CLEO: 2013

Laser Science to Photonic Applications
Technical Conference: 8-13 June 2013
Expo: 8-13 June 2013
Short Courses: 8-10 June 2013
San Jose Convention Center, San Jose, CA, USA

The Conference on Lasers and Electro Optics (CLEO: 2013) concluded in San Jose, Calif. on June 14 after six days of technical sessions, special symposia, tutorials, business programming, exhibits and special events—all highlighting the latest research, applications and market-ready technologies in all areas of lasers and electro-optics. Attendees heard presentations from leading experts on hot topics such as lab-on-a-chip applications, high-power lasers, quantum dot technologies, attosecond physics, silicon photonics, and more.

The vital role of lasers in research and applications was evident in the more than 1,800 technical presentations in three core areas: CLEO: QELS - Fundamental Science, CLEO: Science & Innovations, and CLEO: Applications & Technology, as well as on the exhibit floor at CLEO: Expo—featuring 300 participating companies—and in the business-focused programming at CLEO: Market Focus.

Conference Program

The CLEO: 2013 conference program covers cutting edge topics presented under CLEO: QELS – Fundamental Science and CLEO: Science & Innovations' complete and up-to-date technical curriculum as well as this year's expanded Applications & Technology programming.

Hear breakthrough research during five days of in-depth technical sessions and network at key events like the Plenary Session and more.

Abstracts

- Monday (pdf)
- Tuesday (pdf)
- Wednesday (pdf)
- Thursday (pdf)
- Friday (pdf)

Agenda of Sessions and Key to Authors and Presiders

- Agenda of sessions (pdf)
- Key to Authors & Presiders (pdf)

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CLEO: 2013 Invited Speakers

FS 1: Quantum Optics of Atoms, Molecules and Solids

Tutorial Speaker

Quantum Simulation and Many-body Physics with Hundreds of Trapped Ions, John Bollinger; *NIST, USA*

Invited Speakers

A Cold-atom Laser with <1 Intracavity Photon, James Thompson; *Univ. of Colorado at Boulder JILA, USA*
Solid-state Quantum Memory for Quantum Communication, Mikael Tony Afzelius; *Universite de Geneve, Switzerland*

FS 2: Quantum Science, Engineering and Technology

Tutorial Speaker

Nonclassical States of Light, Ian A. Walmsley; *Univ. of Oxford, UK*

Invited Speakers

QKD Security, Renato Renner; *ETH Zurich, Switzerland*

Quantum Computation with Circuit QED Systems, Juan Jose Garcia-Ripoll; *CSIC Centro de Fisica Miguel A Catalan, Spain*
Quantum Imaging, Kevin Resch; *Univ. of Waterloo, Canada*

FS 3: Metamaterials and Complex Media

Tutorial Speaker

Hyperbolic Metamaterials, Evgenii E. Narimanov; *Purdue Univ., USA*

Invited Speakers

Color Production by Isotropic Nanostructures with Short-range Order in Bird Feather Barbs, Hui Cao; *Yale Univ., USA*

Negative Optical Force, Che Ting Chan; *Hong Kong Univ. of Science & Technology, Hong Kong*

Plasmonic Crystals, Anatoly V. Zayats; *Univ. of London King's College London, UK*
Topological Transitions in Metamaterials: QED and Related Effects, Vinod M. Menon; *Univ. of New York (CUNY), USA*

FS 4: Optical Excitations and Ultrafast Phenomena in Condensed Matter

Tutorial Speaker

Graphene: Optical Properties and Emerging Photonics Applications, Tony F. Heinz; *Columbia Univ., USA*

Invited Speakers

Transient Excitons at Metal Surfaces, Hrvoje Petek; *Univ. of Pittsburgh, USA*
Ultrafast Order Parameter Dynamics and Critical Phenomena of Ising-Nematic Phase in Iron Pnictides, Jigang Wang; *Iowa State Univ., USA*

