlinear coupling between waveguides. The output temporal width shows power-dependent pulse shortening.

CThDD6 • 6:00 p.m.
Fourier Pulse Shaping with Enhanced Spectral Control Using a 2-D VIPA Grating Pulse Shaper, *V. R. Supradeepa, Daniel E. Leaird, Andrew M. Weiner; Purdue Univ., USA.* We demonstrate Fourier pulse shaping over a wide bandwidth with high spectral resolution allowing a large number of controllable features utilizing a grating and a VIPA in a two-dimensional configuration as the spectral disperser.

CThDD7 • 6:15 p.m.
A 648-Pixel, 2-D Spatial Light Modulator with an Over-Two-Octave Bandwidth from Ultraviolet to Near-Infrared, *Kouji Hazu[1,2], Naoya Nakagawa[1,2], Shao bo Fang[1,2], Yasuhide Nakano[1,2], Taro Sekikawa[1,2], Mikio Yamashita[1,2]; [1]Dept. of Applied Physics, Hokkaido Univ., Japan, [2]Core Res. for Evolutional Science and Technology, Japan Science and Technology Agency, Japan.* We developed a 648-pixel, two-dimension spatial light modulator operating from 260 to 1100 nm, which is useful for ultrabroadband chirp compensation.

CThEE • Photonic Band-Gap Fibers—Continued

CThEE5 • 5:45 p.m.
High Thermal and Electrical Tunability of Negative Dielectric Liquid Crystal Photonic Bandgap Fibers, *Lei Wei[1], Lara Scolari[1], Johannes Weirich[1], Thomas Tanggaard Alkeskjold[2], Lars Eskildsen[1], Anders Bjarklev[1]; [1]Technical Univ. of Denmark, Denmark, [2]Crystal Fibre A/S, Denmark.* We infiltrate photonic crystal fibers with negative dielectric liquid crystals. 400nm bandgap shift is obtained in the range 22°C-80°C and 119nm shift of the long-wavelength bandgap edge is achieved by applying a voltage of $200V_{rms}$.

CThEE6 • 6:00 p.m.
Biased Liquid Crystal Photonic Bandgap Fiber, *Johannes Weirich[1], Jesper Laegsgaard[1], Thomas Tanggaard Alkeskjold[2], Jan S. Hesthaven[3], Lara Scholari[1], Lei Wei[1], Lars Eskildsen[1], Anders Bjarklev[1]; [1]Dept. of Communications, Optics and Materials, Technical Univ. of Denmark, Denmark, [2]Crystal Fibre A/S, Denmark, [3]Brown Univ., USA.* We simulate the director structure of all capillaries in a biased photonic crystal fiber infiltrated with liquid crystals. Various mode simulations for different capillaries show the necessity to consider the entire structure.

CThEE7 • 6:15 p.m.
Square-Lattice Large-Pitch Hollow-Core Photonic Crystal Fiber, *Francois Couny[1], Peter J. Roberts[2], Fetah Benabid[1], Tim A. Birks[1]; [1]Ctr. for Photonics and Photonic Materials, Dept. of Physics, Univ. of Bath, UK, [2]Dept. of Communications, Optics and Materials, Technical Univ. of Denmark, Denmark.* Large pitch square-lattice hollow core photonic crystal fibers have been fabricated. Measurements show that the fiber exhibits similar optical linear properties to the Kagome fiber.

6:30 p.m.–8:00 p.m., Dinner Break *(on your own)*

8:00 p.m.–10:00 p.m., CLEO/QELS Postdeadline Paper Sessions, *Rooms A2, A3 and A4*

Room C1 and C2 — QELS

QThL • Exciton Dynamics II—Continued

QThL5 • 5:45 p.m.
Direct Determination of Exciton Homogeneous and Inhomogeneous Linewidths in Semiconductor Quantum Wells with Two-Dimensional Fourier Transform Spectroscopy, *Tianhao Zhang[1], Alan D. Bristow[1], Xingcan Dai[1], Irina Kuznetsova[2], Torsten Meier[3], Peter Thomas[2], Steven T. Cundiff[1]; [1]JILA, Univ. of Colorado and National Institute of Standards and Technology, USA, [2]Dept. of Physics and Material Sciences Ctr., Philipps Univ., Germany, [3]Dept. Physik, Fakultät für Naturwissenschaften, Univ. Paderborn, Germany.* Homogeneous and inhomogeneous broadening of heavy- and light-hole excitons in semiconductor quantum wells are measured along with the excitation dependence of both broadenings. Isolation of disorder-induced broadening is possible with spectra in different coherent pathways.

