CLEO/QELS 2006

Technical Conference: May 21-26, 2006

Exposition: May 23-25, 2006

Long Beach Convention Center, Long Beach, CA, USA

CLEO/QELS & *PhAST* 2006 once again reiterated their roles as the leading events for the fields of lasers, electro-optics and photonics. With more than 1,500 talks on the latest breakthroughs in research and applications, these conferences are the source of the most timely and innovative new developments for the industry.

Consistent with previous year's shows, attendance reached 5,200. Technical attendance was strong at more than 2,500 and exhibit walk-in traffic remained steady with 2005.

The CLEO exhibition showcased 358 participating companies this year, with almost a 100 percent increase in corporate sponsor participation. The show really is an international must-attend event, with approximately 25% of companies coming from outside the United States.

There also were exciting new programs and topics introduced at the 2006 event. The *PhAST* conference established the *PhAST/Laser Focus World* Innovation Award which recognizes a company who has developed one of the most promising new products in the field. This year, Daylight Solutions won for its submission, "Commercializing the Mid-IR" and four honorable mentions were given to Thorlabs, Sacher Lasertechnik, Fianium and PolarOnyx. CLEO also launched the Terahertz Technologies and Applications subcommittee, a new topic area developed due to a consistent increase in papers in this area over the last few meetings.

CLEO/QELS and PhAST had a great year in 2006. We're looking forward to seeing you in Baltimore , May 6-11, 2007.

Conference Program

Postdeadline Papers

CPDA-CLEO Postdeadline Session I

CPDA1 St. Pierre **4 kW Phase Conjugated MOPA Laser**

CPDA2	Ebrahim-Zadeh	**High-Power, Widely Tunable Femtosecond Optical Parametric Oscillator for the Visible and Ultraviolet**
CPDA3	Kung	**A Monolithic Red-Green-Blue Laser Projection Source Based on PPSLT**
CPDA4	Chatterjee	**Near-Field Observation of Negative Refraction Superlensing at the Near-Infrared**
CPDA5	Kim	**Complete Temporal Reconstruction of an Attosecond Pulse Train Using the FROG Technique**
CPDA6	Okino	**Interferometric Autocorrelation of an Attosecond Pulse Train in the Single Cycle Regime**
CPDA7	Kosuge	**Frequency-Resolved Optical Gating of Isolated Attosecond Harmonic Pulses**
CPDA8	Xiao	**Coherent Photonic Microwave Phase Filtering and Fourier Transform Electrical Pulse Shaping**
CPDA9	Abedin	**Highly Efficient Slow and Fast Light Generation via Brillouin Scattering in As_2Se_3 Chalcogenide Fiber**
CPDA10	Xia	**0.8-4.5 Microns Supercontinuum Generation in ZBLAN Fluoride Fibers Scaled up to 1.25 W Power**
CPDA11	Travers	**Dispersion-Decreasing PCF for Blue-UV Supercontinuum Generation**

CPDB-CLEO Postdeadline Session II

CPDB1	Rutz	**First Passively Mode-Locked GaInNAs VECSEL**
CPDB2	Hopfer	**High Speed Performance of 980 nm VCSELs Based on Submonolayer Quantum Dots**
CPDB3	Nagarajan	**Single Chip, 40-Channel x 40Gbit/s per Channel, InP Transmitter Photonic Integrated Circuit**
CPDB4	Liao	**Diffraction-Limited 65-μm Core Yb-Doped LMA Fiber Based High Energy Fiber CPA Systems**
CPDB5	Skorobogatiy	**Biodegradable, Double-Core, Porous Optical Fiber**

CPDB6	Chow	**Serial OTDM for 100 Gb/s Ethernet Applications**
CPDB7	Funabashi	**First Field Demonstrations of 1000-Hop Cascaded All-Optical 3R Regeneration in 10Gb/s NRZ Transmission**
CPDB8	Kröll	**Terahertz Time-Domain Spectroscopy of a Quantum Cascade Laser**
CPDB9	Amzajerdian	**Fiber-Based Coherent Lidar for Target Ranging, Velocimetry, and Atmospheric Wind Sensing**
CPDB10	Hartl	**Optical and Microwave Frequency Synthesis with an Integrated Fiber Frequency Comb**
CPDB11	Ludlow	**Ultracold Strontium Optical Lattice Clock**

QPDA-QELS Postdeadline Session

QPDA1	LeCoq	**Kilohertz Level Optical Spectroscopy of Cold Atoms with the Amplified Output of a Femtosecond Frequency Comb**
QPDA2	Ido	**Narrow Line Photoassociation in an Optical Lattice**
QPDA3	Fulconis	**Quantum Interference with Photon Pairs Using Two Micro-Structured Fibres**
QPDA4	Ali Khan	**Experimental Demonstration of Large Alphabet Quantum Key Distribution Using Energy Time Entanglement**
QPDA5	Sokolov	**Broadband Coherent Light Generation in Raman-Active Crystals**
QPDA6	Carmon	**Opto-Mechanical Chaotic Behaviour of Micron-Scaled On-Chip Resonators**
QPDA7	Tanabe	**Time-Domain Observation of Photon Trapping in Ultra-Small High-** ***Q*** **Photonic Crystal Nanocavities**
QPDA8	Polli	**Coherent Structural Distortion as Origin for the Colossal Photo-Resistance Effect in $Pr_{0.7}Ca_{0.3}MnO_3$**
QPDA9	Lindenberg	**Femtosecond X-ray Diffuse Scattering Measurement of Liquid State Dynamics**

QPDA10 Zheludev **Generation of Propagating Plasmonic Waves on Unstructured Gold Surface by an Electron Beam**

QPDA11 Konishi **Parity-Odd Magneto-Optical Effect in Ferromagnetic-Metal Chiral Nanogratings**

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Invited Speakers

CLEO INVITED SPEAKERS

CLEO 01: Laser Processing and Optical Instrumentation

CME1, **Improved Microelectronics Manufacturing Using New Laser Technologies**, Edward Swenson; *Electric Scientific Industries, Inc., USA.*

CMHH1, **Ultra-Fast Lasers for Nano-Material Growth and Processing**, Samuel Mao; *Univ. of California at Berkeley, USA.*

CMX1, **Fringe-Free Nondiffracting Beams for Advanced Laser Diagnostics and Processing**, Ruediger Grunwald; *Max-Born-Inst., Germany*.