FS 5: Nonlinear Optics and Novel Phenomena

Tutorial Speaker

Strong-field Effects in Metallic Nanostructures, Claus Ropers; *Georg-August-Universität Gottingen, Germany*

Invited Speakers

Bosonic Cascade Terahertz Lasers, Alexey Kavokin; *Univ. of Southampton, UK*

Optical Logic with Cascaded Silicon Microring Resonators, Minghao Qi; *Purdue Univ., USA*

FS 6: Nano-Optics and Plasmonics

Tutorial Speaker

The Chemical Design of Plasmonic Building Blocks, Christopher B. Murray; *Univ. of Pennsylvania, USA*

Invited Speakers

Chiral Plasmonics, David Norris; *ETH Zürich, Switzerland*
Graphene Nano-optoelectronics, Frank Koppens; *ICFO Barcelona, Spain*

Quantum Plasmons and Magnetic Metafluids, Jennifer Dionne; *Stanford Univ., USA*

FS 7: High-Field Physics and Attoscience

Tutorial Speaker

Laser Plasma Acceleration of Electrons and Plasma Diagnostics at High Laser Fields, Michael C. Downer; *Univ. of Texas at Austin, USA*

Invited Speakers

Attosecond Absorption Spectroscopy in Atoms and Molecules, Giuseppe Sansone; *Politecnico di Milano, Italy*
High-Order Harmonic Comb from Relativistic Electron Spikes, Alexander S. Pirozhkov; *JAEA, Japan*

View photographs of the invited speakers.

S&I 1: Light-matter Interactions and Materials Processing

Tutorial Speaker

Mechanisms of Nanoscale Materials Modification by Photon Beams, Alexander Shluger; *Univ. College London, UK*

Invited Speakers

Image-guided Ultrafast Laser Microsurgery Probes, Adela Ben-Yakar; *Univ. of Texas at Austin, USA*

Ultrafast Lasers in Industrial Applications, David M. Gaudiosi; *Raydiance Inc., USA*

S&I 2: Advanced Science and Technology for Laser Systems and Facilities

Tutorial Speaker

Scaling Thin Disk Lasers to High Power and Energy, Adolf Giesen; *German Aerospace Center, Germany*

Invited Speakers

Plasma as an Amplifying Medium: Raman CPA and the Transition to the Nonlinear Regime, Dino A. Jaroszynski; *Univ. of Strathclyde, UK*
Ultra-broadband Front-end Laser Development for the Apollon 10PW Laser, Patrick Georges; *Institut d'Optique, France*

S&I 3: Semiconductor Lasers

Tutorial Speaker

Photonic Crystal Lasers, Susumu Noda; *Kyoto Univ., Japan*

Invited Speakers

Electrically Driven Single Photon Source at Room Temperature by using Single NV Center in Diamond , Norikazu Mizuochi; *Osaka University, Japan*

Nanolasers Employing Epitaxial Plasmonic Layers, Chih-Kang (Ken) Shih; *Univ. of Texas at Austin, USA*
Polariton Lasing at Room Temperature, Nicolas Grandjean; *Ecole Polytechnique Federale de Lausanne, Switzerland*
Room-temperature Quantum Cascade Laser Sources of Terahertz Radiation,, Mikhail A. Belkin; *Univ. of Texas at Austin, USA*

S&I 4: Nonlinear Optical Technologies

Tutorial Speaker

Dissipative Solitons, a Novel Paradigm for Mode-locked Lasers, Philippe Grelu; *Universite de Bourgogne, France*

Invited Speakers

Advances in Hydrothermally Grown UV Nonlinear Crystals, Joseph W. Kolis; *Clemson Univ., USA*
High Average Power Few-cycle Pulses in the Mid-IR, Self-compression and Continuum Generation, Jens Biegert; *ICFO - Institut de Ciències Fotòniques, Spain*

Quantum Frequency Conversion of Single-Photon States by Three- and Four-Wave Mixing, Michael G. Raymer; *Univ. of Oregon, USA*
Ultra-stable CW OPOs in the Visible, Fabien Bretenaker; *Laboratoire Aime Cotton, France*

