

CLEO/IQEC 2004

Technical Conference: May 16-21, 2004

Exhibit: May 18-20, 2004

Moscone Center West, San Francisco, CA, USA

CLEO/IQEC 2004 was a resounding success! With a 31% increase in papers, this year's conference boasted 1,733 presentations and 16 parallel sessions. The introduction of *PhAST*, the collocated conference focused on Photonic, Applications Systems and Technologies, provided attendees with another option for analyzing applications of laser science and quantum electronics, emphasizing such timely topics as biophotonics instrumentation, photonics for national security and lasers in manufacturing.

CLEO/IQEC 2004 had an attendance of 5,857, a 7% increase over 2003 attendance! With 2,674 technical attendees, the conference also saw a significant 10% increase in this area. Sessions including the celebration of the 50th anniversary of the maser, attosecond photonics, and the Plenary session itself were standing-room only. A buzz hovered around the conference this year and attendees were excited about the new information revealed.

The exhibit was also thriving in 2004, and 283 companies participated this year, unveiling new products and initiatives at CLEO! Companies came from around the world to showcase their materials. In fact, 20% of companies were from outside the United States, with a large number attending from Europe and the Pacific Rim.

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2. Solid-State Lasers

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3. Semiconductor Lasers and LEDs

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4. Applications of Nonlinear Optics

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5. Holography, Wavemixing, Photorefractives & Storage

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6. Optical Materials, Fabrication & Characterization

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7. High Field Lasers & Physics & Fusion Tech.

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8. Ultrafast Optics, Optoelectronics & Applications

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9. Optical Components: Interconnects & Processing

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10. Medical and Biological Applications

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11. Fiber and Guided-Wave Lasers, Amplifiers & Sensors

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Ulrike Woggon, *Univ. of Dortmund, Germany*

IQEC Program Committee

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Fujio Shimizu, *Inst. for Laser Science, Japan*

Ulrike Woggon, *Univ. of Dortmund, Germany*

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3. Periodic Media

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4. Ultrafast Dynamics

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5. Nonlinear Optics

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Susan Dexheimer, *Washington State Univ., USA*
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Kenneth Schepler, *US Air Force, USA*
Craig Siders, *Univ. of Central Florida, USA*
Nikolay Zheludev, *Univ. of Southampton, United Kingdom*

6. Nano-Optics

Selim Unlu, *Boston Univ., USA, Subcommittee Co-chair*
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Toshiharu Saiki, *Keio Univ., Japan*
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7. High Field Physics

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Daniele Hulin, *Ecole Polytechnique, France*
Chang Nam, *KAIST, South Korea*
Antoine Rousse, *Ecole Polytechnique, France*
Philip Sprangle, *Naval Res. Lab., USA*

8. Other topics in quantum electronics and laser science

Ulrike Woggon, *Univ. of Dortmund, Germany, Subcommittee Chair*
Daniel Kilper, *Lucent Technologies, Inc., USA*
Juergen Kuhl, *Max Planck Inst., Germany*
Margaret Murnane, *Univ. of Colorado Boulder, USA*

Invited Speakers

CLEO 2004 Invited Speakers

1. Laser Application and Optical Instrumentation Systems

Richard DeFreez, **Optical instrumentation for fluorescence-based detection of biological aerosols**, *Pacific Scientific Instruments, USA*

Peter Herman, **Biophotonics lab on a chip**, *Univ. of Toronto, Canada*

Chris Schaffer, **Laser-induced multi-photon imaging of hemorrhages in brain tissue**, *Univ. of California at San Diego, USA*

Xianfan Xu, **Laser machining using temporally controlled ultrafast pulses**, *Purdue Univ., USA*

2. Solid-State Lasers

Craig Denman, **Continuous wave sodium guide star laser systems**, *Air Force Res. Lab., USA*

Stefan Kueck, **Photon-avalanche pumped solid state lasers**, *PTB Germany, Germany*

Peter Moulton, **The changing technology of solid-state lasers**, *Q-Peak Inc., USA*

Wilson Sibbett, **Compact ultrashort-pulse lasers**, *Univ. of St. Andrews, UK*

3. Semiconductor Lasers and LEDs

Amber Abare, **Ultraviolet laser diodes**, *CREE, Inc., USA*

Shigehisa Arai, **1.5-um-wavelength single mode semiconductor lasers with deeply etched vertical grating**, *Tokyo Inst. of Tech., Japan*