CLEO 02: Solid-State Lasers

CTuEE2, **High Power Frequency Upconversion of Ultra-Fast Fiber Amplifiers**, Ingmar Hartl, Lawrence Shah, Zhenlin Liu, Genady Imeshev, Gyu Cho, Martin Fermann; *IMRA America, Inc., USA.*

CWF2, **Progress on the National Ignition Facility**, Edward I. Moses; *Lawrence Livermore Natl. Lab, USA.*

CWN1, **High-Energy Laser Pulses Directly from the Oscillator**, Uwe Morgner; *Max-Planck-Inst., Germany*.

CWN4, **Cavity Dumped Mode-Locked Lasers**, Alexander W. Killi; *MPI fuer Kernphysik, Germany*.

CThFF1, **Diode-Pumped One Joule per Q-Switched Pulse 2 µm Laser**, Jirong Yu; *NASA Langley Res. Ctr., USA.*

CLEO 03: Semiconductor Lasers

CMBB1, **Progress in Si-Photonics**, Mario Paniccia; *Intel Corp., USA.*

CMKK1, **High-Power Single-Lobed Surface-Emitting Photonic-Crystal Laser**, Wataru Kunishi[1,2], Dai Ohnishi[1,2], Eiji Miyai[2], Kyosuke Sakai[2], Susumu Noda[2]; *[1]ROHM Co.,Ltd., Japan, [2]Kyoto Univ., Japan.*

CTuFF1, **High Performance MOCVD Quantum Cascade Lasers**, Dave Bour; *Agilent Technologies, USA.*

CThH5, **High Power Monolithic Passively Mode-Locked Slab-Coupled Optical Waveguide Lasers**, Juliet T. Gopinath, Jason J. Plant, Bien Chann, Robin K. Huang, Christopher Harris, Leo Missaggia, Joseph P. Donnelly, Paul W. Juodawlkis, Daniel J. Ripin; *MIT Lincoln Lab, USA.*

CThX1, **Theory of Quantum Dot Lasers**, Frank Jahnke; *Inst. for Theoretical Physics, Germany.*

CLEO 04: Applications of Nonlinear Optics

CWA4, **Long-Wavelength Infrared Chemical Sensing**, Scott Bisson; *Sandia Natl. Labs, USA.*

CWO6, **High-Energy Pulse Compression to the Single-Cycle Regime in Quadratic Media**, Jeffrey Moses, Frank Wise; *Cornell Univ., USA.*

CThG4, **Broadband Continuum Generation in GaAs**, Paulina S. Kuo; *Stanford Univ., USA.*

CThW4, **Nonlinear Slow Light and High Bit Rates**, Jacob B. Khurgin; *Johns Hopkins Univ., USA.*

CLEO 05: Terahertz Technologies and Applications

CMCC1, **THz Attenuated Total Reflection Spectroscopy**, Koichiro Tanaka; *Dept. of Physics, Kyoto Univ., Japan.*

CTuF4, **THz Silicon Lasers**, Heinz-Wilhelm Hubers; *Inst. of Planetary Res., German Aerospace Ctr., Germany.*

CTuL4, **THz Quantum Semiconductor Devices**, Hui Liu; *Natl. Res. Council of Canada, Canada.*

CTuT1, **Long Wavelength, Multi Frequency THz Quantum Cascade Lasers**, Giacomo Scalari[1], Christoph Walther[1], Lorenzo Sirigu[1], Jérôme Faist[1], Marcin L. Sadowsky[2], Harvey E.

Beere[3], David Ritchie[3]; *[1]Univ. of Neuchatel, Switzerland, [2]Grenoble High Magnetic Field Lab, France, [3]Cavendish Lab, Univ. of Cambridge, United Kingdom*.

CLEO 06: Optical Materials, Fabrication & Characterization

CTuAA6, **GaN-Based Photonic Crystals and Integrated Optics**, Armand Rosenberg; *NRL, USA.*

CThI1, **New Building Blocks and Growth Processes for High-Performance Self-Assembled Electro-Optic Materials**, Antonio Facchetti, Hu Kan, Hua Jiang, Tobin Marks; *Dept. of Chemistry, Northwestern Univ., USA.*

CFI6, **Sub-Micron Size Photonic Devices on a Silicon Chip**, Michal Lipson; *ECE Dept., Cornell Univ., USA.*

CLEO/QELS 07: High-Field Physics and High-Intensity Lasers

JTuG1, **Current Status of Fast Ignition and Its Prospect at Osaka University**, Kazuo Tanaka; *Osaka Univ., Japan*.

JThA3, **X-ray and Proton Measurements from Petawatt Laser Interactions**, Pravesh K. Patel; *Lawrence Livermore Natl. Lab, USA.*

JThB1, **Thomson Backscattering from Laser-Accelerated Electrons**, Roland Sauerbrey; *Friedrich-Schiller-Univ. Jena, Germany*.

JThE1, **Few-Cycle Chirped-Pulse Parametric Amplification**, Andrius Baltuska, Nobuhisa Ishii, Takao Fuji, Ferenc Krausz; *MPQ, Germany*.

JFA1, **Multielectron Dynamics in Ultrafast Laser Atom Interactions**, Robert Moshammer; *Max-Planck-Inst. für Kernphysik, Germany*.

JFB1, **Imaging of Molecular Orbitals and Attosecond Pulses**, David Villeneuve; *Steacie Inst. for Molecular Science, Natl. Res. Council of Canada, Canada*.

