Rooms 318-320 — IQEC

8:00 a.m.–9:45 a.m.
IThA • Photonic Crystals
Yanina Shevchenko; Carleton Univ., Canada, Presider

IThA1 • 8:00 a.m.
Effect of Surface Modes on Photon Propagation through Dielectric Bandgaps, *Natalia Malkova[1,2], Sergey V. Polyakov[3,2], Garnett Bryant[1,2], Alan Migdall[3,2]; [1]Atomic Physics Div., NIST, USA, [2]Joint Quantum Inst., Univ. of Maryland, USA, [3]Optical Technology Div., NIST, USA.* We investigate Hartman saturation effect in multilayer dielectric stacks. We show that the experimentally observed jumps of photon transversal times due to adding single quarter-wave layers to structures is caused by appearance of surface modes.

IThA2 • 8:15 a.m.
Ultrafast All-Optical Switching in AlGaAs Photonic Crystal Waveguide Interferometers, *Dominik M. Szymanski[1], Ben D. Jones[1], David O'Brien[2], Maurice S. Skolnick[1], John S. Roberts[1], Mark A. Fox[1], Thomas F. Krauss[2]; [1]Univ. of Sheffield, UK, [2]Univ. of St Andrews, UK.* We have demonstrated ultrafast switching with photonic crystals integrated into Mach–Zehnder interferometers. The nonlinearity is induced by excitation of carriers into one arm of the interferometer, and switching times as short as 3ps are achieved.

IThA3 • 8:30 a.m.
Multiple Scattering of Light in Three-Dimensional Photonic Quasicrystals, *Alexandra Ledermann[1], Georg von Freymann[1], Diederik S. Wiersma[2], Michael Kallenberg[3], Martin Wegener[3]; [1]Inst. of Nanotechnology, Germany, [2]European Lab for Nonlinear Spectroscopy, Italy, [3]Inst. für Angewandte Physik, Univ. Karlsruhe, Germany.* Three-dimensional icosahedral dielectric photonic quasicrystals previously revealed highly structured transmittance spectra and unusual photon transport properties. Using a periodic approximant approach, we show that all these findings are consistent with multiple scattering of light.

IThA4 • 8:45 a.m.
Minimizing Coherent Thermal Conductance Using Multi-Layer Photonic Crystal Heterostructures, *Wah Tung Lau, Jung-Tsung Shen, Shanhui Fan; Stanford Univ., USA.* Multi-layer photonic crystal heterostructures, formed by interfacing homogeneous crystals of different lattice configurations, can attain coherent thermal conductance significantly below the vacuum value, due to mismatches in the photonic band structures between each individual crystal.

Rooms 321-323 — CLEO

8:00 a.m.–9:45 a.m.
CThA • High-Power Solid-State Lasers CLEO Symposium I: Multikilowatt Solid-State Lasers
Don Seeley; HEL-JTO, USA, Presider

CThA1 • 8:00 a.m. Invited
100 kW Coherently Combined Slab MOPAs, *Stuart J. McNaught, Hiroshi Komine, S. Benjamin Weiss, Randy Simpson, Adam M. F. Johnson, Jason Machan, Charles P. Asman, Mark Weber, Gina C. Jones, Marcy M. Valley, Andrew Jankevics, David Burchman, Michael McClellan, Jeff Sollee, Jay Marmo, Hagop Injeyan; Northrop Grumman Corp., USA.* We are developing a 100 kW Nd:YAG cw solid-state laser system. Seven wavefront-corrected 15 kW MOPA (master oscillator power amplifier) laser chains are phase locked to achieve a single aperture output beam with good beam quality.

CThA2 • 8:30 a.m. Invited
Physics of High Performance Yb:YAG Thin Disk Lasers. *Petras V. Avizonis[1], David J. Bossert[1], Mark S. Curtin[1], Alexander Killi[2]; [1]Boeing Co., USA, [2]TRUMPH GmbH, Germany.* We have achieved over 25kW power with Yb:YAG thin disks, achieved under high performance conditions, where slope optical efficiencies approaching 70%, strong ASE suppression, high heat removal, and other data based parameters will be presented.

Rooms 324-326 — JOINT

8:00 a.m.–9:45 a.m.
JThA • Nanophotonics and Metamaterials Symposium III: Active Plasmonics
Ulf Leonhardt; Univ. of St Andrews, UK, Presider

JThA1 • 8:00 a.m. Invited
Coherent Metamaterials: From "Optical Ferromagnetism" to the Lasing Spaser, *N. Papasimakis, V. A. Fedotov, Nikolay I. Zheludev; Univ. of Southampton, UK.* We introduce a new class of coherent metamaterials where regular ensembles of meta-molecules show collective, coherent narrow-band response leading to unusual electromagnetic properties and potential applications in the lasing spaser.

JThA2 • 8:30 a.m.
Gain-Assisted Surface Plasmon Microcavity, *Min W. Kim, Jeremy Moore, Yi Hao Chen, Yi Kuei Wu, Pallab Bhattacharya, L. Jay Guo, Peicheng Ku; Univ. of Michigan, USA.* The enhancement of cavity Q factor of a gain-assisted surface plasmon microcavity is experimentally demonstrated. This is believed to be the first experimental demonstration of gain-assisted cavity Q enhancement in a surface plasmon microcavity.

JThA3 • 8:45 a.m. Invited
Nanostructure-Based Optoelectronics and Plasmonics, *Hongkun Park; Harvard Univ., USA.* I will discuss several examples of our research efforts, concentrating on coupled single-photonic and plasmonic devices that allows the generation, guiding, and detection of single photons.

Room 314 — CLEO

8:00 a.m.–9:45 a.m.
CThB • Novel Devices and Techniques
David C. Hutchings; Univ. of Glasgow, UK, Presider

CThB1 • 8:00 a.m. Invited
Tunable VCSEL Using High Contrast Grating, *Connie J. Chang-Hasnain, Ye Zhou, M. C. Y. Huang, C. Chase, Vadim Karagodsky, Bala Pesala; Univ. of California at Berkeley, USA.* We will discuss extraordinary properties of a single-layer one-dimensional high-indexcontrast subwavelength grating and its versatility to manipulate light in various incidence angles relative to the grating periodicity, including broadband reflector, high-Q resonator and hollowcore waveguides.

CThB2 • 8:30 a.m.
Gigabit/s Modulation of Twin-Electrode High-Brightness Tapered Laser with High Modulation Efficiency, *C. H. Kwok[1], M. Xia[1], R. V. Penty[1], I. H. White[1], M. Ruiz[2], N. Michel[2], M. Krakowski[2], M. Calligaro[2], M. Lecomte[2], O. Parillaud[2]; [1]Univ. of Cambridge, UK, [2]Alcatel-Thales III-V Lab, France.* Simultaneous high modulation speed and high modulation efficiency operation of a two-electrode tapered laser is reported. 1Gb/s direct data modulation is achieved with 68mA applied current swing for a 0.95W output optical modulation amplitude.

CThB3 • 8:45 a.m.
Optical Non-Reciprocity in Optomechanical Structures, *Sasikanth Manipatruni, Jacob T. Robinson, Michal Lipson; Cornell Univ., USA.* We propose non-reciprocal optomechanical devices where light and matter interact via momentum exchange with a movable mirror. Non-reciprocity arises by utilizing the direction of linear momentum of light to differentiate forward and backward propagating light.

Room 315 | Room 316 | Room 317

IQEC

CLEO

8:00 a.m.–9:45 a.m.
IThB • Quantum Dot Science I
Perry Rice; Miami Univ., USA, Presider

IThB1 • 8:00 a.m.
Resonance Fluorescence from a Quantum Dot Spin, *Nick Vamivakas, Yong Zhao, Chao-Yang Lu, Mete Atature; Univ. of Cambridge, UK.* Here we report the observation of spin-selective photon emission from a resonantly driven singly charged QD. The relative frequencies of the spin-tagged photons are optically tuned via the spin-selective dynamic Stark effect.

IThB2 • 8:15 a.m.
Coherent Population Trapping of an Electron Spin in a Single Negatively Charged Quantum Dot, *Bo Sun[1], Xiaodong Xu[1], Paul R. Berman[1], Duncan G. Steel[1], Allan Bracker[2], Dan Gammon[2], Lu Sham[3]; [1]Univ. of Michigan, USA, [2]NRL, USA, [3]Univ. of California at San Diego, USA.* We report the demonstration of coherent population trapping of an electron spin by means of coherent optical spectroscopy of a single negatively charged quantum dot.

IThB3 • 8:30 a.m.
Optical Spin Initialization and Nondestructive Measurement in a Quantum Dot Molecule, *Danny Kim, Sophia E. Economou, Stefan C. Badescu, Michael Scheibner, Allan S. Bracker, Mark Bashkansky, Thomas L. Reinecke, Dan Gammon; NRL, USA.* The spin of an electron in an InAs/GaAs quantum-dot molecule is optically prepared and nondestructively measured through trion-triplet states. With two-laser transmission spectroscopy we demonstrate both simultaneously, something not previously accomplished in single quantum dots.

IThB4 • 8:45 a.m.
Coherent Ultrafast Optical Control of an Electron Spin Initialized to a Pure State in a Charged Self-Assembled Quantum Dot, *Erik D. Kim[1], Katherine Smirl[1], Xiaodong Xu[1], Bo Sun[1], Duncan Steel[1], Allan Bracker[2], Dan Gammon[2], Lu Sham[3]; [1]Univ. of Michigan, USA, [2]NRL, USA, [3]Univ. of California at San Diego, USA.* We demonstrate the optical initialization and ultrafast coherent control of an electron spin in a self-assembled dot, showing a spin Rabi oscillation and time-resolved precession of the electron spin coherence.

8:00 a.m.–9:45 a.m.
CThC • Quantum Cascade Lasers I
Igor Vurgaftman; NRL, USA, Presider

CThC1 • 8:00 a.m.
Low Temperature Sensitive, Deep-Well 4.8 μm Emitting Quantum Cascade Semiconductor Lasers, *Jae Cheol Shin[1], Mithun D'Souza[1], Jeremy Kirch[1], Luke J. Mawst[1], Dan Botez[1], Igor Vurgaftman[2], Jerry Meyer[2]; [1]Univ. of Wisconsin-Madison, USA, [2]NRL, USA.* A quantum-cascade laser design for suppressing carrier leakage from the active region was achieved. For both threshold and slope efficiency the characteristic temperatures, T_0 and T_1, reach values of 238 K over the 20-60oC range.

CThC2 • 8:15 a.m.
Ultra-Low Voltage Defect Quantum Cascade Lasers, *Matthew D. Escarra[1], Anthony J. Hoffman[1], Kale J. Franz[1], Scott S. Howard[1,2], Xiaojun Wang[3], Jen-Yu Fan[3], Claire Gmachl[1]; [1]Princeton Univ., USA, [2]Cornell Univ., USA, [3]AdTech Optics, Inc., USA.* We demonstrate a quantum cascade laser featuring a low-voltage-defect short injector. Devices showing a voltage-defect as low as 20meV and voltage efficiency of 88% at 80K are reported, with >80% voltage efficiency at room temperature.

CThC3 • 8:30 a.m.
Femtosecond Dynamics of a Mid-Infrared Quantum Cascade Laser, *Wilhelm Kuehn[1], Wolfgang Parz[2], Peter Gaal[1], Klaus Reimann[1], Michael Woerner[1], Thomas Elsaesser[1], Thomas Müller[2], Juraj Darmo[2], Karl Unterrainer[2], Maximilian Austerer[3], Gottfried Strasser[3], Luke R. Wilson[4], John W. Cockburn[4], Andrey B. Krysa[5], John S. Roberts[5]; [1]Max-Born-Inst., Germany, [2]Inst. für Photonik, Technische Univ. Wien, Austria, [3]Zentrum für Micro and Nano Strukturen, Technische Univ. Wien, Austria, [4]Dept. Physics and Astronomy, Univ. of Sheffield, UK, [5]EPSRC Natl. Ctr. for III-V Technologies, Univ. of Sheffield, UK.* The optical gain dynamics in an InGaAs/AlInAs quantum cascade laser is studied by midinfrared pump-probe experiments and electro-optic sampling. We find an extremely fast gain recovery time of <1 ps.

CThC4 • 8:45 a.m.
Interface Roughness Broadening in Intersubband Lasers: Homogeneous or Not? *Jacob B. Khurgin, Yamac Dikmelik; Johns Hopkins Univ., USA.* We demonstrate the inhomogeneous character of interface roughness broadening in intersubband transitions and analyze its impact on temperature dependence of the gain and absorption spectra in the quantum cascade laser.

8:00 a.m.–9:45 a.m.
CThD • Quasi Phase Matching
Yushi Kaneda; Univ. of Arizona, USA, Presider

CThD1 • 8:00 a.m.
Uniformity of 50 mm-Long Quasi-Phase-Matched Adhered Ridge Waveguide, *Rai Kou[1,2], Sunao Kurimura[1,2], Kiyofumi Kikuchi[2], Akihiro Terasaki[2], Hirochika Nakajima[2], Katsutoshi Kondou[3], Junichiro Ichikawa[3]; [1]Natl. Inst. for Materials Science, Japan, [2]Waseda Univ., Japan, [3]Sumitomo Osaka Cement Co., Ltd., Japan.* A 50 mm-long Mg:$LiNbO_3$-based quasi-phase-matched adhered ridge waveguide wavelength converter records over 5000%/W SHG normalized conversion efficiency at 8 μm-wide waveguide with a low insertion loss of 4.4dB for 1550 nm.

CThD2 • 8:15 a.m.
Random-Phase-Matching in Periodically-Poled Material, *Chien-Jen Lai[1], Wei-Ting Chen[1], A. H. Kung[1,2]; [1]Inst. of Atomic and Molecular Sciences, Academia Sinica, Taiwan, [2]Natl. Chiao Tung Univ., Taiwan.* We show that randomness in the periodicity and the duty-cycle of inverted domains in a periodically-poled crystal can result in substantial enhancement in non-phase-matched second harmonic generation. The result is corroborated by experiment.

CThD3 • 8:30 a.m.
Progress in Sub-Micrometer Periodicity of Quasi-Phase Matching Structures, *Carlota Canalias, Valdas Pasiskevicius, Michael Fokine, Fredrik Laurell; Royal Inst. of Technology, Sweden.* We report on the progress in fabrication of sub-micrometer ferroelectric domain gratings in $KTiOPO_4$. Periods as short as 565 nm have been created in the bulk of the crystal by electric-filed poling.

CThD4 • 8:45 a.m. Invited
Semiconductor Guided-Wave Wavelength Conversion Devices, *Takashi Kondo; Univ. of Tokyo, Japan.* Fabrication processes for periodically inverted AlGaAs and AlGaP waveguides have been developed. Considerably high conversion efficiencies in AlGaAs-based devices and the first observation of a quasi-phase-matched parametric interaction in a GaP-based device will be reported.

Room 336

CLEO

8:00 a.m.–9:45 a.m.
CThE • Fiber Sensors and Gratings
Jacques Albert; Carleton Univ., Canada, Presider

CThE1 • 8:00 a.m.
Ultra-Sensitive Photonic Crystal Fiber Refractive Index Sensor, *Darran K. C. Wu, Boris T. Kuhlmey, Benjamin J. Eggleton; Univ. of Sydney, Australia.* We introduce a refractive index sensing geometry exploiting modes beyond cutoff in a selectively infiltrated PCF. We demonstrate a detection limit of 4.6×10^{-7} RIU and sensitivity of 30,100nm/RIU, a one order of magnitude improvement over previous PCF sensors.

CThE2 • 8:15 a.m.
Spectral Properties of Liquid-Core Bragg Fibers, *Kristopher J. Rowland[1], Shahraam Afshar V.[1], Alexander Stolyarov[2], Yoel Fink[2], Tanya M. Monro[1]; [1]Univ. of Adelaide, Australia, [2]MIT, USA.* We demonstrate significant shifting of the fundamental bandgap of a hollow-core Bragg fiber by systematically filling the core with liquids of various refractive indices. Comparison with theory demonstrates the importance of considering material dispersion.

CThE3 • 8:30 a.m.
Demonstration of a 9cm Side-Emitting Fiber Laser Line Source with a Tilted Fiber Grating Output Coupler, *Paul Westbrook, Ken S. Feder; OFS Labs, USA.* We demonstrate an Er doped fiber laser line source whose output coupler is a 9cm, 45° tilted fiber grating. Our approach shows potential for improved efficiency and simplicity over previously described line sources.

CThE4 • 8:45 a.m.
Active Fiber Hydrogen Sensors for Low-Temperature Operation, *Tong Chen[1], Michael P. Buric[1], Kevin P. Chen[1], Philip R. Swinehart[2], Mokhtar Maklad[2]; [1]Univ. of Pittsburgh, USA, [2]Lake Shore Cryotronics Inc., USA.* We report a fiber hydrogen sensor for low-temperature operation. The low-temperature response time of palladium-coated fiber Bragg grating in high attenuation fiber is enhanced by 40 times with in-fiber laser heating.

Room 337

IQEC

8:00 a.m.–9:45 a.m.
IThC • THz Interactions with Condensed Matter
Roberto Morandotti; Enérgie, Matériaux et Télécommunications, INRS, Canada, Presider

IThC1 • 8:00 a.m.
Interaction of Intense Narrowband THz Pulses with Coherent Excitons in Semiconductor QWs, *Yun-Shik Lee[1], Andrew D. Jameson[1], Joseph L. Tomaino[1], Johannes T. Steiner[2], Mackillo Kira[2], Stephan W. Koch[2], John P. Prineas[3]; [1]Oregon State Univ., USA, [2]Philipps-Univ. Marburg, Germany, [3]Univ. of Iowa, USA.* We investigate the coherent dynamics of excitonic wavepackets in semiconductors driven by intense narrowband THz pulses. Time-resolved THz-pump and optical-probe measurements demonstrate strong nonlinear-optical transients of the light-hole and heavy-hole excitonic resonances in GaAs/AlGaAs QWs.

IThC2 • 8:15 a.m.
Direct Phonon Excitation in Semiconductors by Ultrashort Intense THz Radiation, *Jean-Michel Manceau, Panagiotis A. Loukakos, Stelios Tzortzakis; Inst. of Electronic Structure and Laser, Foundation for Res. and Technology-Hellas, Greece.* Ultrashort intense THz radiation generated through laser filamentation in air is employed to directly excite the lattice of AlGaAs semi-insulating crystals. Incoherent as well as coherent phonons are shown to be excited in this way.

IThC3 • 8:30 a.m.
Formation Dynamics of Excitons and Electron-Hole Droplets in Si Probed by THz Time Domain Spectroscopy, *Takeshi Suzuki, Ryo Shimano; Dept. of Physics, Univ. of Tokyo, Japan.* We investigate the formation dynamics of excitons and electron-hole droplets (EHD) in Si by broad-band THz time domain spectroscopy. A clear 1S-2P transition of indirect excitons and surface plasmon of EHD is observed.

IThC4 • 8:45 a.m.
Terahertz Signatures of Plasmons in a Two-Dimensional Electron Gas, *Torben Grunwald[1], Sangam Chatterjee[1], Klaus Pierz[2], Daniel Golde[1], Mackillo Kira[1], Stephan W. Koch[1,2]; [1]Philipps-Univ. Marburg, Germany, [2]Physikalisch-Technische Bundesanstalt, Germany.* A finite density-dependent plasmon pole is observed in the inverse dielectric response function of a two-dimensional electron gas by THz-spectroscopy. A microscopic many-body theory explains the experimental results.

Room 338

CLEO

8:00 a.m.–9:45 a.m.
CThF • Ultrafast Photonics I
Andrew Weiner; Purdue Univ., USA, Presider

CThF1 • 8:00 a.m.
All-Optical Self-Switching in an Optimized Fiber Bragg Grating with a π Phase Shift, *Irina V. Kabakova[1], Bill Corcoran[1], Jeremy A. Bolger[1,2], C. Martijn de Sterke[1], Ben J. Eggleton[1]; [1]Univ. of Sydney, Australia, [2]Finisar Corp., Australia.* We experimentally demonstrate all-optical self-switching of sub-nanosecond pulses in a fiber grating with a π phase-shift, which acts as a cavity, enhancing the intensity. At 1.5 kW peak power the transmission increases by 4.2 dB.

CThF2 • 8:15 a.m.
All-Optical Clock Recovery Using Temporal Talbot Effect Followed by SOA-Based Fiber Ring Laser, *Masaki Oiwa, Shunsuke Minami, Kenichiro Tsuji, Noriaki Onodera, Masatoshi Saruwatari; Natl. Defense Acad., Japan.* We demonstrate 10-Gbit/s all-optical clock recovery using the temporal Talbot effect in single-mode fibers with subsequent optical pulse injection into an SOA-based fiber ring laser. The clear clock is recovered from 2^{31}–1 PRBS optical pulses.

CThF3 • 8:30 a.m.
Optical Injection Locking of a Coupled Opto-Electronic Oscillator, *Charles Williams, Franklyn Quinlan, Josue Davila-Rodriguez, Peter J. Delfyett; CREOL, College of Optics and Photonics, Univ. of Central Florida, USA.* A semiconductor based, injection locked coupled optoelectronic oscillator is presented, operating at 10.25 GHz and seeded with a narrow linewidth CW laser operating at 1550 nm. Optical supermode suppression is demonstrated via increased comb visibility.

CThF4 • 8:45 a.m. Invited
Ultrafast and Nanoscale Optics, *Yeshaiahu Fainman; Univ. of California at San Diego, USA.* This paper explores the role of nanotechnology with special focus on nanophotonics in dielectric and metal-dielectric inhomogeneous metamaterials with applications for optical information processing in space and time, communications, and sensing.

Room 339

JOINT

8:00 a.m.–9:45 a.m.
JThB • Attosecond Science
David Villeneuve; Natl. Res. Council Canada, Canada, Presider

JThB1 • 8:00 a.m. Invited
Laser Induced Tunneling in Less than 12 Attoseconds: Instantaneous or Invalid Concept? *Adrian N. Pfeiffer[1], Petrissa Eckle[1], Claudio Cirelli[1], André Staudte[2], Reinhard Dörner[3], Harm Geert Muller[4], Ursula Keller[1]; [1]Physics Dept., ETH Zürich, Switzerland, [2]Steacie Inst. for Molecular Sciences, Canada, [3]Inst. für Kernphysik, Johann Wolfgang Goethe Univ., Germany, [4]FOM-Inst. AMOLF, Netherlands.* We use attosecond angular streaking to place an intensity-averaged upper limit of 12 attoseconds on the tunneling delay time in strong field ionization of helium. This is far shorter than most tunneling times discussed before.

JThB2 • 8:30 a.m.
XUV Supercontinua Supporting Pulse Durations of Sub-One Atomic Unit of Time, *Hiroki Mashiko, Steve Gilbertson, Eric Moon, Zenghu Chang; Kansas State Univ., USA.* Double optical gated high-order harmonic supercontinuous spectra were generated in the extreme ultraviolet region including the "water window". The spectra supported 16 as pulse durations that are below one atomic unit of time (24 as).

JThB3 • 8:45 a.m.
Characterization of Isolated Attosecond Pulses from Multi-Cycle Lasers, *Steve Gilbertson, Ximao Feng, Hiroki Mashiko, He Wang, Sabih Khan, Michael Chini, Zenghu Chang; Kansas State Univ., USA.* Through FROG-CRAB based on attosecond streaking, we characterized 140 attosecond single isolated pulses generated with a double optical gating using 9 fs lasers.

Room 340 | Room 341 | Rooms 328-329

CLEO

8:00 a.m.–9:45 a.m.
CThG • Emerging Applications in Laser Processing
Craig B. Arnold; Princeton Univ., USA, Presider

CThG1 • 8:00 a.m. Tutorial

Laser Processing: Basic to Advanced Applications, *Peter Herman; Univ. of Toronto, Canada.* The basic components of laser material processing systems are broken down and examined in the context of common industry platforms. Laser interaction physics and their scaling on cw to femtosecond time scales for macro-to-micro-to-nano-processing applications are discussed.

Professor Herman guides a large research group that develops and applies laser technology and advanced beam delivery systems to control and harvest laser interactions in new frontiers of 3-D nanofabrication. Laser frontiers of extreme short wavelength, ultrashort duration, and high coherence are exploited in a research program that emphasizes passive and active lightwave circuits, photonic bandgap devices, lab-on-a-chip biophotonics, and micro-optical sensing systems. Professor Herman is a Fellow of The Optical Society, an active member of the OSA, IEEE, and SPIE, and co-chair of the SPIE Photonics West 'LASE' conference. His group interacts with numerous academic and industrial partners and has published more than 200 scientific journal and conference papers. More information can be found at: http://photonics.light.utoronto.ca/laserphotonics/.

8:00 a.m.–9:45 a.m.
CThH • THz QCL
Iwao Hosako; NICT, Japan, Presider

CThH1 • 8:00 a.m.

High-Frequency Modulation of Bound-to-Continuum Terahertz Quantum Cascade Lasers up to 24GHz, *Wilfried Maineult[1], Lu Ding[1], Pierre Gellie[1], Lorenzo Lugani[1,2], Pascal Filloux[1], Carlo Sirtori[1], Stefano Barbieri[1], S. Guilet[3], R. Braive[3], Isabelle Sagnes[3], Harvey Beere[4], David Ritchie[4]; [1]Univ. of Paris, France, [2]Natl. Enterprise for nanoScience and nanotechnology, CNR-INFM and Scuola Normale Superiore, Italy, [3]Lab de Photonique et Nanostructures, France, [4]Cavendish Lab, UK.* We report on the high frequency modulation of Terahertz quantum cascade lasers. By resonantly enhancing the frequency response of the RF package we show that metal-metal waveguide 2.3THz QCLs, can be modulated up to 24GHz.

CThH2 • 8:15 a.m.

InP Based Terahertz Quantum Cascade Lasers with 4 Quantum Well Active Region Design, *Milan Fischer, Giacomo Scalari, Maria Ines Amanti, Mattias Beck, Christoph Walther, Jérôme Faist; Inst. for Quantum Electronics, ETH Zürich, Switzerland.* We present a terahertz quantum-cascade laser based on InGaAs/InAlAs/InP material system with double metal waveguide that reaches operating temperature of 123K with continuous-wave power output 4.5mW at 10K and slope efficiency comparable to GaAs/AlGaAs counterparts.

CThH3 • 8:30 a.m.

Low Divergence Single Mode Edge Emitting Double Metal Terahertz Quantum Cascade Laser, *Maria Ines Amanti, Milan Fischer, Mattias Beck, Giacomo Scalari, Jérôme Faist; ETH Zürich, Switzerland.* We present the use of a third-order distributed feedback waveguide for double metal THz quantum-cascade laser as a successful design to obtain high slope efficiency of 50mW/A, spectral emission control and narrow single lobed far field(5°x8°).

CThH4 • 8:45 a.m.

Low-Threshold Terahertz Quantum-Cascade Lasers with One-Well Injector Operating up to 174K, *Sushil Kumar[1], Qing Hu[1], John L. Reno[2]; [1]MIT, USA, [2]Sandia Natl. Labs, USA.* We report operation of 2.7THz quantum-cascade lasers upto 174K. A new three-well active region, one-well injector scheme is utilized to lower the operating current densities, while maintaining temperature performance comparable to the best published THz-QCLs.

8:00 a.m.–9:45 a.m.
CThI • Spectroscopic Gas Sensing II
Douglas J. Bamford; Physical Sciences Inc., USA, Presider

CThI1 • 8:00 a.m.

Portable Spectroscopic Carbon Dioxide Monitor for Carbon Sequestration Applications, *Anatoliy A. Kosterev[1], Lei Dong[1], David Thomazy[1], Frank K. Tittel[1], Igor Pavlovsky[2], Katherine Romanak[3]; [1]Rice Univ., USA, [2]Applied Nanotech Inc., USA, [3]Univ. of Texas at Austin, USA.* A portable sensor for CO_2 monitoring based on QEPAS technology and using a DFB diode laser operating at λ=1.57 μm will be described. The sensor is primarily intended for studies of CO_2 penetration through soil.

CThI2 • 8:15 a.m.

CO and CH_4 Sensing with Single Mode 2.3μm GaSb-Based VCSEL, *Jia Chen[1,2], Andreas Hangauer[1,2], Alexander Bachmann[2], Taek Lim[2], Kaveh Kashani-Shirazi[2], Rainer Strzoda[1], Markus-Christian Amann[2]; [1]Siemens AG, Germany, [2]Walter Schottky Inst., Technische Univ. München, Germany.* Successful application of recently developed GaSb-based singlemode vertical-cavity surface-emitting lasers for gas-sensing at 2.3 μm is reported. CO and CH_4 have been detected simultaneously using wavelength modulation spectroscopy with a multi-line curve fit concept.

CThI3 • 8:30 a.m. Invited

Challenges and Opportunities for Next-Generation Diode Laser Active Sensing, *Mark G. Allen; Physical Sciences Inc., USA.* New applications for diode laser-based sensors in the automotive industry are described. Opportunities for MWIR and LWIR sources is highlighted. Heterodyne measurement techniques, allowing for sensitive room-temperature detection methods in the FIR, are described.

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IQEC	CLEO	JOINT	CLEO

IThA • Photonic Crystals—Continued

IThA5 • 9:00 a.m.
Absence of Backscattering in Honeycomb Photonic Lattice, *Omri Bahat-Treidel, Or Peleg, Mark Grobman, Moti Segev; Technion-Israel Inst. of Technology, Israel.* We study scattering processes in deformed honeycomb photonic lattices. For certain deformations, we demonstrate both non-resonant (independent of the defect-width) total-transmission and total-reflection, emphasizing that optical excitations in honeycomb lattices behave as relativistic fermions.

IThA6 • 9:15 a.m.
Light Localization and Label-Free Colorimetric Sensing with Deterministic Aperiodic Photonic Structures, *Svetlana V. Boriskina, Ashwin Gopinath, Sylvanus Lee, Luca Dal Negro; Boston Univ., USA.* We theoretically investigate light localization and local density of states manipulation in aperiodic photonic structures and discuss their applications as pseudo-random lasers and label-free optical biosensors.

IThA7 • 9:30 a.m.
Single-Photon Traversal of Dielectric Stacks, *Natalia B. Rutter[1,2], Sergey V. Polyakov[2,3], Paul Lett[3,4], Alan Migdall[2,3]; [1]Georgetown Univ., USA, [2]Optical Technology Div., NIST, USA, [3]Joint Quantum Inst., Univ. of Maryland, USA, [4]Atomic Physics Div., NIST, USA.* We examine single-photon bandgap traversal times. We see significant change in traversal times due to subtle differences in stack structures. We also analyze how propagation through inhomogeneous media affects Hong-Ou-Mandel visibility.

CThA • High-Power Solid-State Lasers CLEO Symposium I: Multikilowatt Solid-State Lasers—Continued

CThA3 • 9:00 a.m. Invited
Power Scaling of SM Fiber Lasers toward 10kW, *Michael O'Connor; IPG Photonics Corp., USA.* The physical and engineering challenges in scaling fiber lasers toward 10kW include 1) avoiding nonlinear thresholds, particularly SRS, 2) obtaining sufficient pump brightness, and 3) overcoming thermal issues. The methods to overcome these barriers are reviewed and results >6kW SM are provided.

CThA4 • 9:30 a.m.
Current Status and Most Recent Developments of Industrial High Power Disk Lasers, *Jochen Deile[1], Rüdiger Brockmann[2], David Havrilla[1]; [1]TRUMPF Inc., USA, [2]TRUMPF Laser GmbH & Co. KG, Germany.* This report described a 1.5 kW source with a beam parameter product of 2 mm*mrad and a >10 kW system out of two disks with a BPP of 8 mm*mrad among other disk laser developments.

JThA • Nanophotonics and Metamaterials Symposium III: Active Plasmonics—Continued

JThA4 • 9:15 a.m.
Tunable, Nanoscale Free-Electron Source of Photons and Plasmons, *G. Adamo[1], K. F. MacDonald[1], N. I. Zheludev[1], Y. H. Fu[2], C.-M . Wang[2], D. P. Tsai[2], F. J. García de Abajo[3]; [1]Optoelectronics Res. Ctr., Univ. of Southampton, UK, [2]Natl. Taiwan Univ., Taiwan, [3]Inst. de Optica, CSIC, Spain.* The passage of a free-electron beam through a nanohole in a periodically layered metal/dielectric structure creates a new type of tuneable, nanoscale radiation source, analogous to the free-electron laser - a "light-well".

JThA5 • 9:30 a.m.
Surface Plasmon Polariton Enhanced Fluorescence from Quantum Dots on Nanostructured Metal Surfaces, *Ehren Hwang[1], Igor Smolyaninov[2], Christopher C. Davis[1]; [1]Dept. of Electrical and Computer Engineering, Univ. of Maryland, USA, [2]Advanced Technologies, Electronics and Integrated Solutions, BAE Systems, USA.* Surface-plasmon-polariton-enhanced fluorescence from CdSe/ZnS quantum dots (QD) deposited onto patterned gold/PMMA substrates has been observed, and the enhancement related to QD position with regard to the type of surface and nanostructures.

CThB • Novel Devices and Techniques—Continued

CThB4 • 9:00 a.m.
Optimization of Metallic Micro-Heaters for Reconfigurable Silicon Photonics, *Amir H. Atabaki, Mohammad Soltani, Siva Yegnanarayanan, Ali A. Eftekhar, Ali Adibi; Georgia Tech, USA.* Integration of silicon microresonators with metallic microheaters optimized for low power consumption and fast reconfigurability is experimentally demonstrated. It is shown that narrower heaters improve the performance and also LPCVD SiN over-cladding enhances tuning speed.

CThB5 • 9:15 a.m.
Adjustable Polarization Mode Dispersion Compensation Using 3-D Hollow Waveguide Bragg Reflector, *Mukesh Kumar, Takahiro Sakaguchi, Akihiro Matsutani, Fumio Koyama; Tokyo Inst. of Technology, Japan.* An adjustable polarization mode dispersion compensator with a variable tapered-3-D-hollow-waveguide Bragg-reflector has been demonstrated exhibiting a giant-birefringence of 0.01 and a 13-psec tuning in differential-group-delay for a 3-mm-long compact device.

CThB6 • 9:30 a.m.
Time-Gated Filter for Sideband Suppression, *Jason Chou[1], Todd S. Rose[1], Josh A. Conway[1], George C. Valley[1], Bahram Jalali[2]; [1]Aerospace Corp, USA, [2]Univ. of California at Los Angeles, USA.* A time-gated filter is demonstrated that converts a double-sideband radio-frequency waveform on a pulsed optically chirped carrier into a single sideband waveform. The filter is used to reduce the dispersion penalty in time-stretch ADCs.

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

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

10:30 a.m.-12:30 p.m. *PhAST* Market Focus Session: Terahertz–Imaging and Surveillance, *Exhibit Hall*

NOTES

Room 315 | Room 316 | Room 317

IQEC | CLEO

IThB • Quantum Dot Science I—Continued

IThB5 • 9:00 a.m.
Optical Coupling of Nitrogen-Vacancy Centers in Diamond to GaP Waveguides, *Kai-Mei C. Fu[1], Charles Santori[1], Paul E. Barclay[1], Neal Meyer[2], Arliena M. Holm[2], Igor Aharonovich[3], Steven Prawer[3], Raymond G. Beausoleil[1]; [1]Hewlett-Packard Labs, USA, [2]Hewlett-Packard Co., USA, [3]School of Physics, Univ. of Melbourne, Australia.* In this work NV coupling to GaP waveguides on a diamond surface is demonstrated. The NV-waveguide coupling strength and waveguide loss are measured. Waveguide-coupled NV devices should be useful for NV-based quantum information processing.