Joseph P. Donnelly, **High-brightness slab-coupled semiconductor lasers with single-spacial, large-diameter mode**, *MIT Lincoln Lab., USA*

Claire Gmachl, **Nonlinear light generation in quantum cascade lasers**, *Princeton University, USA*

Steven Slivken, **High power quantum cascade lasers: A room temperature reality**, *Northwestern Univ., USA*

Motonobu Takeya, **400-nm-band high power lasers**, *Sony Shiroishi Semiconductor Inc., Japan*

4. Applications of Nonlinear Optics

Valentin Gapontsev, **Visible and UV colors generation by frequency conversion of fiber lasers and amplifiers**, *IPG Photonics Corp., USA*

Petra Gross, **Mid-IR continuous-wave fiber-laser-pumped optical parametric oscillators**, *Univ. of Twente, Netherlands*

Philip Russell, **Generation and wavelenth conversion of laser light in photonic crystal fibres**, *Univ. of Bath, UK*

Takunori Taira, **QPM devices based on MgO: PPLN with large aperture**, *Laser Res. Ctr. for Molecular Science, Japan*

William L. Wilson, **High density, high performance optical storage via volume holography: A product development status of the photonics holy grail**, *InPhase Tech., USA*

5. Holography, Wavemixing, Photorefractives, Storage and Wavefront Correction

Wm. Randall Babbitt, **Radar processing with spectral holography**, *Montana State Univ., USA*

Karsten Buse, **Optimization of the photorefractive response of lithium niobate crystals**, *Univ. Bonn, Germany*

6. Optical Materials, Fabrication and Characterization

Peter Michler, **Quantum optics of single quantum dots and single**

impurities, *Univ. of Bremen, Germany*

Clivia Sotomayor Torres, **Towards silicon-compatible 2D and 3D photonic crystals**, *Univ. of Wuppertal, Germany*

Kim Winick, **Fabrication and characterization of photonic devices directly written in glass using femtosecond laser pulses**, *Univ. of Michigan, USA*

8. Ultrafast Optics, Optoelectronics and Applications

Markus Drescher, **Attosecond physics: Time-resolved atomic inner-shell spectroscopy**, *Univ. Bielefeld, Germany*

Patrick Georges, **Directly diode-pumped oscillators and regenerative-amplifiers for ultra-short pulse generation**, *Univ. Paris Sud, France*

Andreas Liem, Jens Limpert, Andreas Tunnermann, Holger Zellmer, **High power femtosecond fiber CPA system and applications**, *Friedrich Schiller Univ. Jena, Germany*

Roy Taylor, **Ultrashort pulse generation from fiber based sources**, *Imperial College, UK*

Rick Trebino, **The measurement of unstable, ultracomplex, ultrabroadband, ultraweak, ultrashort pulses**, *Georgia Inst. of Tech., USA*

9. Optical Components: Interconnects and Processing

Joe Campbell, **High-speed, high-power photodiodes**, *Univ. of Texas at Austin, USA*

Christi Madson, **Signal processing with guided-wave optical filters**, *Lucent Techn., Inc., USA*

Richard Williamson, **Two decades of photonic analog-to-digital converters**, *MIT Lincoln Lab., USA*

10. Medical and Biological Applications

Mary Ann Fitzmaurice, **Raman spectroscopy and breast cancer: Looking beyond mammography for the early detection of breast cancer**, *Case Western Reserve Univ., USA*

Jerome Mertz, **Biological imaging techniques based on second harmonic generation**, *École Normale Supérieure de Paris, France*

Rebecca Richards-Kortum, **Optically active contrast agents for molecular imaging of cancer**, *Univ. of Texas at Austin, USA*

Urs Utzinger, **Optical signals of the ovary**, *Univ. of Arizona, USA*

11. Fiber and Guided-wave Lasers, Amplifiers and Sensors

Mike Durkin, **Advances in fibre Bragg gratings and application to fibre lasers**, *Southampton Photonics LTD, UK*