CLEO 08: Ultrafast Optics, Optoelectronics & Applications

CThEE6, **Three-Dimensional Micromachining Inside Transparent Materials Using Femtosecond Laser Pulses: New Applications**, Jim Bovatsek[1], Alan Arai[1], Chris B. Schaffer[2]; *[1]IMRA America, Inc., USA, [2]Cornell Univ., USA.*

CThV2, **Ultra-Fast Nonlinear Interactions in Photonic Crystal Fibers**, Alexander Gaeta; *Cornell Univ., USA.*

CThV5, **Super-Continuum Generation to 3 µm in Fused Silica Fiber with Nanosecond Diode Pumping**, Chenan Xia[1], Malay Kumar[1], Ojas P. Kulkarni[1], Mohammed N. Islam[1], Fred L.

Terry[1], Daniel A. Nolan[2], William A. Wood[2]; *[1]Dept. of Electrical Engineering and Computer Science, Univ. of Michigan, USA, [2]Res., Development and Engineering Div., Corning, Inc, USA.*

CFF3, **Attosecond Pulse Characterization by XUV Nonlinear Optics**, Shuntarou Watanabe; *Inst. for Solid State Physics, Japan.*

CFF4, **100 MHz Frequency Combs in the XUV Spectral Region**, R. Jason Jones, Kevin Moll, Michael J. Thorpe, Jun Ye; *JILA/ Univ. of Colorado and NIST, USA.*

CFN1, **High-Power Ultra-Fast Fiber Amplifiers**, Lawrence Shah; *IMRA America, Inc., USA.*

CLEO 09: Optical Components, Interconnects & Processing

CTuD3, **Self-Clocked Serial-to-Parallel and Parallel-to-Serial Conversion with an Optically Clocked Transistor Array**, Ryohei Urata, Ryo Takahashi, Tetsuya Suemitsu, Hiroyuki Suzuki; *NTT Photonics Labs, Japan.*

CTuM3, **High-Index-Contrast Microphotonics from Concept to Implementation**, Michael R. Watts[1,2], Tymon Barwicz[1], Milos A. Popovic[1], Minghao Qi[1], Peter T. Rakich[1], Luciano Socci[3], Erich P. Ippen[1], Franz X. Kaertner[1], Henry I. Smith[1], Marco Romagnoli[3]; *[1]MIT, USA, [2]Sandia Natl. Labs, USA, [3]Pirelli Labs, Italy.*

CWK3, **Optical Nonlinear Phase Shifter Using Vertical Microcavity with Saturable Absorber**, Satoshi Suda[1], Fumio Koyama[1], Nobuhiko Nishiyama[2], Catherine Caneau[2], Chung-En Zah[2]; *[1]Tokyo Inst. of Technology, Japan, [2]Corning Inc., USA.*

CThK1, **Ultra-Fast Photonic Crystal/Quantum Dot All-Optical Switch for Future Photonic Networks**, Hitoshi Nakamura[1,2], Yoshimasa Sugimoto[1,3], Kiyoshi Asakawa[1,4]; *[1]Femtosecond Technology Res. Association (FESTA), Japan, [2]Central Res. Lab, Hitachi Ltd., Japan, [3]Natl. Inst. of Advanced Industrial Science and Technology, Japan, [4]TARA Ctr., Univ. of Tsukuba, Japan.*

CThS3, **2-D Planar Waveguide and Devices**, Shanhui Fan; *Stanford Univ., USA.*

CLEO 10: Medical and Biological Applications

CMH1, **Nano-Aperture Array Based Optical Imaging System on a Microfluidic Chip**, Xin Heng[1], Xiquan Cui[1], Kevin Reynolds[2], David Erickson[3], Demetri Psaltis[1], Changhuei Yang[1]; *[1]Caltech, USA, [2]Norfolk State Univ., USA, [3]Cornell Univ., USA.*

CMR4, **Single Fiber Confocal Microscope Using a Two-Axis Microscanner for Cellular Imaging**, Kristen D. Carlson[1], Hyun Joon Shin[2,3], Hyejun Ra[4], Daesung Lee[4], Olav Solgaard[4], Rebecca R. Richards-Kortum[2]; *[1]Univ. of Texas at Austin, USA, [2]Rice Univ., USA, [3]Korea Inst. of Science and Technology, Republic of Korea, [4]Stanford Univ., USA.*

CTuG1, **Multiple-Experiment and Multiple-Physics Approaches for Fluorescence Guided Molecular Tomographic Imaging**, Amit Joshi[1], Wolfgang Bangerth[2], Eva M. Sevick-Muraca[1];

[1]*Baylor College of Medicine, USA,* [2]*Texas A&M Univ., USA.*

CTuO1, **Diffuse Optical Tomography and Light Transport in Tissue**, Venugopalan Vasan; *Beckman Laser Inst., USA.*

CLEO 11: Fiber and Guided-Wave Lasers & Amplifiers

CMC2, **High-Peak Power Nonlinear Processes in Photonic Crystal Fibers**, Aleksei Zheltikov; *Moscow State Univ., Russian Federation*.

CMGG1, **Optical Microfibers: Fundamentals and Applications**, Mikhail Sumetsky; *OFS Labs, USA.*

CWD1, **Continuous-Wave Silicon Lasers Based on Stimulated Raman Scattering**, Haisheng Rong[1], Richard Jones[1], Ansheng Liu[1], Oded Cohen[2], Mario Paniccia[1]; [1]*Intel, USA,* [2]*Intel, Israel*.