IThB6 • 9:15 a.m.
Tuning the Coupling of a Single Quantum Dot to a Photonic Crystal Waveguide, *Henri Thyrrestrup, Toke Lund-Hansen, Peter Lodahl; DTU Fotonik, Technical Univ. of Denmark, Denmark.* We present time-resolved spontaneous emission measurements of a single quantum dot that is temperature tuned around the band edge of a photonic crystal waveguide. 85% efficient coupling to the slowlight waveguide mode is obtained.

IThB7 • 9:30 a.m.
Engineering Anti-Bunching via Photon Blockade in Photonic Crystal Cavity-Quantum Dot Systems, *Arka Majumdar, Andrei Faraon, Jelena Vuckovic; Stanford Univ., USA.* Methods to improve single photon generation via photon-blockade in a photonic-crystal cavity with a strongly coupled quantum-dot are presented. With realistic system parameters, significant improvement in second-order-auto-correlation $g^2(0)$ (from 0.93 to 0.79) is achieved.

CThC • Quantum Cascade Lasers I—Continued

CThC5 • 9:00 a.m.
Instantaneous Power and Threshold in Continuous Wave Quantum Cascade Lasers, *Anthony J. Hoffman[1], Phillip X. Braun[1], Matthew D. Escarra[1], Scott S. Howard[1,2], Kale J. Franz[1], Xiaojun Wang[3], Jen-Yu Fan[3], Claire Gmachl[1]; [1]Princeton Univ., USA, [2]Cornell Univ., USA, [3]AdTech Optics Inc., USA.* Using low-duty cycle pulses superimposed on a DC current, we determine the type of power roll-over and obtain the instantaneous threshold current, current efficiency and core temperature of a quantum-cascade laser in continuous wave operation.

CThC6 • 9:15 a.m.
Broad-Area Quantum Cascade Lasers with Pulsed Output Power up to 53 W, *Jill A. Nolde[1], Joshua Abell[1], Mijin Kim[1], Chulsoo Kim[1], Igor Vurgaftman[1], Jerry R. Meyer[1], X. J. Wang[2], J. Y. Fan[2]; [1]NRL, USA, [2]AdTech Optics, Inc., USA.* A 3-mm-long, 150-μm-wide broad-area quantum cascade laser (λ = 4.65 μm) with sidewall corrugations produced a maximum-current-limited pulsed output power of 53 W and wall-plug efficiency of 29.4% from two facets at 80 K.

CThC7 • 9:30 a.m.
Novel Thermal Tuning of Quantum Cascade Lasers Utilizing Thermochromic Claddings, *Bernhard Basnar[1], Elvis Mujagic[1], Aaron M. Andrews[1], Pavel Klang[1], Werner Schrenk[1], Gottfried Strasser[1,2]; [1]Ctr. for Micro- and Nanostructures, Vienna Univ. of Technology, Austria, [2]SUNY Buffalo, USA.* We present a novel method for the thermal tuning of a grating-free mid-IR QCLs utilizing the absorbance changes of a thermochromic cladding. Both higher tuning coefficients as well as thermostable emission are achievable.

CThD • Quasi Phase Matching—Continued

CThD5 • 9:15 a.m.
Tunable Narrow-Band Terahertz Generation at Quasi-Phase Matched Crystals Using Femtosecond Laser Pulse, *Nan Ei Yu[1], Chul Kang[1], Hyung Keun Yoo[1], Yeung Lak Lee[1], Do-Kyeong Ko[1], Kenji Kitamura[2], Shunji Takekawa[2]; [1]Advanced Photonics Res. Inst., Republic of Korea, [2]Natl. Inst. for Materials Science, Japan.* Terahertz pulses were generated in periodically poled lithium niobate and lithium tantalate around 1.4 and 0.6 THz with band-width of 20 GHz. The generated intensity was rapidly increased depending on temperature decreasing of the crystal.

CThD6 • 9:30 a.m.
A Comparative Study of Second-Harmonic Generation and Diffraction Experiments in Ferroelectric Domain Engineered Crystals, *Krishnamoorthy Pandiyan, Yeon-Suk Kang, Hwan-Hong Lim, Byeong-Joo Kim, Myoungsik Cha; Pusan Natl. Univ., Republic of Korea.* We demonstrate that the nonlinear optical performance of periodically poled crystals can be exactly predicted by observing the far-field diffraction pattern. The diffraction pattern is shown to be equivalent to the second-harmonic generation tuning curve.

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

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

10:30 a.m.-12:30 p.m. *PhAST* Market Focus Session: Terahertz–Imaging and Surveillance, *Exhibit Hall*

NOTES

Room 336	Room 337	Room 338	Room 339
CLEO	IQEC	CLEO	JOINT

CThE • Fiber Sensors and Gratings—Continued

CThE5 • 9:00 a.m.
Reconstruction of a Strong Fiber Bragg Gratings Complex Coupling Coefficient in Erbium Doped Fiber with Optical Space Domain Reflectometry, *Geoffrey A. Cranch; NRL, USA.* An improved implementation of optical space domain reflectometry is presented using an interferometric characterization method and deconvolution technique. Reconstruction of a strong Bragg grating written in erbium fiber, with a qL=8.6 is demonstrated.

CThE6 • 9:15 a.m.
Reducing Phase Errors during the Inscription Process of Distributed Feedback Fiber Lasers, *Gary A. Miller[1], Gordon M. H. Flockhart[2], Geoffrey A. Cranch[3]; [1]NRL, USA, [2]Univ. of Strathclyde, UK, [3]SFA Inc., USA.* The fabrication of a reduced phase error, distributed feedback fiber laser in erbium-doped fiber is presented. Using the Trace Grating technique, the overall phase error has been reduced by a factor of 2.5.

CThE7 • 9:30 a.m.
Interrogation of Birefringent Fiber Sensors Using Fiber Gyroscope Technology, *Klaus M. Bohnert, Stephan Wildermuth, Hubert Brändle; ABB Ltd., Switzerland.* A novel fiber interferometer, adapted from a Sagnac-type interferometer with non-reciprocal phase modulation, is used to measure the differential optical phase shift in birefringent fiber sensors. The interferometer is applied to voltage sensing.

IThC • THz Interactions with Condensed Matter—Continued

IThC5 • 9:00 a.m.
THz Emission from Coherently Controlled Photocurrents in Epitaxial Graphene, *Dong Sun[1], Charles J. Divin[1], Claire Berger[2], Walt de Heer[2], Julien Rioux[3], John Sipe[3], Theodore B. Norris[1]; [1]Univ. of Michigan, USA, [2]School of Physics, Georgia Tech, USA, [3]Dept. of Physics, Univ. of Toronto, Canada.* We inject ballistic electric currents into epitaxial graphene at 300 K via quantum interference between phase controlled cross-polarized 3.2-μm and 1.6-μm 200- fs pulses. The transient currents are detected via the emitted terahertz radiation.

IThC6 • 9:15 a.m.
Ultrafast Optical-Pump THz-Probe Spectroscopy of the Carrier Dynamics in Oriented Germanium Nanowires, *Jared H. Strait, Paul A. George, Farhan Rana, Mark Levendorf, Martin Blood-Forsythe, Jiwoong Park; Cornell Univ., USA.* We present ultrafast optical-pump THz-probe measurements of the carrier intraband relaxation and interband recombination dynamics in oriented Germanium nanowires. We find 2-3 ps intraband relaxation times and density-dependent recombination times in the 50-100 ps range.

IThC7 • 9:30 a.m.
Scattering of Terahertz Radiation from Oriented Carbon Nanotube Films, *Finn Eichhorn[1], Peter U. Jepsen[1], Nicholas Schroeder[2], Gregory Kozlowski[2], Jason A. Deibel[2], Krzysztof K. K. Koziol[3]; [1]Technical Univ. of Denmark, Denmark, [2]Wright State Univ., USA, [3]Univ. of Cambridge, UK.* We report on the use of terahertz time-domain spectroscopy to measure scattering from multi-walled carbon nanotubes aligned normal to the film plane. Measurements indicate scattering from the nanotubes is significantly stronger than for bulk metal.

CThF • Ultrafast Photonics I—Continued

CThF5 • 9:15 a.m.
Demonstration of Spin Polarization Switching at 2.2 TBit/Sec for Proposed Spin-Photon Memory, *Vadym Zayets, Koji Ando; Nanoelectronics Res. Inst., AIST, Japan.* A new type of nonvolatile high-speed optical memory is proposed, utilizing magnetization reversal of nanomagnet by spin-polarized photo-excited electrons. To verify the high speed of the proposed demultiplexing method, spin-polarization switching at 2.2TBit/sec was demonstrated.

CThF6 • 9:30 a.m.
Ultrafast Real-Time Vibronic Coupling of a Breather Soliton in Trans-Polyacetylene Using a Few Cycle Pulse, *Takayoshi Kobayashi[1,2,3,4], Takahiro Teramoto[1,2], Valerii M. Kobryanskii[5], Takashi Taneichi[1,2]; [1]Dept. of Applied Physics and Chemistry and Inst. for Laser Science, Univ. of Electro-Communications, Japan, [2]Intl. Cooperative Res. Project, Japan Science and Technology Agency, Japan, [3]Dept. of Electrophysics, Natl. Chiao Tung Univ., Taiwan, [4]Inst. of Laser Engineering, Osaka Univ., Japan, [5]Inst. of Chemical Physics, RAS, Russian Federation.* The ultrafast electron-phonon coupling dynamics due to a breather soliton inducing amplitude and frequency modulations after photoexcitation in *trans*-polyacetylene was observed by ultrafast multicolor spectroscopy. The results were in good agreement with recent theoretical predictions.

JThB • Attosecond Science—Continued

JThB4 • 9:00 a.m.
Characterizing Isolated Attosecond Pulses from a Hollow-Core Waveguide Using Multi-Cycle Driving Pulses, *Isabell Thomann[1], Alon Bahabad[1], Rick Trebino[2], Margaret M. Murnane[1], Henry C. Kapteyn[1]; [1]JILA, Univ. of Colorado at Boulder and NIST, USA, [2]Georgia Tech, USA.* We temporally characterize 200 attosecond FWHM pulses created by high harmonic generation of 15 femtosecond pulses. Simulations of the interferometric two-color crosscorrelation data and an iterative algorithm were used to extract the pulse duration.

JThB5 • 9:15 a.m.
Fourier Spectroscopy of Fragmentation of D_2^+ Irradiated with Attosecond Pulse Trains, *Yusuke Furukawa[1], Tomoya Okino[2], Kaoru Yamanouchi[2], Sébastien Saugout[1], Yasuo Nabekawa[1], Katsumi Midorikawa[1]; [1]Laser Technology Lab, RIKEN, Japan, [2]School of Science, Univ. of Tokyo, Japan.* The kinetic energy release of the D^+ fragment ion from D_2 molecule is measured using an interferometric autocorrelation technique. The interference fringes of the ω, 3ω, and 5ω fields emerge on the D^+ fragment signals.

JThB6 • 9:30 a.m.
High Order Harmonic Generation Driven by a Yb-Doped Fiber Amplifier System at 1 MHz Repetition Rate, *Johan Boullet[1], Johan Zaouter[1,2], Jens Limpert[3], Stéphane Petit[1], Eric Mevel[1], Eric Constant[1], Eric Cormier[1]; [1]CELIA, France, [2]Amplitude Systèmes, France, [3]Inst. of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany.* We demonstrate high brightness XUV emission through high order harmonic generation driven by a 100 μJ-class ytterbium-doped fiber, CPA system at controllable ultrahigh (100 kHz to 1 MHz) repetition rate.

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

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

10:30 a.m.-12:30 p.m. *PhAST* Market Focus Session: Terahertz–Imaging and Surveillance, *Exhibit Hall*

CThG • Emerging Applications in Laser Processing—Continued

CThG2 • 9:00 a.m.
Parallel Direct-Write Nanolithography Using Arrays of Optically Trapped Microlenses, *Euan McLeod, Craig B. Arnold; Princeton Univ., USA.* We use Bessel beam optical traps to self-position arrays of microsphere objectives near surfaces. Pulsed laser illumination of these objectives is used to perform near-field direct-write sub-wavelength optical nanopatterning with 100 nm feature sizes.

CThG3 • 9:15 a.m.
Flow Monitoring in Optofluidic Channels Using Planar Bragg Gratings, *Christopher Holmes, James C. Gates, Corin B. E. Gawith, Peter G. R. Smith; Optoelectronics Res. Ctr., Univ. of Southampton, UK.* An integrated pressure/flow sensor using a direct UV written planar Bragg grating situated inside a flexible diaphragm of thickness 200 micrometres has been fabricated. The diaphragm is created by etching away the underlying silicon support.

CThG4 • 9:30 p.m.
Real-Time Coherent Imaging of Ultrafast Ablation, *Ben Y. C. Leung, Paul J. L. Webster, Joe X. Z. Yu, James M. Fraser; Queen's Univ., Canada.* By integrating coherent imaging (optical coherence tomography) into an ultrafast machining platform, we directly monitor surface and subsurface changes in sample morphology due to the laser ablation and subsequent relaxation between laser pulses.

CThH • THz QCL—Continued

CThH5 • 9:00 a.m.
Frequency-Tunable External Cavity Terahertz Quantum Cascade Laser, *Alan W. M. Lee[1], Qi Qin[1], Sushil Kumar[1], Qing Hu[1], John L. Reno[2]; [1]MIT, USA, [2]Sandia Natl. Labs, USA.* We demonstrate a tunable terahertz quantum cascade laser using an abutted silicon lens and grating feedback. The device tunes discontinuously over 160 GHz with a center frequency of 4.4 THz.

CThH6 • 9:15 a.m. Invited
Surface-Emitting Photonic Crystal Terahertz Semiconductor Lasers, *Y. Chassagneux[1], Raffaele Colombelli[1], W. Maineult[2], S. Barbieri[2], H. Beere[3], D. Ritchie[3], S. P. Khanna[4], A. G. Davies[4], E. Linfield[4]; [1] Inst. d'Electronique Fondamentale , Univ. Paris-Sud, France, [2]Univ. Paris 7, MPQ, France, [3]Cambridge Univ., UK, [4]Univ. of Leeds, UK.* We demonstrate single-mode, surface-emitting photonic-crystal terahertz lasers, with well-behaved far-field emission patterns. In addition, we elucidate a general issue, i.e. the crucial role played by the boundary conditions for electrically injected, photonic-crystal lasers.

CThI • Spectroscopic Gas Sensing II—Continued

CThI4 • 9:00 a.m.
Vapor Phase Hydrogen Peroxide Imaging Using Photofragmentation Laser-Induced Fluorescence, *Olof Johansson[1], Joakim Bood[1], Marcus Aldén[1], Ulf Lindblad[2]; [1]Lund Univ., Sweden, [2]Tetra Pak Packaging Solutions AB, Sweden.* Imaging of vapor-phase H_2O_2 concentrations is performed using photofragmentation LIF. An Nd:YAG-laser is used for photolysis and a dye laser for LIF on OH generated in the photolysis process. Detection limit is ~30 ppm.

CThI5 • 9:15 a.m.
Multiple Chemical Sensor Using a Rapidly Tuned External Cavity Quantum Cascade Laser, *Mark C. Phillips, Matthew S. Taubman, Tanya L. Myers; Pacific Northwest Natl. Lab, USA.* We demonstrate simultaneous detection of multiple airborne chemicals at low-ppb concentrations using a sensor based on a rapid tuning of an external cavity quantum cascade laser from 7.87-8.70 µm.

CThI6 • 9:30 a.m.
Improved Sensitivity Spontaneous Raman Scattering Multi-Gas Sensor, *Michael P. Buric[1,2], Kevin P. Chen[1,2], Joel Falk[1,2], Steven D. Woodruff[2]; [1]Natl. Energy Technology Lab, USA, [2]Univ. of Pittsburgh, USA.* We report a backward-wave spontaneous-Raman multi-gas sensor employing a hollow-core photonic-bandgap-fiber to contain gasses and increase interaction length. Silica Raman noise and detection speed are reduced using a digital spatial filter and a cladding seal.

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

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

10:30 a.m.-12:30 p.m. *PhAST* Market Focus Session: Terahertz–Imaging and Surveillance, *Exhibit Hall*

Rooms 318-320

IQEC

10:30 a.m.–12:15 p.m.
IThD • Lasing and Propagation in Disordered Media
Hui Cao; Yale Univ., USA, Presider

IThD1 • 10:30 a.m. Invited
Lasing in Chaotic and Random Scattering Media, *Hakan E. Türeci[1], Li Ge[2], A. Douglas Stone[2], Robert J. Tandy[2], Stefan Rotter[3]; [1]ETH Zurich, Switzerland, [2]Yale Univ., USA, [3]Vienna Univ. of Technology, Austria.* Application of the *ab initio* self-consistent (AISC) laser theory to multi-mode chaotic and random lasing media is presented.

IThD2 • 11:00 a.m.
Breakdown of Anderson Localization due to Dynamic Disorder, *Liad Levi, Tal Schwartz, Mordechai Segev, Shmuel Fishman; Technion-Israel Inst. of Technology, Israel.* We demonstrate experimentally that Anderson Localization breaks down when the disorder superimposed on a photonic lattice varies dynamically with propagation, and investigate the existence of a cross-over threshold.

IThD3 • 11:15 a.m.
Imaging through Thick Random Media with a Speckle Intensity Correlation over Excitation Position, *Zhenyu Wang, Jason A. Newman, Andrew M. Weiner, Kevin J. Webb; Purdue Univ., USA.* We demonstrate that imaging through thick random media can be facilitated by intensity correlations with respect to input beam location. Example results suggest that the approach could lead to new imaging opportunities.

Rooms 321-323

CLEO

10:30 a.m.–12:15 p.m.
CThJ • High-Power Solid-State Lasers CLEO Symposium II: High Average and High Peak Power Lasers
Andy J. Bayramian; Lawrence Livermore Natl. Lab, USA, Presider

CThJ1 • 10:30 a.m. Invited
High Time for Fibers-Towards kW Class Laser Systems with GW Peak Power, *Fabian Röser, Tino Eidam, Jan Rothhardt, Steffen Hädrich, Damian Nikolaus Schimpf, Jens Limpert, Andreas Tünnermann; Friedrich-Schiller-Univ. Jena, Germany.* We review the recent results for high peak power and high average power fiber based chirped-pulse amplification systems. Both current challenges and possible approaches for further power scaling are discussed.

CThJ2 • 11:00 a.m.
Ultrafast Ytterbium Doped INNOSLAB Amplifier with High Average Power, *Torsten Mans[1], Peter Rußbüldt[1], Johannes Weitenberg[2], Guido Rotarius[1], Dieter Hoffmann[1], Reinhart Poprawe[1,2]; [1]Fraunhofer Inst. for Laser Technology, Germany, [2]Chair for Laser Technology, RWTH Aachen Univ., Germany.* A Yb:YAG-INNOSLAB amplifier with 400W output power and 682 fs pulse duration was realized. At a pulse repetition rate of 76 MHz this was achieved without any stretcher or compressor setup.

CThJ3 • 11:15 a.m. Invited
Femtosecond High-Power Thin Disc Laser Oscillators, *Thomas Dekorsy[1], Joerg Neuhaus[1], Dominik Bauer[1,2], Christoph Scharfenberg[2], Jochen Kleinbauer[2], Alexander Killi[2], Sascha Weiler[2], Dirk H. Sutter[2]; [1]Univ. Konstanz, Germany, [2]TRUMPF Laser GmbH & Co. KG, Germany.* We demonstrate the generation of pulses with twenty-five microjoules of energy generated from a thin-disk oscillator at repetition rates below three megahertz with the potential to drive high field experiments. First micromachining experiments are presented.

Rooms 324-326

JOINT

10:30 a.m.–12:15 p.m.
JThC • Nanophotonics and Metamaterials Symposium IV: Modern Trends in Photonics
Gennady Shvets; Univ. of Texas at Austin, USA, Presider

JThC1 • 10:30 a.m. Invited
Non-Euclidean Ideas for Broadband Invisibility, *Ulf Leonhardt[1,2], Tomas Tyc[1,3], Huanyang Chen[4]; [1]Univ. of St Andrews, UK, [2]Natl. Univ. of Singapore, Singapore, [3]Masaryk Univ., Czech Republic, [4]Hong Kong Univ. of Science and Technology, Hong Kong.* All the previous proposals for invisibility require materials with extreme properties. We show that transformation optics of a curved space relaxes these requirements and can lead to invisibility in a broad band of the spectrum.

JThC2 • 11:00 a.m.
Emulating Metamaterial Anisotropy by Tapered Waveguides, *Igor I. Smolyaninov[1], Vera N. Smolyaninova[2], Alexander V. Kildishev[3], Vladimir M. Shalaev[3]; [1]Advanced Technologies, Electronics and Integrated Solutions, BAE Systems, USA, [2]Dept. of Physics, Astronomy and Geosciences, Towson Univ., USA, [3]Birck Nanotechnology Ctr., Purdue Univ., USA.* We demonstrate that metamaterial devices requiring anisotropic dielectric permittivity and magnetic permeability can be emulated by specifically designed tapered waveguides.

JThC3 • 11:15 a.m. Invited
Diacritical Analysis of Light, Electrons, and Sound Scattering by Particles and Holes, *Javier Garcia de Abajo; Inst. de Optica, Spain.* The scattering of waves by small apertures and particles has been the source of numerous controversies over the last seventy years. I will discuss in this paper the similarities and differences in the behavior of different types of waves (light, electrons, and sound) when they are transmitted through subwavelength holes (either individual or arranged in periodic arrays) or when they are scattered by small particles. The opportunities and limitations of each of these types of waves will be analyzed and presented in the context of current metamaterials research.

Room 314

CLEO

10:30 a.m.–12:15 p.m.
CThK • Nanostructured Nonlinear Optics
Jean-Claude Diels; Univ. of New Mexico, USA, Presider

CThK1 • 10:30 a.m.
Observation of Second-Harmonic Whispering-Gallery Modes in ZnO Nanotetrapod, *Yong Zhang, Huajun Zhou, S. W. Liu, Z. Ryan Tian, Min Xiao; Univ. of Arkansas, USA.* We report on the formation of second-harmonic whispering-gallery modes (SH-WGMs) on the tapered ZnO nanotetrapod legs. The SH-WGMs have strong dependence on the polarization of the fundamental infrared excitation beam relative to the crystal axis.

CThK2 • 10:45 a.m.
Few-Femtosecond Electronic Dephasing of an Individual Plasmonic Nanostructure Using Interferometric FROG, *Alexandria Anderson[1], Günter Steinmeyer[2], Markus B. Raschke[1]; [1]Univ. of Washington, USA, [2]Max-Born-Inst., Germany.* Frequency resolved optical gating (FROG) using ~10 fs laser pulses is adopted to probe the response function of individual plasmonic nanostructures. Using symmetry-selective second-harmonic scattering we deduce the associated ultrafast electronic dephasing of several femtoseconds.

CThK3 • 11:00 a.m.
Correlation Spectroscopy of Third-Harmonic Generation by Single Nanorods, *Jing Yong Ye, Moussa N'Gom, Yu-Chung Chang, Ashish Agarwal, Nicholas Kotov, James Baker, Jr., Theodore Norris; Univ. of Michigan, USA.* We have observed third-harmonic generation by single nanorods in solution and investigated its excitation polarization dependence. Our findings demonstrate the possibility of using third-harmonic signals for correlation spectroscopy, in contrast to conventional fluorescence correlation spectroscopy.

CThK4 • 11:15 a.m.
Intense Multi-μJ High-Order Harmonics Generated from Neutral Atoms of In_2O_3 Nanoparticles, *L. B. Bom[1], Rashid A. Ganeev[2], J. Abdul-Hadi[1], François Vidal[1], Ozaki Tsuneyuki[1]; [1]Ctr. Énergie, Matériaux et Télécommunications, INRS, Canada, [2]Scientific Assn. Akadempribor, Acad. of Sciences of Uzbekistan, Canada.* We study harmonic generation in plasma containing indium oxide nanoparticles. We generate intense harmonics, with harmonic energy ranging from 6 μJ for the 9th harmonic to 1 μJ for the 17th harmonic.

Room 315	Room 316	Room 317
IQEC	CLEO	

10:30 a.m.–12:15 p.m.
IThE • Quantum Dot Science II
David Gershoni; Technion-Israel Inst. of Technology, Israel, Presider

IThE1 • 10:30 a.m.
Ultrafast All-Optical Switching with a Single Quantum Dot, *Dirk Englund, Andrei Faraon, Arka Majumdar, Ilya Fushman, Jelena Vučković; Stanford Univ., USA.* We demonstrate ultrafast, all-optical switching based on a single quantum dot coupled to a photonic crystal cavity. The quantum-dot mediated interaction between the signal and control beams occurs at the single-photon level.

IThE2 • 10:45 a.m.
Ultra-Fast Quantum Dot Inversion and Switching in a Structured Electromagnetic Vacuum, *Xun Ma, Sajeev John; Dept. of Physics, Univ. of Toronto, Canada.* We demonstrate a novel ultra-fast high-contrast switching mechanism of two-level atoms driven by milliwatt picosecond pulse trains in PBG circuits with step-shaped density of states profiles. Possible application as low-threshold, multi-wavelength-channel all-optical transistors is discussed.

IThE3 • 11:00 a.m.
Optical Control of Photon-Pair Entanglement from a Semiconductor Quantum Dot, *Andreas Muller[1], Wei Fang[1], John Lawall[2], Glenn S. Solomon[1,2]; [1]Joint Quantum Inst., NIST and Univ. of Maryland, USA, [2]Atomic Physics Div., NIST, USA.* We show that polarization-entangled photon pairs can be obtained deterministically from a semiconductor quantum dot by optically tuning the fine-structure split exciton states into degeneracy.

IThE4 • 11:15 a.m.
Optically Controlled Locking of the Nuclear Field via Coherent Dark State Spectroscopy, *Bo Sun[1], Xiaodong Xu[1], Wang Yao[2], Duncan Steel[1], Allan Bracker[3], Dan Gammon[3], Lu Sham[4]; [1]Univ. of Michigan, USA, [2]Univ. of Hong Kong, Hong Kong, [3]NRL, USA, [4]Univ. of California at San Diego, USA.* We report the suppression of nuclear spin fluctuations in a self assembled quantum dot via coherent dark state spectroscopy, resulting in a factor of 40 enhancement of the coherence time of a single electron spin.

10:30 a.m.–12:15 p.m.
CThL • Quantum Cascade Lasers II
Mikhail A. Belkin; Univ. of Texas, USA, Presider

CThL1 • 10:30 a.m.
Quantum Cascade Lasers with Ultra-Strong Coupling Injection, *Peter Q. Liu[1], Anthony J. Hoffman[1], Matthew D. Escarra[1], Kale J. Franz[1], Jacob B. Khurgin[2], Yamac Dikmelik[2], Xiaojun Wang[3], Jen-Yu Fan[3], Claire F. Gmachl[1]; [1]Princeton Univ., USA, [2]Johns Hopkins Univ., USA, [3]AdTech Optics, USA.* We demonstrate a Quantum Cascade Laser employing ultra-strong (~20meV) coupling between the injector and the upper laser state. The laser shows a pulsed wall-plug efficiency of 34%(8%) and peak power of 8.0W(2.0W) at 80K(300K).

CThL2 • 10:45 a.m.
Four-Well Highly Strained Quantum Cascade Lasers Grown by Metal-Organic Chemical Vapor Deposition, *Allen L. Hsu[1], Qing Hu[1], Benjamin Williams[2]; [1]MIT, USA, [2]Univ. of California at Los Angeles, USA.* We demonstrate a novel four-well injectorless design with short wavelength (5.5 μm) and room temperature operation utilizing highly strained $Ga_{0.35}In_{0.65}As$ /$Al_{0.70}In_{0.30}As$ (0.8/-1.5%) quantum wells.

CThL3 • 11:00 a.m.
Gain and Losses of Mid-Infrared Quantum Cascade Lasers by Frequency Chirping Spectroscopy, *Elsa Benveniste[1], Sabine Laurent[1], Angela Vasanelli[1], Christophe Manquest[1], Carlo Sirtori[1], Mathieu Carras[2], Xavier Marcadet[2]; [1]Univ. Paris Diderot, France, [2]Alcatel-Thales III-V Lab, France.* We report an efficient technique to measure gain and losses of quantum cascade lasers (QCLs). It consists on the analysis of the Fabry-Perot fringes induced by the optical injection of a chirped distributed feedback QCL.

CThL4 • 11:15 a.m.
High Power Injectorless Quantum Cascade Laser Structure in the 6.0 μm Wavelength Range, *Simeon Katz, Gerhard Boehm, Markus-Christian Amann; Walter Schottky Inst., Technische Univ. München, Germany.* An injectorless quantum cascade laser design, using two 0.6 nm InAs spikes within the active zone, yielding shorter wavelength and improved performance is presented. The average pulsed output power was measured to 880mW at 297K.

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

CThM1 • 10:30 a.m.
Pockels Effect in Short Period Silicon Germanium Superlattices, *Jacob B. Khurgin[1], Marcel W. Pruessner[2], Todd H. Stievater[2], William S. Rabinovich[2]; [1]Johns Hopkins Univ., USA, [2]NRL, USA.* We introduce a method for calculating Pockels coefficients in SiGe superlattices. We show that the Pockels effect in $(Si)_1(Ge)_1$ superlattice is half as strong as in GaAs. This opens a path to efficient CMOS-compatible modulators.

CThM2 • 10:45 a.m.
Cavity-Coupled Photoluminescence from Site-Selectively Localized Colloidal PbSe Quantum Dots on Planar Silicon Photonic Crystal Microcavities, *Haijun Qiao[1], Andras G. Pattantyus-Abraham[2,1], Jeff F. Young[1], Keith A. Abel[3], Frank C. J. M van Veggel[3]; [1]Univ. of British Columbia, Canada, [2]Univ. of Toronto, Canada, [3]Univ. of Victoria, Canada.* Colloidal PbSe quantum dots (QDs) are site-selectively bound to silicon-based L3 photonic crystal cavities through a robust process consisting of AFM-lithography and surface chemistry techniques. High-contrast cavity-mode emission is observed, indicating good cavity-QDs coupling.

CThM3 • 11:00 a.m.
Cavity Quantum Electrodynamics in Electrically Driven Quantum Dot-Micropillar Cavities, *Stephan Reitzenstein, Caroline Kistner, Tobias Heindel, Arash Rahimi-Iman, Christian Schneider, Sven Höfling, Alfred Forchel; Technische Physik, Univ. Würzburg, Germany.* We report on cavity quantum electrodynamics effects in high-Q electrically contacted quantum dot-micropillar cavities. The structures show weak coupling and strong coupling via electro-optical tuning as well as single photon emission and low threshold lasing.

CThM4 • 11:15 a.m.
Single-Mode Quasi-L2 Photonic Crystal Micro-Cavity for 1.3 μm InAs Quantum Dots Light Sources, *Yen-Chun Tseng[1], Shu-Ping Lee[1], Chun-Jun Wang[1], Pei-Chin Chiu[1], Wen-Yen Chen[2], Tzu-Min Hsu[2], Jen-Inn Chyi[1,3,4]; [1]Dept. of Electrical Engineering, Natl. Central Univ., Taiwan, [2]Dept. of Physics, Natl. Central Univ., Taiwan, [3]Dept. of Optics and Photonics, Natl. Central Univ., Taiwan, [4]Res. Ctr. for Applied Sciences, Academia Sinica, Taiwan.* We realize single-mode qL2 photonic crystal cavities near 1.3 μm. Taking advantage of the small mode-volume, 1.3 μm InAs QDs light emitters exhibit an emission intensity as high as 70-times over the ones without cavities.

Room 336 — CLEO

10:30 a.m.–12:15 p.m.
CThN • Novel Fiber Sources
Shibin Jiang; AdValue Photonics Inc, USA, Presider

CThN1 • 10:30 a.m.
High-Power Single-Frequency Thulium-Doped Fiber Master-Oscillator Power-Amplifier at 1943nm, *Lee Pearson, Ji Won Kim, Zhaowei Zhang, Jayanta K. Sahu, Morten Ibsen, William A. Clarkson; Univ. of Southampton, UK.* A Tm-doped fiber master-oscillator power-amplifier system that generates over 100W of single frequency output in a near-diffraction-limited beam with an M^2 parameter of 1.25 is described. The prospects for further increase in power are considered.

CThN2 • 10:45 a.m.
Guided Mode Resonance Filters as Stable Line-Narrowing Feedback Elements for Tm Fiber Lasers, *Robert A. Sims[1], Zachary Roth[2], Timothy McComb[1], Lawrence Shah[1], Vikas Sudesh[1], Poutous Menelaos[2], Eric Johnson[2], Martin C. Richardson[1]; [1]Univ. of Central Florida, USA, [2]Univ. of North Carolina at Charlotte, USA.* Guided mode resonance filters produced a stable spectrally narrow Thulium fiber laser, at ~1985nm. Laser spectral linewidths of 10-30pm with a slope efficiency of ~35% were demonstrated. Spectral reflectivity was explored and showed 0.4-1.0nm FWHM.

CThN3 • 11:00 a.m. Invited
Recent Advances in Phosphate Glass Fiber Lasers, *Axel Schülzgen[1], L. Li[1], X. Zhu[1], J. Albert[2], N. Peyghambarian[1]; [1]Univ. of Arizona, USA, [2]Carleton Univ., Canada.* Phosphate glasses are excellent host materials for lasers using rare-earth ion transitions. Combining highly-doped phosphate glasses and advanced fiber drawing techniques, we developed phosphate glass fiber lasers and will review recent advances in their performance.

Room 337 — IQEC

10:30 a.m.–12:15 p.m.
IThF • Multidimensional Spectroscopy
Henry van Driel; Univ. of Toronto, Canada, Presider

IThF1 • 10:30 a.m.
Interplay between Disorder and Coulomb Correlations in Semiconductors, *Zheng Sun, Thomas Jarvis, Xiaoqin Li; Univ. of Texas at Austin, USA.* We investigate exciton dynamics in disordered quantum wells with optical two-dimensional Fourier transform spectroscopy (2-D FTS). The lack of cross peaks in 2-D FTS suggests that excitons localized in spatially separated regions are uncoupled.

IThF2 • 10:45 a.m.
A Simple Implementation of Optical Two-Dimensional Fourier Transform Spectroscopy, *Thomas W. Jarvis, Zheng Sun, Xiaoqin (Elaine) Li; Dept. of Physics, Univ. of Texas at Austin, USA.* We demonstrate a simple experimental technique to perform optical two-dimensional Fourier transform spectroscopy. This technique derives from a modified pump-probe geometry with a pair of collinear, phase-locked pump pulses.

IThF3 • 11:00 a.m. Invited
High-Order Optical Nonlinearities from Collinear Time-Resolved Two-Dimensional Spectroscopy, *Wilhelm Kuehn[1], Klaus Reimann[1], Michael Woerner[1], Thomas Elsaesser[1], R. Hey[2]; [1]Max-Born-Inst., Germany, [2]Paul-Drude-Inst. für Festörperelektronik, Germany.* The combination of collinear time-resolved two-dimensional spectroscopy and field-resolved detection allows for the measurement of optical nonlinearities of arbitrary order. Results are presented for intersubband transitions in a multiple quantum well sample.

Room 338 — CLEO

10:30 a.m.–12:15 p.m.
CThO • Ultrafast Photonics II
Iain McKinnie; Kapteyn-Murnane Labs, USA, Presider

CThO1 • 10:30 a.m.
Carrier-Envelope Phase Stabilization of Amplified Pulses Using an All-Electronic Servo Loop, *Sebastian Koke, Christian Grebing, Bastian Manschwetus, Günter Steinmeyer; Max-Born-Inst., Germany.* Novel all-electronic carrier-envelope phase stabilization for amplified pulses with kHz-bandwidth is demonstrated. Residual carrier-envelope phase noise exhibits two major contributions: one glitch-like mechanism from the pump laser and carrier-envelope phase noise inherited from the oscillator.