Morten Eriksrud, **Fiber optic instrumentation systems for the oil and gas industry**, *Optoplan AS, Norway*

Martijn van Eijkelenborg, **Microstructured polymer optical fibres**, *Univ. of Sydney, Australia*

Jens Limpert, **Continuous-wave and pulsed high performance fiber laser systems**, *Freidrich Schiller Univ. Jena, Germany*

12. Lightwave Communications and Networks

B. Roe Hemenway, **High bandwidth, low latency, burst-mode optical interconnect for high performance computing systems**, *Corning, Inc., USA*

Lynn Nelson, *OFS Fitel, USA*; Herwig Kogelnik, Peter Winzer, *Lucent Tech., USA*, **PMD and its impact in optical communication systems**

Morten Nissov, Jing-Xing Cai, Alexei Pilipetskii, Li Liu, Yi Cai, Dmitri Foursa, Carl Davidson, **Advanced modulation formats for long-haul optical transmission systems**, *Tyco Telecommunications, USA*

Kristian Stubkjaer, **Optical switching systems using nanostructures**, *Technical Univ. of Denmark, Denmark*

Keith Williams, **Components and subsystems for analog microwave photonics**, *NRL, USA*

13. Active Optical Sensing

William Von Drasek, **Laser-based multiple gas monitoring sensor for harsh combustion process control applications**, *American Air Liquid, USA*

Jay Jeffries, **Tunable diode laser sensors for combustion and propulsion applications**, *Stanford Univ., USA*

J. Yoshihito Hirano, **High-performance 1.5-micron coherent Doppler**

LIDAR systems for wind-field measurement, Mitsubishi Electric Corp., Japan

Jean-Pierre Wolf, **Probing the atmosphere using a femtosecond terawatt lidar, Univ. Claude Bernard Lyon 1, France**

14. Optical Metrology

Mathias Hain, **Liquid crystal adaptive optics to improve optical sensors, Darmstadt Univ. of Tech., Germany**

David Jones, **Optical transmission of frequency standards using femtosecond combs, JILA Univ of Colorado & NIST, USA**

Hidetoshi Katori, **Ultrastable optical clock with neutral atoms in an engineered light shift trap, Univ. of Tokyo, Japan**

Feng Zhao, **Picometer laser metrology for the Space Interferometer Mission (SIM), JPL, USA**

15. Displays and Solid-State Lighting Devices

Mary Crawford, **Recent advances in AlGaIn-based deep UV LEDs, Sandia Natl. Labs, USA**

Yoichi Taira, **LCD displays backlit with LEDs, IBM, Japan**

IQEC 2004 List of Topics

1. Cold Atoms, Coherent Atoms, and Atom Optics

Rudolf Grimm, *Inst. für Experimentalphysik, Austria*

Deborah Jin, *Univ. of Colorado, USA*

Ferdinand Schmidt-Kaler, *Univ. Innsbruck, Austria*

Tsutomu Yabuzaki, *Kyoto Univ., Japan*

2. Quantum Optics

Ignacio Cirac, **Fast quantum gates and coherent control with trapped ions, Max-Planck Inst. für Quanten, Germany**

Philippe Grangier, *Inst. d'Optique, France*

Kunchi Peng, **Experimental generation of multiparticle entanglement for continuous variables and its applications in quantum communication**, *Shanxi Univ., China*

3. Fundamental Optics in Periodic and Random Media

Azriel Genack, **Light localization in disordered media**, *City Univ. of New York, USA*

Vladimir Shalaev, **Left-handed photonics with plasmonic nanomaterials**, *Purdue Univ., USA*

Willem Vos, **Physics of photonics crystals**, *Univ. of Twente, Netherlands*

4. Ultrafast Dynamics

Guglielmo Lanzani, **Ultrafast studies of organic polymers**, *Politecnico di Milano, Italy*

Christoph Lienau, **Ultrafast studies of single semiconductor quantum dots**, *Max-Born-Inst., Germany*

Katsumi Midorokawa, **Generation of applications of high intensity XUV lights by high-order harmonics**, *RIKEN, Japan*

Philippe Roussignol, **Ultrafast dynamics in carbon nanotubes**, *École Normale Supérieure, France*