S&I 5: Terahertz Technologies and Applications

Tutorial Speaker

Terahertz Nano Antennas: Fundamentals and Applications, Dai-Sik Kim; *Seoul National Univ., South Korea*

Invited Speakers

Light-matter Interaction in Terahertz Meta-atoms, Juraj Darmo; *Vienna Univ. of Technology, Austria*
Scanning Laser THz Imaging System and its Application, Masayoshi Tonouchi; *Osaka Univ., Japan*
Terahertz Plasmonics and Metamaterial-Based Optics, Marco H. Rahm; *Technische Universität Kaiserslautern, Germany*

S&I 6: Optical Materials, Fabrication and Characterization

Tutorial Speaker

Plasmonic and Semiconductor Building Blocks for Nanophotonic Devices, Mark Brongersma; *Stanford Univ., USA*

Invited Speakers

Chemically Etched Ultra-High-Q Resonators, Kerry J. Vahala; *California Inst.. of Technology, USA*
Nanostructured Optical Polymer Surfaces by Imprinting and Injection Moulding , Anders Kristensen; *Danmarks Tekniske Universitet, Denmark*
Theory-guided Nano-engineering of Organic Electro-optic Materials for Integration with Silicon Photonics, Plasmonics, and Metamaterial Devices, Larry R. Dalton ; *Univ. of Washington, USA*

S&I 7: Micro- and Nano-Photonic Devices

Tutorial Speaker

Routes to Non-reciprocity in Nanophotonics: with or without Magneto-optics, Shanhui Fan; *Stanford Univ., USA*

Invited Speakers

Integrated Transmitters, Graham T. Reed; *Univ. of Southampton, UK*
Nanophotonic Structures for Extreme Nonlinearities On-chip , Michal Lipson; *Cornell Univ., USA*
Nano-plasmonics on Silicon and their Applications, Sailing He; *Zhejiang University, China; Joint Research Center of Photonics of the Royal Institute of Technology, Sweden*
Quantum Photonic Circuits, Jeremy O'Brien ; *Univ. of Bristol, UK*

SNAP: Fabrication of Ultra-low-loss Miniature Photonic Circuits with Sub-angstrom Precision, Mikhail Sumetsky; *OFS Laboratories, USA*
Sub-100µm Wide-Bandwidth Si Photonic Crystal MZI Modulators, Hong Chuyen Nguyen; *Yokohama National Univ., Japan*

S&I 8: Ultrafast Optics, Optoelectronics and Applications

Tutorial Speaker

Attosecond Time-scale Manifestations of Multi-electron Dynamics, Mark Vrakking; *Max Born Inst., Germany*

Invited Speakers

Atomic and Molecular X-ray Lasers, Nina Rohringer; *Center for Free-Electron Laser Science, Germany*
Coherent Synthesis of Ultra-broadband Optical Parametric Amplifiers, Cristian Manzoni; *IFN-CNR, Italy*
Light Scattering from Soliton-induced Relativistically Travelling Inhomogeneities, Daniele Faccio; *Heriot-Watt University, UK*
Optical Kerr Effect in the Strong Field Regime, Olivier Faucher; *Université de Bourgogne, France*

S&I 9: Components, Integration, Interconnects and Signal Processing

Tutorial Speaker

Photodetectors - UV to IR, Joe Charles Campbell; *Univ. of Virginia, USA*

Invited Speakers

Semiconductor Laser based Optical Frequency Combs for Applications in Microwave Photonics, Peter J. Delfyett,; *Univ. of Central Florida, USA*
TBD, Takahiro Nakamura; *PETRA, Japan*