CThAA1, **Engineered Refractive Index Profiles for High Power Fiber Lasers**, Donnell Walton; *Corning Inc., USA.*

CLEO 12: Lightwave Communications and Networks

CMDD1, **Modern Coherent Optical CommunicatIons**, Leonid Kazovsky, Georgios Kalogerakis; *Stanford Univ., USA.*

CMDD5, **LDPC Coded Orthogonal Frequency Division Multiplexing Over the Atmospheric Turbulence Channel**, Ivan B. Djordjevic, Bane Vasic, Mark A. Neifeld; *Univ. of Arizona, USA.*

CMNN1, **Experimental Analysis of SCM-Based Transmission Over 500 m of FDDI-Grade Multimode Fiber With Enhancement From Electronic Equalization**, Amin M. E-a. Diab, Jonathan D. Ingham, Richard V. Penty, Ian H. White; *Univ. of Cambridge, United Kingdom*.

CWH1, **Advanced Network Concepts**, Polina Bayvel; *Univ. Coll. London, United Kingdom*.

CThHH1, **Fast Tunable Lasers in Switches and Routers**, Jesse Simsarian; *Bell Labs, Lucent Technologies, USA.*

CThP1, **High Capacity Long-Haul Undersea Systems: Technology Evolution**, Alexei Pilipetskii; *Tyco Telecommunications, USA.*

CThY1, **40-Gb/s Transmission Over Systems Built for 10-Gb/s**, Pavel Mamyshev; *Mintera Corp., USA.*

CFH1, **Optical MSK Modulation Format**, Lu Chao; *Lightwave Dept., Inst. for Infocomm Res., Singapore, Singapore*.

CFP1, **High-Data-Rate Photon-Counting Optical Communications Using a NbN-Nanowire**

Superconducting Detector, Bryan S. Robinson[1], Andrew J. Kerman[1], Eric A. Dauler[1,2], Richard J. Barron[1], David O. Caplan[1], Mark L. Stevens[1], John J. Carney[1], Scott A. Hamilton[1], Joel K. W. Yang[2], Karl K. Berggren[2]; *[1]MIT Lincoln Lab, USA, [2]Dept. of Electrical Engineering and Computer Science, MIT, USA.*

CLEO 13: Active Optical Sensing

CThT1, **Advanced Coherent Laser Radar Systems**, Sammy Henderson; *Coherent Technologies Inc., USA.*

CFD1, **Tunable Laser Photoacoustic Spectroscopy: Searching for a Tiny Needle in a Large Haystack**, Kumar Patel; *Pranalytica Inc, USA.*

CFL1, **Advanced IR Laser Spectrometers for Identifying the Origin of Earth's Cirrus Clouds and Life on Mars**, Chris Webster; *NASA JPL, USA.*

CLEO 14: Optical Metrology

CMII3, **Metrology for the Space Interferometry Mission**, Bijan Nemati; *JPL, USA.*

CMO3, **Optical Frequency Standards and Clocks Based on Single Trapped Ions**, Helen S. Margolis, Geoffrey P. Barwood, Kazumoto Hosaka, Hugh A. Klein, Stephen N. Lea, Adrian Stannard, Barney R. Walton, Stephen A. Webster, Patrick Gill; *NPL, United Kingdom*.

CTuH3, **Optical Resonators for Frequency Combs**, Christoph Gohle, Maximilian Herrmann, Albert Schliesser, Alma Fernandez, Jens Rauschenberger, Björn Stein, Ronald Holzwarth, Thomas Udem, Theodor W. Hänsch; *Max-Planck-Inst. für Quantenoptik, Germany*.

CTuV4, **Ultrahigh-Speed Fiber Laser and Its Application to Optical Metrology**, Masataka Nakazawa; *Res. Inst. of Electrical Communication, Tohoku Univ., Japan*.

CLEO 15: LEDs, Organic LEDs and Solid-State Lighting

CTuN1, **Growth of P-Type ZnO and Its Application to ZnO LEDs**, Seong-Ju Park; *GIST, Republic of Korea*.

CWB3, **Resonant-Cavity LED Transceiver Arrays for Optical Wireless CommunicatIons**, Gareth Parry; *Imperial College, United Kingdom*.

QELS INVITED SPEAKERS

QELS 01: Cold Atoms and Molecules, Atom Optics

QThC2, **Coherent Matter Wave Optics on an Atom Chip**, Peter Krueger; *Univ. of Heidelberg, Germany*.

QThC4, **Optical Lattice Clock: Towards Frequency Measurement at 10-18 Level**, Hidetoshi Katori; *Univ. of Tokyo, Japan*.

QThG4, **Atomic Quantum Simulator for Lattice Gauge Theories and Ring Exchange Models**, Hans Buechler; *Univ. of Innsbruck, Austria*.

QELS 02: Quantum Optics and Quantum Information

QMA1, **Quantum Communication Based on Multi-photon Entanglement**, Jian-Wei Pan, Yu-Ao Chen, Qiang Zhang; *Univ. Heidelberg, Germany*.

QMD1, **Light-Matter Interface in Quantum Networks**, Dzmitry N. Matsukevich, Thierry Chaneliere, Stewart D. Jenkins, Shau-Yu Lan, T. A. Brian Kennedy, Alexander Kuzmich; *Georgia Tech, USA.*

QThD2, **Experimental Quantum Measurement: New Techniques and New Applications**, Aephraim M. Steinberg; *Ctr. for Quantum Information and Quantum Control, Inst. for Opt. Sci, Dept. of Physics, Univ. of Toronto, Canada*.

QELS 03: Fundamentals of Metamaterials, Periodic & Random Media

QTuF1, **Photonic Analogues of Electronic Phenomena**, Diederik S. Wiersma; *European Lab for Non-linear Spectroscopy and INFM-Matis, Italy*.

QTuI1, **Two-Scatterer Laser**, Hui Cao, Xiaohua Wu, Wei Fang, Andrey A. Chabanov, Alexey Yamilov; *Northwestern Univ., USA.*

QWE1, **Plasmonic Metamaterials and Superlens**, Xiang Zhang; *Univ. of California at Berkeley, USA.*

QFC1, **The Effect of Higher Order Dispersion on Slow Light Propagation in Photonic Crystal Waveguides**, Rob J. P. Engelen[1], Yoshimasa Sugimoto[2,3], Yoshinori Watanabe[3], Jeroen P. Korterik[4], Noaki Ikeda[2], Niek F. van Hulst[4], Kiyoshi Asakawa[2,3], Laurens Kuipers[1,4]; *[1]FOM Inst. AMOLF, Netherlands, [2]Femtosecond Technology Res. Association, Japan, [3]TARA Ctr., Univ. of Tsukuba, Japan, [4]Applied Optics Group, Univ. of Twente, Netherlands*.