QThL6 • 6:00 p.m.
Influence of Excitonic Effects on Two-Color Injection of Ballistic Electrical Currents in a Bulk Semiconductor, *Christian Sames, Jean-Michel Ménard, Markus Betz, Henry M. van Driel; Univ. of Toronto, Canada.* Currents in CdSe are coherently controlled using phase-related ω/2ω femtosecond pulses at 80 K. For carrier excitation just above the exciton energy, CdSe reveals an additional delayed and phase-shifted source term via the THz emission.

QThL7 • 6:15 p.m.
Decoherence in Single and Two-Particle Correlations in Optically Excited Semiconductors, *Kuljit S. Virk, John Sipe; Univ. of Toronto, Canada.* Decoherence between exciton states is compared with their decoherence with the ground state of a semiconductor in the presence of an electron-hole plasma. Non-equilibrium Green functions are used for deriving dynamical equations.

Room C3 and C4 — JOINT

JThC • Ultrafast Laser Plasmas and Filaments—Continued

JThC5 • 5:45 p.m.
Effect of Aligned Nitrogen Molecules on Atmospheric Propagation of Ultrashort Laser Pulses, *Sanjay R. Varma, Yu-hsin Chen, Howard M. Milchberg; Univ. of Maryland at College Park, USA.* A 90fs pulse is focused, in air, to non-ionizing intensity. A collinear probe pulse follows the pump into a region of spontaneously re-aligned N_2. The aligned molecules affect the focusing and filamenting of the probe.

JThC6 • 6:00 p.m.
Backward Raman Amplification in a Plasma Waveguide, *Chih-Hao Pai[1], Ming-Wei Lin[2], Li-Chuang Ha[2], Shian-Ting Huang[2], Yun-Chin Tsou[2], Jyhpyng Wang[2], Szu-yuan Chen[2], Jiunn-Yuan Lin[3]; [1]Natl. Taiwan Univ., Taiwan, [2]Inst. of Atomic and Molecular Sciences, Academia Sinica, Taiwan, [3]Natl. Chung Cheng Univ., Taiwan.* Backward Raman amplification of a short laser pulse in a plasma waveguide is demonstrated. Besides providing a larger gain, the plasma waveguide also suppresses premature Raman backscattering of the pump pulse.

JThC7 • 6:15 p.m.
Application of Corrugated Plasma Waveguides, *Brian D. Layer, Andrew G. York, John Palastro, Thomas M. Antonsen Jr., Sanjay Varma, Yu-hsin Chen, Howard M. Milchberg; Inst. for Res. in Electronics and Applied Physics, Univ. of Maryland, USA.* We report progress towards the application of corrugated plasma waveguides to THz generation and direct electron acceleration. These waveguides are generated in hydrogen, nitrogen and argon plasmas with a wide range of controllable parameters.

Room B1 and B2 — CLEO

CThFF • Ytterbium Lasers—Continued

CThFF5 • 5:45 p.m.
High Energy Hybrid Fiber - Yb:SFAP Laser with Dynamic Spectral and Temporal Pulse Shaping, *James P. Armstrong, Andrew J. Bayramian, Rob W. Campbell, Jay W. Dawson, Christopher A. Ebbers, Barry L. Freitas, Rodney K. Lanning, Robert A. Kent, Noel L. Peterson, Kathleen I. Schaffers, Nick Schenkel, Steven J. Telford, Everett J. Utterback, John A. Caird, Christopher P. J. Barty; Lawrence Livermore Natl. Lab, USA.* We have commissioned a turnkey 500mJ, 10Hz front end laser. The system delivers temporally and spectrally tailored pulses to correct signal distortions within itself or subsequent amplifiers from single longitudinal mode to 250GHz RF bandwidth.

CThFF6 • 6:00 p.m.
First Indirectly Diode Pumped Yb:SFAP Laser, Reaching the Watt Level at 985 nm, *Marc Castaing[1,2], Francois Balembois[1], Patrick Georges[1], Thierry Georges[2], Kathleen Schaffers[3], John Tassano[3]; [1]Inst. d'Optique, Univ. Paris-SUD, France, [2]Oxxius S.A., France, [3]Lawrence Livermore Natl. Lab, USA.* We present the first demonstration of the three-level-laser transition at 985nm in an Yb:S-FAP crystal intracavity pumped at 914nm. We obtained 940mW output power at 985nm for 20W incident pump power at 808nm.