S&I 10: Biophotonics and Optofluidics

Tutorial Speaker

Speaker listings coming soon

Invited Speakers

Advances in Super-resolution Fluorescence Microscopy, Joerg Bewersdorf; *Yale University Medical School, USA*
Optical Manipulation of Particles using Silicon Photonics, Andrew W. Poon; *Hong Kong Univ. of Science & Technology, Hong Kong*
Three-dimensional Polarization and Doppler Imaging of Living Tissue by Multi-functional Optical Coherence Tomography, Yoshiaki Yasuno; *Univ. of Tsukuba, Japan*

S&I 11: Fiber, Fiber Amplifiers, Lasers and Devices

Tutorial Speaker

Fiber Optical Parametric Amplifiers in Optical Communication, Michel E. Marhic; *Swansea Univ., UK*

Invited Speakers

2 Micron Fiber Lasers Using Multi-component Glass Fibers, Shibin Jiang; *AdValue Photonics, Inc., USA*
Nanoscale Metal Optics using Evanescent Fields from Fiber Cladding Modes, Jacques Albert; *Carleton Univ., Canada*
Optical Vortex Fiber Lasers and their Application to Material Nano-processing, Takashige Omatsu; *Chiba Univ., Japan*
Single-frequency Fiber Amplifiers for Gravitational Wave Detection, Peter Wessels; *Laser Zentrum Hannover e.V., German*
Single-mode Air-core Photonic Bandgap Fibers, Linli Meng; *OFS Laboratories, USA*
Ultrafast Optical Signal Processing, using Fiber Nonlinearities, Shu Namiki; *Natl. Inst. of Adv. Industrial Sci. & Tech., Japan*

S&I 12: Lightwave Communications and Optical Networks

Tutorial Speaker

Integrated Silicon Nanophotonics for High-bandwidth Chip-to-Chip Communications, Yurii A. Vlasov; *IBM TJ Watson Research Center, USA*

Invited Speakers

Signal Regeneration Techniques for Advanced Modulation Formats, Radan Slavik; *Univ. of Southampton, UK*
The Pursuit of Ultimate Photon Efficiency, Xiang Liu; *Bell Labs, Alcatel-Lucent, USA*

S&I 13: Active Optical Sensing

Tutorial Speaker

Progress in QCL for Spectroscopy Applications, Jérôme Faist; *ETH Zurich, Switzerland*

Invited Speakers

Recent Progress in High Precision Atmospheric Trace Gas Instruments using Mid-infrared Quantum Cascade Lasers, John Barry McManus; *Aerodyne Research Inc., USA*
TBD, Jim Anderson; *Harvard Univ., USA*

S&I 14: Optical Metrology

Tutorial Speaker

Attosecond Physics: The First Decade and Beyond, Ferenc Krausz; *LMU Muenchen and Max Planck Institute of Quantum Optics, Germany*

Invited Speakers

COMPASS – Towards Centimeter Positioning & Applications, Lijung Wang; *Tsinghua Univ., China*
Test of QED Effects in Molecules; Precision Laser Spectroscopy of H_2, Wim Ubachs; *Vrije Universiteit, Netherlands*

S&I 15: LEDS, Photovoltaics and Energy-Efficient ("Green") Photonics

Tutorial Speaker

Quantum Dots for Displays and Lighting, Seth Coe-Sullivan; *QD Vision Corporation, USA*

Invited Speakers

III-Nitride Nanowire LEDs, Nathan Gardner; *Glo USA, Inc., USA*
III-V Compound Semiconductor Nanowire Solar Cells, Takashi Fukui; *RCIQE, Hokkaido Univ., Japan*

A&T 1: Biomedical

Tutorial Speaker

Optogenetics: Molecular and Optical Tools for Controlling Life with Light, Ed Boyden; *MIT, USA*

Invited Speakers

Adaptive Optics Imaging for Studying Retinal Vasculature in Health and Disease, Stephen Allen Burns; *Indiana Univ., USA*
Fluorescence Lifetime Spectroscopy and Imaging for Clinical Diagnostics, Laura Marcu; *Univ. of California Davis, USA*
OCT Image Guidance for RFA Therapy of Cardiac Arrhythmias, Andrew M. Rollins; *Case Western Reserve Univ., USA*
OCT-Guided Eye Surgery, David Huang; *Oregon Health and Science Univ., USA*
Phase Contrast Endomicroscopy, Jerome C. Mertz; *Boston Univ., USA*