Fabrice Vallee, **Ultrafast electron-phonon scattering in silver nanoparticles**, *CNRS Univ. de Bordeaux I, France*

5. Nonlinear Optics

Yoshinori Tokura, **Nonlinear magneto-optical Kerr rotation of an oxide superlattice with artificially broken symmetry**, *Univ. of Tokyo, Japan*

Jonathan Underwood, **Nonlinearly switched wave packets**, *Natl. Res. Council Canada, Canada*

George Welch, **New applications of electromagnetically induced transparency**, *Texas A&M Univ., USA*

Joseph Zyss, **Nonlinear spectroscopy of single molecules**, *LPMC - ENS Paris, France*

6. Nano-optics

Bennett Goldberg, **High-resolution subsurface imaging, solid immersion lens microscopy**, *Boston Univ., USA*

Eli Kapon, **Optics of nanostructures and nanostructure arrays**, *Swiss Federal Inst. of Tech., Switzerland*

Brahim Louis, **Sources of single photons and single semiconductor nanocrystals**, *Univ. Bordeaux, France*

Kazunari Matsuda, **Near-field optical mapping of exciton and biexciton wavefunctions confined in a semiconductor quantum dot**, *Kanagawa Acad. of Science and Tech., Japan*

Jörg Wrachtrup, **Manipulation and measurement of quantum states of single spins**, *Univ. of Stuttgart, Germany*

7. High-Field Physics

Ferenc Krausz, **Measurement of single attosecond pulses and first applications**, *Max-Planck Inst. Quantum Optics, Germany*

Karl Krushelnick, **Electrons and protons with a petawatt scale laser**, *Imperial College, UK*

Kim Ta Phuoc, **All optically driven femtosecond KeV X-ray source**, *École Polytechnique, France*

Tutorials

2. Solid-State Lasers

Tso Yee Fan, **Laser beam combining: Techniques and prospects**, *MIT Lincoln Lab., USA*

3. Semiconductor Lasers and LEDs

Alfred Forchel, **GaInNAs and quantum dot lasers - GaAs based lasers for telecommunication**, *Tech. Physik, Germany*

4. Applications of Nonlinear Optics

David Hanna, **Nonlinear frequency conversion in quasi-phase-matched materials**, *Univ. of Southampton, UK*

6. Optical Materials, Fabrication and Characterization

Stephen Quake, **Photonic Microfluidics**, *Caltech MS, USA*

8. Ultrafast Optics, Optoelectronics and Applications

Paul Corkum, **Attosecond science**, *Natl. Res. Council of Canada, Canada*

9. Optical Components: Interconnects and Processing

Monique Renaud, **Signal processing with semiconductor optical amplifiers**, *Alcatel CIT, France*

11. Fiber and Guided-wave Lasers, Amplifiers and Sensors

Steve Cundiff*, Alexander Gaeta**, **Noise and pulse properties of continuum generation in microstructured fiber**, **JILA/Univ. of Colorado, USA, **Cornell Univ., USA*

15. Displays and Solid-State Lighting Devices

Nadarajah Narendran, **Solid-state lighting**, *Rensselaer Polytech. Inst., USA*

Special Symposia

Energetic Ultrafast Laser-Driven Radiation Sources

Organizers:

Donald Umstadter, *Univ. of Michigan, USA*

Martin Richardson, *Univ. of Central Florida, USA*

This joint symposium highlights a new generation of compact, ultrafast and energetic radiation sources which are driven by high-intensity, short-pulse laser systems. The radiation that can be generated from a number of unique laser-matter interactions includes attosecond-duration x-rays, and MeV-energy electrons, protons, neutrons and positrons. By combining ultrahigh spatial resolution with ultrahigh temporal resolution, these new sources open new avenues on the frontier of ultrafast science. Contributions are solicited in these areas of fundamental research as well as on potential applications.

non-destructive testing, remote sensing, space propulsion, medical imaging, advanced medical therapies, and advanced nuclear fusion.