CThFF7 • 6:15 p.m.
Passively Mode-Locked Yb:KY$(WO_4)_2$ Thin Disk Oscillator with Cavity-Dumping, *Guido Palmer[1], Martin Siegel[1], Andy Steinmann[1], Marcel Schultze[1], Uwe Morgner[1,2]; [1]Inst. of Quantum Optics, Univ. Hannover, Germany, [2]Laser Zentrum Hannover, Germany.* We present the first solitary mode-locked thin disk oscillator with cavity-dumping. The laser generates pulse energies of 3 µJ with pulse durations below 700 fs at 1 MHz repetition rate.

Room J2

CThGG • Nonlinear Photonic Crystals—Continued

CThGG5 • 5:45 p.m.
Electrooptic Control of Quasiphase Matched Second Harmonic Generation with a Periodic Electrode, *Adrián J. Torregrosa, Haroldo Maestre, Carlos R. Fernández-Pousa, Juan Capmany; Univ. Miguel Hernández, Spain.* We have investigated theoretically the performance of electrooptic control of quasiphase matched second harmonic generation efficiency in periodically poled ferroelectric crystals for the case where a periodic electrode is used.

CThGG6 • 6:00 p.m.
High-Power Red-Green-Blue All Solid State Laser Based on an Optical Superlattice, *S. N. Zhu, Z. Yan, X. P. Hu, G. Zhao, Z. D. Gao, J. L. He; Nanjing Univ., China.* A stable red, green and blue output was obtained by frequency doubling and tripling an alternate resonant dual-wavelength Q-switched Nd:YAG laser with an optical superlattice in a $LiTaO_3$ crystal as a frequency converter.

CThGG7 • 6:15 p.m.
1.2-2.2-µm Tunable Raman Soliton Source Based on a Cr:Forsterite-Laser and a Photonic-Crystal Fiber, *Ming-Che Chan[1], Shih-Hsuan Chia[1], Tzu-Ming Liu[1], Tsung-Han Tsai[1], Min-Chen Ho[1], Anatoly A. Ivanov[2], Aleksei M. Zheltikov[3], Jiun-Yi Liu[4], Hsiang-Lin Liu[4], Chi-Kuang Sun[1,5]; [1]Dept. of Electrical Engineering and Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Ctr. of Photochemistry, Russian Acad. of Sciences, Russian Federation, [3]Dept. of Physics, Intl. Laser Ctr., M. V. Lomonosov Moscow Univ., Russian Federation, [4]Dept. of Physics, Natl. Taiwan Normal Univ., Taiwan, [5]Res. Ctr. for Applied Sciences, Academia Sinica, Taiwan.* A widely tunable femtosecond light source based on a Cr:Forsterite laser and a nonlinear photonic-crystal-fiber is reported. With a 910nm tuning range, this simple, easily-tunable and low-cost source could be widely applicable for many applications.

6:30 p.m.–8:00 p.m., Dinner Break *(on your own)*

8:00 p.m.–10:00 p.m., CLEO/QELS Postdeadline Paper Sessions, *Rooms A2, A3 and A4*

Room J3	Marriott San Jose Salon 1 and 2	Marriott San Jose Salon 3	Marriott San Jose Salon 4

CLEO

CThHH • Quantum Dot Lasers—Continued

CThHH2 • 5:45 p.m.
Dynamic Response of Quantum Dot Lasers—Influence of Nonlinear Electron-Electron Scattering, *Kathy Lüdge[1], Ermin Malic[1], Matthias Kuntz[2], Dieter Bimberg[2], Andreas Knorr[1], Eckehard Schöll[1]; [1]Inst. für Theoretische Physik, Technische Univ. Berlin, Germany, [2]Inst. für Festkorperphysik and Ctr. of Nanophotonics, Technische Univ. Berlin, Germany.* The dynamic response of semiconductor quantum dot lasers can be quantitatively understood by including the strong nonlinearity of electron-electron scattering processes. We combine microscopically calculated Coulomb scattering rates with a rate equation model.