A&T 2: Environment/Energy

Tutorial Speaker

UV Nitride Semiconductor Lasers, Noble Johnson; *PARC, USA*

Invited Speakers

InGaN-Based Solar Cells and High-Performance Broadband Optical Coatings for Ultrahigh Efficiency Hybrid Multijunction Device Designs, Robert M. Farrell; *University of California, Santa Barbara, USA*

Laser-based Sensors for Water Vapor and Other Greenhouse Gases on NASA Aircraft, Glen Diskin; *NASA Langley, USA*
Multi Junction Solar Cells, Rebecca Jones-Albertus; *Solar Junction, USA*
Semipolar Faceting for InGaN-based Polychromatic LEDs, Mitsuru Funato; *Kyoto Univ., Japan*

A&T 3: Government & National Science, Security & Standards Applications

Invited Speakers

Electron-beam Based Coherent Radiators for Security and Defense, Sandra Biedron; *Colorado State University, USA*
High Power Laser Generated Fast Neutrons and their Applications, Satyabrata Kar; *Queen's University of Belfast, UK*
Laser-driven Radiation Sources for Penetrating Imaging, Robert M. Deas; *Defence Science and Technology Laboratory, UK*
Optimal Use of Laser Resources for Molecular Detection, Herschel Rabitz; *Princeton Univ., USA*

A&T 4: Industrial

Tutorial Speaker

A Pragmatic Guide to Building a Multi Photon Microscope with Applications to Micro Machining, Jeff Squier; *Colorado School of Mines, USA*

Invited Speakers

Atom Probe Tomography : An Imaging Tool at the Atomic Level using Ultrafast Laser Assisted Field Evaporation, Bernard Deconihout; *CNRS Université et INSA de Rouen, France*
Direct Joining and Welding with Ultrashort Laser Pulses, Wataru Watanabe; *Natl Inst of Adv Industrial Sci & Tech, Japan*
Precision Inertial and Time Measurement with Atoms Near Absolute Zero, Philippe Bouyer; *Institut d'Optique, France*

Special Symposia

Advances in Extreme UV Science and Applications

Joint CLEO: Applications & Technology/ CLEO: QELS–Fundamental Science/ CLEO: Science & Innovations

Symposium Organizer:
Patrick Naulleau, *Lawrence Berkeley National Laboratory, USA*
Jorge Rocca, *Colorado State, USA*
Michael Goldstein, *Intel and SEMATECH, USA*

Invited Speakers:
High Power EUV LPP, Danny Brown, *Cymer, USA*
Development of a Coherent EUV Scatterometry Microscope, Hiroo Kinoshita, *University of Hyogo, Japan*
Metrology Sources for EUV Lithography, Stephen Horne, *Energetiq, USA*
Probing of Atomic and Molecular Dynamics with Attosecond EUV Pulses, Stephen Leone, *Univ. of California Berkeley, USA*
Nanoscale Soft X-ray Microscopy in the Laboratory for Biological Applications, Arno Merkle, *Xradia, USA*
Coherent eUV High Harmonic Sources for Applications in Imaging, Margaret Murnane, *Univ. of Colorado at Boulder, USA*
High Average Power, 100Hz Repetition Rate, Table-top EUV/Soft X-ray Lasers, Brendan Reagan, *Colorado State Univ., USA*
The need for shorter wavelengths to perpetuate Moore's Law via next generation lithography, and to enable exciting potential future applications in biomedicine, surface science, and molecular dynamics is driving significant current investment in optics and sources for the extreme ultraviolet (EUV) spectral region. For example, in academia, major advances continue to be made in the development of tabletop EUV sources – based on discharge plasma sources and on high harmonic generation of ultrafast lasers - with potential future applications in EUV metrology and biomedical imaging. In industry, much higher power EUV sources based on laser induced plasmas are being developed for use as EUV exposure tools, while lower power sources are being integrated into EUV tools and measurement devices. Meanwhile unique, facility-class synchrotron sources are enabling a wide range of EUV science and technology in areas such as mask inspection, nano-magnetrism, nano-fabrication, and X-ray microscopy.