QELS 04: Ultrafast Dynamics

QTuH3, **Ultrafast Manipulation of Antiferromagnetism of NiO**, M. Fiebig; *Max-Born-Inst., Germany*.

QTuK4, **Ultrafast Quantum Kinetics of Carrier-LO-phonon Interaction in Quantum Dots and Quantum Wells**, P. Gartner; *Univ. Bremen, Germany*.

QThB2, **Dynamics of Cold Excitons in Cu2O by Time-Resolved Lyman Spectroscopy**, Makoto Kuwata-Gonokami; *Univ. of Tokyo, Japan*.

QELS 05: Nonlinear Optics and Novel Phenomena

QFE1, **10-THz Repetition-Rate Ultrashort-Pulse Generation by Synthesizing Phase-Coherent Raman-Sidebands**, Masayuki Katsuragawa[1], Takashi Onose[1], Keitaro Yokoyama[1], Kazuhiko Misawa[2]; *[1]Univ. of Electro-Communications, Japan, [2]Tokyo Univ. of Agriculture and Technology, Japan.*

QTuJ2, **Nanophotonics Under a Scanning Electron Microscope: Studying Resonator-less All-Optical Switching and Memory Functionality in Gallium Nanoparticles**, Kevin F. MacDonald, Max V. Bashevoy, Andrey I. Denisyuk, Fredrik Jonsson, Bruno F. Soares, Nikolay I. Zheludev; *Univ. of Southampton, United Kingdom*.

QTuJ5, **Double Resonance in Nanostructured Optical Materials and Negative Refractive Index Properties**, Ildar R. Gabitov; *Univ. of Arizona, USA.*

QWC1, **Nonlinear Optics at Very Low Power Levels**, Marin Soljacic[1], Aristeidis Karalis[1], Elefterios Lidorikis[1], Mihai Ibanescu[1], Lene V. Hau[2], J. D. Joannopoulos[1]; *[1]MIT, USA, [2]Harvard Univ., USA.*

QFE1, **10-THz Repetition-Rate Ultrashort-Pulse Generation by Synthesizing Phase-Coherent Raman-Sidebands**, Masayuki Katsuragawa[1], Takashi Onose[1], Keitaro Yokoyama[1], Kazuhiko Misawa[2]; *[1]Univ. of Electro-Communications, Japan, [2]Tokyo Univ. of Agriculture and Technology, Japan.*

QELS 06: Nano-Optics and Plasmonics

QMC1, **Linear and Nonlinear Optical Properties of Strongly Coupled Metal Nanoparticles**, Harald Giessen; *Univ. Stuttgart, Germany, Germany*.

QTuD1, **Ordered Photon Emission from Single CdSe Nanocrystals**, Moungi Bawendi; *MIT, USA.*

QThI1, **Optical Generation and Dephasing of Spin Coherence in Quantum Dots**, Manfred Bayer; *Univ. Dortmund, Germany, Germany*.

CLEO/QELS 07: High-Field Physics and High-Intensity Lasers

JTuG1, **Current Status of Fast Ignition and Its Prospect at Osaka University**, Kazuo Tanaka; *Osaka Univ., Japan*.

JThA3, **X-ray and Proton Measurements from Petawatt Laser Interactions**, Pravesh K. Patel; *Lawrence Livermore Natl. Lab, USA.*

JThB1, **Thomson Backscattering from Laser-Accelerated Electrons**, Roland Sauerbrey; *Friedrich-Schiller-Univ. Jena, Germany*.

JThE1, **Few-Cycle Chirped-Pulse Parametric Amplification**, Andrius Baltuska, Nobuhisa Ishii, Takao Fuji, Ferenc Krausz; *MPQ, Germany*.

JFA1, **Multielectron Dynamics in Ultrafast Laser Atom Interactions**, Robert Moshammer; *Max-Planck-Inst. für Kernphysik, Germany*.

JFB1, **Imaging of Molecular Orbitals and Attosecond Pulses**, David Villeneuve; Steacie Inst. for Molecular Science, *Natl. Res. Council of Canada, Canada*.

SPECIAL SYMPOSIA INVITED SPEAKERS

CLEO/QELS Symposium: Enabling Quantum Technologies

JTuA1, **Measurement Induced Entanglement for Excitation Stored in Remote Atomic Ensembles**, Hugues de Riedmatten[1], Chin-wen Chou[1], Daniel Felinto[1], Sergey Polyakov[1], Steven van Enk[2], Jeff Kimble[1]; *[1]Caltech, USA, [2]Bell Labs, Lucent Technologies, USA*.

JTuC1, **Nanophotonic Devices for Quantum Information Processing**, Jelena Vuckovic, Dirk Englund, Edo Waks, Ilya Fushman, Andrei Faraon; *Stanford Univ., USA*.

JTuF1, **Recent Advances in Solid-State Single Photon Detectors**, Danna Rosenberg[1], Sae Woo Nam[2], Richard P. Mirin[2], Philip A. Hiskett[1], Jane E. Nordholt[1]; *[1]Los Alamos Natl. Lab, USA, [2]NIST, USA*.

QELS Symposium: Nonlinear Nanophotonics

QThA1, **Fiber on a Chip: Nonlinear Optics in Silicon Photonic Wires**, Richard Osgood; *Columbia Univ., USA*.

QThE1, **Nonlinear Photoelectron Imaging of Surface Plasmons in Nanostructures**, Hrvoje Petek; *Univ. of Pittsburgh, USA*.