CThO2 • 10:45 a.m.
Single-Shot Optical Sampling of Ultrafast Signals Using a Silicon-Chip Time Lens, *Reza Salem, Mark A. Foster, Amy C. Turner-Foster, David F. Geraghty, Michal Lipson, Alexander L. Gaeta; Cornell Univ., USA.* We demonstrate single-shot optical sampling using a time lens based on four-wave mixing in a silicon nanowaveguide. The eye diagram for an 80-Gb/s data is characterized at 1.3 TS/s sampling rate using a 5-GHz oscilloscope.

CThO3 • 11:00 a.m.
Generation of Sub-20fs Ultraviolet Pulses with Achromatic Phase-Matching Sum Frequency Mixing, *Yongliang Jiang[1,2], Baozhen Zhao[1,2], Keiich Sueda[1], Noriaki Miyanaga[1], Takayoshi Kobayashi[3,2,4,1]; [1]Inst. of Laser Engineering, Osaka Univ., Japan, [2]Intl. Cooperative Res. Project, JST, Japan, [3]Dept. of Applied Physics and Chemistry and Inst. for Laser Science, Univ. of Electro-Communications, Japan, [4]Dept. of Electrophysics, Natl. Chiao Tung Univ., Univ. of Electro-Communications, Taiwan.* 17.4fs ultraviolet pulses with 400nJ energy were generated by sum frequency mixing of 805nm pulses and ultra-broadband visible pulses. Angular dispersion was introduced to achieve broadband phase-matching.

CThO4 • 11:15 a.m.
Low Saturation Fluence Antiresonant Quantum Dot SESAMs for MIXSEL Integration, *Yohan Barbarin, Aude-Reine Bellancourt, Deran J. H. C. Maas, Mohammad Shafiei, Martin Hoffmann, Matthias Golling, Thomas Südmeyer, Ursula Keller; ETH Zurich, Switzerland.* A detailed QD-SESAM growth study enabled the first mode-locking of a VECSEL with similar spot size on gain and antiresonant SESAM. Antiresonant designs can strongly improve MIXSELs, a novel type of ultrafast integrated VECSELs.

Room 339 — JOINT

10:30 a.m.–12:15 p.m.
JThD • Molecules in Strong Fields
Koichi Yamakawa; JAEA, Japan, Presider

JThD1 • 10:30 a.m. Invited
Ultrafast Hydrogen Migration in Hydrocarbon Molecules in Ultrashort Intense Laser Fields, *Kaoru Yamanouchi; Univ. of Tokyo, Japan.* Ultrafast hydrogen migration processes within hydrocarbon molecules in ultrashort intense laser fields were investigated by detecting the fragment ions generated through the two-body and three-body Coulomb explosion pathways using the coincidence momentum imaging method.

JThD2 • 11:00 a.m.
The Creation of Super-Excited Electronic Feshbach Resonances by EUV-Induced Dissociation of O_2, *Etienne Gagnon[1], Arvinder S. Sandhu[1], Vandana Sharma[1], Robin Santra[2,3], Wen Li[1], Phay Ho[2], Predrag Ranitovic[4], C. L. Cocke[4], Margaret M. Murnane[1], Henry C. Kapteyn[1]; [1]JILA, Univ. of Colorado at Boulder, USA, [2]Argonne Natl. Lab, USA, [3]Univ. of Chicago, USA, [4]J. R. MacDonald Lab, Kansas State Univ., USA.* We resolve complex electron autoionization dynamics in molecules in real time for the first time, where a second electron cannot be ejected from O_2 until the internuclear separation of the fragments is >30Å.

JThD3 • 11:15 a.m.
Studying the Neutral Dissociation of O_2 and CH_4 Molecules in Strong Laser Field, *Ali Azarm[1], Yousef Kamali[1], Jens Bernhardt[1], H. L. Xu[1,2], D. Song[3], Y. Teranishi[4,5], S. H. Lin[4,5], A. Xia[3], F. Kong[3], See Leang Chin[1]; [1]Univ. Laval, Canada, [2]Univ. of Tokyo, Japan, [3]Inst. of Chemistry, CAS, China, [4]Inst. of Atomic and Molecular Science, Academia Sinica, Taiwan, [5]Inst. of Applied Chemistry, Inst. of Molecular Science, Chiao-Tung Univ., Taiwan.* We report neutral dissociation of oxygen and methane in femtosecond laser field through superexcited states. Moreover, the lifetime of the superexcited state is measured by pump and probe technique to be about few hundred femtosecond.

Room 340 | Room 341 | Rooms 328-329

CLEO

10:30 a.m.–12:15 p.m.
CThP • Femtosecond Laser Writing and Sensing
Tommaso Baldacchini; Newport Corp., USA, Presider

CThP1 • 10:30 a.m.
Second Harmonic and Raman Imaging of Ultrafast Laser Written $LiTaO_3$ Waveguides, *Ben McMillen[1], Kevin P. Chen[1], Daniel Jaque[2], Honglin An[3], Simon Fleming[3]; [1]Univ. of Pittsburgh, USA, [2]Univ. Autónoma de Madrid, Spain, [3]Univ. of Sydney, Australia.* This paper presents the fabrication of waveguides in lithium-tantalate using a 250-kHz repetition-rate ultrafast laser. Micro-Raman and second-harmonic microscopy studies indicate the preservation of optical nonlinearity in guiding regions formed by the laser-induced lattice compression.

CThP2 • 10:45 a.m.
Optical Phase Measurements during fs-Processing of Materials Using Time-Resolved White-Light Interferometry, *Ilya Mingareev[1], Dirk Wortmann[1], Andreas Brand[1], Alexander Horn[2]; [1]Lehrstuhl für Lasertechnik, Germany, [2]Inst. of Physics and Ctr. for Interdisciplinary Nanostructure Science and Technology, Germany.* Fs-laser induced modifications of glasses and metals are investigated *in situ* by means of time-resolved white-light interferometry. The optical phase shift and corresponding refractive index change is calculated from the interference images.

CThP3 • 11:00 a.m. Invited
The Art of Femtosecond Laser Writing, *Peter G. Kazansky[1], Weijia Yang[1], Yasuhiko Shimotsuma[2], Kazuyuki Hirao[2], Alan Arai[3], Yuri Svirko[4]; [1]Optoelectronics Res. Ctr., Univ. of Southampton, UK, [2] Dept. of Material Chemistry, Graduate School of Engineering, Kyoto Univ., Japan, [3]Applications Res. Lab, IMRA America, Inc., USA, [4]Dept. of Physics and Mathematics, Univ. of Joensuu, Finland.* Common beliefs that laser writing does not change when reversing beam scan or propagation direction are challenged. Recently discovered phenomena of quill and non-reciprocal femtosecond laser writing in glasses and crystals are reviewed.

10:30 a.m.–12:15 p.m.
CThQ • THz Waveguides
Daniel Grischkowsky; Oklahoma State Univ., USA, Presider

CThQ1 • 10:30 a.m.
Whispering-Gallery-Mode THz-Pulse Propagation on a Single Curved Metallic Plate, *Rajind Mendis, Daniel M. Mittleman; Rice Univ., USA.* We demonstrate THz-pulse propagation on a 25-cm-long semi-circular aluminum plate with low loss and negligible dispersion via whispering-gallery-modes. This represents the first demonstration of these modes on a curved metallic surface in the THz regime.

CThQ2 • 10:45 a.m.
Undistorted Terahertz Pulses Propagation in Slightly Curved Parallel Plate Waveguide, *Yuri H. Avetisyan[1], Arsen Hakhoumian[1], Armen Makaryan[1], Tigran Poghosyan[1], Garik Torosyan[2], Rene Beigang[2], Hiroaki Minamide[3], Hiromasa Ito[3]; [1]Yerevan State Univ., Armenia, [2]Kaiserslautern Univ., Germany, [3]RIKEN, Japan.* It is proposed and investigated the 8-cm-long slightly curved parallel plate oversized waveguide as wideband THz interconnecting line. Its use in waveguide TDS is demonstrated by measuring absorbance of tiny amount of water vapor.

CThQ3 • 11:00 a.m.
THz Energy Confinement in Finite-Width Parallel-Plate Waveguides, *Hui Zhan, Rajind Mendis, Daniel M. Mittleman; Rice Univ., USA.* We investigate the TEM-mode energy confinement in finite-width parallel-plate waveguides using THz pulses, and observe a narrowing of the mode profile due to the finite width, although this does not result in better energy confinement.

CThQ4 • 11:15 a.m.
Terahertz Waveguide Emitters with Subwavelength Confinement, *Michael Martl, Juraj Darmo, Karl Unterrainer, Erich Gornik; Vienna Univ. of Technology, Austria.* The generation of terahertz radiation within subwavelength waveguides is studied in time- and frequency-domain. Such waveguide emitters enable the efficient launching of terahertz waves within compact terahertz optical systems.

PhAST

10:30 a.m.–12:30 p.m.
PThA • Visible Displays and Projectors
Clifford R. Pollack; Cornell Univ., USA, Presider

PThA1 • 10:30 a.m. Invited
Future Flexible OLED Displays for Army Applications, *Eric Forsythe[1], J. Shi[1], S. Liu[1], D. C. Morton[1], Doug Loy[2], Yong Kyun Lee[2], Cynthia Bell[2], Mark Richards[2], Ed Bawolek[2], Scott Ageno[2], Curt Moyer[2], Michael Marrs[2], Jann Kaminski[2], Nick Colaneri[2], Shawn M. O'Rourke[2], Jeff Silvernail[3], Kamala Rajan[3], Ruiqing Ma[3], Michael Hack[3], Julie J. Brown[3]; [1]US Army Res., USA, [2]Arizona State Univ., USA, [3]Universal Display Corp., USA.* Organic light emitting diodes have been fabricated on an active matrix backplane employing amorphous Si thin film transistors on polyethylene naphthalate substrates. Organic material development will be discussed in the context of future Army applications.

PThA2 • 11:00 a.m. Invited
Multiwatt High-Efficiency CW Single-Mode Visible Lasers for Ultrahigh-Resolution Displays, *Forrest L. Williams, Dennis E. Elkins, Jesse P. Anderegg, Bret D. Winkler, Robert R. Christensen, Cameron C. Farmer, Calvin L. Simmons; Evans & Sutherland, USA.* An ultrahigh-resolution display (~ 33 megapixels) employs high-power CW visible lasers which are generated through three-wave external mixing of infrared fiber lasers. The lasers provide > 6 W at red, green and blue wavelengths.

Rooms 318-320	Rooms 321-323	Rooms 324-326	Room 314
IQEC	CLEO	JOINT	CLEO

IThD • Lasing and Propagation in Disordered Media—Continued

IThD4 • 11:30 a.m.
Laser Gain Media Based on Nanocomposite Materials, *Ksenia Dolgaleva[1], Robert W. Boyd[1], Peter W. Milonni[2]; [1]Inst. of Optics, Univ. of Rochester, USA, [2]Los Alamos Natl. Lab, USA.* We develop simple theoretical models for calculating the gain of layered and Maxwell Garnett composite materials with a resonant component. Laser systems that utilize such composite gain media could display significantly improved properties.

IThD5 • 11:45 a.m.
Enhanced Nonlinear Absorption in Low-Finesse Metal-Dielectric Fabry-Perot Resonators, *Canek Fuentes-Hernandez[1], Lazaro A. Padilha[2], Joel M. Hales[1], Daniel Owens[1], Jungbae Kim[1], Scott Webster[2], Joseph W. Perry[1], David J. Hagan[2], Eric W. VanStryland[2], Bernard Kippelen[1]; [1]Georgia Tech, USA, [2]Univ. of Central Florida, USA.* We report on the nonlinear optical properties of metal-dielectric Fabry-Perot resonators with broad spectral bandwidths in the visible, peak transmittance larger than 70%, and a nonlinear absorption up to 20x larger than bulk ZnO.

IThD6 • 12:00 p.m.
Impact of the Residual Disorder on the Slow Light Regime in 1-D and 2-D Photonic Crystals Structures, *Nicolas Le Thomas[1], Romuald Houdré[1], Maria V. Kotlyar[2], Daryl Beggs[2], Thomas F. Krauss[2]; [1]École Polytechnique Fédérale de Lausanne, Switzerland, [2]Univ. of St Andrews, UK.* We experimentally investigate the effect of residual disorder on the dispersion curve of light near a band edge. A Fourier space imaging technique accurately distinguishes the propagating regime from evanescent regime in planar photonic crystal.

CThJ • High-Power Solid-State Lasers CLEO Symposium II: High Average and High Peak Power Lasers—Continued

CThJ4 • 11:45 a.m. Invited
High-Average-Power Cryogenically-Cooled Picosecond Yb:YAG Amplifier Seeded by a Fiber CPA System, *Kyung-Han Hong[1], Juliet Gopinath[2], Aleem Siddiqui[1], Jeffrey Moses[1], Chien-Jen Lai[1], John Hybl[2], Tso Yee Fan[2]; [1]MIT, USA, [2]MIT Lincoln Lab, USA.* We report on a 300 W level picosecond laser based on a cryogenically-cooled Yb:YAG amplifier seeded by a fiber CPA system. High average power picosecond second harmonic generation is also presented.

JThC • Nanophotonics and Metamaterials Symposium IV: Modern Trends in Photonics—Continued

JThC4 • 11:45 a.m.
Lossless Design of an Eaton Lens and Invisible Sphere by Transformation Optics with No Bandwidth Limitation, *Aaron J. Danner[1], Ulf Leonhardt[2]; [1]Natl. Univ. of Singapore, Singapore, [2]Univ. of St Andrews, UK.* Limitations on the physical realization of objects with point singularities in the refractive index are explored through transformation optics. Details of a lossless air/semiconductor composite for implementation of three structures are worked out.

JThC5 • 12:00 p.m.
Experimental Demonstration of Spatial Quantum Correlations in Multiple Scattering Media, *Stephan Smolka[1], Alexander Huck[2], Ulrik L. Andersen[2], Ad Lagendijk[3], Peter Lodahl[1]; [1]DTU Fotonik, Dept. of Photonics Engineering, Technical Univ. of Denmark, Denmark, [2]DTU Physics, Dept. of Physics, Technical Univ. of Denmark, Denmark, [3]FOM-Inst. AMOLF, Netherlands.* We demonstrate that spatial quantum correlations are induced by multiple scattering of squeezed light. The correlation relates multiple scattered photons at different spatial positions, and is tunable by varying photon fluctuations of the illuminating beam.

CThK • Nanostructured Nonlinear Optics—Continued

CThK5 • 11:30 a.m.
High-Order Harmonic Generation from C_{60} Fullerene Using the Plasma Harmonic Method, *L. B. Bom[1], Rashid A. Ganeev[1,2], J. Abdul-Hadi[1], M. C. H. Wong[3], J.- P. Brichta[3], Ravi Bhardwaj[3], Ozaki Tsuneyuki[1]; [1]INRS, Canada, [2]Acad. of Sciences of Uzbekistan, Uzbekistan, [3]Univ. of Ottawa, Canada.* We demonstrate high-order harmonic generation from C_{60}. Laser-produced plasmas from C_{60}-rich epoxy and C_{60} films were used as media. The harmonic yield from C_{60} films is about 25 times larger than those from bulk-carbon target.

CThK6 • 11:45 a.m.
Second-Harmonic Generation in GaAs Microdisks, *Paulina S. Kuo[1], Wei Fang[2], Glenn Solomon[1,2]; [1]NIST, USA, [2]Joint Quantum Inst., NIST and Univ. of Maryland, USA.* We discuss design and tuning of second-harmonic generation in a GaAs microdisk. Quasi-phasematching is automatically achieved in a microdisk geometry, but efficient mixing requires resonating all waves, which leads to stringent tuning requirements.

CThK7 • 12:00 p.m.
160 GHz Wavelength Conversion Using Four-Wave Mixing in Quantum Dots, *David Nielsen[1], S. L. Chuang[1], N, J. Kim[2], D. Lee[2], S. H. Pyun[3], W. G. Jeong[3]; [1]Univ. of Illinois at Urbana-Champaign, USA, [2]Chungnam Natl. Univ., Republic of Korea, [3]Sungkyunkwan Univ., Republic of Korea.* We experimentally investigate wavelength conversion in quantum-dot semiconductor optical amplifiers via four-wave mixing. Using four 40-GHz probes we demonstrate greater than 100% conversion over 160 GHz with a large signal-to-noise ratio.

12:15 p.m.-1:00 p.m. Lunch Break *(concessions available on exhibit floor)*

NOTES

Room 315 | Room 316 | Room 317

IQEC | CLEO

IThE • Quantum Dot Science II—Continued

IThE5 • 11:30 a.m.
A Diamond Trap for Indirect Excitons in Coupled Quantum Wells, *Alexander A. High[1], Averi K. Thomas[1], Aaron T. Hammack[1], Leonid V. Butov[1], Micah Hanson[2], Arthur C. Gossard[2]; [1]Univ. of California at San Diego, USA, [2]Univ. of California at Santa Barbara, USA.* We report on trapping and control of indirect excitons in diamond-shaped electrostatic traps. The diamond trap creates a parabolic-like trapping potential for excitons on a large scale while utilizing only a single electrode.

IThE6 • 11:45 a.m.
Experimental Evidence of Single-Phonon Mediated Inter-Level Excitonic Transitions in a Semiconductor Quantum Dot, *Edward Flagg[1], John Robertson[1], Sébastien Founta[1], Wenquan Ma[2], Min Shao[2], Gregory J. Salamo[2], Chih-Kang Shih[1]; [1]Dept. of Physics, Univ. of Texas at Austin, USA, [2]Univ. of Arkansas, USA.* Resonance fluorescence of a single InGaAs/GaAs quantum dot enables us to show direct evidence of population up-conversion to an excited state in a quantum dot, which we attribute to single-acoustic-phonon processes at low temperature.

IThE7 • 12:00 p.m.
Spin Transport of Indirect Excitons in GaAs/AlGaAs Coupled Quantum Wells, *Jason R. Leonard[1], Sen Yang[1], Leonid V. Butov[1], Arthur C. Gossard[2]; [1]Dept. of Physics, Univ. of California at San Diego, USA, [2]Materials Dept., Univ. of California at Santa Barbara, USA.* Spin transport of indirect excitons in GaAs/AlGaAs CQW was observed by measuring the spatially resolved circular polarization of exciton emission. This originates from the long spin relaxation time and long lifetime of indirect excitons.

CThL • Quantum Cascade Lasers II—Continued

CThL5 • 11:30 a.m.
Negative Differential Resistance and Pulse Instabilities in Minimalized Quantum Cascade Laser Structures, *Kale J. Franz[1], James J. J. Raftery[1], Peter Q. Liu[1], Anthony J. Hoffman[1], Matthew D. Escarra[1], Scott S. Howard[1,2], Yamac Dikmelik[3], Jacob B. Khurgin[3], Xiaojun Wang[4], Jen-Yu Fan[4], Claire Gmachl[1]; [1]Princeton Univ., USA, [2]Cornell Univ., USA, [3]Johns Hopkins Univ., USA, [4]AdTech Optics, Inc., USA.* We study high performing mid-infrared quantum cascade lasers with highly discretized injector regions. We observe negative differential resistance features of ~2 V that persist to room temperature and pulse instabilities below 180K.

CThL6 • 11:45 a.m.
Spatial Hole Burning in Actively Mode-Locked Quantum Cascade Lasers, *Vasileios-Marios Gkortsas[1], Ariel Gordon[1], Christian Jirauschek[2], Christine Wang[3], Lyuba Kuznetsova[3], Laurent Diehl[3], Mikhail Belkin[3], Alexey Belyanin[4], Federico Capasso[3], Franz Kärtner[1]; [1]MIT, USA, [2]Technische Univ. München, Germany, [3]Harvard Univ., USA, [4]Texas A&M Univ., USA.* A theoretical study of active mode-locking in quantum cascade lasers including spatial-hole-burning is presented. It is found that spatial-hole-burning reduces the pulse duration at the expense of slight pulse instability and strongly structured pulse shapes.

CThL7 • 12:00 p.m.
Surface Emitting Photonic Crystal Mid-Infrared Quantum Cascade Lasers, *Gangyi Xu[1], Virginie Moreau[1], Yannick Chassagneux[1], Adel Bousseksou[1], Raffaele Colombelli[1], Gilles Patriarche[2], Gregoire Beaudoin[2], Isabelle Sagnes[2]; [1]Inst. d'Electronique Fondamentale, Univ. Paris-Sud, France, [2]CNRS, Lab de Photonique et Nanostructures, France.* We demonstrate spectrally single-mode, low-divergence surface-emission from photonic-crystal quantum cascade lasers operating in the mid-infrared spectral range (λ~7.2micron). The photonic-crystal resonator is defined by the sole top metallization. No semiconductor etch is employed.

CThM • Quantum Materials Technology—Continued

CThM5 • 11:30 a.m.
Optical Microcavities on Si Formed by Self-Assembled InGaAs/GaAs Quantum Dot Microtubes, *Vicknesh Sahmuganathan, Feng Li, Zetian Mi; McGill Univ., Canada.* We have investigated the fabrication and characterization of 3-dimensionally confined optical microcavities on Si formed by self-assembled InGaAs/GaAs quantum dot microtubes. Such microcavities on Si are free of defects and exhibit a Q-factor of 3,000.

CThM6 • 11:45 a.m.
Electroluminescence from Silicon-Based Photonic Crystal Microcavities with PbSe Colloidal Quantum Dots, *Junseok Heo[1], Ting Zhu[2], Jian Xu[2], Pallab Bhattacharya[1]; [1]Univ. of Michigan, USA, [2]Penn State Univ., USA.* An electrically injected PbSe colloidal quantum dots embedded in silicon photonic crystal microcavities is demonstrated at room temperature with peak emission wavelength of 1.55μm. The resonant modes of the microcavity are observed in the spectra.

CThM7 • 12:00 p.m.
Carrier Localization Impact on Time-Resolved Dependence of the Photoluminescence of CdSe/ZnCdMgSe Self-Assembled Quantum Dots at Different Temperatures, *Iosif Zeylikovich, Vladimir Kartazaev, Bidyut Das, Taposh K. Gayen, Aidong Shen, Maria Tamargo, Robert R. Alfano; Inst. for Ultrafast Spectroscopy and Lasers, City College and Graduate Ctr. of CUNY, USA.* We report on the effects of carrier localization at different temperatures on the integrated photoluminescence (PL) and time-resolved PL of CdSe/ZnCdMgSe self-assembled quantum dots. Results explain the PL anomalous temperature behavior.

12:15 p.m.-1:00 p.m. Lunch Break *(concessions available on exhibit floor)*

NOTES

Room 336 — CLEO

CThN • Novel Fiber Sources—Continued

CThN4 • 11:30 a.m.
Bi_2O_3-Based Ytterbium Doped Fiber Laser, *Seiki Ohara, Yutaka Kuroiwa; Asahi Glass Co., Ltd., Japan.* Ytterbium doped Bi_2O_3-based glasses have been developed. The absorbance is as high as 2600-dB/m/mol. Maximum absorption of 7800-dB/m is achieved. Bi_2O_3-based Ytterbium doped fiber is fabricated, and demonstrated fiber lasers using newly developed fibers.

CThN5 • 11:45 a.m.
Dual-Pump Double-Pass Double-Clad Cr^{4+}:YAG Crystal Fiber Broadband ASE Light Source, *Kuang-Yu Hsu[1], Dong-Yo Jheng[1], Mu-Han Yang[1], Yen-Sheng Lin[1], Kuang-Yao Huang[1], Cheng-Ting Lin[2], Si-Rong Lin[2], Sheng-Lung Huang[1,3]; [1]Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Dept. of Photonics, Natl. Sun Yat-Sen Univ., Taiwan, [3]Dept. of Electrical Engineering, Natl. Taiwan Univ., Taiwan.* Dual-pump scheme and a high-reflection coating deposited on one crystal fiber endface were used to increase the ASE of the Cr^{4+}:YAG double-clad crystal fiber. As much as 1.72 mW of collimated ASE power was obtained.

CThN6 • 12:00 p.m.
Generating Mid-IR Source Using As_2S_3-Based Chalcogenide Photonic Crystal Fibers, *Jonathan Hu[1], Curtis R. Menyuk[1], L. Brandon Shaw[2], Jasbinder S. Sanghera[2], Ishwar D. Aggarwal[2]; [1]Univ. of Maryland, Baltimore County, USA, [2]NRL, USA.* We found that 25% of the input power of a 2μm 1kW peak-power source can be shifted into the region between 3—5μm using an As_2S_3-based chalcogenide PCF. Tapering increases the output at wavelengths above 4μm.

Room 337 — IQEC

IThF • Multidimensional Spectroscopy—Continued

IThF4 • 11:30 a.m.
Inhomogeneity and Binding Energy of Biexcitons in Quantum Wells Using 2-D Fourier-Transform Spectroscopy, *Alan D. Bristow[1], Denis Karaiskaj[1], Xingcan Dai[1], Richard P. Mirin[2], Steven T. Cundiff[1]; [1]JILA, Univ. of Colorado and NIST, USA, [2]NIST, USA.* Two-dimensional Fourier transform spectroscopy shows a strong variation in the biexciton binding energy across the inhomogeneous absorption width. This effect is observed for both co- and cross-linearly polarized excitation, where the latter suppresses many-body interactions.

IThF5 • 11:45 a.m.
Direct Phase-Sensitive Impulsive Vibrational Spectroscopy with Spectral Interferometry, *Jesse W. Wilson, Philip Schlup, Randy Bartels; Colorado State Univ., USA.* New techniques for time-domain ultrafast vibrational spectroscopy through direct time-dependent phase detection of coherently excited vibrations via spectral interferometry. Three variants with advantages for spectral resolution, sensitivity and speed are presented.

IThF6 • 12:00 p.m.
Observation of High-Frequency Coherent Vibrational Motion with Strongly Chirped Probe Pulses, *Dario Polli, Daniele Brida, Guglielmo Lanzani, Giulio Cerullo; Politecnico di Milano, Italy.* We observe time-domain coherent vibrational wavepackets at 1585-cm^{-1} frequency (21-fs period) using broadband probe pulses strongly chirped up to 150-fs duration. The results are explained theoretically using the Wigner representation of the chirped pulse.

Room 338 — CLEO

CThO • Ultrafast Photonics II—Continued

CThO5 • 11:30 a.m. Invited
Ultrafast Imaging with Electron Pulses, *Martin Centurion[1], Peter Reckenthaeler[1], Werner Fuss[1], Sergei Trushin[1], Alexander Apolonski[2], Ferenc Krausz[1,2], Ernst E. Fill[1]; [1]Max-Planck-Inst. für Quantenoptik, Germany, [2]Ludwig-Maximilians-Univ. Muenchen, Germany.* Probing ultrafast dynamics with electron pulses reveals information not accessible by other methods. Here we present two experiments where we have used electron pulses to observe molecular dynamics and to measure localized electromagnetic fields.

CThO6 • 12:00 p.m.
Generation of 3.7-fs, 1.2-mJ Pulses from a kHz Ti:Sapphire Laser with a Differentially Pumped Hollow-Fiber Pulse Compressor, *Juyun Park, Jae-Hwan Lee, Chang Hee Nam; KAIST, Republic of Korea.* Pulse compression in a differentially pumped gas-filled hollow-fiber was used to generate compressed laser pulses of 1.2 mJ at 3.7 fs, corresponding to 1.5-cycle, 0.3-TW output, from positively chirped 33-fs laser pulses.

Room 339 — JOINT

JThD • Molecules in Strong Fields—Continued

JThD4 • 11:30 a.m.
Comparison of R-Dependent Ionization and Bond-Softening as Mechanisms for Creating Vibrational Coherence in Hot Molecules, *Li Fang, George N. Gibson; Univ. of Connecticut, USA.* We compare wavepackets induced by "R-dependent ionization" and bond-softening in strong fields through both simulations and experiments. We conclude that the former produces stronger vibrations than the latter and results in vibrational cooling.

JThD5 • 11:45 a.m.
High Harmonic Generation from Multiple Molecular Orbitals, *Brian K. McFarland, Joseph P. Farrell, Philip H. Bucksbaum, Markus Gühr; Stanford Univ., USA.* The contribution of the HOMO and HOMO-1 orbitals are observed in high harmonics from N_2. We discuss the harmonic modulation in the rotational revival structure and present a semi-classical model that reproduces the spectral features.

JThD6 • 12:00 p.m.
Elliptically Polarized High Harmonic Emission from Molecules Driven by Linearly Polarized Light, *Xibin Zhou, Robynne Lock, Nicholas Wagner, Wen Li, Henry Kapteyn, Margaret Murnane; JILA and Dept. of Physics, Univ. of Colorado and NIST, USA.* We perform an accurate polarimetry measurement of high harmonic emission from aligned molecules. Surprisingly, we find that harmonic emission from N_2 molecules can be strongly elliptically polarized even when driven by linearly polarized laser fields.

12:15 p.m.-1:00 p.m. Lunch Break *(concessions available on exhibit floor)*

NOTES

Room 340 | Room 341 | Rooms 328-329

CLEO | PhAST

CThP • Femtosecond Laser Writing and Sensing—Continued

CThP4 • 11:30 a.m.
Optical Sensing by Femtosecond Laser Written Waveguides in a Microfluidic Chip for Capillary Electrophoresis, *Rebeca Martinez-Vazquez[1], Roberto Osellame[1], Marina Cretich[2], Marcella Chiari[2], Chaitanya Dongre[3], Hugo J. W. Hoekstra[3], Hans H. van den Vlekkert[4], Roberta Ramponi[1], Markus Pollnau[3], Giulio Cerullo[1]; [1]Inst. di Fotonica e Nanotecnologie del CNR, Italy, [2]Inst. di Chimica del Riconoscimento Molecolare, CNR, Italy, [3]Univ. of Twente, Netherlands, [4]LioniX BV, Netherlands.* Femtosecond-laser-written optical waveguides are integrated into a commercial capillary electrophoresis chip. A fluorescence detection scheme is implemented, resulting in a compact device. Testing is performed by electrophoresis and detection of a 1-nM oligonucleotide plug.

CThP5 • 11:45 a.m.
Ultrafast Switching of Nanostructure in Fused Silica, *Yasuhiko Shimotsuma[1], Masaaki Sakakura[1], Kiyotaka Miura[2], Kazuyuki Hirao[2], Jiarong Qiu[3,4], Peter Kazansky[5]; [1]Innovative Collaboration Ctr., Kyoto Univ., Japan, [2]Dept. of Material Chemistry, Kyoto Univ., Japan, [3]Dept. of Materials Science, Zhejiang Univ., China, [4]State Key Lab of High Field Laser Physics, Shanghai Inst. of Optics and Fine Mechanics, CAS, China, [5]Optoelectronics Res. Ctr., Univ. of Southampton, UK.* Femtosecond switching of anisotropic nanostructure indicating birefringence with a time constant of ±200fs was observed. Such anisotropy has evolved by lowering threshold for defect formation and enhanced coherency of the electron plasma wave.

CThP6 • 12:00 p.m.
Temperature Distribution during Heat Accumulation in Femtosecond Laser Processing inside Glasses, *Masaaki Sakakura, Masahiro Shimizu, Yasuyuki Shimotsuma, Kiyotaka Miura, Kazuyuki Hirao; Kyoto Univ., Japan.* The temperature distribution after 250 kHz fs laser irradiation inside a glass as well as the specific temperature for determining the boundary of the heat modification were determined by analyzing the heat modification.

CThQ • THz Waveguides—Continued

CThQ5 • 11:30 a.m.
THz Anti-Resonant Reflecting Tube Waveguide, *Yu-Chun Hsueh[1], Chih-Hsien Lai[1], Hung-Wen Chen[1], Yuh-jing Huang[2], Hung-Chung Chang[1,3], Chi-Kuang Sun[1,3,4]; [1]Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Inst. of Astronomy and Astrophysics, Academia Sinica, Taiwan, [3]Dept. of Electrical Engineerings, Natl. Taiwan Univ., Taiwan, [4]Res. Ctr. for Applied Sciences, Academia Sinica, Taiwan.* We successfully demonstrated a simple plastic tube waveguide with an air core for low loss THz waveguiding. Our study on the attenuation spectra indicated its anti-resonant reflecting waveguiding nature.

CThQ6 • 11:45 a.m.
Design and Fabrication of Subwavelength THz Fibers with Multiple Holes, *Alexandre Dupuis, Alireza Hassani, Maksim Skorobogatiy; École Polytechnique de Montréal, Canada.* We discuss the design and fabrication of a porous subwavelength THz polymer fiber containing many subwavelength air holes. Very low absorption and bending losses are predicted in the case of high porosity.

CThQ7 • 12:00 p.m.
Low-Loss and Bendable THz Fiber with Tailored Dispersion, *Kristian Nielsen[1], Ole Bang[1], Henrik K. Rasmussen[1], Auréle J. L. Adam[2], Paul C. M. Planken[2], Peter U. Jepsen[1]; [1]Technical Univ. of Denmark, Denmark, [2]Delft Univ. of Technology, Netherlands.* A polymer THz fiber made of Topas and having a Photonic Crystal Fiber structure is demonstrated. It has low broadband loss and the dispersion of the fiber can be tailored by adjusting the structural parameters.

PThA • Visible Displays and Projectors—Continued

PThA3 • 11:30 a.m. Invited
Solid-State SHG Green Laser for Laser TV, *Yoshihito Hirano, Tomohiro Sasagawa, Takayuki Yanagisawa, Syuhei Yamamoto, Akira Nakamura, Tetsuya Yagi, Hiroaki Sugiura; Mitsubishi Electric Corp., Japan.* A compact, highly efficient, and high-power SHG green laser has been newly developed for the first laser TV 'LaserVue.' Technical basic concepts and features of this laser are briefly summarized.

PThA4 • 12:00 p.m. Invited
Green Lasers for Micro-Projection Display Applications, *David A. S. Loeber; Corning Photonic Technologies, Inc., USA.* Rapid progress in green laser technology is enabling laser light sources to become the ideal light sources for micro-projection displays, where the size and power efficiency of the display creates a new display category.

12:15 p.m.-1:00 p.m. Lunch Break *(concessions available on exhibit floor)*

NOTES

1:00 p.m.–2:30 p.m.
JThE • Joint CLEO/IQEC Poster Session III

JThE1
Selective Generation of Radially Polarized Nd:YAG Laser Beams of Higher-Order Transverse Mode, *Yuichi Kozawa, Shunichi Sato; Inst. of Multidisciplinary Res. for Advanced Materials, Tohoku Univ., Japan.* Single higher-order transverse mode operation with radial polarization of a Nd:YAG laser was demonstrated by use of a spatially reflectivity-modulated output coupler. By adjusting the cavity, TM_{02}, TM_{03}, and TM_{04} modes were selectively obtained.

JThE2
Selective TM_{01} and TE_{01} Mode Operation of Nd:YAG Laser Based on Cavity Stability Incorporating Thermal Effects, *Akihiko Ito, Yuichi Kozawa, Shunichi Sato; Tohoku Univ., Japan.* By varying the length of a flat-flat cavity, polarization selective operation of a Nd:YAG laser was achieved only in a stable region of either TM_{01} or TE_{01} mode based on cavity stability incorporating thermally effects.