CThHH3 • 6:00 p.m.
Temperature Dependences of Quantum-Dot Laser Thresholds under Simultaneously Three-State or Two-State Lasing Operations, *D.-C. Wu[1], Y.-C. Lin[1], M.-H. Mao[1], W. S. Liu[2], P. C. Chiu[2], J.-I. Chyi[2], J. S. Wang[3], Gray Lin[4], J. Y. Chi[4]; [1]Graduate Inst. of Electronics Engineering, Natl. Taiwan Univ., Taiwan, [2]Dept. of Electrical Engineering, Natl. Central Univ., Taiwan, [3]Dept. of Physics, Chung Yuan Christian Univ., Taiwan, [4]Nanophotonics Ctr., Opto-Electronics and Systems Labs, Industrial Technology Res. Inst., Taiwan.* Three-state lasing in quantum-dot lasers is demonstrated for the first time in this work. The individual threshold currents corresponding to different states are measured as a function of temperature, respectively. Their correlations will be discussed.

CThHH4 • 6:15 p.m.
Temperature Insensitive 1305 nm InGaAs/GaAs Quantum Dot Distributed Feedback Lasers, *Florian Gerschütz[1], Marc Fischer[1], Johannes Koeth[1], Igor Krestnikov[2], Alexey Kovsh[2], Alfred Forchel[3]; [1]nanoplus Nanosystems and Technology GmbH, Germany, [2]Innolume, Germany, [3]Würzburg Univ., Germany.* Based on high quality p-modulation doped InGaAs/GaAs quantum dot (QD) material we realized highly temperature stable operation of distributed feedback (DFB) lasers in the temperature range from 25°C to 85°C.

CThII • Novel Spectroscopy and Microscopy Methods—Continued

CThII5 • 5:45 p.m.
First Laser-Based Determination of Deuterated Water Vapor in Human Breath, *Richard Bartlome, Markus W. Sigrist; Inst. für Quantenelektronik, Eidgenössische Technische Zurich, Switzerland.* Following the ingestion of only 5 mL D_2O, an infrared laser spectrometer determines the D/H isotope ratio increase in exhaled water vapor for the first time. No preliminary breath sample preparation is required.

CThII6 • 6:00 p.m.
A Path for Non-Invasive Glucose Detection Using Mid-IR Supercontinuum, *Peter Domachuk[1], Martin Hunter[1], Rebecca Batorsky[1], Mark Cronin-Golomb[1], Fiorenzo Omenetto[1], Aimin Wang[2], Alan K. George[2], Jonathan C. Knight[2]; [1]Tufts Univ., USA, [2]Univ. of Bath, UK.* We propose the use of large bandwidth mid-IR supercontinuum coupled with machine learning algorithms could provide a solution to non-invasive glucose detection. The SC uses millimeters of non-linear optical fiber, lowering costs and enhancing compactness.

CThII7 • 6:15 p.m.
On-Chip Spectroscopy Using Compact Silicon Microring Resonators Integrated with Microfluidic Channels, *Arthur Nitkowski, Michal Lipson; Cornell Univ., USA.* We demonstrate on-chip absorption spectroscopy using silicon microring resonators with integrated microfluidic channels. Using a 40μm radius resonator with Q>15,000 we show absorption spectra of less than 90nL volumes of water and methanol from 1460nm-1560nm.

CThJJ • Coherent Detection and Signal Processing—Continued

CThJJ5 • 6:00 p.m.
Application of Nonlinear MLSE Based on Volterra Theory in NZ-DSF Optical Communication Systems, *Xianming Zhu[1], Shiva Kumar[1], Srikanth Raghavan[2], Yihong Mauro[2]; [1]McMaster Univ., Canada, [2]Corning Inc., USA.* We show that a nonlinear adaptive MLSE receiver based on Volterra theory with 4-bit ADC and 3-fold oversampling can result in a reach of 960 km over 10 Gb/s NZ-DSF fiber-optic communication systems.

CThJJ6 • 6:15 p.m.
Power Gain of Homodyne Detection over Direct Detection Receivers for Free Space Optical Communication in the Presence of Interference, *Etty J. Lee, Vincent W. S. Chan; MIT, USA.* Diversity mitigates fades, but increasing diversity does not always improve direct detection's performance in the presence of interference. We find the power gain of homodyne over direct detection with optimal diversity, with and without interference.