QThE5, **Nonlinear Optics of Surface Plasmon Polaritons at the "Planck" Scale**, Igor I. Smolyaninov; *Univ. of Maryland, USA*.

CLEO TUTORIALS

CLEO 01: Laser Processing and Optical Instrumentation

CMP1, **Chemically Assisted Laser Processing**, Dieter Bäuerle; *Johannes-Kepler-Univ., Austria*.

CLEO 02: Solid-State Lasers

CThU1, **Solid-State Raman Lasers**, James A. Piper; *Macquarie Univ., Australia*.

CLEO 03: Semiconductor Lasers

CThM1, **VCSELs, VECSELs, and MicroCavity Semiconductor Lasers**, Martin Dawson; *Univ. of Strathclyde, Inst. of Optics, United Kingdom*.

CLEO 04: Applications of Nonlinear Optics

CFM4, **Phase-Conjugate Solid-State Lasers**, David Rockwell; *Raytheon, USA*.

CLEO 05: Terahertz Technologies and Applications

CTuF1, **Quest to Semiconductor Intraband Terahertz Lasers: From p-Ge Intersubband and CR Lasers to Cascade and Si Donor Raman Lasers**, Alexander A. Andronov; *Inst. for Physics of Microstructures, Russian Acad. of Sciences, Nizhny Novgorod, Russian Federation*.

CLEO 06: Optical Materials, Fabrication & Characterization

CFE4, **Quantum-Dot Based Optolelectronic Devices**, Yasuhiko Arakawa; *Univ. of Tokyo, Inst. of Industrial Science, Japan*.

CLEO/QELS 07: High-Field Physics and High-Intensity Lasers

JTuE1, **High Harmonic Generation and Attosecond Pulses**, Kenneth J. Schafer; *Louisiana State Univ., USA*.

CLEO 08: Ultrafast Optics, Optoelectronics & Applications

JTuB1, **Ultra-Fast Plasmonics: Nanometer-Attosecond World**, Mark I. Stockman; *Georgia State Univ., USA*.

CLEO 09: Optical Components, Interconnects & Processing

CWE4, **Advances in Low Vpi LiNbO3 Modulators and Optical Switches**, Walt Charczenko; *EOSPACE Corp., USA*.

CLEO 10: Medical and Biological Applications

CMZ1, **Optical Coherence Tomography**, Jim Fujimoto; *MIT, USA*.

CLEO 11: Fiber and Guided-Wave Lasers & Amplifiers

CWM1, **Nonlinear Materials and Devices for Optical Communication Systems**, Barry Luther-Davies; *Australia Natl. Univ., Australia*.

CLEO 12: Lightwave Communications and Networks

CThE1, **Optical Fiber Nonlinearity: From Fundamental Physics to Communication Systems**, Rene-Jean Essiambre; *Lucent Technologies, Inc., USA*.

CLEO 13: Active Optical Sensing

CThDD1, **Introduction to Ultra-Trace Laser Spectroscopy and Its Industrial Applications**, Eric Crosson; *Picarro, Inc., USA*.

CLEO 14: Optical Metrology

CMF1, **Quantum Information Processing with Trapped Ions**, Rainer Blatt; *Leopold-Franzens Univ. Innsbruck, Austria*.

CLEO 15: LEDs, Organic LEDs and Solid-State Lighting

CTuDD1, **The Light-Emitting Field Effect Transistor: A Novel Optoelectronic Device Concept**, Alan Heeger, James Swensen, Cesare Soci; *Univ. of California at Santa Barbara, USA.*

CTuDD2, **Innovations in Solid-State Lighting**, E. Fred Schubert; *Rensselaer Polytechnic Inst., USA.*

CLEO/QELS 07: High-Field Physics and High-Intensity Lasers

JTuE1, **High Harmonic Generation and Attosecond Pulses**, Kenneth J. Schafer; *Louisiana State Univ., USA.*

QELS TUTORIALS

QELS 02: Quantum Optics and Quantum Information

QMJ1, **Electronic Quantum Computing**, David DiVincenzo; *IBM, USA.*

QELS 03: Fundamentals of Metamaterials, Periodic & Random Media

QWA1, **Dynamic Control of Light by Photonic-Crystal Resonator-Waveguide-Coupled System**, Masaya Notomi, T. Tanabe, E. Kuramochi, A. Shinya, H. Taniyama, S. Mitsugi; *NTT Basic Res. Labs, Japan.*

QELS 05: Nonlinear Optics and Novel Phenomena

QTuG4, **Nonlinear Waves and Solitons in Photonic Lattices**, Mordechai (Moti) Segev[1], Demetri N. Christodoulides[2]; [1]*Technion, Israel,* [2]*School of Optics, CREOL, Univ. of Central Florida, USA.*

CLEO/QELS 07: High-Field Physics and High-Intensity Lasers

JTuE1, **High Harmonic Generation and Attosecond Pulses**, Kenneth J. Schafer; *Louisiana State Univ., USA.*

Special Symposia

CLEO/QELS Symposium on Enabling Technologies for Quantum Communication

Organizers:
CLEO - Matthew Goodman and Robert Runser; *Telcordia Technologies, USA*
QELS - Carl Williams and Joshua Bienfang; *NIST, USA*

Invited Speakers

Recent Advances in Single Photon Detectors; *Danna Rosenberg, NIST, USA*

Nanophotonic Devices for Quantum Information Processing; *Jelena Vuckovic, Stanford Univ., USA*

The joint CLEO/QELS symposium on Enabling Technologies for Quantum Communication is a forum for the advance of Quantum Optics components critical to quantum information and quantum communication technology. Part of the focus will be on technologies for practical quantum information systems, particularly quantum cryptography and quantum computing. This includes novel single-photon sources, detectors, and low-loss optical switching systems and other components. Additionally, practical systems-level implementations, advanced testbeds, and field trials of new quantum information applications will be emphasized. The symposium will also cover components for quantum information technologies, including sources, measurement, and processing of entanglement, squeezing and other non-classical states of light, Bell tests, quantum-enhanced measurements, and the application of quantum dots, BEC, and EIT to quantum information and communication.