JThE3
Optical Amplification in Er^{3+} and Yb^{3+} Codoped Electro-Optic Lead Lanthanum Zirconate Titanate Ceramics, *Piling Huang[1], Xuesheng Chen[1], Kewen K. Li[2], Yingyin K. Zou[2], Jingwen W. Zhang[2], Hua Jiang[2]; [1]Wheaton College, USA, [2]Boston Applied Technologies, Inc., USA.* Over 108% single-pass net gains were achieved at wavelength of 1550 and 1500 nm both in highly transparent Er^{3+} doped and in Er^{3+} and Yb^{3+} codoped electro-optic lanthanum-modified lead zirconate titanate (PLZT) ceramics.

JThE4
Nd^{3+}: TiO_2 Active Medium Prepared via Sol-Gel Technique, *Adnan S. Al-Ithawi[1], Fadel Abed[2], Majdaa Ali[1]; [1]Baghdad Univ., Iraq, [2]Babel Univ., Iraq.* Nd^{3+}-doped TiO_2 gels have been prepared via sol-gel method. The manufactured samples, where a signal was detected around (1.06 μm). So, Nd^{3+}-doped TiO_2 via sol-gel can be used as a laser active medium.

JThE5
Efficient Laser Emission of Nd-Vanadates on the 1.34-μm $^4F_{3/2}$ to $^4I_{13/2}$ Transition under Pumping with Diode Lasers Directly into the Emitting Level, *Nicolaie Pavel, Traian Dascalu, Nicoleta Vasile, Voicu Lupei; Natl. Inst. for Laser, Plasma and Radiation Physics, Romania.* Efficient 1.34-μm laser emission is realized in Nd-vanadates under pumping with diode lasers at 0.88 μm. A Nd:YVO_4 crystal yielded 3.4-W output power for 9.3-W absorbed pump power, at a slope efficiency of 0.43.

JThE6
High-Temperature Operation of a Diode-Pumped Nd:YAG Laser Passively Q-Switched by Cr^{4+}:YAG Saturable Absorber, *Traian Dascalu, Nicolaie Pavel, Nicoleta Vasile; Natl. Inst. for Laser, Plasma and Radiation Physics, Romania.* The output performances of a Nd:YAG laser passively Q-switched by Cr^{4+}:YAG saturable absorber are investigated function of temperature. Small variations in pulse energy and duration were observed over the 25°C to 150°C range.

JThE7
High-Power Optically Pumped Semiconductor Laser, *Tsuei-Lian Wang[1], Yushi Kaneda[1], J. M. Yarborough[1], Jörg Hader[1], Jerome V. Moloney[1], Stephan W. Koch[2], Bernardette Kunert[2], Wolfgang Stolz[2]; [1]Univ. of Arizona, USA, [2]Univ. Marburg, Germany.* We report 23W output from optically pumped semiconductor laser in a near-diffraction limited beam using one OPSL chip in the resonator. The OPSL device needs no antireflective coating, and exploits the strong subcavity gain enhancement.

JThE8
Influence of the Linewidth Enhancement Factor on the Critical Feedback Level in a Quantum Dash Laser, *Frederic Grillot, Nader A. Naderi, Mike Pochet, Chang-Yi Lin, Luke F. Lester; Univ. of New Mexico, USA.* Contributions of both the ground and excited states in the degradation of the coherence collapse threshold in a quantum dash laser are analyzed. The excited states are found to strongly alter the device's feedback sensitivity.

JThE9
Effects of Optical Feedback in InAs/GaAs Monolithic Quantum Dot Passively Mode-Locked Lasers, *Frederic Grillot, Chang-Yi Lin, Nader A. Naderi, Mike Pochet, Luke F. Lester; Univ. of New Mexico, USA.* The impact of optical feedback on the performance of a monolithic InAs/GaAs quantum dot passively mode-locked laser is experimentally investigated. We show that a feedback level greater than -25dB can be detrimental to mode-locking operation.

JThE10
Mode-Resolved Measurement of the Linewidth Enhancement Factor of Multiple Longitudinal-Mode Lasers, *Asier Villafranca, Aitor Villafranca, Juan Ignacio Garcés; Univ. of Zaragoza, Spain.* The linewidth enhancement factor of a Fabry-Perot laser is measured using the traditional Hakki-Paoli gain measurement and two proposed modifications to techniques used for single longitudinal mode lasers.

JThE11
Optical Injection-Induced Timing Jitter Reduction in Gain-Switched Single-Mode 1550 nm-VCSELs, *Antonio Consoli[1], Angel Valle[2], Luis Pesquera[2], Ignacio Esquivias[1], Francisco Jose Lopez-Hernandez[1]; [1]Dept. de Tecnología Fotónica, Univ. Politécnica de Madrid, Spain, [2]Inst. de Fisica de Cantabria, CSIC, Univ. de Cantabria, Spain.* We experimentally investigate how optical injection changes timing jitter and pulse width in gain-switched single mode VCSELs at several repetition rates. Jitter reductions larger than 70% over a 0.4 nm detuning range are obtained.

JThE12
O-Band InAs/InGaAs Quantum Dot Laser Diode with Sandwiched Sub-Nano Separator (SSNS) Structures, *Naokatsu Yamamoto[1], Hiroki Fujioka[2], Kouichi Akahane[1], Redouane Katouf[3], Tetsuya Kawanishi[1], Hiroshi Takai[2], Hideyuki Sotobayashi[3]; [1]NICT, Japan, [2]Tokyo Denki Univ., Japan, [3]Aoyama Gakuin Univ., Japan.* O-band InAs/InGaAs quantum-dot (QD) laser-diode has been successfully demonstrated by using sandwiched sub-nano separator (SSNS) structures on GaAs. Improvement of crystal-qualities and enhancement of luminescence intensities were attained for the QD laser by SSNS technique.

JThE13
All Quantum Dot Modelocked Vertical External Cavity Surface Emitting Laser, *Martin Hoffmann[1], Yohan Barbarin[1], Deran J. H. C. Maas[1], Aude-Reine Bellancourt[1], Mohammad Shafiei[1], Matthias Golling[1], Thomas Südmeyer[1], Ursula Keller[1], Igor L. Krestnikov[2], Sergey S. Mikhrin[2], Alexey R. Kovsh[2]; [1]ETH Zurich, Switzerland, [2]Innolume GmbH, Germany.* We report the first entirely quantum-dot-based SESAM-modelocked VECSEL, using quantum-dot layers for gain and absorber. We obtain 22 mW average output power at 1053 nm wavelength in 10-ps pulses with 2.54 GHz repetition rate.

JThE14
Observation of Degenerate and Non-Degenerate Lateral-Mode Patterns in Mid-IR Quantum Cascade Lasers, *Nikolai M. Stelmakh[1], Michael Vasilyev[1], Fatima Toor[2], Claire Gmachl[2]; [1]Univ. of Texas at Arlington, USA, [2]Princeton Univ., USA.* We investigate near-field lateral mode patterns of Quantum Cascade wide-ridge lasers using a spatially-resolving spectrometer. The results support box-model theory and show that lateral mode pattern can be made either degenerate or non-degenerate in frequency.

JThE15
270GHz, 580fs Optical Pulse Generation from a Single-Section Quantum-Dash Fabry-Pérot Laser Using Frequency Multiplication, *M. Xia[1], C. H. Kwok[1], M. G. Thompson[1], R. V. Penty[1], I. H. White[1], F. V. Dijk[2], A. Enard[2], F. Lelarge[2], G. -H. Duan[2]; [1]Univ. of Cambridge, UK, [2]Alcatel-Thales III-V Lab, France.* Pulse generation from a mode-locked single-section 1.55 μm quantum-dash FP laser is demonstrated under continuous-wave operation. A 270GHz, 580fs pulse train is achieved by applying frequency multiplication using fiber dispersion.

JThE16
Improved Mode-Beat Stability of a Multisection Quantum Dot Semiconductor Laser by Fiber Optical Feedback, *Stefan Breuer[1], Wolfgang Elsäßer[1], John G. McInerney[2], Jose M. P. Torres[3], Erwin E. A. Bente[3]; [1]Darmstadt Univ. of Technology, Germany, [2]Natl. Univ. of Ireland, Ireland, [3]Technische Univ. Eindhoven, Netherlands.* The mode-locking beat stability of a monolithic mode-locked quantum-dot laser is improved by an auxiliary mode-comb. A tenfold enhancement of the beating carrier red-shift and a substantial improvement of the RMS timing jitter is achieved.

JThE17
Mode Selection in a Microdisk Laser Coupled to a Passive Cavity for Optical Interconnections, *Fabien Mandorlo[1,2], Pedro Rojo-Romeo[1], Xavier Letartre[1], Jean-Marc Fedeli[2], Pierre Viktorovitch[1]; [1]Lyon Inst. of Nanotechnology, Univ. of Lyon, France, [2]CEA - LETI, Minatec, France.* Coupling a microdisk based laser to an external passive cavity can be used to strengthen mode selectivity and get a single, unidirectional and tunable output waveguide.

JThE18
Enhancing Wavelength Selection for Quantum Cascade Laser Based Chemical Sensors by Cavity Length Variation, *Christina Young[1,2], Richard Cendejas[1], Scott S. Howard[1], Wendy Sanchez-Vaynshteyn[1,3], Anthony J. Hoffman[1], Kale J. Franz[1], Yu Yao[1], Boris Mizaikoff[2,4], Xiaojun Wang[5], Jenyu Fan[5], Claire F. Gmachl[1]; [1]Princeton Univ., USA, [2]Georgia Tech, USA, [3]CUNY, USA, [4]Univ. of Ulm, Germany, [5]AdTech Optics, Inc., USA.* Varying Quantum Cascade laser cavity length results in gain peak selection across a 118 cm^{-1} range; a result of a change in threshold voltage, and applied electric field as a function of cavity length.

JThE19
Fabrication of Highly Stacked Quantum Dot Laser, *Kouichi Akahane, Naokatsu Yamamoto, Tetsuya Kawanishi; NICT, Japan.* We fabricated broad-area laser diodes containing highly stacked InAs quantum dots (QDs) using the strain-compensation technique; these diodes showed laser emission at 1529 nm in pulsed mode with a threshold current of 517.5 mA.

JThE20
31% DC to RF Differential Efficiency Using Monolithic Quantum Dot Passively Mode-Locked Lasers, *Chang-Yi Lin[1], Nader A. Naderi[1], Furqan Chiragh[1], Junghoon Kim[1], Christos G. Christodoulou[1], Luke F. Lester[1], Yongchun Xin[2]; [1]Ctr. for High Technology Materials, Univ. of New Mexico, USA, [2]IBM Systems and Technology Group, Semiconductor Solutions, USA.* 31% DC to RF differential efficiency of the mode-locked laser's output electrical signal is reported for the first time. The external quantum efficiency of the saturable absorber and the operating regime are also analyzed.

JThE21
Generation of High Energy, Ultrashort Pulses in the Near-IR with an OPA System Based on BIBO, *Masood Ghotbi[1], Marcus Beutler[1], Valentin Petrov[1], Frank Noack[1], Alexander Gaydardzhiev[2]; [1]Max-Born-Inst., Germany, [2]Dept. of Physics, Sofia Univ., Bulgaria.* Using a two stage, white-light seeded, collinear, femtosecond optical parametric amplifier based on BIBO crystal, sub-30-fs signal pulses with energies exceeding 200-μJ, corresponding to 5-fold pulse shortening and ~30% internal conversion efficiency, are generated.

JThE22
Plasma-Enhanced Third Harmonic Generation of Ultrafast Pulses Focused in a Gas, *Klaus Hartinger, Randy Bartels; Colorado State Univ., USA.* Enhancement of 300x in third harmonic generation conversion efficiency for ultrafast laser pulses in gases is demonstrated. The enhancements are obtained by generating a spatially-localized plasma in the focal region of an ultrashort pulse.

JThE23
Raman Fiber Laser Arrays, *Tsai-Wei Wu, Herbert Winful; Univ. of Michigan, USA.* We propose and analyze coupled fiber lasers based on Raman gain. The nonlinear phases inherent in the stimulated Raman scattering process are shown to contribute to the phase locking mechanism in the weak coupling regime.

JThE • Joint CLEO/IQEC Poster Session III—Continued

JThE24
Study of Four-Wave Mixing between a Coherent Signal and Incoherent Pump in a Highly-Nonlinear Fiber, *Yan Yan, Changxi Yang; State Key Lab of Precision Measurement Technology and Instruments Dept. of Precision Instruments, Tsinghua Univ., China.* Four-wave mixing between a coherent laser signal and incoherent pump in highly nonlinear fiber are investigated theoretically and experimentally, and the effect of incoherence pump on signal is studied.

JThE25
Tunable Pulse Compression Technique Using Optical Pulse Synthesizer, *Ken Kashiwagi, Yuichiro Kodama, Yosuke Tanaka, Takashi Kurokawa; Tokyo Univ. of Agriculture and Technology, Japan.* We propose and demonstrate tunable pulse compression using an optical pulse synthesizer. The technique showed tunability of compressed pulse widths and shapes by line-by-line manipulation of initial pulses.

JThE26
Coherent Mid-Infrared Broadband Generation in Non-Uniform ZBLAN Fiber Taper, *Zhigang Chen, Antoinette J. Taylor, Anatoly Efimov; Ctr. for Integrated Nanotechnologies, Los Alamos Natl. Lab, USA.* We describe and numerically demonstrate asymmetric coherent continuum generation in mid-infrared by a fundamental soliton propagating in non-uniform fiber taper via dispersive wave emission in a stabilized regime near continuously shifting second dispersion zero.

JThE27
Second Harmonic Generation in Lithium Niobate Planar Waveguides Grown by Liquid Phase Epitaxy, *Yi Lu, Benjamin Johnston, Peter Dekker, Judith M. Dawes; MQPhotonics, Dept. of Physics, Macquarie Univ., Australia.* High quality lithium niobate planar waveguides, with $LiTaO_3$ substrates, were grown using liquid phase epitaxy from K_2O flux. The waveguides do not exhibit impurity absorption in the visible, yielding efficient second harmonic generation.

JThE28
Efficient Generation of Transform-Limited Mid-Infrared Pulses Based on Sum-Frequency Generation in CdSe Crystal, *Yi Jiang[1], Yujie J. Ding[1], Ioulia B. Zotova[2]; [1]Lehigh Univ., USA, [2]ArkLight, USA.* We have efficiently generated coherent mid-infrared pulses at 3.42 μm by mixing a CO_2 laser beam with its second-harmonic output beam in a CdSe crystal with the output peak power as high as 39.2 W.

JThE29
Filament Assisted Third Harmonic Generation at Interface, *Feng Liang, Quan Sun, Réal Vallée, See Leang Chin; Ctr. d'Optique, Photonique et Laser (COPL) and Dept. de Physique, de Génie Physique et d'Optique, Univ. Laval, Canada.* Filament assisted third harmonic generation is studied at interface. The third harmonic energy induced by the filament crossing the rear surface keeps constant because of intensity clamping during filamentation.

JThE30
Monte-Carlo-Based Spectral Gain Analysis for THz Quantum Cascade Lasers, *Christian Jirauschek[1,2], Paolo Lugli[2]; [1]Emmy Noether Res. Group, Technischen Univ. München, Germany, [2]Inst. for Nanoelectronics, Technischen Univ. München, Germany.* Using a Monte-Carlo analysis, we self-consistently calculate the spectral gain for different types of THz quantum cascade lasers, investigate its temperature-dependent broadening and the influence of carrier-carrier scattering, and compare the results to experimental data.

JThE31
Dendrimer Based Terahertz Source and Spectroscopy, *Anis Rahman, Aunik K. Rahman; Applied Res. and Photonics, Inc., USA.* Electro-optic dendrimer was used to generate terahertz radiation. Sub-pico second temporal pulse was detected via time-domain spectroscopy. Fourier spectrum of the temporal signal reveals a frequency range of more than 4 THz.

JThE32
Narrow Linewidth mm-Wave Signal Generation Based on Two Phase-Locked DFB Lasers Mutually Coupled via Four Wave Mixing, *Marco Soldo[1], Nicholas Gibbons[2], Guido Giuliani[1]; [1]Univ. di Pavia, Italy, [2]Univ. of Cambridge, UK.* Two DFB lasers are phase-locked via mutual injection assisted by a FWM process that occurs in a third auxiliary DFB. This demonstrates the generation of spectrally pure tunable mm-wave signals without a reference RF seed.

JThE33
Comparison of Index and Extinction Analysis for Time-Domain Terahertz Computed Axial Tomography, *David A. Zimdars, Greg Fichter, Artur Chernovsky; Picometrix, LLC., USA.* Time domain terahertz computed axial tomography is used to reconstruct three dimensional images aerospace components. CT slices can be reconstructed with voxels proportional to index of refraction, extinction coefficient yielding unique representation of the object.

JThE34
Optimum Phase-Matched Terahertz-Wave Generation of BNA-DFG, *Katsuhiko Miyamoto[1], Seigo Ohno[1], Masazumi Fujiwara[2], Hiroaki Minamide[1], Hideki Hashimoto[2], Hiromasa Ito[1,3]; [1]RIKEN Sendai, Japan, [2]Osaka City Univ., Japan, [3]Tohoku Univ., Japan.* We calculated wideband refractive index of BNA crystal and established the optimum phase-matched condition of DFG configuration. Terahertz generation ranges had expanded from 0.1 to 20THz, the maximum output power obtained was ten times.

JThE35
Drastic Power Enhancement of THz Emission from Nonpolar InN, *Hyeyoung Ahn[1], K.-J Yu[1], Ci-Ling Pan[1], Shangjr Gwo[2]; [1]Dept. of Photonics, Natl. Chiao Tung Univ., Taiwan, [2]Dept. of Physics, Natl. Tsing Hua Univ., Taiwan.* We report more than two orders of magnitude stronger power enhancement of THz emission and the emission mechanism from the InN film grown along a nonpolar (*a*-axis) direction compared to that from polar InN.

JThE36
Development of Vacuum Ultraviolet Streak Camera System with Bright Spectrograph for the Evaluation of Luminescent Materials, *Marilou M. Cadatal[1], Yusuke Furukawa[1], Kouhei Yamanoi[1], Satoru Takatori[1], Minh Pham[1], Elmer Estacio[1], Tomoharu Nakazato[1], Toshihiko Shimizu[1], Nobuhiko Sarukura[1], Ken Kitano[2], Kozo Ando[2], Koro Uchiyama[3], Yoshio Isobe[3], Kentaro Fukuda[4,5], Toshihisa Suyama[4], Takayuki Yanagida[4,5], Akira Yoshikawa[5], Fumio Saito[5]; [1]Inst. of Laser Engineering, Osaka Univ., Japan, [2]Vacuum and Optical Instruments, Japan, [3]Hamamatsu Photonics Corp., Japan, [4]Tokuyama Corp., Japan, [5]Inst. of Multidisciplinary Res. for Advanced Materials, Tohoku Univ., Japan.* Bright vacuum ultraviolet Seya-Namioka type spectrometer and streak camera system with reflection-type input optics is developed and used to measure 175-nm Nd^{3+}:LaF_3 fluorescence with 7-ns decay time.

JThE37
Proton and Gamma Radiation Effects in Undoped, Single-Doped and Co-Doped $YLiF_4$ and $LuLiF_4$, *Hyung R. Lee[1], Yingxin Bai[2], Jirong Yu[3], Upendra N. Singh[3]; [1]Natl. Inst. of Aerospace, USA, [2]Science Systems and Applications, Inc., USA, [3]NASA Langley Res. Ctr., USA.* Proton and gamma radiation effects in various $YLiF_4$ and $LuLiF_4$ crystals have been investigated. The color centers are compared with six different crystal samples. The absorption coefficients are dependent on polarization and concentration of ions.

JThE38
Single-Shot Focal Spot Image of EUV Laser Using a ZnO Scintillator, *Tomoharu Nakazato[1], Toshihiko Shimizu[1], Kouhei Yamanoi[1], Satoru Takatori[1], Elmer Estacio[1], Marilou M. Cadatal[1], Nobuhiko Sarukura[1], Hiroaki Nishimura[1], Kunioki Mima[1], Momoko Tanaka[2], Masaharu Nishikino[2], Yoshihiro Ochi[2], Toshiyuki Ohba[2], Takeshi Kaihori[2], Tetsuya Kawachi[2], Yuji Kagamitani[3], Dirk Ehrentraut[3], Tsuguo Fukuda[3]; [1]Inst. of Laser Engineering, Osaka Univ., Japan, [2]Advanced Photon Res. Ctr., Japan Atomic Energy Agency, Japan, [3]Inst. of Multidisciplinary Res. for Advanced Materials, Tohoku Univ., Japan.* This work demonstrates a novel way to image the beam profile of an EUV laser in a single shot by employing the scintillator properties of ZnO crystal. These results are important for EUV lithography applications.

JThE39
High-Brightness White Light Point Source Using Ce,Sm:YAG Crystal Fiber, *Yen-Sheng Lin[1], Tzu-Chieh Cheng[1], Kuang-Yu Hsu[1], Chien-Chung Tsai[1], Dong-Yo Jheng[1], Cheng-Nan Tsai[2], Chia-Yao Lo[3], Sheng-Lung Huang[1,4]; [1]Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Dept. of Electronics Engineering, Cheng Shiu Univ., Taiwan, [3]Inst. of Optoelectronic Sciences, Natl. Taiwan Ocean Univ., Taiwan, [4]Dept. of Electrical Engineering, Natl. Taiwan Univ., Taiwan.* High-brightness white light point source using 10-μm-core diameter Ce,Sm:YAG double cladding crystal fiber was successful fabricated. The luminance and luminous efficiencies were 2.56×10^{10} cd/m^2 and 11.2 lm/W, respectively.

JThE40
The Electro-Optic Measurement for Glass Ceramics with Highly Oriented Crystal Layer, *Naoki Iwafuchi, Masai Hirokazu, Yoshihiro Takahashi, Takumi Fujiwara; Tohoku Univ., Japan.* The first order electro-optic coefficient (Pockels coefficient) was measured on $30BaO\text{-}20TiO_2\text{-}50SiO_2$ glass ceramics with c-axis oriented fresnoite crystals. The measurement showed Pockels coefficients (r_{33}~1 pm/V, r_{13}~3 pm/V).

JThE41
Spin-Coating of $Ge_{23}Sb_7S_{70}$ Chalcogenide Glass Thin Films, *Shanshan Song[1], Nathan Carlie[2], Laeticia Petit[2], Kathleen Richardson[2], Craig B. Arnold[1]; [1]Princeton Univ., USA, [2]Clemson Univ., USA.* We demonstrate a spin-coating technique for the deposition of $Ge_{23}Sb_7S_{70}$ chalcogenide glass films. We show that the use of the amine-based solvent allows the deposition of stoichiometric films with low surface roughness and controlled thickness.

JThE42
Nonlinear Absorption in Thallium (III) Phthalocyanines, *Jeffrey P. Fitzgerald[1], Peter D. Huffman[1], Ian A. Brenner[1], Steven R. Flom[2], Guy Beadie[2], Richard G. S. Pong[2], James S. Shirk[2]; [1]Chemistry Dept., U.S. Naval Acad., USA, [2]NRL, USA.* New thallium (III) phthalocyanines were synthesized and their nonlinear optical responses characterized on the femtosecond and nanosecond time scale. They are promising nonlinear absorption materials in the ~425 nm to ~600 nm region.

JThE43
Lifetime Broadening in GaInNAs Material, *Nikolaos Vogiatzis, Judy M. Rorison; Univ. of Bristol, UK.* Using a many impurity Anderson model, we describe the interaction of localized N states with GaInAs conduction states. N dependent DOS and material gain reflect features from strong mixing with N pairs/clusters, suggesting its broadband tunability.

JThE44
The XUV Monochromator for Ultrashort Pulses at ARTEMIS, *Fabio Frassetto[1], Stefano Bonora[1], Paolo Villoresi[1], Luca Poletto[1], Emma Springate[2], Chris Froud[2], Edmond Turcu[2], Dan Wolff[2], John Collier[2], Sarnjeet Dhesi[3], Andrea Cavalleri[4]; [1]Univ. of Padova, Italy, [2]Central Laser Facility, UK, [3]Diamond Light Source, UK, [4]Oxford Univ., UK.* The XUV monochromator for ultrashort pulses at the ARTEMIS beamline is presented. It adopts an innovative configuration with gratings in the off-plane mount. The design and characterization of the monochromator are discussed.

JThE45
Coupling between Energy and Carrier-Envelope Phase in Hollow-Core Fiber Based f-to-2f Interferometers, *Michael Chini, He Wang, Eric Moon, Hiroki Mashiko, Zenghu Chang; Kansas State Univ., USA.* The coupling coefficient between carrier-envelope phase and laser pulse energy is measured for white-light generation from a hollow-core fiber. It is determined that 1% fluctuation in laser energy gives a phase shift of 128 mrad.

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JThE46
Near-Field Intensity Shaping with Binary Phase Plates, *Christophe Dorrer; Lab for Laser Energetics, Univ. of Rochester, USA.* An error-reduction algorithm for near-field intensity shaping with binary phase plates is presented. Excellent beam-shaping capability is shown with the advantage of high-power handling capabilities.

JThE47
A High-Resolution Amplitude and Wavefront Control System Based on a Direct Zonal Closed-Loop Approach, *Seung-Whan Bahk, Jonathan D. Zuegel; Univ. of Rochester, USA.* We demonstrate a high-spatial-resolution adaptive-optic system using a liquid-crystal-on-silicon spatial-light modulator and a Hartmann-Shack sensor. The correction algorithm is suitable for fine-tuning laser-beam amplitude and wavefront in fine scales.

JThE48
All-Fiber, Discrete Arbitrary Picket-Pulse Shaping, *Ildar A. Begishev, Andrey V. Okishev, Richard G. Roides, Jonathan D. Zuegel; Univ. of Rochester, USA.* A novel all-fiber, hybrid pulse-shaping system based on the temporal stacking of discrete optical picket pulses combined with continuously shaped optical pulses provides 100-ps resolution with high dynamic range and flexibility required for laser fusion.

JThE49
Efficient Selection of High Harmonics by a Pulse-Front-Compensated Separator, *Tatsuya Okamoto, Kanako Sato, Mikio Yamashita, Taro Sekikawa; Hokkaido Univ., Japan.* We developed a wavefront-compensated harmonic separator consisting of just two toroidal gratings. This simple configuration enables us to select and focus the 17-31st harmonics of Ti:sapphire laser with ~10^5 photons per pulse.

JThE50
Electra: Repetitively Pulsed Electron Beam Pumped Angularly Multiplexed KrF Laser System, *Matthew F. Wolford[1], Matthew C. Myers[1], John Giuliani[1], John D. Sethian[1], Patrick Burns[2], Frank Hegeler[3], Reginald Jaynes[4]; [1]NRL, USA, [2]Res. Support Instruments, USA, [3]Commonwealth Technology Inc., USA, [4]Science Applications Intl. Corp., USA.* The electron beam pumped angularly multiplexed Electra laser system has achieved 522 J in a single shot. The main amplifier of Electra has operated in oscillator mode for multi-thousand shot runs 2.5 and 5 Hz.

JThE51
Measurement of Damage Threshold for Metallic Gratings under Intense Laser Pulse Irradiation, *Suman Baghchi, Sudeep Banerjee, Jun Zhang, Vidya Ramanathan, Nate C.-Smith, Donald P. Umstadter; Univ. of Nebraska, USA.* We have studied the damage characteristics of gold gratings irradiated with 40 fs laser pulses. The damage threshold for gold-on-glass gratings is twice that of holographic gratings and allows 10 Hz operation with PW pulses.

JThE52
Non-Sinusoidal Phase Modulations for High Power Laser Performance Control, *Steve Hocquet[1], Denis Penninckx[1], Jean-François Gleyze[1], Yves Jaouën[2]; [1]CEA CESTA, France, [2]Inst. TELECOM/TELECOM ParisTech, France.* We show numerically and experimentally that use of non-sinusoidal phase modulations instead of sinusoidal modulations improves high power laser performances. We demonstrate that pulse distortions are reduced for a same stimulated Brillouin scattering power threshold.

JThE53
Measurements of Temporal Correlation between Pump Noise and Mode-Locked Laser Noise, *Theresa D. Mulder, Ryan P. Scott, Jae H. Jeon, Brian H. Kolner; Univ. of California at Davis, USA.* Using direct time domain techniques, we show that the instantaneous amplitude noise of a mode-locked Ti:sapphire laser is correlated with the fluctuations of its pump laser. A two-dimensional joint probability histogram reveals the correlation.

JThE54
Simultaneous Beam Shaping and Dispersion Tuning for Femtosecond Optical Vortex Beams, *Alexander Schwarz, Reed A. Weber, Luke A. Emmert, Wolfgang Rudolph; Univ. of New Mexico, USA.* Vortex beams have been produced with sub 20-fs pulses using a prism pair and a computer generated holographic grating. The device combines comparatively high throughput, large bandwidth and GVD tuning capability.

JThE55
Spatio-Temporal Shaping of Picosecond Laser Pulses, *Avnish K. Sharma, Thomas Tsang, Triveni Rao; Brookhaven Natl. Lab, USA.* Spatio-temporal shaping of picosecond laser pulses is achieved by cascading a stack of birefringent crystals with a refractive optical system. An optical transport system delivers the beer can-shaped pulses onto a photocathode located 9m away.

JThE56
Synchronization of Remotely Separate Ultrashort Lasers of Large Cavity Detunings by Cross Phase Modulation Induced Nonlinear Polarization Rotation, *Yao Li, Qiang Hao, Wenxue Li, E. Wu, Heping Zeng; State Key Lab of Precision Spectroscopy, East China Normal Univ., China.* An erbium-doped fiber laser (1550 nm) was synchronized to a Yb:GSO (1030 nm) with a large detuning mismatch of 14 mm, while its pulse duration can be changed from picosecond to nanosecond.

JThE57
Diode-Pumped Mode-Locked Yb:YAG Ceramic Laser, *Hiroaki Yoshioka[1], Shinki Nakamura[1], Takayo Ogawa[2], Satoshi Wada[2]; [1]Ibaraki Univ., Japan, [2]RIKEN, Japan.* A diode-pumped mode-locked Yb:YAG ceramic laser was demonstrated. 551-fs pulses were obtained with an average power of 195 mW by using the SESAM. To our knowledge, this is the first mode-locked Yb:YAG ceramic laser.

JThE58
Highly Flexible Time and Wavelength-Interleaved Pulse Train Generation Based on High-Speed Optical Switch and Dispersion, *Xin Fu, Hongming Zhang, Yuancheng Zhang, Minyu Yao; Tsinghua Univ., China.* A method for generation of time- and wavelength-interleaved pulse train is demonstrated. This method is highly flexible because the repetition rate, the intensity of each wavelength and the time-interval can be readily controlled.

JThE59
Spatiotemporal Vector Pulse Shaping of Femtosecond Laser Pulses with a Multi-Pass 2-D-SLM, *Yoshihiro Esumi, Masudul Kabir, Hiroki Yazawa, Fumihiko Kannari; Dept. of Electronics and Electrical Engineering, Keio Univ., Japan.* A novel non-interferometric vector pulse shaping scheme is developed for femtosecond laser pulses using a 2-D-SLM. By utilizing spatiotemporal pulse shaping obtainable by the 2-D-SLM, we demonstrate spatiotemporal vector pulse shaping for the first time.

JThE60
Condensed Monte Carlo Modeling of Reflectance Spectroscopy with a Single Illumination-Detection Fiber, *Quanzeng Wang[1,2], Anant Agrawal[1], Nam Sun Wang[2], Joshua Pfefer[1]; [1]Ctr. for Devices and Radiological Health, FDA, USA, [2]Univ. of Maryland, USA.* A condensed Monte Carlo model for simulation of reflectance from an illumination-detection fiber was developed, validated and implemented to predict the influence of fiber size on reflectance spectra measured in malignant and adipose breast tissues.

JThE61
Infrared Stimulated Parametric Emission Microscopy, *Xuejun Liu, Cristina Rodriguez, Wolfgang Rudolph, James L. Thomas; Univ. of New Mexico, USA.* A femtosecond four-wave mixing microscopy was applied to image electronically resonant species, and to measure nonlinear susceptibilities. The parametric emission signal from dye molecules is resistant to photobleaching, making this technique attractive for biological samples.

JThE62
Enhanced Resolution in Two-Photon Imaging Using a TM_{01} Laser Beam, *Harold Dehez[1,2], Michel Piché[1], Yves De Koninck[2]; [1]Ctr. d'Optique, Photonique et Laser, Univ. Laval, Canada, [2]Ctr. de Recherche Univ. Laval Robert-Giffard, Canada.* We demonstrate experimentally that the resolution of a two-photon microscope is improved by a factor of 1.7 by using a TM_{01} laser beam and a plane interface between dielectrics instead of a Gaussian beam.

JThE63
Characterization of Immunolabeled Nanoparticle Binding Efficiency for Detecting Epidermal Growth Factor Receptor Expression, *Yongrui Luan, Matthew Crow, Adam Wax; Duke Univ., USA.* Hyperspectral darkfield microscopy is used to perform an immunoassay to quantitatively characterize immunolabeled nanoparticle binding efficiencies. This essay will determine the efficacy of our procedure for using immunolabeled nanoparticles to detect cell surface EGFR expression.

JThE64
Time-Resolved Fluorescence Polarization of Cancer Receptor-Targeted Contrast Agents in Prostate Tissues, *Yang Pu[1], Wubao Wang[1], B. Das[1], Samuel Achilefu[2], Robert R. Alfano[1]; [1]Inst. for Ultrafast Spectropscopy and Lasers, CUNY, USA, [2]Washington Univ. School of Medicine, USA.* Time-dependent fluorescence depolarization measurements were performed and an empirical model was discussed to investigate the evolution of polarization-dependent fluorescence emitted from cancer receptor-targeted contrast agents in cancerous and normal prostate tissues.

JThE65
Backscattering-Mode Nonlinear Absorption Imaging in Turbid Media, *Liping Cui, Wayne H. Knox; Inst. of Optics, Univ. of Rochester, USA.* Two color nonlinear absorption backscattering-mode imaging of a capillary tube phantom in turbid media is demonstrated. Imaging depth of 1.4 mm at S/N ~1 is achieved with 2 mw per beam in calibrated scattering solution.

JThE66
Image-Guided Raman Endoscopy for *in vivo* Detection of High Grade Dysplasia in Gastric, *Seng Khoon Teh[1], Wei Zheng[1], Khek Yu Ho[2], Ming Teh[2], Khay Guan Yeoh[2], Zhiwei Huang[1]; [1]Natl. Univ. of Singapore, Singapore, [2]Natl. Univ. of Singapore and Natl. Univ. Hospital, Singapore.* The purpose of this study was to investigate the feasibility of near infrared (NIR) Raman spectroscopy coupled with narrow band imaging for distinguishing high grade dysplasia from normal gastric mucosa tissues at gastroscopy.

JThE67
Ablation of Hard Dental Tissue Using Ultrashort Pulsetrain-Burst (>100MHz) Laser, *Christian Dille[1], Patrick Kaifosh[1], Paul Forrester[1], Aghapi Mordovanakis[1], Lothar Lilge[2], Robin Marjoribanks[1]; [1]Dept. of Physics and Inst. for Optical Sciences, Univ. of Toronto, Canada, [2]Dept. of Medical Biophysics, Univ. of Toronto, Canada.* Effects of irradiating dental hard tissue with an ultrashort pulsetrain-burst (>100 MHz) laser are studied. The ablation rate is investigated as a function of the pulsetrain duration. Material modification is characterized using micro-Raman spectroscopy.