Applied Optical Measurements in Fabrication Processes and Products

CLEO: Applications & Technology

Symposium Organizers
Marla L. Dowell, *NIST, USA*
John H. Lehman, *NIST, USA*

Invited Speakers:
Laser Material Processing Inspired by Digitally-Scripted Genotype Sequencing, Henry Helvajian, *Aerospace Corporation, USA*
Recent Advances in Acousto-optic Tunable Filters for Hyperspectral Imaging with Real-time Spectral Unmixing, Chris Pannell, *Gooch and Housego, USA*
An Optically Enabled Biosensor for Medical Diagnostics, Chris Myatt, *Mbio Diagnostics, USA*
The Impact of Fiber Laser Technology on the World Wide Material Processing Market, Bill Shiner, IPG *Photonics, USA*

This session brings together researchers, instrumentation engineers and optical metrologists from both private and public sectors to share industrial and commercial applications, as well as cutting-edge advances in optical measurement science. Such science may provide the basis for new industrial measurement techniques or improved applications of optical measurements. In addition, the forum presents real-world challenges facing emerging commercial applications that might benefit from measurement science advances. The program will be a combination of invited and contributed talks. Topic areas may include spectroscopy, combustion diagnostics, high power laser measurements and semiconductor manufacturing.

Fundamentals of Absorption and Emission in Nanostructures and Composites
Joint CLEO: QELS–Fundamental Science/ CLEO: Science & Innovations
Symposium Organizers:
John B. Pendry*, Imperial College London, UK*
Viktor A. Podolskiy *University of Massachusetts Lowell, USA*

Invited Speakers:
Non-Markovian Radiation Dynamics in Photonic Band Gap Materials, Kurt Busch, *Max-Born-Institut, Berlin, Germany*
Optical absorption and emission in graphene, Javier Garcia de Abajo, *ICFO-The Institute of Photonic Sciences, Spain*
Quantum Plasmonics: Electron transfer and nonlocal screening in narrow metallic junctions, Peter Nordlander, *Rice University, USA*
Plasmon-assisted nanochemistry, Romain Quidant, *ICFO-Institut de Ciencies Fotoniques, Spain*

Nanostructures and complex composites with nanostructured components are emerging as the new frontier in optics, photonics, and plasmonics research. The topics related to fundamentals of light emission, propagation, and interactions in these structures are of great interest and importance for the broad optics community, spanning theoretical, experimental, and computational science. Given the breadth and the explosive growth of the research related to light interaction with nanoscale-based-systems, it appears both timely and necessary to bring together the experts in various aspects of light emission and interaction with complex systems under one unified roof of a symposium that will bring together researchers working on the broad theme of light interaction with nanostructured complex structures, ranging from plasmonics to composite media to optics of condensed matter. Some representative topics include lifetime engineering, energy transfer, and other novel optical phenomena in nanostructured systems.

High Power Diode Laser Arrays: Technology and Applications
Joint CLEO: Applications & Technology/ CLEO: Science & Innovations
Symposium Organizer:
Andy Bayramian, *NIF, USA*