QELS Symposium on Nonlinear Nanophotonics

Organizers:
Jacob Khurgin, *Johns Hopkins Univ., USA*
Mark Stockman, *Georgia State Univ., USA*
Yurii Vlasov, *IBM, TJ Watson Res. Ctr., USA*
Ulrike Woggon, *Univ. of Dortmund, Germany*

Invited Speakers

Nonlinearities in SOI Photonic Wires; *Richard Osgood, Columbia Univ., USA*

Nonlinear Photoelectron Imaging of Surface Plasmons in Nanostructures; *Hrvoje Petek, Univ. of Pittsburgh, USA*

Nonlinear Optics of Surface Plasmon Polaritons at the Planck Scale; *Igor Smolyaninov, Univ. of Maryland, USA*

The QELS Symposium on Nonlinear Nanophotonics is devoted to nonlinear optical phenomena occurring on subwavelength and nanometer scales in nanostructured systems, both synthesized

and naturally occurring, and metamaterials (composites) consisting of metals, semiconductors, and dielectrics. Both fundamental phenomena and their applications in sensing, nonlinear spectroscopy of nanostructures, nanoimaging, nanolithography, optical computing on the nanoscale, limiters, and others are within the scope. Topics include, but are not limited to, enhancement of optically-nonlinear phenomena, nonlinear surface plasmons and polaritons, nonlinear photoelectron emission, surface plasmon lasers (spasers), locally-enhanced stimulated emission and superradiance, and coherent control of nanophotonic phenomena.

Plenary

Defense Applications for Emerging Opto-Electronic Technologies, *Robert F. Leheny, Deputy Director, Defense Advanced Research Projects Agency*

CLEO Plenary Speaker - Monday Plenary Session

Fiber Lasers: The Next Generation, *David Payne, Univ. of Southampton, UK*

While at kW levels fiber lasers have already had a substantial impact on markets for laser marking, cutting and welding, this is just the beginning. Prospects for beam combination, visible sources, MW pulsed and other revolutionary configurations are exciting.

Professor David N. Payne, CBE, FRS, FREng is the Director of the Optoelectronics Research Centre at the University of Southampton, one of the world's best-known photonics research laboratories. He led the team that invented the fibre laser and amplifier and over the past 30 years has made many other key advances in optical fibre communications. He is also Director and Founder of SPI Lasers plc.

In recognition of his work, Professor Payne is a frequent invited speaker at major international conferences, particularly in the USA and Japan . He has won the 1991 John Tyndall Award (USA) for his outstanding contribution to the design, measurement and fabrication of optical fibres, sensors and fibre devices, the 1991 Rank Prize for his contribution to the advancement of optoelectronics and the Japanese Computers and Communications Prize.

In 1998, Professor Payne was awarded the prestigious Benjamin Franklin Medal (USA), making him one of the only individuals to have won the top European, American and Japanese prizes for optical telecommunications. In 2001 Professor Payne was awarded the Basic Research Award by the Eduard Rhein Foundation, and in 2002 the Mountbatten Medal of the IEE. For his unique contributions to both science and engineering, in 2004 he was awarded the Kelvin medal by the combined UK Societies.

Prof Payne is an original member of the world's most highly cited, influential researchers, as determined by ISI in the USA . He is a Fellow of the Royal Society, the Royal Academy of Engineering, the IEE and the Optical Society of America.

CLEO Plenary Speaker - Wednesday Plenary Session

The Mars Laser Communications Demonstration Project, *Don Boroson, MIT Lincoln Lab, USA*

From 2003 to 2005, NASA ran a project which was to have demonstrated the world's first interplanetary laser communications system. With a space terminal, built by MIT Lincoln Laboratory, to have flown on the 2009 Mars Telecom Orbiter, and two Earth-based terminals, built by Lincoln and by the Jet Propulsion Laboratory, the system was to have demonstrated up to 50 Mbps. In this presentation, we will discuss how, despite the cancellation of the project in the face of NASA's recent strategic redirection, the project's legacy will likely influence many future lasercom systems.

Don M. Boroson was born in Brooklyn , NY in 1951. He earned B.S.E. and Ph.D. degrees in electrical engineering from Princeton University . Since receiving his degree, he has worked at the MIT Lincoln Laboratory in Lexington , Massachusetts , where he is presently a senior staff member in the Optical Communications Technology Group. At Lincoln , Dr Boroson has worked in a diverse set of areas in communications including signal processor and receiver architecture design, beamforming algorithm design and analysis, modulation and coding design, satellite system engineering, large system integration and test, and space-ground network design. He has published widely, and was co-author of "A System Architecture for the MILSTAR Teleport", an early attempt to create a simple global military space-ground network, which won Best Paper at MILCOM 96. Since the mid-1980's, Dr Boroson has led several projects designing, building, and comprehensively testing high data rate laser communications systems for space applications. This laboratory experience led to his acting as Lincoln 's Lead Engineer for the GeoLITE mission, the world's first successful demonstration of high-rate, space-based lasercom. Recently, Dr Boroson was selected to be the Lead System Engineer on NASA's Mars Laser Communications Demonstration, a joint project with Lincoln, JPL, and NASA, which was to have been the first demonstration of interplanetary laser communications.

QELS Plenary Speaker - Wednesday Plenary Session

Quantum Phenomena in Optical Communications Systems: Is the Quantum Internet Next?
Richart E. Slusher, Lucent Technologies Inc., USA

Quantum phenomena are critical in determining the channel capacities of today's optical communications systems. Future quantum optical repeaters are described that will enable

quantum teleportation, distributed quantum computing and high security quantum channels over a global quantum internet.