JThE68
Ultra-Stable and Ultra-Wideband Wavelength-Tunable Actively Mode-Locked Short-Cavity Fiber Ring Laser Using a Bismuth-Based Highly Nonlinear Erbium-Doped Fiber, *Yutaka Fukuchi, Joji Maeda; Tokyo Univ. of Science, Japan.* We demonstrate an actively mode-locked short-cavity laser employing a 151cm-long bismuth-oxide-based highly nonlinear erbium-doped fiber. Stable 10GHz short pulses are obtained with an 87nm tuning range. An 8m-long cavity realizes better stability against external perturbation.

JThE69
Solitonic Interactions in Actively Multi-Bound Soliton Fiber Lasers, *Nguyen D. Nhan, Le N. Binh; Dept. of Electrical and Computer System Engineering, Monash Univ., Australia.* We experimentally investigate the interactions between solitons in multi-bound states generated from an active mode-locked fiber laser and within the ring cavity. Their phase difference and corresponding interactions between solitons are studied.

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JThE70
High-Average-Power Tunable Square Nanosecond Laser, *Wenxue Li, Qiang Hao, Heping Zeng; State Key Lab of Precision Spectroscopy, East China Normal Univ., China.* Diode-pumped nanosecond double-clad fiber amplification to 90-W average power has been demonstrated. The seed square pulses with tunable pulse duration from 1 to 14 ns were generated in a self-starting, passively mode-locked ytterbium fiber laser.

JThE71
Dispersion-Flattened Holey Fiber with an Ultra-Small Mode Area Using a High Index Slot Structure, *Lin An[1], Zheng Zheng[1], Zheng Li[1], Tao Zhou[2], Jiangtao Cheng[3]; [1]Beihang Univ., China, [2]New Jersey Inst. of Technology, USA, [3]Penn State Univ., USA.* A holey fiber design with a high index nanostructure that can achieve an effective mode area not in excess of 0.3 μm^2 and a flat dispersion at the 1.55 μm band is proposed and studied.

JThE72
Low Bend Loss in Tightly-Bent Optical Fibers through Adiabatic Bend Transitions, *Lei Yao[1,2], Tim Birks[2], Jonathan Knight[2]; [1]Inst. of Lightwave Technology, Beijing Jiaotong Univerity, China, [2]Ctr. for Photonics and Photonic Materials, Univ. of Bath, UK.* We demonstrate low bend loss for tightly bent optical fibers by winding the fiber around a mandrel designed to follow an adiabatic transition path into the bend.

JThE73
Amplified-Spontaneous-Emission Pumped Raman Fiber Laser, *Boris Levit, Alexander Bekker, Vladimir Smulakovsky, Baruch Fischer; Technion-Israel Inst. of Technology, Israel.* We present a low-threshold Raman fiber laser at 1670nm, pumped for the first time by the ASE of EDFA. The output was 340mW, 34% of the pump power, and the threshold (with another laser) 160mW.

JThE74
Yb-Doped Rod-Type Photonic Crystal Fibers for Single-Mode Amplification, *Federica Poli[1], Davide Passaro[1], Annamaria Cucinotta[1], Stefano Selleri[1], Jesper Lægsgaard[2], Jes Broeng[3]; [1]Univ. of Parma, Italy, [2]DTU Fotonik, Technical Univ. of Denmark, Denmark, [3]Crystal Fibre A/S, Denmark.* The competition among the guided modes in rod-type photonic crystal fibers with a low refractive index ring in the Yb-doped core is investigated with an amplifier model to demonstrate the effective higher-order mode suppression.

JThE75
Brillouin Gain Coefficient Measurement of Bismuth Oxide-Based Photonic Crystal Fiber, *Ju Han Lee[1], K. Y. Song[2], H. J. Yoon[3], J. S. Kim[3], T. Hasegawa[4], T. Nagashima[4], S. Ohara[4], N. Sugimoto[4]; [1]Univ. of Seoul, Republic of Korea, [2]Chung-Ang Univ., Republic of Korea, [3]Korea Railroad Res. Inst., Republic of Korea, [4]Asahi Glass Res. Ctr., Japan.* The Brillouin gain coefficient of a 1.16-m-long Bismuth Oxide-based PCF is measured by using a beat lock-in detection scheme to overcome the pump beam back-reflection-induced limitation at splicing points. g_B is found to be ~$4x10^{-11}$m/W.

JThE76
Bend-Resistant, Single-Stage, S-Band Erbium-Doped Photonic Crystal Fiber Amplifiers, *Shailendra K. Varshney[1,2], Kunimasa Saitoh[1], Masanori Koshiba[1]; [1]Hokkaido Univ., Japan, [2]Indian Inst. of Technology, India.* We present design guidelines to achieve ~ 50-dB of gain with an average gain value of 26-dB over 70-nm bandwidth in a 7.2-m long erbium-doped depressed-cladding photonic crystal fiber amplifier showing bend-resistant functionality.

JThE77
160-Gb/s OTDM De-Multiplexing Based on a Pulsed-Pump Parametric Wavelength Exchange, *Mengzhe Shen, Xing Xu, Kenneth Yip Wong; Univ. of Hong Kong, Hong Kong.* We report the experimental demonstration of pulsed-pump wavelength exchange for all-optical time de-multiplexing of 160-Gb/s RZ signals. Power penalty ≤ 2.7 dB at 10^{-9} was achieved for all de-multiplexed 10-Gb/s RZ signals.

JThE78
Polarization Dependent Power Penalty in DPSK Demodulation, *Dragos Cotruta[1], Odile Liboiron-Ladouceur[1], Yannick Lize[2], David V. Plant[1]; [1]McGill Univ., Canada, [2]StrataLight, Canada.* We analyze the power penalty associated with polarization dependency in DPSK demodulation. We demonstrate polarization-dependent phase shift mitigation by optimization of the phase component on one of the branches of the delay interferometer.

JThE79
Experimental Demonstration on Phase-Erased Demodulation for RZ-DPSK/CSRZ-DPSK Signals and ODB/AMI-to-RZ Format Conversion, *Jian Wang, Qizhen Sun, Junqiang Sun; Huazhong Univ. of Science and Technology, China.* We report 40 Gbit/s phase-erased demodulation for RZ-DPSK/CSRZ-DPSK signals by exploiting cascaded second-order nonlinearities in a periodically poled lithium niobate (PPLN) waveguide. All-optical 40 Gbit/s ODB/AMI-to-RZ format conversion is also demonstrated in the experiment.

JThE80
Low Complexity Optical DQPSK Receiver with Enhanced Tolerance to Transmission Impairments, *Ilya Lyubomirsky, Yi-Hsiang Wang, Cheng-Chung Chien; Univ. of California at Riverside, USA.* A low complexity DQPSK receiver based on frequency discriminator demodulator is demonstrated experimentally, showing 2x enhanced tolerance to fiber chromatic dispersion, and 4-dB higher nonlinear threshold to Gordon-Mollenauer effect compared with conventional delay-interferometer based receiver.

JThE81
Weak-Resonant-Cavity FPLD Based Down-Stream Amplitude Squeezer for Injection-Locking RSOA Transmitter in DWDM-PON, *Yin-Hsun Huang[1], Gong-Cheng Lin[1], Hai-Lin Wang[1], Yi-Hung Lin[2], Sun-Chien Ko[1], Jy-Wang Liaw[1], Gong-Ru Lin[2]; [1]Telecommunication Labs Advanced Technology, Chunghwa Telecom Co., Ltd., Taiwan, [2]Inst. of Photonics and Optoelectronics, Dept. of Electrical Engineering, Natl. Taiwan Univ., Taiwan.* We demonstrate dual low-facet-reflectivity FPLD amplitude squeezers to suppress extinction ratio of down-stream signal by 8.6 dB for injection-locking RSOA in DWDM-PON with error-free 1.25Gbps up-stream transmission at receiving power of -25.5 dBm.

JThE82
Demonstration of 40-km-Reach WDM-PON with Capacity of 40-Gb/s Based on Wavelength-Locked F-P LD, *Jung-Hyung Moon, Joon-Young Kim, Sil-Gu Mun, Hoon-Keun Lee, Chang-Hee Lee; Korea Advanced Inst. of Science and Technology, Republic of Korea.* We demonstrate 40-km-reach 32-channel gigabit wavelength division multiplexing-passive optical network (WDM-PON) based on Fabry-Perot laser diode with external ASE injection. The dispersion, back-reflection and crosstalk effects in WDM-PON are also investigated.

JThE83
Modeling Opto-Electronic Oscillators, *Etgar C. Levy[1], Moshe Horowitz[1], Curtis R. Menyuk[2], Olukayode Okusaga[3], Weimin Zhou[3], Gary M. Carter[2]; [1]Technion-Israel Inst. of Technology, Israel, [2]Univ. of Maryland at Baltimore, USA, [3]ARL, USA.* A comprehensive model to accurately study phase noise and dynamics in optoelectronic oscillators is presented. The model results are compared to experiments. The comparison shows that the flicker noise increases as the cavity length increases.

JThE84
Quadrature Detection and Cancellation of Absolute Wavelength in a Prism-Pair Interferometer for High-Accuracy Refractive Index Measurements of Glasses, *Yasuaki Hori, Akiko Hirai, Kaoru Minoshima; AIST, Japan.* Uncertainty of refractive-index measurements of optical-glasses are further suppressed in a prism-pair interferometer by a quadrature-detection and a shared light-source. Uncertainty of 1.50×10^{-6} is confirmed by an interlaboratory comparison based on other methods.

JThE85
A Tunable Laser System for the Wavelength Calibration of Astronomical Spectrographs, *Claire E. Cramer[1], Steven Brown[2], Nelson Caldwell[3], Andrea K. Dupree[3], Sylvain G. Korzennik[3], Keith R. Lykke[2], Andrew Szentgyorgyi[3]; [1]Harvard Univ., USA, [2]NIST, USA, [3]Harvard-Smithsonian Ctr. for Astrophysics, USA.* Precise wavelength calibration of the multi-object echelle spectrographs used in searches for extrasolar planets is an unsolved problem in astrophysical instrumentation. We present results from a novel tunable laser calibration system that achieves unprecedented precision.

JThE86
Frequency Scanning Laser for High Speed Phase Shifting Interferometry, *Roma Jang[1,2], Jae Wan Kim[2], Chu-Shik Kang[2], Jong-Ahn Kim[2], Tae Bong Eom[2], Jae-Eun Kim[1], Hae Yong Park[1]; [1]KAIST, Republic of Korea, [2]Korea Res. Inst. of Standards and Science, Republic of Korea.* A Multichannel frequency scanning laser which is to be used as a source in a high speed phase-shifting interferometer to measure 3-D profiles of nanostructures is presented.

JThE87
Pulse Characterization and Arbitrary Waveform Generation via Spectral Phase Comb Shaping, *Dmitry Pestov, Vadim V. Lozovoy, Marcos Dantus; Michigan State Univ., USA.* Spectral phase comb-shaping is shown to be a powerful concept for phase-only generation and *in situ* characterization of arbitrary optical pulse sequences, where the temporal shape of every pulse in the train is controlled independently.

JThE88
High Density Spectral Fringe Analysis, *James H. Easter; Ctr. for Ultrafast Optical Science, Univ. of Michigan, USA.* Interpolation to an evenly spaced frequency domain is shown to introduce errors in phase retrieval from spectral interferograms with dense fringes. A simple method for performing phase retrieval without interpolation is presented.

JThE89
A Comparison between Digital and Analog Pound-Drever-Hall Laser Stabilization, *Timothy T-Y Lam, Sheon Chua, Bram J. J. Slagmolen, Jong H. Chow, Ian C. M. Littler, David E. McClelland, Daniel A. Shaddock; Australian Natl. Univ., Australia.* We locked a laser to a cavity using an all-digital Pound-Drever-Hall feedback system. By performing the demodulation and feedback controller digitally the low frequency noise performance was improved compared to a conventional analog system.

JThE90
High Efficiency Solar Cells Based on Spontaneous Emission Inhibition in Photonic Crystals, *Bryan C. Ellis, Tomas Sarmiento, James Harris, Jelena Vuckovic; Stanford Univ., USA.* The design of a photonic crystal photovoltaic device is described. We discuss the feasibility of demonstrating that inhibition of spontaneous emission can be used to increase the efficiency of solar cells.

JThE91
Compensation of Slow Light Velocity Dispersion in Tapered Period One-Dimensional Photonic Crystal Coupled Cavities, *Qin Chen, Duncan W. E. Allsopp; Univ. of Bath, UK.* It is shown that full compensation of the group velocity dispersion for chip free slow light (~c/100) over a bandwidth of 230 GHz is possible using a coupled-cavity waveguide comprising cavities of $Q \sim 10^6$.

JThE92
Redirection of Lateral Emission Using Nanorod Reflectors for Power Enhancement of GaN Light Emitting Diodes, *Yun-Wei Cheng[1], Kun-Mao Pan[1], Liang-Yi Chen[1], Cheng-Pin Chen[1], Min-Yung Ke[1], JianJang Huang[1,2]; [1]Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Dept. of Electrical Engineering, Natl. Taiwan Univ., Taiwan.* We fabricate the nanorod arrays at the periphery of light-emitting mesa as the reflector. The nanorod arrays redirect the laterally propagated light. The output power is enhanced by 32.1% at 30mA injection current.

JThE93
Optical and Mechanical Design of a "Zipper" Photonic Crystal Optomechanical Cavity, *Jasper Chan, Matt Eichenfield, Ryan Camacho, Oskar Painter; Caltech, USA.* Design of a simple doubly clamped cantilever structure capable of localizing mechanical and optical energy at the nanoscale is presented. Current designs for thin-film SiNx indicate that an optical Q-factor greater than 10^6 is realizable.

JThE • Joint CLEO/IQEC Poster Session III—Continued

JThE94
When and How Coupled-Mode Theory Fails in High-Index Contrast Arrayed and Multi-Slot Waveguides, *Michael L. Cooper, Shayan Mookherjea; Univ. of California at San Diego, USA.* We describe a method of reconstruction for investigating the validity of coupled-mode theory for high index contrast arrayed waveguides. We quantify at which separation distances next-to-nearest-neighbor coupling becomes significant, and why the theory breaks down.

JThE95
Lasing on Higher-Order Whispering Gallery Modes at Room Temperature, *Chih-Yao Chen[1], Yuan Yao Lin[1], Ching-Jen Cheng[1], Tsin-Dong Lee[2,3], Ray-Kuang Lee[1]; [1]Natl. Tsing-Huang Univ., Taiwan, [2]Industrial Technology Res. Inst., Taiwan, [3]Natl. Yunlin Univ. of Science and Technology, Taiwan.* We report a direct method to observe higher-order whispering gallery modes in VCSELs at room temperature. Perfect whispering gallery modes with an azimuthal number as large as 41 are observed in experiments and simulations.

JThE96
Macroscopic Entanglement between Two Spatially Separated Quantum-Dot Excitons in a Planar Photonic Crystal, *Peijun Yao, Stephen Hughes; Dept. of Physics, Queen's Univ., Canada.* We introduce a formalism for describing the quantum dynamics between two spatially-separated quantum dots on-chip, and apply this formalism to demonstrate pronounced entanglement between two quantum-dot excitons separated by distances of 300 μm and more.

JThE97
Magneto-Optical Kerr Effect Tomography of an Electron Spin State in a Semiconductor Quantum Dot, *Yoshiaki Rikitake[1,2], Hiroshi Imamura[3,2], Hideo Kosaka[4,2]; [1]Sendai Natl. College of Technology, Japan, [2]CREST-JST, Japan, [3]Nanotechnology Res. Inst., AIST, Japan, [4]Res. Inst. of Electrical Communication, Tohoku Univ., Japan.* We propose an magneto-optical Kerr effect tomography (MOKET) of an electron spin state in a semiconductor quantum dot. This method can measure the quantum spin coherence between spin up and down states.

JThE98
Spatial and Temporal Magnetometry Using Cold Atoms in Dark Optical Tweezers, *Fredrik K. Fatemi, Matthew L. Terraciano, Mark Bashkansky; NRL, USA.* We use Faraday spectroscopy of atoms confined to crossed hollow beam tweezers to map magnetic fields over several millimeters with 100 micron resolution. The traps permit several hundred measurements in a single loading cycle.

JThE99
Trapped Ion Qubit Operations with Ultrashort Pulses, *Wesley C. Campbell, Qudsia Quraishi, Jonathan Mizrahi, Chris Monroe; Univ. of Maryland, USA.* We describe an experiment to achieve ultrafast qubit operations on trapped $^{171}Yb^{+}$ ions. We plan to use a series of short optical pulses to perform bit rotations and multi-bit entangling gates independent of ion temperature.

JThE100
Phase Separation in a Two-Species Atomic Bose-Einstein Condensate with an Interspecies Feshbach Resonance, *Lu Zhou[1], Jing Qian[1], Han Pu[2], Weiping Zhang[1], Hong Y Ling[3]; [1]State Key Lab of Precision Spectroscopy, Dept. of Physics, East China Normal Univ., China, [2]Dept. of Physics and Astronomy, and Rice Quantum Inst., Rice Univ., USA, [3]Rowan Univ., USA.* We consider a mixture of two-species atomic Bose-Einstein condensates coupled to a bound molecular state at zero temperature via Feshbach resonance. This system is shown to be able to support rich sets of phase separations.

JThE101
MINIATOM: Miniaturized Coherent Atom Sensors, *Baptiste Battelier; Inst. d'Optique, France.* We conceive and build a compact cold atom interferometer with an original architecture based on integrated optical components. These new inertial sensors can play a significant role in navigation, fundamental physics and earth observation.

JThE102
Experimental Two-Way Quantum Key Distribution, *Bingjie Xu, Xiang Peng, Hao Jiang, Hong Guo; Peking Univ., China.* We propose a modified system to reduce the Rayleigh backscattering and to increase the key rate. We also propose a practical two-way system to monitor the photon distribution of the untrusted source in real time.

JThE103
Silicon Single-Photon Detector with 5 Hz Dark Counts, *Yong-Su Kim[1], Vadim Makarov[2], Youn-Chang Jeong[1], Yoon-Ho Kim[1]; [1]Pohang Univ. of Science and Technology, Republic of Korea, [2]Norwegian Univ. of Science and Technology, Norway.* We report operation of a passively quenched silicon-SPAD at extremely low dark count rate of 5 Hz. While the quantum efficiency remained constant from -32°C down to -77°C, the after-pulsing depended on the cooling temperature.

JThE104
Shannon Dimensionality of Quantum Channels, *Bart-Jan Pors[1], Sumant Oemrawsingh[2], Andrea Aiello[3], Martin van Exter[1], Gert 't Hooft[1], Eric Eliel[1], Johannes Woerdman[1]; [1]Leiden Univ., Netherlands, [2]Univ. of California at Santa Barbara, USA, [3]Univ. Erlangen-Nürnberg, Germany.* We introduce the Shannon dimensionality *D* to quantify the capacity of quantum channels. This is applied to angular entanglement of photons. Experimentally, *D* varies from 3 to 6 and values up to 50 are feasible.

JThE105
Quantum Diffraction of Biphoton Beam at a Blazed Grating, *Dirk Puhlmann, Martin Ostermeyer; Inst. for Physics and Astronomy, Univ. of Potsdam, Germany.* A blazed grating is used for the separation of single photons from photon pairs. The Fraunhofer far field of the two-photon rate depends on the spatial correlation strength of the photons and enables correlation characterizations.

JThE106
Diffraction Enhancement via Bloch Surface Waves in a-SiN:H Multilayers, *Marco Liscidini[1], Matteo Galli[2], Maddalena Patrini[2], Richard Loo[3], Cynthia Goh[3], Carlo Ricciardi[4], Fabrizio Giorgis[4], John Sipe[1]; [1]Dept. of Physics, Univ. of Toronto, Canada, [2]Dept. of Physics, Univ. of Pavia, Italy, [3]Dept. of Chemistry, Univ. of Toronto, Canada, [4]Materials Science and Chemical Engineering Dept., Polytechnic Univ. of Torino, Italy.* Using the excitation of a Bloch Surface Wave (BSW), we demonstrate a 45-fold diffraction enhancement for a protein grating printed on a-SiN:H multilayers. This may lead to a new generation of high sensitivity diffraction-based biosensors.

JThE107
The Local Density of States of Metamaterial Photonic Crystals, *Ara A. Asatryan[1], Lindsay C. Botten[1], Kokou B. Dossou[1], Christopher G. Poulton[1], Parry Chen[2], Ross C. McPhedran[2], Martijn C. de Sterke[1]; [1]Univ. of Technology, Sydney, Australia, [2]Univ. of Sydney, Australia.* We study the local density of states (LDOS) of photonic crystals made with metamaterial inclusions and show that the introduction of metamaterial components substantially widens and deepens band gaps in comparison with normal photonic crystals.

JThE108
Proposal of Fabricating a Woodpile Photonic Crystal Nanocavity by a Two-Directional Etching without Wafer Bonding, *Lingling Tang, Tomoyuki Yoshie; Duke Univ., USA.* Ultra-high-Q modes are designed in woodpile photonic crystal by modulating the unit cell size along a waveguide in complete photonic band gap. We propose to fabricate the nanocavities with a two-directional etching without wafer bonding.

JThE109
Negative Permeability Using Arrays of Aperiodic Silver Nanoclusters, *Anurag Agrawal, Wounjhang Park, Rafael Piestun; Univ. of Colorado at Boulder, USA.* We present a metamaterial architecture that exhibits a strong magnetic resonance leading to negative effective permeability. The building blocks are aperiodic silver nanowire clusters that generate stronger magnetic resonance than their periodic counterparts.

JThE110
Impedance of Square and Hexagonal Photonic Crystals, *Felix J. Lawrence[1], Lindsay C. Botten[2], Kokou B. Dossou[2], C. Martijn de Sterke[1]; [1]Univ. of Sydney, Australia, [2]Univ. of Technology, Sydney, Australia.* We rigorously define an impedance for photonic crystals, which generally needs to be a matrix. We use it to design a two-layer anti-reflection coating for a frequency where the bulk crystal reflects over 50%.

JThE111
Design of Hyper-Gratings for Far Field Sub-wavelength Focusing in Planar Geometry, *Sukosin Thongrattanasiri, Viktor A. Podolskiy; Oregon State Univ., USA.* We propose a new class of planar focusing and imaging systems capable of subwavelength focusing of radiation in the far field of the source and present the Fourier-optics applications of these structures.

2:00 p.m.-4:00 p.m. ***PhAST*** **Market Focus Session: Sensing and Threat Detection,** *Exhibit Hall*

JThE • Joint CLEO/IQEC Poster Session III—Continued

JThE112
Laser Spectra of ZnO Powders and Complex Structures, *Valery M. Markushev, Mikhail V. Ryzhkov, Charus' M. Briskina, Andrey A. Borodkin; Inst. of Radio Engineering and Electronics of RAS, Russian Federation.* Laser spectra of different ZnO powders and two complex structures were investigated at room temperature under nanosecond pumping. The nature of lasing modes is discussed. Simplified model for modes is suggested and numerically supported.

JThE113
Controlled Zero-*n* Bandgaps in Negative Refraction Photonic Superlattices for Wavefront Control and Open Resonances, *Serdar Kocaman[1], Rohit Chatterjee[1], Nicolae C. Panoiu[2], Mingbin Yu[3], Dim-Lee Kwong[3], Richard M. Osgood[1], Chee Wei Wong[1]; [1]Columbia Univ., USA, [2]Univ. College London, UK, [3]Inst. of Microelectronics, Singapore.* We present experimental measurements of tuned zero-n bandgaps in photonic crystal superlattices supported by precise nanofabrication and rigorous 3-D *ab initio* simulations, these zero-order gaps have potential for wavefront control for arbitrary phase delay lines.

JThE114
All-Optical Tunable Photonic Crystal Based on CdTeS Quantum Dots Doped Polymer, *Xiaoyong Hu, Jiaxiang Zhang, Ping Jiang, Hong Yang, Qihuang Gong; Dept. of Physics, Peking Univ., China.* An ultrafast tunable photonic crystal made of CdTeS quantum dots doped MEH-PPV is realized. The photonic bandgap shifts 1.7 nm under excitation of 25 MW/cm^2 pump light. The response time is 30 ps.

JThE115
Paper Withdrawn.

JThE116
Vibrational Coherence Modulated Interfacial Third Harmonic Generation Spectroscopy, *David B. Kupka, Jesse Wilson, Philip Schlup, Randy Bartels; Colorado State Univ., USA.* We present a new interfacial probing technique of vibrational spectroscopy to provide additional insight over current methods on the structure and dynamics of interfacial boundaries.

JThE117
Nonlinear Transmission of a Tapered Fiber in Rubidium, *Scott M. Hendrickson[1,2], Todd B. Pittman[2], James D. Franson[2]; [1]Johns Hopkins Univ., USA, [2]Univ. of Maryland, Baltimore County, USA.* The transmission of a tapered fiber surrounded by rubidium vapor can be reduced by atoms accumulating on the fiber surface. We demonstrate that tapered fiber transmission can be controlled by power propagating in the waveguide.

JThE118
Spatiotemporal Pulse-Train Solitons, *Hassid C. Gurgov, Oren Cohen; Technion-Israel Inst. of Technology, Israel.* We propose spatiotemporal solitons that consist of trains of short pulses. The pulses are collectively trapped in the transversal directions by a slow nonlinearity and each pulse is self-trapped temporally by a fast nonlinearity.

JThE119
Ultrafast Studies of Metal Nanorod Coherent Acoustic Oscillations, *Jeffrey C. Owrutsky[1], Michael B. Pomfret[1], Douglas J. Brown[2]; [1]NRL, USA, [2]US Naval Acad., USA.* Ultrafast transient absorption spectroscopy was used to characterize coherent acoustic oscillations of a series of nanorods composed of a wide variety of metals. The oscillations provide information on the nanorods' composition, structure and relaxation properties.

JThE120
Impedance-Matching Surface Plasmon Absorber for FDTD Simulation, *Chien-Chang Chao[1], Chih-Ming Wang[2], Jeng-Yang Chang[1]; [1]Dept. of Optics and Photonics, Natl. Central Univ., Taiwan, [2]Inst. of Optoelectronic Engineering, Natl. Dong Hwa Univ., Taiwan.* An impedance-matching layer is implemented between scattered SP and PML to reduce reflected SP from the edge of metal surface. Very low SP reflection of -28.69dB is achieved by an IML with length of λ/3.

JThE121
Polarization-Gated Surface Enhanced Optical Field and Its Applications, *Peifen Lu, Jian Wu, Hongxing Qi, Heping Zeng; East China Normal Univ., China.* We show that the polarization of surface-plasmon-resonance enhanced optical field can be manipulated to be linear by using a polarization-gating scheme, which benefits the ultrafast electron acceleration and efficient XUV frequency comb generation.

JThE122
Numerical Prediction of Minimum Sub-Diffraction-Limit Image Resolved by Silver Surface Plasmon Lenses, *Masafumi Fujii; Univ. of Toyama, Japan.* The minimum possible size of sub-diffraction-limit imaging by the surface plasmon polariton (SPP) induced in thin metal lenses has been analyzed with FDTD method, considering plasmon interference, reflection and transmission of evanescent fields.

JThE123
Huygens-Fresnel Principle for Evanescent Waves, *Konstantinos Makris, Demetri Psaltis; École Polytechnique Fédérale de Lausanne (EPFL), Switzerland.* We derive from the modified Huygens-Fresnel principle the exponential wave decay in the evanescent region of a dielectric interface. This perspective can open new possibilities for analyzing or numerically simulating the diffraction from sub-wavelength structures.

JThE124
Stimulated Scatterings of Light in Three-Dimensional Photonic Crystals, *Nikolay V. Tcherniega, Anna D. Kudryavtseva; Lebedev Physical Inst., RAS, Russian Federation.* Experimental results on the stimulated Raman scattering and stimulated globular scattering properties in three-dimentional photonic crystals - synthetic opal matrices - are presented. Connection of SRS excitation with the photonic band gap position is established.

JThE125
Near-Field Probe Characterizations Using Radially and Azimuthally Polarized Beams in the Collection Mode, *J. E. Kihm, J. S. Ahn, K. J. Ahn, K. G. Lee, D. S. Kim; Ctr. for Subwavelength Optics, Dept. of Physics and Astronomy, Seoul Natl. Univ., Republic of Korea.* Optical responses of metal nano-aperture probes for the electric and the magnetic field polarization are investigated with radially and azimuthally polarized lights.

JThE126
Spatially Localized Enhancement of Evanescent Coupling to Whispering-Gallery Modes at 1550 nm Due to Surface Plasmon Resonances of Au Nanowire Fragments, *Elijah Dale, Deepak Ganta, Razvan I. Stoian, Prem Thapa, Deok J. Yu, Bret N. Flanders, Albert T. Rosenberger; Oklahoma State Univ., USA.* Spatially localized enhanced evanescent coupling between a tapered optical fiber and a high-Q dielectric microresonator results from the resonant excitation of surface plasmons of Au nanowire fragments deposited non-uniformly on the surface of the microresonator.

2:00 p.m.-4:00 p.m. ***PhAST* Market Focus Session: Sensing and Threat Detection,** *Exhibit Hall*

Rooms 318-320

IQEC

2:30 p.m.–4:15 p.m.
IThG • Plasmonic Metamaterials
Alexandra Boltasseva; Danmarks Tekniske Univ., Denmark, Presider

IThG1 • 2:30 p.m. Invited
Mapping Electron Excitations in the Visible-UV Range Using Sub-nm Resolved STEM-EELS Spectrum Imaging, *Mathieu Kociak; Lab de Physique des Solides, Univ. Paris-Sud, France.* Spatially resolved electron energy loss spectroscopy experiments have given the measurement of the electromagnetic eigenmodes of individual metallic nanoparticles.

IThG2 • 3:00 p.m.
Self-Assembled Metal Nanocluster Metamaterials, *Qi Wu, Jin Hyoung Lee, Wounjhang Park; Univ. of Colorado at Boulder, USA.* A bottom-up approach based on template-directed colloidal self-assembly was used for fabricating metal nanocluster based matematerials and their optical properties were studied experimentally. Negative index material composed of nanoclusters and metal wires was numerically demonstrated.

Rooms 321-323

CLEO

2:30 p.m.–4:15 p.m.
CThR • High-Power Solid-State Lasers CLEO Symposium III: Novel High-Power SS Lasers
Martin Ostermeyer; Univ. of Potsdam, Germany, Presider

CThR1 • 2:30 p.m. Invited
2.3 kW Cryogenically Cooled Yb:YAG Laser, *Jason K. Brasseur, Akheelesh K. Abeeluck, Andrew R. Awtry, Lei S. Meng, Kevin E. Shortoff, Nicholas J. Miller, Richard K. Hampton, Michael H. Cuchiara, David K. Neumann; Directed Energy Solutions, USA.* We present our 2.3-kW Yb:YAG master oscillator power amplifier which has shown optical wall-plug efficiencies above 30-% with excellent beam quality. In addition, we will present our all-cryogenic Yb:YAG laser.

CThR2 • 3:00 p.m.
Total-Reflection Active-Mirror Laser with Directly Liquid-Nitrogen-Cooled Yb:YAG Ceramics, *Hiroaki Furuse[1], Taku Saiki[1], Kazuo Imasaki[1], Masayuki Fujita[1], Shinya Ishii[2], Kenji Takeshita[2], Noriaki Miyanaga[3], Junji Kawanaka[3]; [1]Inst. for Laser Technology, Japan, [2]Mitsubishi Heavy Industries, Japan, [3]Inst. of Laser Engineering, Osaka Univ., Japan.* We report on the efficient operation of directly liquid-nitrogen-cooled Yb:YAG active-mirror laser. A CW output power of 273 W with slope efficiency of 72% was demonstrated. High heat removal ability was ensured at 743 W/cm^2.

Rooms 324-326

JOINT

2:30 p.m.–4:15 p.m.
JThF • Nanophotonics and Metamaterials Symposium V: Measurement and Fabrication Techniques
Henri Lezec; NIST, USA, Presider

JThF1 • 2:30 p.m. Invited
Sub-Wavelength Imaging Using Infrared Metamaterials, *Gennady Shvets[1], S. Trendafilov[1], H. Moussavi[1], A. Pena[2], A. A. Chabanov[2], J. B. Pendry[3], A. K. Sarychev[4]; [1]Univ. of Texas at Austin, USA, [2]Univ. of Texas at San Antonio, USA, [3]Blackett Lab, Imperial College, UK, [4]Inst. of Theoretical and Applied Electrodynamics, Russian Federation.* Tapered arrays of metallic wires can manipulate fields on the sub-wavelength scale. Two types of nanoscale imaging applications using terahertz and mid-infrared waves are enabled: image magnification and radiation focusing.

JThF2 • 3:00 p.m.
Measuring Angular Dependent Effective Properties of Metamaterials, *Christian Helgert[1,2], Christoph Menzel[3], Carsten Rockstuhl[3], Ekaterina Pshenay-Severin[1,2], Johannes Üpping[4], Ernst-Bernhard Kley[1], Falk Lederer[3], Thomas Pertsch[1,2]; [1]Inst. of Applied Physics, Friedrich-Schiller-Univ., Jena, Germany, [2]ZIK Ultra-Optics, Friedrich-Schiller-Univ., Jena, Germany, [3]Inst. of Condensed Matter Theory and Solid State Optics, Friedrich Schiller Univ., Jena, Germany, [4]Inst. of Physics, µMD group, Martin-Luther-Univ. Halle-Wittenberg, Germany.* We measure the angular dependent response of a Swiss-cross metamaterial that has an effective index of n = -1.9 at normal incidence. It is experimentally shown how the effective properties depend on the incidence angle.

Room 314

CLEO

2:30 p.m.–4:15 p.m.
CThS • QPM Devices I
Andrew Schober; Lockheed Martin Coherent Technologies, USA, Presider

CThS1 • 2:30 p.m.
Sawtooth Grating-Assisted-Phase-Matching, *Pavel Sidorenko[1], Alon Bahabad[2], Tenio Popmintchev[2], Margaret Murnane[2], Henry Kapteyn[2], Oren Cohen[1]; [1]Technion–Israel Inst. of Technology, Israel, [2]JILA and Dept. of Physics, Univ. of Colorado at Boulder, USA.* A quasi-phase-matching method where the QPM modulation has a sawtooth profile and the phase-mismatch is almost fully corrected is suggested. Schemes for implementing sawtooth grating-assisted-phase-matching in low-order as well as high-order harmonic generation are proposed.

CThS2 • 2:45 p.m.
Efficient Second Harmonic Generation in the Optical Telecom S-Band Using Non-Segmented PPKTP Waveguides, *Amir H. Nejadmalayeri[1], Franco N. C. Wong[1], Tony D. Roberts[2], Franz X. Kärtner[1]; [1]MIT, USA, [2]ADvR Inc., USA.* Continuous channel waveguides in periodically poled $KTiOPO_4$ with guided orthogonal polarizations are used to demonstrate type-II background-free second harmonic generation at 1505 nm with 1.2 %/(W cm^2) normalized efficiency.

CThS3 • 3:00 p.m.
Gain-Enhanced and Spectral-Narrowed Optical Parametric Oscillator Using PPLN Electro-Optic Polarization-Mode Converters, *Chao-Hung Lin[1], Wei-Kuan Chang[1], Yen-Hung Chen[1,2,3], Sidney Yang[4], Reinhard Geiss[2], Thomas Pertsch[2], Andreas Tünnermann[3]; [1]Dept. of Optics and Photonics, Natl. Central Univ., Taiwan, [2]Friedrich-Schiller-Univ. Jena, Germany, [3]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany, [4]Inst. of Photonics Technologies, Dept. of Electrical Engineering, Natl. Tsinghua Univ., Taiwan.* We report a gain-enhanced and spectral-narrowed optical parametric oscillator based on a monolithic PPLN integrating an optical parametric generator with two electro-optically active polarization-mode converters. Unique spectral manipulation of the OPO signal is also demonstrated.