Nonlinear Photonics in Optical Lattices

Organizers:

Hui Cao, *Northwestern Univ., USA*

Konstantin Vodopyanov, *Stanford Univ., USA*

This joint CLEO/IQEC symposium will be focused on nonlinear optical phenomena in photonic crystals, waveguide or fiber arrays, and optically induced lattices, where nonlinear optical properties can be tailored for specific applications by the modification of the density of optical states in periodic structures. The scope will also include new physical phenomena that result from the interplay between optical nonlinearities and structural periodicities. The symposium will provide a forum for the latest and most exciting discoveries and applications in the following areas:

1. Switching, limiting, bistability, and frequency conversion in nonlinear periodic structures.
2. Modulation instabilities, discrete solitons, intrinsic localized modes, and dynamic breathers in nonlinear waveguide arrays and optically induced lattices.
3. Nonlinear phenomena in micro-structured (holey) fibers, such as super-continuum generation, and applications to optical communication, metrology, etc.
4. Photonic crystal lasers and amplifiers.
5. Spatio-temporal (gap) solitons in fiber gratings.
6. Shock waves, vortices, and dynamic singularities in nonlinear periodic media.
7. Light propagation and interaction in nonlinear photonic lattices, discrete diffraction and diffraction management.
8. Slow-Light Nonlinear Photonics.

Spin Photonics: Light-spin interactions in semiconductors, metals, and quantum dots

Organizer:

Ilias E. Perakis, *Univ. of Crete, Greece and Vanderbilt Univ., USA*

The interplay between spin correlations and nanometer scale confinement leads to new physical phenomena for which the underlying physical mechanisms are yet to be understood. Recent advances have shown that linear and nonlinear ultrafast optical spectroscopy are powerful tools for studying and also for controlling the spin and the magnetization dynamics in semiconductors, magnetic metal films or nanoparticles, and semiconductor quantum dots, undoped or doped with magnetic impurities. Beyond the fundamental issues, understanding the coupling of spin to light is important for practical applications. For example, the performance of magneto-optical devices depends on the ability of the magnetization to respond to a driving time-dependent external field, optical or electrical, and the speed of such devices is controlled by the spin dynamics. Magnetism and electron spin have long been important for information storage, and sophisticated technologies based on magnetic metals, such as MRAM (magnetic random access memory) with high switching rates, are already at an advanced stage. With ferromagnetic semiconductors, one could achieve a new class of multifunctional electronics that combine logic, storage, and communications on a single chip. Quantum dots are promising candidates

for quantum computation and fast information processing applications.

The goal of this symposium is to provide a forum to discuss the latest and most exciting efforts to light for studies and control of the spin properties of semiconductors, magnetic metal films, quantum dots and other nanoparticles.

Single-Photon Sources, Detectors and Applications

Organizers:

Gerhard Rempe, *Max-Planck Inst. for Quantum Optics, Germany*

Alan Migdall, *NIST, USA*

Todd Pittman, *Johns Hopkins Univ., Applied Physics Lab., USA*

Single photons in a well-defined mode of the radiation field have recently attracted a lot of attention. Besides exhibiting lots of fascinating physics, single photons find applications in state-of-the-art research fields like quantum communication and quantum networking, quantum cryptography and quantum-key distribution, deterministic quantum teleportation, secret quantum imaging and all-optical quantum computation. Until a few years ago, the only way to approximate a source of single photons was by attenuating a laser pulse or using parametric down-conversion (PDC) setups where photons are emitted in pairs, so one photon can be used to herald the existence of a second. These sources are presently used in a variety of fascinating single-photon experiments. But the inherent limitations of these sources together with the development of novel single-photon applications has fuelled efforts to develop new light sources that are able to emit a deterministic stream of single photons. In addition to significant improvements to PDC-based sources, the new sources proposed and/or demonstrated employ, e.g., molecules, single atoms trapped in a dipole laser, single atoms located in a high-finesse cavity, atom-like vacancies in nano-crystals, and self-assembled semiconductor quantum dots in micro-cavities. Besides the fascinating goal to develop single-photon sources, better photon detectors, especially with the ability to resolve the number of photons in a light pulse, are needed. The symposium aims to bring together researchers from many different fields to survey the current state and latest developments, discuss existing limitations, deficiencies and opportunities for improvement.

Short Courses

CLEO 2004 will feature a broad repertoire of courses, covering information applicable to every attendee. The Courses are taught by highly regarded industry experts on subjects such as tunable lasers, laser remote sensing, nanophotonics,

and packaging.