Richart E. Slusher is director of the Quantum Information and Optics Research Department at Bell Labs, Lucent Technologies, in Murray Hill, New Jersey. Slusher received his Ph.D. degree in physics from the University of California at Berkeley in 1965. His present research interests include nonlinear photonic crystals, quantum optics, and quantum computing using ion traps. He has contributed to a broad range of optical physics research including light scattering in semiconductors, solid and liquid helium and plasmas, self-induced transparency and photon echoes, laser annealing, new nonlinear materials, microdisk lasers, nonlinear optics and lasing in organic materials and solitons in fiber Bragg gratings. He and his collaborators were the first to observe squeezed light in 1985, a new quantum state of light with uncertainties in one field component below the standard quantum limit. He received the 1989 Einstein Award for Laser Science from the Laser '89 Conference and the 1995 Arthur Schawlow Prize in laser spectroscopy from the American Physical Society.

Short Course Schedule by Time

Sunday, May 21, 2006

9:00 a.m. - 5:30 p.m.
SC136 Understanding Lasers and Critical Optical Components, *Shaoul Ezekiel, MIT, USA.*
SC200 Laser Remote Sensing, *Timothy Carrig, Philip Gatt, Lockheed Martin Coherent Technologies, USA.*

12:30 p.m. - 3:30 p.m.
SC133 Reliability Methodologies for Fiber Optic Components, *David Maack, JDS Uniphase, USA.*
SC189 Quantum Technologies, *Ian Walmsley, Oxford Univ., UK.*
SC197 Fiber Wireless Communications, *Dalma Novak, Pharad, LLC, USA.*
SC199 Micro- and Nano-Machined Optics, *Ernst-Bernhard Kley, Friedrich-Schiller Univ. Jena, Germany.*

12:30 p.m. - 4:30 p.m.
SC194 Photonic Crystal Fibers and Devices, *Benjamin J. Eggleton, Univ. of Sydney, Australia.*

Monday, May 22, 2006

8:30 a.m. - 11:30 a.m.
SC147 Optical Fiber Communication Systems, *Alan Willner, Univ. of Southern California, USA.*

SC164 THz Technology, *Alan Cheville, Oklahoma State Univ., USA.*
SC165 Laser Diode-Pumped Solid-State Lasers, *Larry Marshall, Managing Director, Arasor, USA.*
SC195 Tunable Lasers, *Jens Buus, Gayton Photonics Ltd., UK.*
SC221 Nano-Photonics: Physics and Techniques, *Axel Scherer, Caltech, USA.*
NEW! SC271 Quantum Information - Technologies and Applications, *Prem Kumar, Northwestern Univ., USA ; Matt Goodman, Telcordia Technologies, USA.*
NEW! SC272 Biological and Chemical Sensing for Homeland Security, *Stephen Lane, Univ. of California at Davis/LLNL, USA; Thomas Huser, Univ. of California at Davis, USA.*

9:00 a.m. - 5:30 p.m.
SC219 Understanding Laser-Based Sensors, *Shaoul Ezekiel, MIT, USA.*

1:00 p.m. - 5:00 p.m.
SC123 Erbium-Doped Fiber Amplifiers and Raman Fiber Amplifiers, *John Zyskind, Optovia Inc., USA.*
SC149 Foundations of Nonlinear Optics, *Robert Fisher, R. A. Fisher Associates, USA.*
SC157 Laser Beam Analysis, Propagation, and Shaping Techniques, *James Leger, Univ. of Minnesota, USA.*
SC160 Microwave Photonics, *Keith Williams, NRL, USA.*
SC245 New Directions in Nanoscale Lithography and Pattern Transfer, *Steven Brueck, Univ. of New Mexico, USA.*
NEW! SC270 High Power Fiber Lasers and Amplifiers, *W. Andrew Clarkson, Optoelectronics Res. Ctr., UK.*

Tuesday, May 23, 2006

8:30 a.m. - 12:30 p.m.
SC163 Practical OPOs, *Malcolm Dunn, Univ. of St. Andrews, UK; Majid Ebrahim-Zadeh, Inst. de Ciencies Fotoniques, Spain .*
SC167 Advances in VCSELs and Microcavity Lasers, *Kent D. Choquette, Univ. of Illinois, USA; Weng Chow, Sandia Natl. Labs, USA.*
CANCELLED SC191 Tissue Optics: Fundamentals and Applications to Biomedical Optical and Laser Diagnostics, *Valery V. Tuchin, Saratov State Univ., Russian Federation.*
SC192 Fiber Optic Sensors: Principles and Applications, *Michel Digonnet, Stanford Univ., USA.*
SC196 Solid-State Lighting, *Ghassan Jabbour, Arizona State Univ., USA; E. Fred Schubert, Rensselaer Polytechnic Inst., USA.*
SC220 Diffractive Optics, Design, Analysis and Applications, *James Leger, Univ. of Minnesota, USA.*
CANCELLED SC247 Tabletop EUV Sources for Nanoscale Microscopy and Metrology, *Margaret Murnane, JILA, USA; David Attwood, Univ. of California at Berkeley, USA; Jorge Rocca, Colorado State Univ., USA.*

1:30 p.m. - 5:30 p.m.
SC143 Introductory and Intermediate Topics in Polarized Light, *Robert Fisher, R. A. Fisher*

Associates, USA.
NEW! SC153 Quasi-Phasematching for Wavelength Conversion and All-Optical Nonlinear Processing, *Peter G. Smith, Univ. of Southampton, UK.*
SC154 Quantum Well Devices for Optics and Optoelectronics, *David A. Miller, Stanford Univ., USA.*
SC155 Ultrashort Laser Pulse Measurement, *Rick Trebino, Georgia Tech, USA.*
SC166 Photonic Crystal Devices and Integrated Circuits, *Ahmed Sharkawy, Univ. of Delaware, USA.*
SC182 Biomedical Optical Diagnostics and Sensing, *Thomas Huser, Univ. of California at Davis, USA.*
SC198 Packaging of Optoelectronic Components, *Andreas Rose, Ondine Biopharma Corp., USA.*