NOTES

Room 315 | Room 316 | Room 317

IQEC

CLEO

2:30 p.m.–4:15 p.m.
IThH • Interaction of Few Atoms/ Molecules with Light
Peter Maunz; Joint Quantum Inst. and Dept. of Physics, Univ. of Maryland, USA, Presider

IThH1 • 2:30 p.m. Invited
Coherent State Preparation and Observation of Rabi Oscillations in a Single Molecule, *Ilja Gerhardt[1,2], Gert Wrigge[1], Jaesuk Hwang[1], Gert Zumofen[1], Alois Renn[1], Vahid Sandoghdar[1]; [1]ETH Zurich, Switzerland, [2]Ctr. for Quantum Technologies, Natl. Univ. of Singapore, Singapore.* We report the observation of up to 5 Rabi cycles in a single molecule. A π-pulse excitation is achieved with 500 photons, marking an important step towards preparation of coherent superposition states with few photons.

IThH2 • 3:00 p.m.
Perfect Reflection of Light by a Dipolar Emitter, *Mario Agio, Nassiredin M. Mojarad, Gert Zumofen, Vahid Sandoghdar; ETH Zurich, Switzerland.* We investigate the coupling of tightly focused light to single molecules and metal nanoparticles. We find that a single emitter strongly attenuates such a light field and can even perfectly reflect a directional dipole wave.

2:30 p.m.–4:15 p.m.
CThT • Quantum Cascade Lasers III
Claire Gmachl; Princeton Univ., USA, Presider

CThT1 • 2:30 p.m.
Broadband Distributed Feedback Quantum Cascade Laser Array Using a Heterogeneous Cascade, *Laurent Diehl[1], Benjamin G. Lee[1], Haifei A. Zhang[1], Christian Pflügl[1], Mikhail Belkin[2], Milan Fisher[3], Andreas Wittman[3], Jerome Faist[3], Federico Capasso[1]; [1]Harvard Univ., USA, [2]Univ. of Texas at Austin, USA, [3]ETH Zurich, Switzerland.* We demonstrated an array of distributed feedback quantum cascade lasers covering a spectral range of 220cm-1. The variability in threshold current and slope efficiency is explained in terms of the position of the laser end-facets.

CThT2 • 2:45 p.m.
Amplitude Modulation of Quantum Cascade Laser with Vertically Coupled Cavities, *Jean Teissier[1], Sabine Laurent[1], Carlo Sirtori[1], Helene Sillard[2], Francois Lelarge[2], Raffaele Colombelli[3]; [1]Univ. Paris, France, [2]Alcatel-Thales III-V Lab, France, [3]Inst. d'Électronique Fondamentale, France.* We developed a three terminal mid-infrared quantum cascade laser. The third terminal allows one to electrically modulate the optical losses - and thus the laser output independently of the laser's driving current.

CThT3 • 3:00 p.m.
Theory of Transverse Mode Coherence in Quantum Cascade Lasers, *Aleksander K. Wojcik[1], Nanfang Yu[2], Laurent Diehl[2], Ertugrul Cubukcu[2], David Bour[3], Scott Corzine[3], Jintian Zhu[3], Gloria Höfler[3], Kenneth B. Crozier[2], Federico Capasso[2], Alexey Belyanin[1]; [1]Texas A&M Univ., USA, [2]Harvard Univ., USA, [3]Agilent Labs, USA.* We model the phase coherence of multi-transverse modes of buried-heterostructure quantum cascade lasers. The experimentally observed transverse mode locking and beam steering are explained by four-wave mixing of longitudinal modes belonging to different transverse modes.

2:30 p.m.–4:15 p.m.
CThU • Silicon Photonic Waveguides
Richard Osgood; Columbia Univ., USA, Presider

CThU1 • 2:30 p.m.
Very-Large-Scale Photonic Crystal Coupled Cavity Waveguides with Large Delay Per Pulse Width Ratio, *Eiichi Kuramochi, Takasumi Tanabe, Masaya Notomi; NTT Basic Res. Labs, Japan.* A pulse delay more than ten times the pulse width was experimentally achieved in low-loss coupled cavity waveguides formed by 300 photonic crystal nanocavities.

CThU2 • 2:45 p.m.
Slot Waveguides for Achieving 147-nm-Wide and -31.3ps/(m·nm) Dispersion and Near-Zero Flattened Dispersion, *Lin Zhang[1], Yang Yue[1], Raymond G. Beausoleil[2], Alan E. Willner[1]; [1]Univ. of Southern California, USA, [2]HP Labs, USA.* We propose on-chip slot-waveguide-based dispersion-flattening devices, which can exhibit either a highly negative dispersion of -31300 ps/nm/km over 147-nm bandwidth, or a near-zero dispersion of 0±350 ps/nm/km over 306 nm bandwidth.

CThU3 • 3:00 p.m.
Tuning Giant Birefringence in Multi-Slot Silicon Optical Waveguides, *Shun-Hui Yang, Michael L. Cooper, Prabhakar R. Bandaru, Shayan Mookherjea; Univ. of California at San Diego, USA.* We theoretically and experimentally study the variation of giant birefringence in multi-slotted silicon nanophotonic waveguides, etched longitudinally along the waveguide, for different filling fractions. We compare with an analytically derived effective-medium theory, and FDFD simulations.

NOTES

Room 336 — CLEO

2:30 p.m.–4:15 p.m.
CThV • Nonlinear Optical Materials
Kebin Shi; Penn State Univ., USA, Presider

CThV1 • 2:30 p.m. Invited
Femtosecond Nonlinear Frequency Conversion Using BiB_3O_6 Crystals from 250 nm in the UV to 3000 nm in the near-IR, *Valentin Petrov; Max-Born-Inst., Germany.* Relevant properties of BIBO are reviewed and experimental results are presented on both parametric up- and down-conversion of femtosecond pulses, from the high-energy, low-repetition-rate (1-kHz) to the low-energy, high-repetition-rate (56-76-MHz) regime, demonstrating its unique versatility.

CThV2 • 3:00 p.m.
Effect of Water Impurity in $CsLiB_6O_{10}$ Crystals on UV Optical Properties, *Takahiro Kawamura, Masashi Yoshimura, Yoshiyuki Honda, Masato Nishioka, Yohei Shimizu, Yasuo Kitaoka, Yusuke Mori, Takatomo Sasaki; Graduate School of Engineering, Osaka Univ., Japan.* We investigated the effect of water impurity in a $CsLiB_6O_{10}$ crystal on the ultraviolet properties. The bulk LIDT of the sample improved by about 1.6-fold by a heat treatment at 150 °C.

Room 337 — IQEC

2:30 p.m.–4:15 p.m.
IThI • Dynamic Phenomena
Rolf Binder; Univ. of Arizona, USA, Presider

IThI1 • 2:30 p.m.
Ultrahigh Time Resolution Nonlinear Spectroscopy of Polymer/Fullerene Blends, *Sarah M. Falke[1], Daniele Brida[2], Giulio Cerullo[2], Christoph Lienau[1]; [1]Inst. für Physik, Carl von Ossietzky Univ. Oldenburg, Germany, [2]Natl. Lab for Ultrafast and Ultraintense Optical Science, CNR-INFM, Dept. di Fisica, Politecnico di Milano, Italy.* We report ultrafast nonlinear spectra of polymer/fullerene blends measured with unprecedented 10-fs-time resolution. Our results suggest that an extremely fast exciton transport from the optically excited polymer to the fullerene acceptor precedes charge separation.

IThI2 • 2:45 p.m.
Conductivity Dynamics in the Correlated Metallic State of V_2O_3, *Mengkun Liu[1], Brian Pardo[1], Mumtaz M. Qazilbash[2], Sun J. Yun[3], Byung G. Chae[3], B. J. Kim[3], Dimtri N. Basov[2], Richard D. Averitt[1]; [1]Boston Univ., USA, [2]Univ. of California at San Diego, USA, [3]ETRI, Republic of Korea.* We report on time resolved studies of V_2O_3 which is a correlated electron material that undergoes a metal-insulator transition at ~150K. We observe coherent oscillations in the terahertz conductivity following excitation with 35-fs optical pulses.

IThI3 • 3:00 p.m.
Time-Evolution of Carriers after Multiphoton Ionization of Bulk Dielectrics, *David Grojo[1], Marina Gertsvolf[1,2], Shuting Lei[3], David M. Rayner[1], Paul B. Corkum[1,2]; [1]Natl. Res. Council Canada, Canada, [2]Univ. of Ottawa, Canada, [3]Kansas State Univ., USA.* Using the unique characteristics of multiphoton ionization with focused femtosecond pulses, we report on a pump and probe metrology to analyze carrier dynamics inside dielectrics. We characterize the sub-picosecond trapping of carriers inside fused SiO_2.

Room 338 — CLEO

2:30 p.m.–4:15 p.m.
CThW • Pulse Measurement I
Zhiwen Liu; Penn State Electro-Optics Ctr., USA, Presider

CThW1 • 2:30 p.m. Invited
Progress Towards the Solid-State All-Optical Streak Camera, *John E. Heebner[1], Chris H. Sarantos[1,2]; [1]Lawrence Livermore Natl. Lab, USA, [2]Univ. of California at Santa Barbara, USA.* We report progress towards the development of an ultrafast optical beam deflector enabling the single-shot recording of optical signals with near ps resolution at high dynamic range.

CThW2 • 3:00 p.m.
Simple High-Sensitivity, Electro-Optic Sagnac Spectral Shearing Interferometry for Short Optical Pulse Characterization, *Christophe Dorrer, Jake Bromage; Lab for Laser Energetics, Univ. of Rochester, USA.* A stable Sagnac spectral shearing interferometer generating a 0.7-nm shear and interferograms resolvable with a low-resolution spectrometer is demonstrated for real-time optical pulse characterization at microwatt average power.

Room 339 — JOINT

2:30 p.m.–4:15 p.m.
JThG • High Harmonic Generation I
Henry C. Kapteyn; Univ. of Colorado at Boulder, USA, Presider

JThG1 • 2:30 p.m.
Phase Matching of High Harmonic Generation in the Water Window and Beyond at High Pressures Using Mid-IR Lasers, *Tenio Popmintchev[1], Ming-Chang Chen[1], Alon Bahabad[1], Michael Gerrity[1], Paul Arpin[1], Pavel Sidorenko[2], Oren Cohen[2], Matthew Seaberg[1], Richard Sandberg[1], Sterling Backus[3], Xiaoshi Zhang[3], Greg Taft[3], Ivan P. Christov[4], Margaret M. Murnane[1], Henry C. Kapteyn[1]; [1]JILA, Univ. of Colorado at Boulder, USA, [2]Technion - Israel Inst. of Technology, Israel, [3]Kapteyn-Murnane Labs Inc., USA, [4]Sofia Univ., Bulgaria.* We demonstrate that using longer-wavelength driving light in high-order harmonic generation requires moderately ionized larger-density atoms to perfectly phase match the process, scaling conventional phase matching at low ionization to extremely high photon energies.

JThG2 • 2:45 p.m.
Efficient Generation of a Coherent Water Window X-Ray by Phase-Matched High-Order Harmonic, *Eiji J. Takahashi, Tsuneto Kanai, Kenichi Ishikawa, Katsumi Midorikawa; RIKEN Advanced Science Inst., Japan.* We demonstrate the generation of a coherent water window x-ray by phase-matched high-order harmonic under a neutral-medium condition. The maximum harmonic photon energy attained are 300 eV and 450 eV in Ne and He, respectively.

JThG3 • 3:00 p.m.
High Energy Photon Generation by High-Order Harmonic Generation with Mid-Infrared Laser Field, *Han Xu, Hui Xiong, Yuxi Fu, Jinping Yao, Ya Cheng, Zhizhan Xu; State Key Lab of High Field Laser Physics, Chinese Academy of Sciences, China.* In the generation of high-order harmonics in gas cell with mid-infrared femtosecond pulses, a cutoff energy at ~190 eV could be achieved., and high contrast fine interference fringes in the harmonic spectra could be observed.

Room 340

IQEC

2:30 p.m.–4:15 p.m.
IThJ • Generation and Characterization of Single and Entangled Photons
Alan Migdall; NIST, USA, Presider

IThJ1 • 2:30 p.m.
Single-Photon Statistics Generated by Narrow-Band Cavity-Enhanced Parametric Down-Conversion, *Matthias Scholz, Lars Koch, Oliver Benson; Humboldt-Univ. Berlin, Germany.* We proof antibunching in the output of a narrow-band single-photon source based on cavity-enhanced parametric down-conversion. Our realization achieves an unmatched brightness of 14000 counts/(s X mW X MHz) and a 3 MHz linewidth.

IThJ2 • 2:45 p.m.
Direct Production of Three Entangled Fields at Different Wavelengths, *Antônio S. Coelho[1], Felippe A. S. Barbosa[1], Katiúscia N. Cassemiro[2], Alessandro S. Villar[3], Marcelo Martinelli[1], Paulo Nussenzveig[1]; [1]Inst. de Física, Univ. de São Paulo, Brazil, [2]Max-Planck Junior Res. Group, Germany, [3]Max Planck Inst. for the Science of Light, Univ. of Erlangen-Nuremberg, Germany.* An Optical Parametric Oscillator entangles three modes of the field - pump, signal and idler - when operating above threshold. Complete measurement of the covariance matrix enables the test of several inseparability criteria.

IThJ3 • 3:00 p.m.
Bragg Reflection Waveguides: A Novel Platform for Enhanced Control of Photon-Pair Generation via Spontaneous Parametric Down Conversion, *Payam Abolghasem[1], Xiaojuan Shi[2], Martin Hendrych[2], Juan P. Torres[2], Amr S. Helmy[1]; [1]Edward S. Rogers Sr., Dept. of Electrical and Computer Engineering, Univ. of Toronto, Canada, [2]ICFO, Spain.* Spontaneous-parametric down-conversion bandwidth control between 7 nm to 676 nm is reported in an integrated source of frequency anti-correlated photon-pairs using type-I and type-II phase-matched $Al_xGa_{1-x}As$ Bragg reflection waveguide.

Room 341

CLEO

2:30 p.m.–4:15 p.m.
CThX • THz Metamaterial Modulators
Ajay Nahata; Univ. of Utah, USA, Presider

CThX1 • 2:30 p.m.
A Broadband Terahertz Metamaterial Electrical Modulator, *Hou-Tong Chen[1], Willie J. Padilla[2], Michael J. Cich[3], Abul K. Azad[1], Richard D. Averitt[4], Antoinette J. Taylor[1]; [1]Los Alamos Natl. Lab, USA, [2]Boston College, USA, [3]Sandia Natl. Labs, USA, [4]Boston Univ., USA.* We demonstrate hybrid metamaterial devices that are able to electrically switch their resonances therefore the terahertz transmission properties at room temperature. The interrelated amplitude switching and phase shifting allow for fast broadband external terahertz modulation.

CThX2 • 2:45 p.m.
A Spatial Light Modulator for Terahertz Radiation, *Wai Lam Chan[1], Hou-Tong Chen[2], Antoinette J. Taylor[2], Igal Brener[3], Michael Cich[3], Daniel M. Mittleman[1]; [1]Rice Univ., USA, [2]Ctr. for Integrated Nanotechnologies, Los Alamos Natl. Lab, USA, [3]Ctr. for Integrated Nanotechnologies, Sandia Natl. Labs, USA.* We characterize the operation of a 4x4 electrically-driven terahertz metamaterial spatial modulator, and demonstrate high modulation uniformly at each pixel with minimal cross-talk. This modulator will enable high-speed terahertz imaging in a single-pixel imaging system.

CThX3 • 3:00 p.m.
External Modulation of Terahertz Quantum Cascade Lasers Using Electrically-Driven Active Metamaterials, *X. G. Peralta[1], I. Brener[1], W. J. Padilla[2], E. W. Young[1], A. J. Hoffman[3], M. J. Cich[1], R. D. Averitt[4], M. C. Wanke[1], J. B. Wright[1], H-T Chen[5], J. F. O'Hara[5], A. J. Taylor[5], J. Waldman[6], W. D. Goodhue[6], J. Li[6]; [1] Ctr. for Integrated Nanotechnologies and Sandia Natl. Labs, USA, [2]Boston College, USA, [3]Princeton Univ., USA, [4]Boston Univ., USA, [5]MPA- Ctr. for Integrated Nanotechnologies, Los Alamos Natl. Lab, USA, [6]Univ. of Massachusetts at Lowell, USA.* We have designed, fabricated and measured a first generation external modulator for a ~2.4 terahertz Quantum Cascade Laser based on an electrically-driven active terahertz metamaterial structure.

Rooms 328-329

PhAST

2:15 p.m.–4:15 p.m.
PThB • Optical Imaging
Terrence Meyer; Iowa State Univ., USA, Presider

PThB1 • 2:15 p.m. Invited
Sensing for Autonomous Vehicle Navigation, *Wende Zhang; General Motors, USA.* This paper introduces GM's research efforts on sensing technologies for autonomous vehicle navigation with an example of a novel LIDAR-based lane-marker detection on GM-CMU's entry Boss, the autonomous vehicle that won the DARPA Urban Challenge.

PThB2 • 2:45 p.m. Invited
Optical Sensors for Space Proximity Operations, *Patrick Earhart, Rex Craig; Ball Aerospace, USA.* This talk will discuss the application of flash LADAR sensors, which provide a direct measurement of range under any lighting conditions, to rendezvous, proximity operations, docking, landing/hazard avoidance and surface navigation.

Rooms 318-320	Rooms 321-323	Rooms 324-326	Room 314
IQEC	CLEO	JOINT	CLEO

IThG • Plasmonic Metamaterials—Continued

IThG3 • 3:15 p.m.
Optical Hyperspace for Plasmons: Dyakonov States in Metamaterials, *Zubin Jacob, Evgenii E. Narimanov; Purdue Univ., USA.* We show that the subwavelength imaging behaviour observed in the magnifying superlens experiment [Smolyaninov et.al., Science, 2006] is due to Dyakonov plasmons. This previously unobserved state gives rise to sub-diffraction plasmon beams on resonance.

IThG4 • 3:30 p.m.
Transformation Optics of Plasmonic Metamaterials, *Igor I. Smolyaninov; BAE Systems, USA.* Plasmonic metamaterials provide a convenient experimental platform for demonstration of principles of transformation optics. Results of imaging experiments using plasmonic metamaterials have been confronted with numerical simulations.

IThG5 • 3:45 p.m.
Photoluminescence Enhancement by Metal Nanoparticles, *Greg Sun[1], Jacob B. Khurgin[2]; [1]Univ. of Massachusetts at Boston, USA, [2]Johns Hopkins Univ., USA.* We study photoluminescence enhancement with metal nanoparticles by considering optical absorption and emission enhancement. For Ag/GaN, we show that strong enhancement is only for molecules that are originally inefficient in absorbing and emitting optical energy.

IThG6 • 4:00 p.m.
Surface Plasmon Polaritons on Metal-Dielectric Nanocomposite Films, *Zhimin Shi[1], Giovanni Piredda[1], Andreas C. Liapis[1], Mark A. Nelson[2], Lukas Novotny[1], Robert W. Boyd[1]; [1]Inst. of Optics, Univ. of Rochester, USA, [2]Los Alamos Natl. Lab, USA.* We demonstrate both theoretically and experimentally that the surface plasmon polaritons supported by a metal-dielectric nanocomposite film have properties that fall into one of three distinct categories depending on the metal fill fraction.

CThR • High-Power Solid-State Lasers CLEO Symposium III: Novel High-Power SS Lasers—Continued

CThR3 • 3:15 p.m.
High Power, Multi-Segmented Nd:YAG Laser, Longitudinally Pumped at 885 nm, *Sven Hahn, Maik Frede, Jörg Neumann, Dietmar Kracht; Laserzentrum Hannover, Germany.* Power scaling by combining 885 nm upper laser level Nd:YAG pumping and multi-segmented laser rods is presented. An output power of 750 W (optical-to-optical efficiency of 58%) was demonstrated using polarization coupled diode stack pumping.

CThR4 • 3:30 p.m.
All Glass Leakage Channel Fibers with Fluorine-Doped Silica Pump Cladding, *Libin Fu, Andrius Marcinkevičius, Hugh A. McKay, Michiharu Ohta, Martin E. Fermann, Liang Dong; IMRA America Inc., USA.* Direct amplification of ultra short pulses at 1037nm from fiber-oscillators to average powers of ~100 W at 48 MHz is demonstrated using single-stage amplifiers comprising new all-glass-leakage-channel-fibers, providing >70% slope efficiency and >33 dB gain.

CThR5 • 3:45 p.m.
High Power, Tunable Thulium Fiber Laser System for Atmospheric Propagation Experiments, *Timothy S. McComb, Lawrence Shah, Robert A. Sims, Vikas Sudesh, John Szilagyi, Martin Richardson; Townes Laser Inst., CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA.* A system for multi-kilometer atmospheric propagation experiments including a master oscillator with ~108 nm tunability and a power amplifier tested as an oscillator with ~58% slope efficiency and stable 200 W output power is discussed.

CThR6 • 4:00 p.m.
Rod-Type Photonic Crystal Fiber Laser Emitting 94 W at 977 nm, *Johan Boullet[1], Yoann Zaouter[1,2], François Salin[3], Eric Cormier[1]; [1]CELIA, France, [2]Amplitude Systèmes, France, [3]EOLITE Systems, France.* We have demonstrated a photonic crystal fiber laser emitting up to 94 W of average power at 977 nm with a diffraction limited beam quality.

JThF • Nanophotonics and Metamaterials Symposium V: Measurement and Fabrication Techniques—Continued

JThF3 • 3:15 p.m.
Multi-Spectral Surface-Plasmon Resonant Infrared Detectors, *Jessie Rosenberg[1], Rajeev V. Shenoi[2], Thomas E. Vandervelde[3], Sanjay Krishna[2], Oskar Painter[1]; [1]Caltech, USA, [2]Ctr. for High Technology Materials, Univ. of New Mexico, USA, [3]Tufts Univ., USA.* We demonstrate a multi-spectral polarization sensitive mid-infrared photodetector utilizing surface-patterned plasmonic resonators. This design provides a responsivity enhancement of up to 5x while adding only one lithography step to current focal plane array processing.

JThF4 • 3:30 p.m.
InGaAs Quantum Well Nanoneedles on Silicon with Long Wavelength Emission for Silicon Transparency, *Michael Moewe, Linus C. Chuang, Shanna Crankshaw, Billy Ng, Connie Chang-Hasnain; Univ. of California at Berkeley, USA.* We report novel single-crystalline wurtzite InGaAs/GaAs core-shell quantum well nanoneedles with emission below the silicon bandgap grown on GaAs or Si. This wavelength enables integration of III-V material with silicon waveguides and CMOS devices.

JThF5 • 3:45 p.m.
Spatial Wavelength-Tunable Emission between 350 nm and 715 nm from Nanowires on a Single Substrate, *An Lian Pan, Rui Bin Liu, Cun-Zheng Ning; Arizona State Univ., USA.* We demonstrate extremely wide wavelength-tunable emissions from a single substrate of nanowires from 350 nm to 715 nm. This unprecedented tuning range is achieved by a novel method of controlling spatial alloy composition grading.

JThF6 • 4:00 p.m.
Organic Electro-Optic Single-Crystalline Waveguide Modulators, Microresonators and Nanowires Fabricated by Melt Capillary Growth, *Harry Figi, Mojca Jazbinšek, Christoph Hunziker, Manuel Koechlin, Peter Günter; Nonlinear Optics Lab, Inst. of Quantum Electronics, ETH Zurich, Switzerland.* We developed a new approach to fabricate high-quality single-crystalline high-index-contrast waveguiding micro- and nanostructures and demonstrated electro-optic modulation at 1.55 μm in waveguides grown from the melt of a recently developed organic material.

CThS • QPM Devices I—Continued

CThS4 • 3:15 p.m.
Internally Frequency-Doubled PPLN Femtosecond Optical Parametric Oscillator Tunable in the Visible, *Adolfo Esteban-Martin[1], Omid Kokabee[1], Majid Ebrahim-Zadeh[1,2]; [1]ICFO-Inst. de Ciencies Fotoniques, Mediterranean Technology Park, Spain, [2]Inst. Catalana de Recerca i Estudis Avancats (ICREA), Spain.* Statically tunable femtosecond pulses in the red are generated by internal doubling of a PPLN-based OPO in BiB_3O_6. Cavity-delay tuning across 665-785 nm at average power of 260 mW in 140-fs pulses is demonstrated.

CThS5 • 3:30 p.m.
Noncollinear Red-Green-Blue Light Generation Based on a Hexagonally Poled Superlattice in Lithium Tantalite, *Ping Xu, Shi-ning Zhu; Physics Dept., Nanjing Univ., China.* Noncollinear red-green-blue light generation from a single hexagonally poled superlattice in lithium tantalite was achieved. It resulted from the frequency self-doubling optical parametric amplification process in a single-pass quasi-phase-matching scheme.

CThS6 • 3:45 p.m.
Efficient Ultrafast Ultraviolet Generation Based on Frequency-Doubling in Short-Period Periodically-Poled $KTiOPO_4$, *Baigang Zhang[1], Yujie J. Ding[1], Ioulia B. Zotova[2]; [1]Lehigh Univ., USA, [2]ArkLight, USA.* We efficiently generated ultrafast coherent ultraviolet radiation based on second-harmonic generation in periodically-poled $KTiOPO_4$ with the shortest period of 2.55 μm. The highest output power was measured to be 20.1 mW at 377.1 nm.

CThS7 • 4:00 p.m.
Compact 4.3-μm Difference Frequency Generation Light Source for Spectroscopy of CO_2 Isotopomer, *Osamu Tadanaga, Yoshiki Nishida, Tsutomu Yanagawa, Katsuaki Magari, Takeshi Umeki, Masaki Asobe; NTT Photonics Labs, NTT Corp., Japan.* We report a 4.3-μm wavelength conversion laser source using a quasi-phase-matched $LiNbO_3$ waveguide. Using the laser source operated at ambient temperature and in the continuous wave mode, we successfully obtain CO_2 isotopomer absorption lines.

4:15 p.m.-4:45 p.m. Coffee Break, *Pratt Street Lobby, 300 Level*

Room 315 | Room 316 | Room 317

IQEC | CLEO

IThH • Interaction of Few Atoms/ Molecules with Light—Continued

IThH3 • 3:15 p.m.
Phase Shift of a Weak Coherent Beam by a Single Atom, *Syed Abdullah Aljunid, Meng Khoon Tey, Brenda Chng, Gleb Maslennikov, Christian Kurtsiefer; Ctr. for Quantum Technologies, Natl. Univ. of Singapore, Singapore.* We measured the phase shift imposed by a single ^{87}Rb atom to a light field. We observed a value of 1° for a focused Gaussian beam interacting near-resonantly with an atomic two-level system.

IThH4 • 3:30 p.m.
Optical Cavity Cooling of a Large Ensemble of Molecules, *Yongkai Zhao[1], Weiping Lu[1], Peter F. Barker[2], Guangjiong Dong[3]; [1]Heriot-Watt Univ., UK, [2]Univ. College London, UK, [3]East China Normal Univ., China.* We study optical cooling of a large ensemble of particles. We derive a new scaling law with respect to particle number and show a high density molecular cloud are cooled from 10mK to 700μK.

IThH5 • 3:45 p.m.
Amplification of a Laser Beam by a Single Molecule, *Martin R. Pototschnig, Jaesuk Hwang, Gert Zumofen, Robert Lettow, Alois Renn, Stephan Götzinger, Vahid Sandoghdar; Lab of Physical Chemistry, ETH Zurich, Switzerland.* We report on the amplification of light by a single excited molecule in free space.

IThH6 • 4:00 p.m.
Spectral Hole-Burning for Solid-State Quantum Memory, *Elizabeth A. Goldschmidt[1,2], Sarah E. Beavan[1,3], Matthew D. Eisaman[1,2], Jingyun Fan[1,2], Michael Hohensee[4], Zachary H. Levine[1], Ludwig Mathey[1,2], Sergey V. Polyakov[1,2], Alan L. Migdall[1,2]; [1]NIST, USA, [2]Joint Quantum Inst., Univ. of Maryland, USA, [3]Laser Physics Ctr., RSPhysSE, Australian Natl. Univ., Australia, [4]Physics Dept., Harvard Univ., USA.* We report progress in using spectral hole-burning in praseodymium doped Y_2SiO_5 to prepare an ensemble of Pr^{3+} ions with a spectral distribution optimized for use in a Duan-Lukin-Cirac-Zoller-type (DLCZ) quantum-repeater scheme.

CThT • Quantum Cascade Lasers III—Continued

CThT4 • 3:15 p.m.
Beam Shaping in Quantum Cascade Ring Lasers, *Elvis Mujagic[1], Leonard K. Hoffmann[1], Stephan Schartner[1], Michele Nobile[2], Hermann Detz[2], Werner Schrenk[2], Mykhaylo Semtsiv[3], William T. Masselink[3], Gottfried Strasser[1,4]; [1]Inst. for Solid State Electronics, Vienna Univ. of Technology, Austria, [2]Ctr. for Micro- and Nanoelectronics, Vienna Univ. of Technology, Austria, [3]Dept. of Physics, Humboldt Univ. Berlin, Germany, [4]Dept. of Electrical Engineering and Physics, State Univ. of New York, USA.* Mid-infrared beam shaping is demonstrated by using grating coupled surface emitting quantum cascade ring lasers. The devices allow for far-field tuning, ranging from highly symmetric spot- to ring-shaped beam patterns, depending on the grating period.

CThT5 • 3:30 p.m.
Directional Micro-Cavity Lasers with Limaçon-Shaped Chaotic Resonator, *Qi Jie Wang[1], Changling Yan[1], Laurent Diehl[1], Nanfang Yu[1], Christian Pflügl[1], Mikhail A. Belkin[2], Federico Capasso[1], Martina Hentschel[3], Jan Wiersig[4], Tadataka Edamura[5], Masamichi Yamanishi[5], Hirofumi Kan[5]; [1]Harvard Univ., USA, [2]Univ. of Texas at Austin, USA, [3]Max-Planck-Inst. für Physik komplexer Systeme, Germany, [4]Inst. für Theoretische Physik, Univ. Magdeburg, Germany, [5]Central Res. Labs, Hamamatsu Photonics K. K.,, Japan.* We demonstrate Limaçon-shaped microcavity λ=10 μm lasers with directional emission. Their performance is robust with respect to variations of the deformation factor near its optimum value ε=0.40. Excellent agreement between experiments and theory is achieved.

CThT6 • 3:45 p.m.
High Temperature, Magnetic Field Assisted (sub)THz Quantum Cascade Laser, *Aaron Wade[1], Georgy Fedorov[1], Dmitry Smirnov[1], Benjamin S. Williams[2], Sushil Kumar[3], Qing Hu[3], John L. Reno[4]; [1]Natl. High Magnetic Field Lab, USA, [2]Electrical Engineering Dept. and CNSI, Univ. of California at Los Angeles, USA, [3]Dept. of Electrical Engineering and Computer Science, MIT, USA, [4]Sandia Natl. Labs, USA.* We demonstrate magnetic field assisted, (sub)THz quantum cascade laser operating above 200K. This is achieved through the application of strong magnetic fields which provide an additional lateral confinement in order to suppress non-radiative intersubband scattering.

CThT7 • 4:00 p.m.
Low Threshold Step Well Quantum Cascade Laser Emitting at 3 THz, *Giacomo Scalari, Maria I. Amanti, Milan Fischer, Romain Terazzi, Christoph Walther, Mattias Beck, Jerome Faist; ETH Zürich, Inst. of Quantum Electronics, Switzerland.* A resonant-phonon THz quantum-cascade laser based on $Al_{0.03}Ga_{0.97}As$ step well is demonstrated. Maximum pulsed operating temperature is 123 K, with threshold current densities as low as 110A/cm^2 at 10 K and 175A/cm^2 at 100 K.

CThU • Silicon Photonic Waveguides—Continued

CThU4 • 3:15 p.m.
Cladding-Modulated Bragg Gratings in Silicon Waveguides, *Dawn T. H. Tan, Kazuhiro Ikeda, Yeshaiahu Fainman; Univ. of California at San Diego, USA.* A cladding-modulated Bragg grating implemented using periodic placements of silicon cylinders in the cladding along a silicon waveguide is proposed. Modeling results are verified experimentally, demonstrating coupling strengths differing by an order of magnitude.

CThU5 • 3:30 p.m.
Spatial Mode Selector in Silicon Waveguide, *Ilya Goykhman, Boris Desiatov, Uriel Levy; Hebrew Univ. of Jerusalem, Israel.* We demonstrate the design, fabrication and experimental characterization of the spatial mode selector that transmit only the second silicon waveguide mode. Nanofabrication results and near field measurements are presented.

CThU6 • 3:45 p.m.
Low Loss Etchless Silicon Photonic Waveguides, *Jaime Cardenas, Carl B. Poitras, Jacob T. Robinson, Kyle Preston, Long Chen, Michal Lipson; Cornell Univ., USA.* We demonstrate low-loss silicon waveguides fabricated without silicon etching by selective oxidation. We show propagation losses of 0.3dB/cm at 1.55μm, roughness of 0.3nm RMS, and 0.0002dB loss for a 90° bend with 20μm bending radius.

CThU7 • 4:00 p.m.
Characterization of Free-Carrier Nonlinearities in Porous Silicon Waveguides, *Paveen Apiratikul[1], Andrea M. Rossi[2], Thomas E. Murphy[1]; [1]Univ. of Maryland, USA, [2]Inst. Nazionale di Ricerca Metrologica, Italy.* We report the measurement of free-carrier nonlinearities in nanoporous silicon waveguides at 1550 nm. Although the waveguide is approximately 70% porous, it exhibits stronger and faster free-carrier effects than those of crystalline silicon waveguides.

4:15 p.m.-4:45 p.m. Coffee Break, *Pratt Street Lobby, 300 Level*

Room 336 — CLEO

CThV • Nonlinear Optical Materials—Continued

CThV3 • 3:15 p.m.
Polarization-Ratio Reflectance for Determining of Optical Constants Using Laser High-Order Harmonics, *Nicole Brimhall, Nathan Heilmann, Justin Peatross; Brigham Young Univ., USA.* We describe a method for deriving optical constants in the extreme ultraviolet from the measured ratio of p- to s-polarized reflectance curves (as a function of angle).

CThV4 • 3:30 p.m.
Dispersionless Saturable Absorber Mirrors for Ultrashort Pulse Generation, *Matthew P. Lumb[1], Paul N. Stavrinou[1], Edmund M. Clarke[1], Raymond Murray[1], Christopher G. Leburn[2], Christine Jappy[2], Niklaus K. Metzger[2], Christian T. A. Brown[2], Wilson Sibbett[2]; [1]Imperial College London, UK, [2]Univ. of St. Andrews, UK.* Theoretical and experimental results are presented for the potential to eliminate group delay dispersion of resonant SESAMs over broad spectral bandwidths through the design of a single dielectric cap layer of carefully selected refractive index.

CThV5 • 3:45 p.m.
Photo-Induced Absorption of Substituted Poly(Phenylene Vinylene)-Fullerene Composites for Optical Limiting, *San-Hui Chi, Joel M. Hales, Matteo Cozzuol, Joseph W. Perry; Georgia Tech, USA.* MEH-PPV:fullerene composites show strong nonlinear absorption in the near infrared and potential as optical limiters. The photophysics and nonlinear optics of the composites are consistent with the formation of absorbing charge carriers.