Short Course Schedule

SUNDAY MAY 16, 2004

9:00am-5:30pm

SC136 Understanding lasers and critical optical components, Shaoul Ezekiel, *MIT, USA*

SC200 Laser remote sensing, Timothy Carrig and Phillip Gatt, *Coherent Tech. Inc., USA*

1:00pm-5:00pm

SC149 Foundations of nonlinear optics, Robert Fisher, *R. A. Fisher Associates, USA*

SC155 Ultrashort laser pulse measurement, Rick Trebino, *Georgia Inst. of Tech., USA*

SC182 Biomedical optical diagnostics and sensing, Steven Jacques, *Oregon Health and Science Univ., USA*

SC191 Tissue optics and spectroscopy, Valery Tuchin, *Saratov State Univ., Russian Federation*

SC198 Packaging of optoelectronic components, Andreas Rose, *Chromera Corp., USA*

MONDAY MAY 17, 2004

9:00am-5:30pm

SC219 **NEW!** Understanding laser-based sensors, Shaoul Ezekiel, *MIT, USA*

8:30am-12:30pm

SC123 Optical amplifiers in optical networks, John Zyskind, *USA*

SC160 Microwave photonics, Keith Williams, *NRL, USA*

SC163 Practical OPOs, Malcolm Dunn, *Univ. of St. Andrews, UK*; Majid Ebrahimzadeh, *Inst. de Ciencias Fotoniques, Spain*

SC167 Advances in vertical-cavity surface-emitting lasers and microcavity lasers, Kent Choquette, *Univ. of Illinois, USA*; Weng Chow, *Sandia Natl. Labs., USA*

SC194 Photonic crystal fibers and devices, Benjamin Eggleton, *CUDOS, Australia*

SC197 The merging of the wireless and fiber optic worlds, Dalma Novak, *Univ. of Melbourne, Australia*

2:00pm-5:00pm

SC147 Optical fiber communication systems, Alan Willner, *Univ. of Southern*

California, USA

SC164 THz technology, Xi-Cheng Zhang, *Rensselaer Polytechnic Inst., USA*

SC168 Fundamentals of laser diodes, Michael Ettenberg, *Suzmar LLC, USA*

SC189 Quantum technologies, Ian Walmsley, *Univ. of Oxford, UK*

SC220 **NEW!** Diffractive optics, design, analysis, and applications, James R.

Leger, *Univ. of Minnesota, USA*

SC221 **NEW!** Nano-photonics: Physics and techniques, Clivia Sotomayor

Torres, *Wuppertal Univ., Germany*

TUESDAY MAY 18, 2004

9:00am-12:00pm

SC108 Introduction to optoelectronic devices, Joe Campbell, *Univ. of Texas at Austin, USA*

SC133 Reliability methodologies for fiber optic components, David Maack, *JDS Uniphase Corp., USA*

SC151 Fundamentals of ultrashort pulse amplification, Christopher Barty, *Lawrence Livermore Natl. Lab., USA*

SC157 Laser beam analysis, propagation, and shaping techniques, James R. Leger, *Univ. of Minnesota, USA*

SC165 Laser diode-pumped solid-state lasers, Larry Marshall, *Lightbit Corp., USA*

SC199 Micro- and nano-machined optics, Ernst-Bernhard Kley, *Friedrich-Schiller Univ. Jena, Germany*

1:30pm-5:30pm

SC143 Introductory and intermediate topics in polarized light, Robert Fisher, *R.A. Fisher Associates, USA*

SC153 Quasi-phasematching for frequency conversion and all-optical signal processing, Martin Fejer, *Stanford Univ., USA*

SC166 Photonic crystal devices and integrated circuits, Dennis Prather, *Univ. of Delaware, USA*

SC192 Fiber optic sensors: Principles and applications, Michel Dignonnet, *Stanford Univ., USA*

SC193 Optical coherence tomography, Joseph Izatt, *Duke Univ., USA*

SC195 Tunable lasers, Jens Buus, *Gayton Photonics Ltd., UK*

SC196 **NEW!** Solid-state lighting, Steven Johnson, *Lawrence Berkeley National Lab., USA*; E. Fred Schubert, *Rensselaer Polytechnic Inst., USA*