Invited Speakers:
Cryolaser: Innovative Cryogenic Diode Laser Bars Optimized for Emerging Ultra-high Power Laser Applications, Paul Crump, *Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, Berlin, Germany*
Engineering Diode Laser Pumps for Extremely Large Scale Laser Systems, Bob Deri, *LLNL, USA*
Laser Diode Arrays – Designs and Production Techniques for Fusion Energy Power Plants, Ryan Feeler, *Northrop Grumman / Cutting Edge Optronics, USA*
High Efficiency kW-class QCW 88x nm Diode Laser Bars, Manoj Kanskar, *nLIGHT, USA*
High Power High Brightness Laser Diodes Sources, Andreas Kohl, *Quantel, France*
Scalable Compact Laser diode Array Technology for High Energy Applications, Prabhu Thiagarajan, *Lasertel, USA*
Diode lasers form the basis of many of the laser systems used today; either as a direct laser source, or used to pump a laser gain media. High power laser systems are coming into more widespread use in industry and have been demonstrated by many Universities and Government laboratories around the world in high power systems for scientific and defense applications. These high power systems require vast numbers of diode laser bars with high reliability, high efficiency, and high power. These characteristics are essential in the viability of these systems, where size, weight, and power consumption can be very high. This symposium will include talks by industry and the research community representatives on the future of diodes for this application, as well as descriptions of existing systems and systems to be built for defense applications, orbital debris clearing, additive manufacture, etc., where these large diode arrays play a pivotal role.

Lab-on-a-Chip Applications
CLEO: Applications & Technology
Symposium Organizer:
Christopher J. Myatt, MBio Diagnostics, Inc., USA
Invited Speakers:
Second Generation Multiplexed Diagnostics with Silicon Photonics, Cary Gunn, *Genalyte, USA*
Microfluidics Facilitated Genome Sequencing for Limited Number of Cells, Yanyi Huang, *Biodynamic Optical*

Imaging Center (BIOPIC), Peking University, China
SMART (Shrink Manufacturing Advanced Research Tools), Michelle Khine, *UC Irvine, USA*
New Microfluidic Technologies for Accelerating and Enhancing Molecular Binding Processes in Cartridge-format Assay Systems, Daniel Laser, *Wave80 Biosciences, Inc., USA*
Where the Rubber Meets the Road – Clinical Diagnostic Testing and New Technology, Valerie Ng, *Alameda County Med. Ctr., USA*
Computational On-Chip Imaging Toward Telemedicine Applications, Aydogan Ozcan, *UCLA, USA**From Lab-on-a-Chip to Lab-in-the Body: Miniaturization of Diagnostic Tools**, Axel Scherer, California Institute of Technology, USA*
***Lab on a Chip Fluorescence Measurements – from Single Biomolecules to Testing Standards,** Samuel Stavis, NIST, USA*
The ability to miniaturize and package multiple laboratory functions onto a single device promises exciting new applications in biomedical sciences, and photonics is an enabling technology for these applications. In this symposium, we will hear the latest results of applications enabled by photonics, at the intersection of microfluidics, biochemistry, and nanotechnology. Enabling technologies include the laser, LED, computing, and imaging technology developed for consumer electronics and mobile platforms, and adapted for biomedical applications. Emphasis will be on how science meets the demands of real-world applications. The symposium will not only feature discussion of new technology, but also perspectives from laboratory users and other stakeholders. Participants can expect to learn what it takes to translate a technology from "cool idea" and initial experiment to an application delivering real world results.

Mid-infrared Laser Sources

Joint CLEO: Applications & Technology/ CLEO: QELS–Fundamental Science/ CLEO: Science & Innovations

Symposium Organizers:
Konstantin Vodopyanov, *Stanford University, USA*
Jens Biegert, *ICFO - Institut de Ciencies Fotoniques, Spain*
Axel Ruehl, *CFEL - Center for Free-Electron Laser Science, Germany*