CThKK • Semiconductor Optoelectronics—Continued

CThKK5 • 5:45 p.m.
Localized Substrate Removal Technique Enabling Strong-Confinement Microphotonics in Bulk Si CMOS Processes, *Charles W. Holzwarth, Jason S. Orcutt, Hanqing Li, Milos A. Popovic, Vladimir Stojanovic, Judy L. Hoyt, Rajeev J. Ram, Henry I. Smith; MIT, USA.* A novel post-processing fabrication technique, based on XeF_2 etching, has been developed to locally remove the silicon substrate beneath polysilicon waveguides, enabling integration of low-loss strong-confinement microphotonics into standard bulk-silicon CMOS process flows.

CThKK6 • 6:00 p.m.
High Precision Optical Characterization of Semiconductor Saturable Absorber Mirrors (SESAMs), *Deran J. H. C. Maas, Benjamin Rudin, Aude-Reine Bellancourt, Daniel Iwaniuk, Thomas Südmeyer, Ursula Keller; Eidgenössische Technische Zurich, Switzerland.* Precise SESAM design has enabled modelocked lasers with >100 GHz pulse repetition rate or >10 μJ pulse energy. We discuss a new method for wide dynamic range nonlinear reflection measurements of SESAMs with <0.05% accuracy.

CThKK7 • 6:15 p.m.
Revealing Subsurface Defects in Semiconductors Using Near-Field Fluorescence Lifetime Imaging, *Daniel A. Bender, Mansoor Sheik-Bahae; Univ. of New Mexico, USA.* Simultaneous near-field fluorescence lifetime imaging and atomic force microscopy identify radiative, interface and subsurface defect recombination sites in GaAs/GaInP heterostructures. Such unique characterization plays a significant role in identifying candidate samples for laser cooling.

6:30 p.m.–8:00 p.m., Dinner Break *(on your own)*

8:00 p.m.–10:00 p.m., CLEO/QELS Postdeadline Paper Sessions, *Rooms A2, A3 and A4*

CLEO

CThLL • Plasmonics and Nanomanipulation—Continued

CThLL4 • 5:45 p.m.
Hybrid Microdisk Laser on a Silicon Platform Using Lateral-Field Optoelectronic Tweezers Assembly, *Ming-Chun Tien, Aaron T. Ohta, Kyoungsik Yu, Linus C. Chuang, Arash Jamshidi, Steven Neale, Chenlu Hou, Connie Chang-Hasnain, Ming C. Wu; Dept. of Electrical Engineering and Computer Science, Univ. of California at Berkeley, USA.* An InGaAs/InGaAsP microdisk laser is assembled on silicon using lateral-field optoelectronic tweezers, achieving room-temperature pulsed operation with a threshold power of 0.85 mW. The room-temperature assembly enables a post-CMOS process to fabricate micro-lasers on silicon.

CThLL5 • 6:00 p.m.
Study of the Dipole-Dipole Interaction between Metallic Nanowires Trapped Using Optoelectronic Tweezers (OET), *Arash Jamshidi[1], Peter J. Pauzauskie[2], Aaron T. Ohta[1], Jiaxing Huang[3], Steven Neale[1], Hsan-Yin Hsu[1], Justin Valley[1], Peidong Yang[3,4], Ming C. Wu[1]; [1]Dept. of Electrical Engineering and Computer Science, Univ. of California at Berkeley, USA, [2]Chemistry, Materials and Life Sciences Directorate, Lawrence Livermore Natl. Lab, USA, [3]Dept. of Chemistry, Univ. of California at Berkeley, USA, [4]Lawrence Berkeley Natl. Lab, USA.* We present a study of dipole-dipole interaction between silver nanowires trapped using optoelectronic tweezers. Measurement of the maximum repulsion force between nanowires and self-assembly of nanowires to achieve the lowest potential energy configuration are demonstrated.

CThLL6 • 6:15 p.m.
Trap Stiffness in Negative Optoelectronic Tweezers (OET), *Steven L. Neale, Ming C. Wu; Univ. of California at Berkeley, USA.* Optoelectronic Tweezers (OET) allow the control of micron-sized particles suspended in a liquid by controlling the dielectrophoretic force with the selective illumination of a photoconductor. This paper studies negative OET traps.

6:30 p.m.–8:00 p.m.
Dinner Break *(on your own)*

8:00 p.m.–10:00 p.m.
CLEO/QELS Postdeadline Paper Sessions,
Rooms A2, A3 and A4

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