CThV6 • 4:00 p.m.
Spontaneous Raman Scattering in Suspended InGaAsP Waveguides, *Scott A. Holmstrom[1], Todd H. Stievater[2], Marcel W. Pruessner[2], William S. Rabinovich[2], Subramaniam Kanakaraju[3], Lynn C. Calhoun[3], Jacob B. Khurgin[4], Daniel P. Kelly[5], Reza Ghodssi[6]; [1]Univ. of Tulsa, USA, [2]NRL, USA, [3]Lab for Physical Sciences, Univ. of Maryland, USA, [4]Johns Hopkins Univ., USA, [5]NASA-Goddard Space Flight Ctr., USA, [6]Univ. of Maryland, USA.* We demonstrate the spontaneous Raman effect in suspended InGaAsP waveguides and report that the zinc blende Raman selection rules are relaxed in the waveguide geometry.

Room 337 — IQEC

IThI • Dynamic Phenomena—Continued

IThI4 • 3:15 p.m.
Ultrafast Dynamics of Dense Quantized Magneto-Plasmas in High Magnetic Fields, *Jinho Lee[1], Dave H. Reitze[1], Junichiro Kono[2], Alexey Belyanin[3], Glenn Solomon[4], Stephen A. McGill[5]; [1]Univ. of Florida, USA, [2]Dept. of Electrical and Computer Engineering, Rice Univ., USA, [3]Dept. of Physics, Texas A&M Univ., USA, [4]NIST, USA, [5]Natl. High Magnetic Field Lab (NHMFL), USA.* Relaxation and emission dynamics of a dense quantized magneto-plasma excited by intense femtosecond laser pulses in $In_{0.2}Ga_{0.8}As/GaAs$ multiple quantum wells are probed by time-resolved transient absorption and time resolved photoluminescence experiments in high magnetic fields.

IThI5 • 3:30 p.m. Invited
Ultrafast Coherent Photoelectron Emission Effects and Their Application for Time-Domain Studies of Current Transport, *Ulrich Höfer[1], Jens Güdde[1], Marcus Rohleder[1], Torsten Meier[2], Stephan W. Koch[1]; [1]Fachbereich Physik und Zentrum für Materialwissenschaften, Philipps-Univ., Germany, [2]Dept. Physik, Univ. Paderborn, Germany.* By combining coherent control schemes and photoelectron spectroscopy it is possible to generate ultrafast current pulses at surfaces and in solids and to detect their decay directly in momentum space with femtosecond time resolution.

IThI6 • 4:00 p.m.
Ultrafast Carrier Dynamics in Exfoliated Graphene and Graphite, *Ryan W. Newson, Jesse Dean, Henry M. van Driel; Univ. of Toronto, Canada.* We measure 150 fs time-resolved 800 nm pump/ 1300 nm probe differential reflectivity and transmissivity of graphitic samples, ranging from one (graphene) to >100 layers (graphite). Carrier cooling kinetics vary gradually with number of layers.

Room 338 — CLEO

CThW • Pulse Measurement I—Continued

CThW3 • 3:15 p.m.
Single Shot Characterization of Amplitude and Phase of Pulse-to-Pulse Switched Optical Arbitrary Waveforms from a 10 GHz Frequency Comb, *V. R. Supradeepa, Daniel E. Leaird, Andrew M. Weiner; Purdue Univ., USA.* We use dual-quadrature spectral interferometry to demonstrate single shot amplitude and phase retrieval of shaped waveforms generated from a 10 GHz optical frequency comb and switched at the repetition rate of the frequency comb.

CThW4 • 3:30 p.m.
Self-Referenced Spectral Interferometry, *Thomas Oksenhendler[1], Sebastien Coudreau[1], Nicolas Forget[1], Stéphanie Grabielle[1,2], Daniel Kaplan[1], Olivier Gobert[2]; [1]Fastlite, France, [2]Direction des Sciences de la Matiére (DSM)/ Inst. Rayonnement Saclay (IRAMIS)/Service des Photons, Atomes et Molécules (SPAM), CEA Saclay, France.* A new femtosecond pulses characterization method is presented and experimentally demonstrated. Linear spectral interferometry becomes a self-referenced measurement by the self-creation of a reference pulse using pulse shaping optimization and nonlinear temporal filtering.

CThW5 • 3:45 p.m.
Increasing the Consistency and Accuracy of Spectral Shearing Interferometry via Multiple Shearing, *Adam S. Wyatt[1], Dane R. Austin[1], Tobias Witting[1], Ian A. Walmsley[1], Alexander Grün[2], Philip Bates[2], Olivier Chalus[2], Jens Biegert[2,3]; [1]Univ. of Oxford, UK, [2]ICFO, Spain, [3]ICREA, Spain.* We demonstrate improved accuracy and consistency for spectral-shearing interferometry using multiple shears. Using a new algorithm, different spectral shears are combined to perform accurate spectral phase measurements of complicated pulses from a hollow-core fiber system.

CThW6 • 4:00 p.m.
Directly Measuring the Spatiotemporal Electric Field of Ultrashort Bessel-X Pulses, *Pamela Bowlan[1], Rick Trebino[1], Heli Valtna-Lukner[2], Madius Lõhmus[2], Peeter Piksarv[2], Peeter Saari[2]; [1] School of Physics, Georgia Tech, USA, [2]Inst. of Physics, Univ. of Tartu, Estonia.* Using SEA TADPOLE with micron-range spatial and fs-range temporal resolution, we report the first direct spatiotemporal measurements of ultrashort Bessel-X pulses. We demonstrate their propagation invariance and superluminal velocity and verify our results with simulations.

Room 339 — JOINT

JThG • High Harmonic Generation I—Continued

JThG4 • 3:15 p.m.
High-Harmonic Generation in the Water Window Using a CEP-Locked Few-Cycle OPCPA System, *Nobuhisa Ishii[1,2], Shunsuke Adachi[1,2], Yutaka Nomura[1,2], Atsushi Kosuge[1,2], Jiro Itatani[1], Yohei Kobayashi[1], Teruto Kanai[1,2], Shuntaro Watanabe[1,2]; [1]Inst. for Solid State Physics, Univ. of Tokyo, Japan, [2]CREST, Japan Science and Technology Agency, Japan.* We generated high harmonics using a multi-millijoule few-cycle carrier-envelope-phase-locked optical parametric chirped-pulse amplification (OPCPA) system. We observed the high harmonics in the water window and the carrier-envelope phase (CEP) effect on the harmonic spectra.

JThG5 • 3:30 p.m.
High Harmonic Generation from Multiply Ionized Argon Extending Beyond 500 eV, *Paul Arpin, Tenio Popmintchev, Nick Wagner, Amy Lytle, Oren Cohen, Henry C. Kapteyn, Margaret M. Murnane; JILA, Univ. of Colorado at Boulder, USA.* By combining pulse self-compression and high harmonic generation within a single waveguide, we demonstrate harmonic emission from a multiply ionized gas, extending the cutoff photon energy in Ar to > 500 eV.

JThG6 • 3:45 p.m.
Conversion Efficiency, Scaling and Global Optimization of High Harmonic Generation, *Edilson L. Falcão-Filho, Vasileios M. Gkortsas, Ariel Gordon, Franz X. Kärtner; MIT, USA.* Closed form expressions for the high harmonic generation (HHG) conversion efficiency in the plateau and cut-off region are derived showing agreement with previous observations. Application of these results to optimal HHG-based-XUV-sources is discussed.

JThG7 • 4:00 p.m.
Hydrodynamic Explosions of Xenon Clusters Driven by Intense XUV Light from High Harmonic Generation, *Brendan Murphy, Kay Hoffmann, Alexei Belolipetski, John Keto, Todd Ditmire; Univ. of Texas at Austin, USA.* Explosions of xenon clusters exposed to intense XUV pulses are analyzed by time-of-flight spectroscopy. Ion charge states and kinetic energy spectra indicate hydrodynamic, not Coulombic, plasma expansion, in contrast to intense infrared/cluster interactions.

4:15 p.m.-4:45 p.m. Coffee Break, *Pratt Street Lobby, 300 Level*

Room 340

IQEC

IThJ • Generation and Characterization of Single and Entangled Photons—Continued

IThJ4 • 3:15 p.m.
A Versatile, Single-Waveguide, Photon-Pair Source for Chip-Scale Quantum Communication, *Jun Chen, Aaron J. Pearlman, Alexander Ling, Jingyun Fan, Alan Migdall; NIST, USA.* We demonstrate a bright, bandwidth-engineerable, compact, quasi-phase-matched single-waveguide source generating photon pairs near 900 nm and 1300 nm. Coincidence spectra are measured for a periodically-poled $KTiOPO_4$ waveguide for both type-0 and type-I spontaneous parametric down-conversion.

IThJ5 • 3:30 p.m.
Efficient Generation of Entangled Photon Pairs from a Single Quantum Dot Embedded in a Photonic Crystal Cavity, *Pradyumna K. Pathak, Stephen Hughes; Queen's Univ., Canada.* We present a formal theory of single quantum-dot coupling to a planar photonic crystal that supports quasi-degenerate cavity modes, and use this theory to describe, and optimize, entangled-photon-pair generation via the biexciton-exciton cascade.

IThJ6 • 3:45 p.m.
Two-Photon Joint Temporal Density Measurements via Ultrafast Single-Photon Upconversion, *Onur Kuzucu[1], Franco N. C. Wong[1], Sunao Kurimura[2], Sergey Tovstonog[2]; [1]MIT, USA, [2]Natl. Inst. for Materials Science, Japan.* We have developed the technique of two-photon joint temporal density measurements for temporal state characterization, thus facilitating two-photon generation with high temporal entanglement or nearly factorizable outputs by controlling the ultrafast pump bandwidth.

IThJ7 • 4:00 p.m.
Erasing Frequency Distinguishability Using Single-Photon Up-Conversion, *Hiroki Takesue[1,2]; [1]NTT Basic Res. Labs, NTT Corp., Japan, [2]CREST-JST, Japan.* The frequencies of two frequency non-degenerate single photons were converted to the same frequency by using the sum frequency generation process in periodically poled lithium niobate waveguides, while maintaining their temporal indistinguishability.

Room 341

CLEO

CThX • THz Metamaterial Modulators—Continued

CThX4 • 3:15 p.m.
Electrically Tunable Metamaterial for Polarization-Independent Terahertz Modulation, *Oliver Paul[1], Christian Imhof[1], Bert Lägel[1], Sandra Wolff[1], Jan Heinrich[2], Sven Höfling[2], Alfred Forchel[2], Remigius Zengerle[1], René Beigang[1,3], Marco Rahm[1,3]; [1]Univ. of Kaiserslautern, Germany, [2]Univ. of Würzburg, Germany, [3]Fraunhofer Inst. for Physical Measurement Techniques IPM, Germany.* We present a polarization-insensitive, electrically tunable metamaterial operating at terahertz (THz) frequencies and demonstrate the fast modulation of a propagating THz wave. The structure is composed of gold crosses on n-doped gallium arsenide (GaAs).

CThX5 • 3:30 p.m.
Dielectric Tunable Metamaterials with Negative Permeability in Terahertz Range, *Filip Kadlec[1], Hynek Němec[1], Petr Kužel[1], Riad Yahiaoui[2], Patrick Mounaix[2]; [1]Inst. of Physics, Acad. of Sciences of the Czech Republic, Czech Republic, [2]Univ. de Bordeaux1, France.* We present metamaterials for the terahertz range consisting of micromachined thin strontium titanate platelets. They display electromagnetic resonances with negative permeability around a frequency which is tunable as the intrinsic material permittivity depends upon temperature.

CThX6 • 3:45 p.m.
Active Control of Terahertz Optical Activity by Photo-Excitation of Metal Chiral Gratings, *Natsuki Kanda, Kuniaki Konishi, Makoto Kuwata-Gonokami; Univ. of Tokyo, Japan.* We report pronounced light-induced change of the optical activity at terahertz frequency in metal chiral gratings on semiconductor substrates. This result opens new horizons in the active terahertz polarization control.

CThX7 • 4:00 p.m.
Terahertz Semiconductor Metamaterials for Magnetostatic and Thermal Tunability, *Jiaguang Han[1], Akhlesh Lakhtakia[2], Zhen Tian[3,4], Jianqiang Gu[3,4], Xinchao Lu[4], Weili Zhang[4]; [1]Dept. of Physics, Natl. Univ. of Singapore, Singapore, [2]Dept. of Engineering Science and Mechanics, Pennsylvania State Univ., USA, [3]Tianjin Univ., China, [4]Oklahoma State Univ., USA.* We studied a metasurface constituted of a periodic array of semiconductor split-ring resonators. The resonance frequencies were found to be continuously tunable in the terahertz regime through an external magnetostatic field or temperature control.

Rooms 328-329

PhAST

PThB • Optical Imaging—Continued

PThB3 • 3:15 p.m. Invited
Synthetic Aperture Imaging at Optical Wavelengths, *Joseph Buck, B. W. Krause, A. I. R. Malm, C. M. Ryan; Lockheed Martin Coherent Technologies, USA.* Optical implementations of synthetic aperture imaging techniques provide a method of overcoming the platform constrained diffraction limit for optical imaging systems. We discuss progress in applying these methods to outdoor imaging demonstrations.

PThB4 • 3:45 p.m. Invited
Fourier Domain Modelocking (FDML): Rapidly Wavelength Swept Lasers for High Speed Optical Coherence Tomography (OCT), *Robert Huber; Ludwig-Maximilians-Univ. München, Germany.* Fourier Domain Mode Locking (FDML) is a new stationary operating regime of lasers, generating narrowband, rapidly wavelength swept output waveforms. The FDML mechanism and applications for biomedical imaging, coherent sensing and spectroscopy are discussed.

4:15 p.m.-4:45 p.m. Coffee Break, *Pratt Street Lobby, 300 Level*

Rooms 318-320

IQEC

4:45 p.m.–6:30 p.m.
IThK • Quantum Imaging and Spatial Entanglement
Jeffrey H. Shapiro; MIT, USA, Presider

IThK1 • 4:45 p.m.
Quantum Ghost Image Discrimination with a Single Photon Pair, *Mehul Malik, Heedeuk Shin, Petros Zerom, Robert W. Boyd; Inst. of Optics, Univ. of Rochester, USA.* A quantum ghost imaging scheme is modified to discriminate between two spatially non-overlapping objects using a single pair of entangled photons. The "ghost" image information is extracted by means of holographic filtering and coincidence detection.

IThK2 • 5:00 p.m.
Multimode OPOs as Sources for Multipartite Entanglement, *Benoît Chalopin[1], Giuseppe Patera[1], Germán de Valcárcel[2], Nicolas Treps[1], Claude Fabre[1]; [1]Lab Kastler Brossel, Univ. Pierre et Marie Curie, France, [2]Dept. d'Òptica, Univ. de Valencia, Spain.* We present here multimode OPOs as a source of multimode squeezing and multipartite entanglement of continuous-wave light beams, with applications to the engineering of multimode states of light in the spatial and spectral domains.

IThK3 • 5:15 p.m.
Tunable Delay of Entangled Images, *Alberto M. Marino[1], Raphael C. Pooser[1], Vincent Boyer[1,2], Paul D. Lett[1]; [1]NIST, USA, [2]MUARC, School of Physics and Astronomy, Univ. of Birmingham, UK.* We show that non-degenerate four-wave mixing in an atomic vapor can be used as a quantum delay line for multi-spatial-mode twin beams. This makes it possible to delay continuous variable entangled images without significant degradation.

IThK4 • 5:30 p.m.
Partial Cloning of a Continuous Variable Quantum State, *Raphael Pooser[1], Alberto Marino[1], Vincent Boyer[1,2], Kevin Jones[3,1], Paul Lett[1]; [1]NIST, USA, [2]Univ. of Birmingham, UK, [3]Williams College, USA.* We present a universal optical amplifier performing near the quantum limit using a four-wave mixing nonlinear interaction. We show that one mode from a bipartite entangled state can be amplified and cloned while maintaining entanglement.

Rooms 321-323

CLEO

4:45 p.m.–6:30 p.m.
CThY • Novel Lasers and Beam Combining
Junji Kawanaka; Univ. of Osaka, Japan, Presider

CThY1 • 4:45 p.m.
Passive Phase Locking of 169 Lasers, *Eitan Ronen, E. Grinvald, Asher Albert Friesem, Nir Davidson; Weizmann Inst., Israel.* We phase lock an array of 169 Nd:YAG lasers using Fourier filtering in a common degenerated resonator. We observe a wide variety of stable phase structures that are in exact agreement with calculated ones.

CThY2 • 5:00 p.m.
Phase Locking and Beam Combining of Lasers with Intra-Cavity Polarization Elements, *Eitan Ronen, Asher Albert Friesem, Nir Davidson; Weizmann Inst., Israel.* New configurations for phase locking and beam combining very large laser arrays with intra-cavity polarization elements are presented. We demonstrated efficient phase lock of 24 ND:YAG lasers and beam combining of 5 lasers.

CThY3 • 5:15 p.m.
Effect of Surface Waves on Gain-Guided Transverse-Grating Waveguides with Large Mode Area, *Xianyu Ao, Tsing-Hua Her; Dept of Physics and Optical Science, Univ. of North Carolina at Charlotte, USA.* We investigate gain-guided transverse-grating waveguides as large-modal-area optical lasers/amplifiers. Surface modes could sustain higher modal gain than the fundamental core mode, which hinders single mode propagation. A scheme to remove surface modes is proposed.

CThY4 • 5:30 p.m.
Double Sided Diode Edge-Pumped Yb:YAG Planar Waveguide Laser with 230W Output Power, *Ian J. Thomson, Howard J. Baker, Natalia Trela, J. Fernando Monjardin, Jesus D. R. Valera, Denis R. Hall; Heriot-Watt Univ., UK.* Double sided pumping of an Yb:YAG planar waveguide laser is is shown to improve pump absorption and uniformity to give 230 W output using cylindrical mirror waveguide resonator.

Rooms 324-326

IQEC

4:45 p.m.–6:30 p.m.
IThL • Plasmonic Metamaterials
Nikolay Zheludev; Univ. of Southampton, UK, Presider

IThL1 • 4:45 p.m. Invited
Two-Photon Fabrication of Three-Dimensional Metamaterials, *Satoshi Kawata[1,2], Takuo Tanaka[1], Nobuyuki Takeyasu[1]; [1]RIKEN Advanced Science Inst., Japan, [2]Osaka Univ., Japan.* Two-photon-induced reduction technique is developed for fabricating 3-D metallic micro/nano structures. We demonstrate the fabrication of a continuous and electrically conductive silver wire with 100nm resolution. This technique will be applicable for 3-D plasmonic metamaterials.

IThL2 • 5:15 p.m.
Subwavelength Imaging with Non-Magnetic Anisotropic Bilayers, *Huikan Liu, Shivanand Shivanand, Kevin J. Webb; Purdue Univ., USA.* We show the features of a non-magnetic sub-wavelength imaging system achieved with an anisotropic bilayer. The two anisotropic layers can be implemented with metal-insulator stacks, and the resonance condition is not required for either layer.

IThL3 • 5:30 p.m.
Spectrometers Based on Anisotropic Metamaterials, *Huikan Liu, Shivanand Shivanand, Kevin J. Webb; Purdue Univ., USA.* We show a new spectrometer class achieved through resonant cones associated with dispersive anisotropic metamaterials. The anisotropic slab can be implemented by metal-insulator stacks, and a Ag/GaAs multilayer stack example is described.

Room 314

CLEO

4:45 p.m.–6:30 p.m.
CThZ • QPM Devices II
Takunori Taira; Laser Res. Ctr. for Molecular Science, Inst. for Molecular Science, Japan, Presider

CThZ1 • 4:45 p.m.
Broadly and Continuously Tunable, High-Energy Optical Parametric System by Angular Tuning of Tilted QPM Structures, *Hideki Ishizuki[1], Jiro Saikawa[2], Takunori Taira[1]; [1]Laser Res. Ctr., Inst. for Molecular Science, Japan, [2]Chemical Spectroscopy Div., Chemical Resources Lab, Tokyo Inst. of Technology, Japan.* Practically tunable, high-energy optical-parametric systems by combination of angular rotation and tilted QPM structure in periodically poled Mg-doped $LiNbO_3$ are demonstrated. The tunable range can be expanded by tilted QPM instead of conventional right-angled QPM.

CThZ2 • 5:00 p.m.
Synthesis and Shaping of Picosecond Pulses by Frequency Conversion of Femtosecond Pulses in Engineered Quadratic Media, *Marco Marangoni[1], Daniele Brida[1], Cristian Manzoni[1], Roberta Ramponi[1], Giulio Cerullo[1], Matteo Conforti[2], Fabio Baronio[2], Costantino De Angelis[2]; [1]Politecnico di Milano, Italy, [2]Univ. di Brescia, Italy.* Second-harmonic-generation in lithium-tantalate crystals with engineered quasi-phase-matching structures is exploited to synthesize with high efficiency narrow-bandwidth picosecond pulses of predetermined spectral and temporal shape starting from femtosecond ones.

CThZ3 • 5:15 p.m.
Stable, High-Power, Continuous-Wave, Single-Frequency Source at 532 nm Using MgO:sPPLT Crystal, *Suddapalli Chaitanya Kumar[1], Goutam Kumar Samanta[1], Majid Ebrahim-Zadeh[1,2]; [1]ICFO-Inst. de Ciencies Fotoniques, ICREA, Spain, [2]ICREA, Spain.* We describe a compact, high-power, cw green source based on single-pass SHG of a Yb-fiber laser in MgO:sPPLT, providing 7.58W, single-frequency output at 532nm in TEM_{oo} profile(M^2<1.29) with peak-to-peak power stability of 9% over 13h.

CThZ4 • 5:30 p.m.
Efficient Second Harmonic Blue Generation from Self-Doubling of Quasi-Phase-Matched PPLT Parametric Oscillator, *I-Ning Hu[1], Ying-Yao Lai[1], Chun-Yin Li[1], Lung-Han Peng[1], Andy Kung[2]; [1]Graduate Inst. of Photonics and Optoelectronics, Natl. Taiwan Univ., Taiwan, [2]Inst. of Atomic and Molecular Sciences Academic Sinica, Taiwan.* High slope-efficiency ~25% for green-to-blue wavelength conversion, rendering 60mW/440nm blue laser by 400mW/532nm pump of 20ns/4KHz, was demonstrated on 7.9μm-period PPLT due to simultaneous phase matching of the 1st-order QPM-OPO with the 2nd-order QPM-SHG process.

Room 315 | Room 316 | Room 317

IQEC | CLEO

4:45 p.m.–6:30 p.m.
IThM • Coherent Interactions of Matter in Light
Perry Rice; Miami Univ., USA, Presider

IThM1 • 4:45 p.m.
Ultra-Bright Narrow-Band Down-Conversion Source for Atom-Photon Interaction, *Florian Wolfgramm[1], Xingxing Xing[2], Alessandro Cerè[1], Ana Predojević[1], Aephraim M. Steinberg[2], Morgan W. Mitchell[1]; [1]ICFO, Spain, [2]Ctr. for Quantum Information and Quantum Control and Inst. for Optical Sciences, Univ. of Toronto, Canada.* We describe an ultra-bright source of narrow-band pairs of indistinguishable photons based on cavity-enhanced down-conversion. This source is suitable for experiments on light-matter interactions at the single-photon level.

IThM2 • 5:00 p.m.
Trapping Light in a Crystal, *Romain Lauro, Thierry Chanelière, Jean L. Le Gouët; Lab Aimé Cotton, CNRS, France.* We propose a protocol for quantum light storage in solids, taking advantage of the specific properties of rare earth ions doped crystals. As other protocols, light is slowed down, then stopped. Preliminary results are reported.

IThM3 • 5:15 p.m.
Light Storage Using an Atomic Frequency Comb, *Jérôme Ruggiero, Romain Lauro, Jean-Louis Le Gouët, Thierry Chanelière; Lab Aimé Cotton, CNRS, France.* We experimentally investigate the quantum storage capability of a thulium doped crystal by using the Atomic Frequency Comb (AFC) protocol. Preliminary results gives a 9% efficiency. Potential improvements are discussed based on a simple model.

IThM4 • 5:30 p.m.
Analysis of Two-Photon Absorption in Tapered Fibers, *Hao You, Scott M. Hendrickson, James D. Franson; Univ. of Maryland, Baltimore County, USA.* We show that the rate of two-photon absorption in atomic vapors can be enhanced in tapered optical fibers with diameters less than the wavelength of the incident light.

4:45 p.m.–6:30 p.m.
CThAA • Quantum and Interband Cascade Lasers
Benjamin Williams; Univ. of California at Los Angeles, USA, Presider

CThAA1 • 4:45 p.m.
Indirect Pump Scheme for Quantum-Cascade Lasers: Electron Transport and Very High T_0-Values, *Masamichi Yamanishi, Kazuue Fujita, Tadataka Edamura, Hirofumi Kan; Central Res. Labs, Hamamatsu Photonics K.K., Japan.* The indirect pump scheme is proposed to clarify its feasibility. The high device-performance of mid-infrared quantum-cascade lasers based on the proposed scheme is demonstrated: in particular, very high T_0-values of 240~400 K around room temperature.

CThAA2 • 5:00 p.m.
Widely Voltage Tunable Quantum Cascade Lasers, *Yu Yao[1], Kale J. Franz[1], Xiaojun Wang[2], Jen-Yu Fan[2], Claire F. Gmachl[1]; [1]Princeton Univ., USA, [2]Adtech Optics, Inc., USA.* A new Quantum Cascade laser design with a "two-step" coupling between the injector and the active region provides a voltage tuning range of 200cm^{-1} for electroluminescence and 80cm^{-1} for laser spectra at room temperature.

CThAA3 • 5:15 p.m.
Role of Interface Roughness in the Transport and Lasing Characteristics of Quantum-Cascade Lasers, *Jacob B. Khurgin[1], Yamac Dikmelik[1], Peter Q. Liu[2], Anthony J. Hoffman[2], Matthew D. Escarra[2], Kale J. Franz[2], Claire F. Gmachl[2]; [1]Johns Hopkins Univ., USA, [2]Princeton Univ., USA.* A density-matrix based theory of transport and lasing in quantum-cascade lasers reveals that large disparity between lasing linewidth and tunneling broadening changes the design guidelines to favor strong coupling between injector and upper laser level.

CThAA4 • 5:30 p.m.
Short Wavelength Distributed Feedback Quantum Cascade Laser, *Thomas J. Slight[1], Giuseppe Tandoi[1], Charles N. Ironside[1], Andrew McKee[2], Conrad Langton[2], Iain Eddie[2], Dmitry G. Revin[3], Matthew J. Steer[3], Shiyong Y. Zhang[3], John W. Cockburn[3], Vittorio M. N. Passaro[4], Francesco De Leonardis[4]; [1]Dept. of Electronics and Electrical Engineering, Univ. of Glasgow, UK, [2]Compound Semiconductor Technologies Global Ltd., UK, [3]Dept. of Physics and Astronomy, Univ. of Sheffield, UK, [4]Dept. di Elettrotecnica ed Elettronica, Politecnico di Bari, Italy.* We report on a lateral grating, distributed feedback quantum cascade (QC) laser operating at 3.45 μm with the intended application of trace gas detection. It is the shortest wavelength, single mode QC laser.

4:45 p.m.–6:30 p.m.
CThBB • Nonlinear Nanophotonics and Data Conversion
Siegfried Janz; Natl. Res. Council Canada, Canada, Presider

CThBB1 • 4:45 p.m.
160-Gb/s Broadband Wavelength Conversion on Chip Using Dispersion-Engineered Silicon Waveguides, *Benjamin G. Lee[1], Aleksandr Biberman[1], Noam Ophir[1], Amy C. Turner-Foster[2], Mark A. Foster[2], Michal Lipson[2], Alexander L. Gaeta[2], Keren Bergman[1]; [1]Columbia Univ., USA, [2]Cornell Univ., USA.* We demonstrate 160-Gb/s wavelength conversion across 21 nm in the C-band using four-wave mixing in dispersion-engineered silicon photonic waveguides. Measurements show a conversion efficiency of -15.5 dB and a pulse broadening factor of 38%.

CThBB2 • 5:00 p.m.
Nonlinear Transfer Function in Slow Light Silicon Photonic Crystal Waveguides at 10 Gbit/s, *Dominik Pudo[1], Bill Corcoran[1], Christelle Monat[1], Mark Pelusi[1], David J. Moss[1], Benjamin J. Eggleton[1], Thomas P. White[2], Liam O'Faolain[2], Thomas F. Krauss[2]; [1]IPOS, CUDOS, Univ. of Sydney, Australia, [2]School of Physics and Astronomy, Univ. of St. Andrews, UK.* We investigate the nonlinear power transfer function generated through slow-light enhanced nonlinear absorption in silicon photonic crystal waveguides. Pulse regeneration and error reduction in a 10 Gbit/s data signal are observed for 10MHz amplitude distortion.

CThBB3 • 5:15 p.m.
Ultrafast Re-Routing of Slow Light in a Nanophotonic Directional Coupler, *Tobias Kampfrath[1], Daryl M. Beggs[2], Thomas P. White[2], Thomas F. Krauss[2], Laurens (Kobus) Kuipers[1]; [1]FOM Inst. for Atomic Molecular Physics, Netherlands, [2]Univ. of St. Andrews, UK.* We demonstrate that we can switch the transmission of a directional coupler from one output port to another within a time as short as 3ps with laser pulse energies of less than 10pJ.

CThBB4 • 5:30 p.m.
Electro-Optically Tunable Delay on a Silicon Micro-Chip, *Sasikanth Manipatruni, Carl B. Poitras, Michal Lipson; Cornell Univ., USA.* We demonstrate, for the first time, an electro-optically tunable delay element on a silicon micro-chip. We show tunable delays between 5.51 ps to -28 ps, corresponding to group indices between 37.2 and -190.

Room 336 — CLEO

4:45 p.m.–6:30 p.m.
CThCC • Semiconductor Waveguides and Nanostructures
Mahesh Krishnamurthi; Pennsylvania State Univ., USA, Presider

CThCC1 • 4:45 p.m.
Ultrashort Free-Carrier Lifetime for Low Nonlinear Loss in Silicon Waveguides, *Amy C. Turner-Foster, Mark A. Foster, Jacob S. Levy, Carl B. Poitras, Reza Salem, Alexander L. Gaeta, Michal Lipson; Cornell Univ., USA.* We demonstrate significant reduction of one of the main nonlinear loss mechanisms in silicon waveguides - free carrier absorption. We show reduction of the free-carrier lifetime from 3 ns down to less than 12.2 ps.

CThCC2 • 5:00 p.m.
2.0 dB/cm Gain in an Al_2O_3:Er^{3+} Waveguide on Silicon, *Jonathan D. B. Bradley, Laura Agazzi, Dimitri Geskus, Feridun Ay, Kerstin Wörhoff, Markus Pollnau; MESA+ Inst. for Nanotechnology, Univ. of Twente, Netherlands.* Er concentration, energy-transfer upconversion and gain were investigated in Er-doped aluminum oxide channel waveguides. Net gain of up to 2.0 dB/cm was measured, demonstrating this material to provide a competitive active integrated optics technology.

CThCC3 • 5:15 p.m.
High-Index-Contrast Buried-Waveguide for Intersubband Ultrafast All-Optical Switches Fabricated by Wafer Bonding Technology, *Kazumichi Akita, Ryoichi Akimoto, Guangwei Cong, Toshifumi Hasama, Hiroshi Ishikawa; AIST, Japan.* We fabricated high-index-contrast II-VI-based multiple-quantum-well channel-waveguides buried in a SiO_2 cladding-layer, for the application to intersubband transition all-optical-switches at communication wavelengths. We demonstrated the sub-picosecond switching of the waveguides using intersubband absorption saturation recovery.

CThCC4 • 5:30 p.m.
Fabrication of ZnO Photonic Crystals by Electrodeposition, *Yongchun Zhong[1], Kam Sing Wong[1], A. B. Djurišić[2], Y. F. Hsu[2]; [1]Dept. of Physics, Hong Kong Univ. of Science and Technology, Hong Kong, [2]Dept. of Physics, The Univ. of Hong Kong, Hong Kong.* We demonstrate the fabrication of ZnO photonic crystals by electrodeposition using single beam holographic lithographically made polymer template. A blue-shift of the reflection peaks and a clear photonic band gap effect was observed.

Room 337 — IQEC

4:45 p.m.–6:30 p.m.
IThN • Photonic Structures
Cun-Zheng Ning; Arizona State Univ., USA, Presider

IThN1 • 4:45 p.m.
Optical Properties of 1-D Active Fibonacci Quasicrystals, *Joshua R. Hendrickson[1], Benjamin C. Richards[1], Julian Sweet[1], Galina Khitrova[1], Alexander Poddubny[2], Eugeniyus Ivchenko[2], Martin Wegener[3], Marco Werchner[4], Martin Schafer[4], Mackillo Kira[4], Stephan Koch[4], Hyatt Gibbs[1]; [1]College of Optical Sciences, Univ. of Arizona, USA, [2]A. F. Ioffe Physico-Technical Inst., Russian Federation, [3]Inst. fur Angewandte Physik, Univ. Karlsruhe, Germany, [4]Philipps-Univ., Germany.* Quasicrystals based on the excitonic resonances of GaAs/AlGaAs quantum wells were grown with spacings that satisfy a Fibonacci sequence. Linear and nonlinear reflectivity and photoluminescence measurements were performed, agreeing quite well with theory.

IThN2 • 5:00 p.m.
Controlling Energy and Charge Environment of Single Excitons in a Photonic-Crystal Diode, *Nicolas Chauvin[1], Laurent Balet[1,2], Marco Francardi[2], Annamaria Gerardino[3], Lianhe Li[2], Blandine Alloing[2], Andrea Fiore[1]; [1]Communications Technology Basic Res. and Applications (COBRA) Res. Inst., Eindhoven Univ. of Technology, Netherlands, [2]Ecole Polytechnique Fédérale de Lausanne, Inst. of Photonics and Quantum Electronics, Switzerland, [3]Inst. for Photonics and Nanotechnologies, CNR, Italy.* Single quantum dots embedded inside a photonic crystal diode are studied as a function of the reverse bias. The applied electric field strongly enhances the emission from excitonic lines as compared to the background emission.

IThN3 • 5:15 p.m.
Large Vacuum Rabi Splitting in ZnO-Based Microcavities, *Jun-Rong Chen[1], Tien-Chang Lu[1], Yung-Chi Wu[1], Shiang-Chi Lin[1], Wei-Rein Liu[1], Wen-Feng Hsieh[1], Chien-Cheng Kuo[2], Cheng-Chung Lee[2], Hao-Chung Kuo[1], Shing-Chung Wang[1]; [1]Dept. of Photonics, Inst. of Electro-Optical Engineering, Natl. Chiao-Tung Univ., Taiwan, [2]Thin Film Technology Ctr., Natl. Central Univ., Taiwan.* Strong exciton-photon coupling at RT has been observed in ZnO MCs. From the theoretical and experimental exciton-polariton dispersion curves with different cavity-exciton detuning values, the large vacuum Rabi splitting is estimated to be 58 meV.

IThN4 • 5:30 p.m.
Coherently Coupled Exciton Lasing, *Jonathan R. Tischler, Elizabeth R. Young, Daniel G. Nocera, Vladimir Bulović; MIT, USA.* Lowest reported threshold organic semiconductor VCSEL (4.9 μJ/cm^2) is achieved when excitons coherently couple, upon ultrafast non-resonant optical excitation. Temperature dependence of λ/2n device, absent in >= 1.0λ/n cavities, indicates excitons undergo condensate-like phase transition.

Room 338 — CLEO

4:45 p.m.–6:30 p.m.
CThDD • Pulse Measurement II
Daniel J. Kane; Mesa Photonics, USA, Presider

CThDD1 • 4:45 p.m.
Design of Optimal Dispersive Mirrors for Femtosecond Enhancement Cavities and Compressors by Minimizing Phase Distortion Power, *Jonathan R. Birge, Franz X. Kärtner; MIT, USA.* The minimization of phase distortion spectral power density is proposed as an alternative to GDD optimization of ultrafast cavity mirrors. This criterion is shown to produce optimal cavity throughput.

CThDD2 • 5:00 p.m.
Nanoprobe-Based Characterization of Femtosecond Laser Pulses, *Haifeng Li[1], Yaoshun Jia[2], Qian Xu[1], Yong Xu[2], Jian Wu[1], Peter C. Eklund[1], Zhiwen Liu[1]; [1]Pennsylvania State Univ., USA, [2]Virginia Tech., USA.* We propose and develop a nanoprobe-based technique for characterizing femtoseond laser pulses. A preliminary demonstration based on the measurement of the interferometric autocorrelation trace through two-photon fluorescence from a nonlinear nanoprobe is reported.

CThDD3 • 5:15 p.m.
Fiber Delivery of 25 fs Laser Pulses, *Tuan Le, Gabriel Tempea, Zhao Cheng, Martin Hofer, Andreas Stingl; Femtolasers Produktions GmbH, Austria.* Applications in many fields of sciences require the dispersion-managed guiding of short optical pulses. We demonstrate the delivery of 25 fs, 1.1 nJ pulses from a Ti:sapphire laser through 1.6 m optical fiber.

CThDD4 • 5:30 p.m.
Practical Issues of Retrieving Isolated Attosecond Pulse from CRAB, *Sabih D. Khan, He Wang, Ximao Feng, Michael Chini, Zenghu Chang; Dept. of Physics, Kansas State Univ., USA.* The effects of streaking speed, time delay jitter, laser intensity variation and shot noise on the reconstruction of attosecond XUV pulse with PCGPA are studied.

Room 339 — JOINT

4:45 p.m.–6:30 p.m.
JThH • High Harmonic Generation II
Isabell Thomann; JILA, Univ. of Colorado at Boulder, USA, Presider

JThH1 • 4:45 p.m.
First Demonstration of High Harmonic Generation (HHG) in a Hollow-Core Photonic Crystal Fiber, *Oliver H. Heckl[1], Cyrill R. E. Baer[1], Christian Kränkel[1], Sergio V. Marchese[1], Florian Schapper[1], Mirko Holler[1], Thomas Südmeyer[1], Ursula Keller[1], Joseph S. Robinson[2], John W. G. Tisch[2], Francois Couny[3], Phil Light[3], Fetah Benabid[3], Phillip St J. Russell[4]; [1]ETH Zurich, Switzerland, [2]Imperial College London, UK, [3]Univ. of Bath, UK, [4]Univ. of Erlangen-Nuremberg, Germany.* We report the first HHG in a hollow-core photonic crystal fiber. We generate the 7th-13th harmonic of ~800 nm in xenon. The extremely low threshold of 0.4 μJ would be achievable by multimegahertz solid-state lasers.

JThH2 • 5:00 p.m.
Spatially Coherent, Phase Matched, High-Order Harmonic Beams at 50 kHz, *Ming-Chang Chen[1], Michael R. Gerrity[1], Tenio Popmintchev[1], Sterling Backus[2], Xiaoshi Zhang[2], Margaret M. Murnane[1], Henry C. Kapteyn[1]; [1]JILA, Univ. of Colorado at Boulder and NIST, USA, [2]Kapteyn-Murnane Labs Inc, USA.* By tightly focusing a high repetition rate (50kHz), compact, femtosecond laser system with low pulse energy (25uJ), we demonstrate fully phase matched, fully spatially coherent, 50kHz high harmonic beams for the first time.

JThH3 • 5:15 p.m.
Application of Quasiperiodic and Random Quasi-Phase-Matching to High-Harmonic-Generation, *Alon Bahabad[1], Oren Cohen[1,2], Margaret Murnane[1], Henry Kapteyn[1]; [1]Univ. of Colorado and NIST, USA, [2]Technion-Israel Inst. of Technology, Israel.* The utility of quasiperiodic and random quasi-phase matching is demonstrated theoretically for shaping the spectral emission of high harmonic generation. Demonstrated are simultaneous enhancement of arbitrary spectral regions and enhancement of an extremely wide bandwidth.

JThH4 • 5:30 p.m.
Two-Color Driven High-Order Harmonic Source for X-Ray Laser Seeding, *Josef Seres[1,2], Daniel Hochhaus[3,4], Boris Ecker[3,4], Daniel Zimmer[3,4], Christian Spielmann[1,2], Thomas Kuehl[3,4]; [1]Friedrich Schiller Univ., Germany, [2]Univ. of Würzburg, Germany, [3]GSI, Germany, [4]Johannes Gutenberg Univ., Germany.* By two-color pumping and a small pressure induced shift we demonstrate, it is possible to substantially increase the number of x-ray laser schemes reachable for seeding with high-order harmonics created by a Nd:glass laser system.

CLEO

4:45 p.m.–6:30 p.m.
CThEE • Laser Ablation Mechanisms and Applications

Stephan Nolte; Friedrich-Schiller Univ. Jena, Germany, Presider

CThEE1 • 4:45 p.m.
The Influence of Thermal Confinement and Temperature-Dependent Absorption on Resonant Infrared Ablation of Frozen Aqueous and Alcohol Targets, *Daniel M. Bubb[1], Stephen L. Johnson[2], Richard F. Haglund[2]; [1]Rutgers Univ. - Camden, USA, [2]Vanderbilt Univ., USA.* The mechanism of resonant infrared laser ablation of frozen polymer-solvent solutions is investigated by plume shadowgraphy and ablation yield measurements. The temperature dependence of the absorption coefficient and thermal diffusion influences the yield.

CThEE2 • 5:00 p.m.
Mechanistic Studies of Resonant Infrared Laser Ablation of Polystyrene, *Stephen Johnson[1], Richard Haglund[1], Daniel Bubb[2]; [1]Vanderbilt Univ., USA, [2]Rutgers Univ., USA.* We investigate the mechanism of resonant infrared laser ablation of polystyrene using a tunable infrared free-electron laser. Using both experimental data and modeling, we show that it results from spinodal decomposition followed by recoil-induced ejection.

CThEE3 • 5:15 p.m.
Effect of Laser Transfer Mechanism on Damage to Organic Semiconducting Molecules During Laser Direct-Write Printing, *Nicholas T. Kattamis, Neal D. McDaniel, Stefan Bernhard, Craig B. Arnold; Princeton Univ., USA.* By employing different laser forward-transfer techniques, we probe the effects of transfer mechanism on the damage of sensitive organic molecules. Thick-film polymer absorbing layers provide the maximum optical and thermal protection for the molecules.

CThEE4 • 5:30 p.m.
Nanosecond and Femtosecond Polarization Resolved Laser-Induced Breakdown Spectroscopy (PRLIBS) of Aluminum, *Yaoming Liu, John S. Penczak, Robert J. Gordon; Univ. of Illinois at Chicago, USA.* We report single-shot femtosecond and nanosecond-polarization resolved laser-induce breakdown spectroscopy(PRLIBS) measurement results on aluminum. The resolution and detection limit of PRLIBS is highly improved, making this technique especially useful for weak atomic and ionic transitions.

4:45 p.m.–6:30 p.m.
CThFF • THz Metamaterials and Filters

Yujie J. Ding; Lehigh Univ., USA, Presider

CThFF1 • 4:45 p.m.
Flexible Terahertz Metamaterials on Polyimide Substrates, *Hu Tao[1], Andrew Strikwerda[1], Kebin Fan[1], Christopher Bingham[2], Willie J. Padilla[2], Xin Zhang[1], Richard D. Averitt[1]; [1]Boston Univ., USA, [2]Boston College, USA.* Flexible resonant terahertz metamaterials built on ultrathin highly flexible polyimide substrates have been designed, fabricated and measured. Our results provide a path forward for creating multi-layer non-planar metamaterials at terahertz frequencies.

CThFF2 • 5:00 p.m.
Flexible Wide Angle Terahertz Resonant Absorber Based on Perfectly Impedance Matched Metamaterials, *Hu Tao[1], Christopher M. Bingham[2], Andrew C. Strikwerda[1], Daniel Pilon[1], David Shrekenhamer[2], Nathan I. Landy[2], Kebin Fan[1], Willie J. Padilla[2], Xin Zhang[1], Richard D. Averitt[1]; [1]Boston Univ., USA, [2]Boston College, USA.* We present the design, fabrication and characterization of a flexible metamaterial absorber that experimentally obtains an absorptivity of 0.96 at 1.6 THz and operates over wide angular range for transverse electric and transverse magnetic radiation.

CThFF3 • 5:15 p.m.
Porous Silicon Based Terahertz Bragg Grating Filter, *Shu-Zee A. Lo, Thomas E. Murphy; Univ. of Maryland, USA.* We describe the fabrication and measurement of a terahertz bandpass filter based on porous silicon. The device is constructed by electrochemically etching silicon to produce a Bragg mirror comprised of alternating nanoporous silicon layers.

CThFF4 • 5:30 p.m.
Dual-Frequency Switching Liquid Crystal Based Tunable THz Filter, *Thorsten Göbel[1], Peter Meissner[1], Alexander Gaebler[2], Markus Koeberle[2], Stefan Mueller[2], Rolf Jakoby[2]; [1]Optical Communications Dept., Technical Univ. of Darmstadt, Germany, [2]Microwave Engineering Dept., Technical Univ. of Darmstadt, Germany.* The controllable permittivity of Liquid Crystals is utilized to realize a tunable THz filter. By employing dual-frequency switching Liquid Crystals, we achieve pure electrical steering of filter. This facilitates both, measurement setup and filter implementation.

4:45 p.m.–6:30 p.m.
CThGG • Novel 1 Micron Fiber Sources

Ingmar Hartl; IMRA America, Inc., USA, Presider

CThGG1 • 4:45 p.m.
Power Scaling of CCC Fiber Based Lasers, *Shenghong Huang[1], Cheng Zhu[1], Chi-Hung Liu[1,2], Xiuquan Ma[1], Craig Swan[1], Almantas Galvanauskas[1]; [1]Univ. of Michigan, USA, [2]Arbor Photonics, Inc., USA.* We demonstrate robustly single-mode power scaling in fiber laser systems built using 35-µm core Yb-doped double-clad Chirally-Coupled-Core (CCC) fibers. Up to 250W have been demonstrated up to date and further power scaling is in progress.

CThGG2 • 5:00 p.m.
All Fiber Narrow Linewidth High Power Bismuth Doped Fiber Amplifier at 1179 nm, *Mridu P. Kalita, Seongwoo Yoo, Jayanta Sahu; Univ. of Southampton, UK.* We investigated the performance of Bi-doped fiber amplifier at 1179nm, in both low and high input signal regime, when pumped at 1090nm. The amplifier efficiency and the saturation power both depend on the fiber cooling.

CThGG3 • 5:15 p.m. Invited
30W, 1178nm Yb-Doped Photonic Bandgap Fiber Amplifier, *Akira Shirakawa[1], Hiroki Maruyama[1], Ken-ichi Ueda[1], Christina B. Olausson[2], Jens Kristian Lyngsø[2], Jes Broeng[2]; [1]Inst. for Laser Science, Univ. of Electro-Communications, Japan, [2]Crystal Fibre A/S, Denmark.* High-power, high-efficiency ytterbium-doped solid-core photonic-bandgap fiber amplification at the long-wavelength edge of the Yb gain band is reported. Amplified-spontaneous-emission-free, 30W non-polarized and 25W linearly-polarized 1178nm outputs have been achieved with <58% slope efficiencies.

Rooms 318-320	Rooms 321-323	Rooms 324-326	Room 314
IQEC	CLEO	IQEC	CLEO

IThK • Quantum Imaging and Spatial Entanglement—Continued

IThK5 • 5:45 p.m.
Signal-to-Noise Ratio of Gaussian-State Ghost Imaging, *Baris I. Erkmen, Jeffrey H. Shapiro; MIT, USA.* The signal-to-noise ratios of pseudothermal and biphoton ghost imagers are derived and compared by means of a unified Gaussian-state analysis.

IThK6 • 6:00 p.m.
Resolution, Contrast and Noise of Quantum and Thermal Ghost Images, *Malcolm N. O'Sullivan, Mehul Malik, Kam Wai Clifford Chan, Robert W. Boyd; Inst. of Optics, Univ. of Rochester, USA.* We compare the quality of images formed by quantum and thermal ghost imaging systems. We find the resolution to be the same and determine the scaling laws for the contrast and signal-to-noise ratio.

IThK7 • 6:15 p.m.
Computational Ghost Imaging, *Jeffrey H. Shapiro; MIT, USA.* A computational ghost-imaging arrangement that uses only a single-pixel detector is described. It affords a new 3-D sectioning capability and matches the resolution of pseudothermal ghost imaging.

CThY • Novel Lasers and Beam Combining—Continued

CThY5 • 5:45 p.m.
All-Polymer Distributed Feedback Lasers, *Juefei Zhou[1], Hyunmin Song[2], Joseph Lott[2], Yeheng Wu[1], Eric Baer[2], Anne Hiltner[2], Christoph Weder[2], Kenneth D. Singer[1]; [1]Dept. of Physics, Case Western Reserve Univ., USA, [2]Dept. of Macromolecular Science and Engineering, Case Western Reserve Univ., USA.* We report on melt-processed all-polymer distributed feedback lasers. The slope efficiency and lasing threshold of these lasers are found highly pumping angle dependent, with a maximum efficiency of nearly 4.6% and lowest threshold of 0.9mJ/cm2.

CThY6 • 6:00 p.m.
Lasing from Dye-Doped Icosahedral Quasicrystals in Dichromate Gelatin Emulsions, *Mang H. Kok, Weixin Lu, Wing Y. Tam, George K. L. Wong; Dept. of Physics and William Mong Inst. of Nano Science and Technology, Hong Kong Univ. of Science and Technology, China.* We report observation of optically pumped multi-directional lasing at visible wavelengths from dye-doped three-dimensional icosahedral quasicrystals fabricated in dichromate gelatin emulsions using a novel seven-beam optical interference holographic method. The lasing pattern exhibits icosahedral symmetry.

CThY7 • 6:15 p.m.
Two-Dimensional Array and Switching in a Dye-Doped Azo Cholesteric Liquid Crystal Laser, *Boyoung Kang[1], Hyunhee Choi[1], Mi-Yun Jeong[2], Jeong W. Wu[1]; [1]Ewha Womans Univ., Republic of Korea, [2]Gyeongsang Natl. Univ., Republic of Korea.* 2-D laser array is fabricated by optical patterning in a dye-doped azo choelsteric liquid crystal. We could achieve an optically controllable lasing emission at each domain of 2-D array and switching on/off of lasing operation.

IThL • Plasmonic Metamaterials—Continued

IThL4 • 5:45 p.m.
Hypergratings: Sub-Diffraction Optics with Anisotropic Plasmonic Metamaterials, *Viktor A. Podolskiy, Sukosin Thongrattanasiri; Oregon State Univ., USA.* We propose a technique for sub-diffractional focusing in the far field of optical elements. The method combines subwavelength analogs of Fresnel lenses and planar anisotropic metamaterials, used to generate and propagate sub-diffractional information, respectively.

IThL5 • 6:00 p.m.
Magnetic Dipoles Induced in Dielectric Spheres: Coupled Interactions, *Mark S. Wheeler, J. Stewart Aitchison, Mohammad Mojahedi; Dept. of Electrical and Computer Engineering, Univ. of Toronto, Canada.* We study the coupling of magnetic dipoles, induced in dielectric spheres. The spheres are configured in chains and rings, which also form effective media. The results have applications toward more complicated metamaterials and plasmonic devices.

IThL6 • 6:15 p.m.
70nm Resolution in Sub-Surface Two-Photon Optical Beam Induced Current Microscopy through Pupil-Function Engineering in the Vectorial Focusing Regime, *Keith A. Serrels, Euan Ramsay, Derryck Reid; Heriot Watt Univ., UK.* We present experimental evidence for the resolution-enhancing effect of an annular pupil-plane aperture in two-photon semiconductor microscopy in the vectorial-focusing regime. At an illumination wavelength of 1550nm we achieved a resolution of 70nm (λ/22).

CThZ • QPM Devices II—Continued

CThZ5 • 5:45 p.m.
Monolithic SHG Ring Resonator Passively Coupled to an External Cavity Enhanced Broad Area Laser Diode, *Andreas Jechow, Danilo Skoczowsky, Ralf Menzel; Univ. of Potsdam, Germany.* 126 mW visible light was generated by frequency doubling using bulk PPLN in a high finesse ring cavity pumped by a BAL ECDL. The locking between the two cavities is managed purely optical.

CThZ6 • 6:00 p.m.
1.27 W, Tunable, Continuous-Wave, Single-Frequency, Solid-State Blue Source, *Goutam K. Samanta[1], Majid Ebrahim-Zadeh[1,2]; [1]ICFO - Inst. de Ciències Fotòniques, ICREA, Spain, [2]ICREA, Spain.* We describe a tunable, cw, single-frequency blue source based on internal SHG of a cw singly-resonant OPO, providing up to 1.27 W across 425-489 nm with a passive frequency stability <280 MHz over >5 minutes.

CThZ7 • 6:15 p.m.
1.3 Watt Single-Frequency Nd:YLF/ppKTP Red Laser, *Fabiola Camargo[1], Thomas Zanon-Willette[2], Rodolphe Sarrouf[2], Thomas Badr[2], Niklaus U. Wetter[1], Jean-Jacques Zondy[2]; [1]Inst. de Pesquisas Energéticas e Nucleares, Brazil, [2]Inst. Natl. de Métrologie, Conservatoire Natl. des Arts et Métiers, France.* Using a temperature-tuned ppKTP crystal, a record 1.3W single-frequency red laser at 661nm is achieved from intra-cavity second-harmonic generation of a Nd:$YLiF_4$ ring laser oscillating on the π-polarized transition (λ~1321nm).

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 314, 315 and 316*

NOTES

Room 315 | Room 316 | Room 317

IQEC | CLEO

IThM • Coherent Interactions of Matter in Light—Continued

IThM5 • 5:45 p.m.
Dispersive Shock Waves with Negative Pressure, *Wenjie Wan, Dmitry V. Dylov, Christopher Barsi, Jason W. Fleischer; Princeton Univ., USA.* We experimentally observe a spatial optical shock with negative pressure/self-focusing nonlinearity on a partially-spatially-incoherent light. We examine its basic nonlinear properties and observe statistical wave damping.

IThM6 • 6:00 p.m.
Observation of Doubly Dressed States in Ladder-Type Electromagnetically Induced Transparency System, *Yi-Chi Lee[1], Zong-Syun He[2], Ming-Tsung Lee[2], Ray-Yuan Chang[2], Wei-Chia Fang[2], Hsiang-Chen Chui[1], Chin-Chun Tsai[1,2]; [1]Inst. of Electro-Optical Science and Engineering, Natl. Cheng-Kung Univ., Taiwan, [2]Dept. of Physics, Natl. Cheng-Kung Univ., Taiwan.* Doubly dressed states in a ladder-type, three-level system are observed in our system. A numerical simulation demonstrates that Doppler velocity group may perturb the light shift from the symmetric center of the EIT doublet.

IThM7 • 6:15 p.m.
Quantum-Enhanced Measurements of Atomic Spin, *Ana Predojević, Marco Koschorreck, Mario Napolitano, Florian Wolfgramm, Brice Dubost, Yannick de Icaza Astiz, Naeimeh Behbood, Alessandro Cerè, Morgan W. Mitchell; ICFO, Spain.* We use narrow-band quantum light sources, tuned to the rubidium D1 resonance, to produce polarization-squeezed and polarization-N00N states for Heisenberg-limited measurements on atoms. By paramagnetic Faraday rotation these states measure the atomic spin polarization.

CThAA • Quantum and Interband Cascade Lasers—Continued

CThAA5 • 5:45 p.m.
Room Temperature InGaAs-AlAsSb Quantum Cascade Lasers Operating in 3-4 μm Range, *Dmitry G. Revin[1], Shiyong Y. Zhang[1], J. P. Commin[1], John W. Cockburn[1], Ken Kennedy[2], Andrey B. Krysa[2], Mark Hopkinson[2]; [1]Dept. of Physics and Astronomy, Univ. of Sheffield, UK, [2]EPSRC Natl. Ctr. for III- V Technologies, Univ. of Sheffield, UK.* We report the first room temperature strain compensated InGaAs/AlAs(Sb)/InP quantum cascade lasers operating down to 3.15μm. The lasers with selective incorporation of AlAs barriers in the active regions emit hundreds of milliwatts peak optical power.

CThAA6 • 6:00 p.m.
Mid-Infrared Interband Cascade Lasers Operating CW at Room Temperature, *William W. Bewley, Chadwick L. Canedy, Chulsoo Kim, Mijin Kim, J. R. Lindle, Joshua Abell, Igor Vurgaftman, Jerry R. Meyer; NRL, USA.* Improvements in the design of mid-infrared interband cascade lasers have allowed them to operate cw to 334 and 319 K for devices with emission wavelengths of 3.3 and 3.7 μm, respectively.

CThAA7 • 6:15 p.m.
Plasmon Waveguide Interband Cascade Lasers, *Zhaobing Tian, Rui Q. Yang, Tetsuya D. Mishima, Michael B. Santos, Robert T. Hinkey, Mark E. Curtis, Matthew B. Johnson; Univ. of Oklahoma, USA.* We report the demonstration and development of plasmon waveguide interband cascade lasers operating in continuous wave near 6 microns and beyond.

CThBB • Nonlinear Nanophotonics and Data Conversion—Continued

CThBB5 • 5:45 p.m.
Deterministic Phase-Control and Resonance-Detuning in Optical EIT-like Coupled Resonances towards Dynamical Storage of Light, *Xiaodong Yang[1], Mingbin Yu[2], Dim-Lee Kwong[2], Chee Wei Wong[1]; [1]Columbia Univ., USA, [2]Inst. of Microelectronics, Singapore.* We report first observations of deterministic phase- and resonance-controlled all-optical analogue to electromagnetically induced transparency in coherently-coupled silicon photonic crystal nanocavities through thermo-optic tuning method, for realization of all-optical dynamical storage of light.

CThBB6 • 6:00 p.m.
Experimental Confirmation of a Generalized Definition of the Effective Nonlinear Coefficient in Emerging Waveguides with Subwavelength Structures, *Shahraam Afshar, Wenqi Zhang, Tanya M. Monro; Univ. of Adelaide, Australia.* A new vectorially-based definition of effective nonlinear coefficient γ is presented and its validity is confirmed experimentally using a bismuth suspended-core fiber with the core diameter of 530 nm and measured γ of 5400±200 $W^{-1}km^{-1}$.

CThBB7 • 6:15 p.m.
High-Q Microring Resonator with Narrow Free Spectral Range for Pulse Repetition Rate Multiplication, *Minhao Pu, Hua Ji, Lars Hagedorn Frandsen, Michael Galili, Leif Katsuo Oxenløwe, Jørn Märcher Hvam; Technical Univ. of Denmark, Denmark.* We demonstrate a silicon-on-insulator microring resonator with a free-spectral-range of 0.32nm, an extinction ratio of 27dB, and a quality factor of ~140900 at 1550nm that is used for pulse repetition-rate multiplication from 10 to 40GHz.

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 314, 315 and 316*

NOTES

Room 336 — CLEO

CThCC • Semiconductor Waveguides and Nanostructures—Continued

CThCC5 • 5:45 p.m.
Recombination Dynamics of Photogenerated Carriers in 10.4 µm-Cutoff Photodiodes Consisting of W-Structured Superlattices, *Guibao Xu[1], Xiaodong Mu[1], Yujie J. Ding[1], Chad L. Canedy[2], Edward H. Aifer[2], Igor Vurgaftman[2], Jerry R. Meyer[2]; [1]Lehigh Univ., USA, [2]NRL, USA.* We used pump-probe technique to investigate recombination dynamics of photogenerated carriers in photodiodes consisting of InAs/GaInSb W-structured superlattices. Recombination time constants of 1.6 ns and 10 ns were measured under high and low powers, respectively.

CThCC6 • 6:00 p.m.
Dynamics of the Optical Matrix Element in Type II GaAsSb/GaAs Quantum Dots for Laser Applications, *Tomasz J. Ochalski[1], Kamil Gradkowski[1,2], Nicola Pavarelli[1,2], David P. Williams[1], Eoin P. O'Reilly[1], Guillaume Huyet[1,2], Jun Tatebayashi[3], Diana L. Huffaker[3]; [1]Tyndall Natl. Inst., Ireland, [2]Cork Inst. of Technology, Ireland, [3]California NanoSystems Inst., Univ. of California at Los Angeles, USA.* We observe anomalous evolution of the time resolved photoluminescence spectra of type II GaAsSb/GaAs QDs, which we explain in terms of self-consistent 8 band k.p Hamiltonian simulations.

CThCC7 • 6:15 p.m.
Polarized Raman Modes of a Single Wurtzite GaAs Needle, *Shanna Crankshaw, Michael Moewe, Linus C. Chuang, Roger Chen, Connie Chang-Hasnain; Univ. of California at Berkeley, USA.* We report the polarization properties of Raman scattering in a single wurtzite GaAs nanoneedle. Micro-Raman measurements are performed with varying incident and scattered light polarizations, affecting the relative intensities of the observed zone-center phonon lines.

Room 337 — IQEC

IThN • Photonic Structures—Continued

IThN5 • 5:45 p.m.
Exciton-Exciton Annihilation in Organic Polariton Microcavities, *Gleb M. Akselrod, Jonathan R. Tischler, Elizabeth R. Young, M. Scott Bradley, Daniel G. Nocera, Vladimir Bulović; MIT, USA.* Sublinear intensity dependence of photoluminescence from organic exciton-polariton microcavities under non-resonant excitation in two power regimes is shown. The sublinearity is attributed to exciton-exciton annihilation, which could compete with polariton-polariton scattering in these devices.

IThN6 • 6:00 p.m. Invited
Switch-on of Ultrastrong Light-Matter Interaction Faster than a Cycle of Light, *Aji A. Anappara[1,2], Georg Günter[1], Jakob Hees[1], Giorgio Biasiol[3], Lucia Sorba[2,3], Alessandro Tredicucci[2], Alfred Leitenstorfer[1], Rupert Huber[1]; [1]Univ. of Konstanz, Germany, [2]NEST CNR-INFM and Scuola Normale Superiore, Italy, [3]Lab Nazionale TASC CNR-INFM, Italy.* Intersubband cavity polaritons in a quantum well waveguide structure are photogenerated by 12-fs near-infrared pulses. Multi-THz transients trace the non-adiabatic switch-on of ultrastrong light-matter coupling and the conversion of bare photons into cavity polaritons.

Room 338 — CLEO

CThDD • Pulse Measurement II—Continued

CThDD5 • 5:45 p.m.
Spatio-Temporal Characterization of Nonlinear Propagation of Femtosecond Pulses, *Daniel E. Adams, Thomas A. Planchon, Jeff A. Squier, Charles G. Durfee; Colorado School of Mines, USA.* Nonlinear propagation through optically transparent media is characterized using spatially-resolved spectral interferometry. Spatio-temporal coupling given by the nonlinear effect is quantified and several methods are compared to show their advantages.

CThDD6 • 6:00 p.m.
Multifarious Control of Two-Photon Fluorescence Intensities in Multi-Labeled Cell Using a Single Ultrabroadband Light Source, *Keisuke Isobe[1], Akira Suda[1], Hiroshi Hashimoto[2], Fumihiko Kannari[2], Hiroyuki Kawano[3], Hideaki Mizuno[3], Atsushi Miyawaki[3], Katsumi Midorikawa[1]; [1]RIKEN Advanced Science Inst., Japan, [2]Keio Univ., Japan, [3]RIKEN Brain Science Inst., Japan.* We demonstrate that the spectral phase modulation of ultrabroadband laser pulses provides multifarious control of two-photon fluorescence intensities of multiple fluorophores in a HeLa cell.

CThDD7 • 6:15 p.m.
Near Quantum-Limited Single-Shot Full-Field Measurements of Arbitrarily Shaped Optical Waveforms, *Nicolas K. Fontaine, Ryan P. Scott, Chunxin Yang, Jonathan P. Heritage, S. J. Ben Yoo; Dept. of Electrical and Computer Engineering, Univ. of California at Davis, USA.* This paper demonstrates single-shot, four-quadrature balanced homodyne detection in the spectral domain for full field measurements of 500-GHz bandwidth 150-aJ optical waveforms with 200-ps record lengths. Results indicate essentially quantum-limited performance.

Room 339 — JOINT

JThH • High Harmonic Generation II—Continued

JThH5 • 5:45 p.m.
Selection Rule for the Field-Induced Recolliding Electron Spectroscopy, *Tsuneto Kanai, Eiji J. Takahashi, Yasuo Nabekawa, Katsumi Midorikawa; RIKEN Inst. of Physical and Chemical Res., Japan.* We measure the harmonic phase from SF_6 with heterodyne interferometry using mixed gases and reproduce it by group theory, which leads to the selection rule for the new spectroscopy recently proposed by Wagner et al..

JThH6 • 6:00 p.m.
Quantum Path Interferences in High-Harmonic Generation: Ionization Effects and Spatial Structure, *Lukas Gallmann[1], Mirko Holler[1], Amelle Zaïr[1], Florian Schapper[1], Thierry Auguste[2], Eric Cormier[3], Adam Wyatt[4], Antoine Monmayrant[4], Ian A. Walmsley[4], Pascal Salières[2], Ursula Keller[1]; [1]ETH Zurich, Switzerland, [2]CEA-Saclay, France, [3]Univ. Bordeaux I, France, [4]Oxford Univ., UK.* We investigate the influence of microscopic and macroscopic ionization effects on the intensity-dependent quantum-path interferences in high-harmonic generation. The resulting interference structures were analyzed in different gases and in spatially resolved harmonic spectra.

JThH7 • 6:15 p.m.
Manipulation of an Optical/Plasma Filament Propagating in Atmosphere Using Quantum Molecular Alignment Wakes, *Sanjay R. Varma, Yu-hsin Chen, Howard M. Milchberg; Univ. of Maryland, College Park, USA.* An ultrafast pulse filaments in atmosphere and is injected into a quantum molecular alignment wake following a previous filament. The second filament can be enhanced or destroyed, depending on the phase of alignment it encounters.

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 314, 315 and 316*

NOTES

CThEE • Laser Ablation Mechanisms and Applications—Continued

CThEE5 • 5:45 p.m.
Laser-Induced Nano-Corrugation of a Dielectric Surface, *Alexander E. Kaplan, Sergei N. Volkov; Johns Hopkins Univ., USA.* We demonstrate that uneven distribution of evanescent field and sub-threshold ablation at a dielectric surface can explain experimentally observed creation of nanometer-sized surface grooves by femtosecond laser pulses.

CThEE6 • 6:00 p.m.
Femtosecond Laser-Induced Periodic Surface Structures on Tungsten, *Anatoliy Y. Vorobyev, Chunlei Guo; Univ. of Rochester, USA.* We generate periodic surface structures on tungsten at various laser wavelengths, despite that the table values of the dielectric constants indicate the absence of surface plasmons, a wave necessary for forming periodic structures on metals.

CThEE7 • 6:15 p.m.
Tip Assisted Laser Induced Surface Nano-lithography, *Alexander A. Milner, Yehiam Prior; Weizmann Inst. of Science, Israel.* Novel mode of AFM operation is demonstrated to be efficient for non-contact laser induced nano-lithography on the surface of polymers and of metals by means of different mechanisms: localized heat transfer and electro-magnetic field enhancement.

CThFF • THz Metamaterials and Filters—Continued

CThFF5 • 5:45 p.m.
Comparison of Birefringent Metamaterials and Meanderline Structure as Quarter-Wave Plates at Terahertz Frequencies, *Andrew C. Strikwerda[1], Kebin Fan[2], Hu Tao[2], Daniel V. Pilon[1], Xin Zhang[2], Richard D. Averitt[1]; [1]Dept. of Physics, Boston Univ., USA, [2]Dept. of Mechanical Engineering, Boston Univ., USA.* We compare a single layer metamaterial quarter-wave plate with a meanderline polarizer. They achieve 99.9% and 99.6% circular polarization at 639 GHz, respectively. These results highlight the large degree of birefringence exhibited by metamaterial structures.

CThFF6 • 6:00 p.m.
THz Polarimetric Components Based on Metamaterials, *X. G. Peralta[1], I. Brener[1], A. Azad[2], H.-T. Chen[2], E. Smirnova[3], A. J. Taylor[2], J. F. O'Hara[2]; [1] Ctr. for Integrated Nanotechnologies, Sandia Natl. Labs, USA, [2]MPA- Ctr. for Integrated Nanotechnologies, Los Alamos Natl. Lab, USA, [3]ISR-6, Los Alamos Natl. Lab, USA.* The interrelation between transmission amplitude and phase spectra of anisotropic metamaterials enables us to develop realistic designs for a terahertz quarter-wave plate and a polarizing terahertz beam splitter based on an anisotropic metamaterial structure.

CThFF7 • 6:15 p.m.
AlGaN/GaN Plasmon-Resonant Terahertz Detectors with On-Chip Patch Antennas, *Tatsuya Tanigawa[1], Toshikazu Onishi[1], Osamu Imafuji[1], Shinichi Takigawa[1], Taiichi Otsuji[2]; [1]Semiconductor Device Res. Ctr., Semiconductor Co., Panasonic Corp., Japan, [2]Res. Inst. of Electrical Communication, Tohoku Univ., Japan.* We demonstrate room temperature terahertz detection by AlGaN/GaN heterojunction field effect transistors (HFETs) integrated with an on-chip microstrip patch antenna. Polarization dependent photoresponse is observed in accordance with the design of the antenna.

CThGG • Novel 1 Micron Fiber Sources—Continued

CThGG4 • 5:45 p.m.
Spectral Narrowing of Highly Efficient Cryogenically Cooled Ytterbium Doped Fiber Lasers, *Pär Jelger, Kai Seger, Valdas Pasiskevicius, Fredrik Laurell; Royal Inst. of Technology, Sweden.* VBGs can efficiently be used to mitigate the spectrally broad output from cryogenically cooled Yb-fiber lasers. We extract 11.5-W of output power in spectral window of less than 0.4-nm with 14.5-W of launched pump light.

CThGG5 • 6:00 p.m.
TM_{01} Mode Operation of an Yb-Doped Double-Clad Fiber Amplifier, *Tatsuya Chubachi, Yuichi Kozawa, Shunichi Sato; Tohoku Univ., Japan.* A radially polarized beam was amplified up to 1.1 W by passing through an Yb-doped double clad fiber pumped by a semiconductor laser, maintaining both the polarization and intensity patterns of the input beam.

CThGG6 • 6:15 p.m.
Pump Combiner for Air-Clad Fiber with PM Single-Mode Signal Feed-Through, *Danny Noordegraaf[1,2], Martin D. Nielsen[1], Peter M. W. Skovgaard[1], Søren Agger[1], Kim P. Hansen[1], Jes Broeng[1], Christian Jakobsen[1], Harald R. Simonsen[1], Jesper Lægsgaard[2]; [1]Crystal Fibre A/S, Denmark, [2]DTU Photonics, Technical Univ. of Denmark, Denmark.* A pump combiner with single-mode PM signal feed-through designed for an air-clad photonic crystal fiber is demonstrated. Signal coupling is realized by a novel taper element allowing single-mode guidance at a taper ratio of 3.7.

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 314, 315 and 316*

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