Invited Speakers:
New Beam Engineered and Spectrally Engineered Mid-ir Quantum Cascade Lasers by Transverse and Longitudinal Mode, Federico Capasso, *Harvard Univ., USA*
Frequency Comb Sources and Techniques for Mid-infrared Spectroscopy and Sensing, Scott Diddams, *NIST, USA*
Spatial-temporal Imaging in the Strong-field Limit, Louis F DiMauro, *Ohio State Univ., USA,*
Fe-doped II-VI Mid-Infrared Laser Materials for the 3 to 8 um, Vladimir Fedorov, *Univ. of Alabama at Birmingham and IPG Photonics, USA*
Mid-infrared (3 - 15 µm) laser sources became indispensable tools for a broad range of new research fields in chemistry, biology, medicine, physics and materials science. Even at moderate intensities, mid-infrared wavelengths result in higher electron and high-harmonic photon energies in strong-field interactions opening new possibilities for applications such as attosecond science. The ability to address molecular vibrations led to a remarkable progress in spectroscopy. Also in applied science, mid-infrared lasers become increasingly important for remote sensing, free space communications and material processing to name just a few.
This symposium will review the state-of-the-art in mid-infrared laser sources and discuss challenges and novel concepts in this fast growing field of research. It will also address nonlinear frequency conversion and amplification methods as well as different techniques for producing frequency combs and carrier-envelope phase-stabilized pulses in this challenging spectral region. The emerging interest in these sources for fundamental as well as applied science will bring together scientists across various disciplines.

Nanophotonics at the DOE/SC Nanoscale Science Research Centers

CLEO: QELS–Fundamental Science

Symposium Organizers:
Igal Brener, *Center for Integrated Nanotechnologies, Sandia National Laboratories,USA*
Jennifer Hollingsworth, *Center for Integrated Nanotechnologies, Los Alamos National Laboratory, USA*
Rohit Prasankumar, *Center for Integrated Nanotechnologies, Los Alamos National Laboratory, USA*
Invited Speakers:

New Directions in Active Metamaterials, Igal Brener, *Center for Integrated Nanotechnologies, Sandia National Laboratories, USA*
Nanofabrication of Nanophotonic Structures, Particularly Metamaterial and Plasmonic Structures, Stefano Cabrini, *Molecular Foundry, Lawrence Berkeley National Laboratory, USA*

Next-generation Nanocrystals for Cellular Imaging: Non-blinking, Non-bleaching Phosphors, Bruce Cohen, *Molecular Foundry, Lawrence Berkeley National Laboratory, USA*
Tuning Photoinduced Charge Transfer in Quantum Dot-based Hybrids by Self-assembly, Mircea Cotlet, *Center for Functional Nanomaterials, Brookhave National Laboratory, USA*
Non-blinking "Giant" Nanocrystal Quantum Dots: Ideal Molecular Probes for Real-time Three-dimensional Particle Tracking, Jennifer Hollingsworth, *Center for Integrated Nanotechnologies, Los Alamos National Laboratory, USA*
Coherent Ultrafast Probes of Quasi-1D Charge Dynamics, Robert Kaindl, *Lawrence Berkeley National Laboratory, USA*
Modeling, Fabrication, and Characterization of Disk On-pillar Structures for Optical Field Enhancement and Extreme Nanofocusing, Nickolay Lavrik, Center for Nanophase Materials Sciences, *Oak Ridge National Laboratory, USA*
Transduction and Control of Sqeezed Light Sources by Localized and Propagating Surface Plasmons*,* Benjamin Lawrie, *Oak Ridge National Laboratory, USA*
Designing Quantum Rod Morphology, Microstructure, and Surface Chemistry for Optimum Energy Transfer, Matthew Maye, *Syracuse University, USA*
Ultrafast Processes in Semiconductor Nanocrystals and Metal Nanoparticles, Matthew Pelton,*Center for Nanoscale Materials, Argonne National Laboratory, USA*
Nanophotonics at the DOE Nanoscale Science Research Centers, Rohit Prasankumar*, Center for Integrated Nanotechnologies,Los Alamos National Laboratory, USA*
On the Origin of Efficient Photoluminescence in Silicon Nanocrystals, Richard Schaller Center for Nanoscale Materials, *Argonne National Laboratory, USA*
Examining Nanoscale Photovoltaics with High Brightness Fourier Transform Measurements, Matthew Sfeir, Center for Functional Nanomaterials, *Brookhave National Laboratory, USA*
All-dielectric Metamaterials: Path to Low Losses and High Spectral Selectivity, Gennady Shvets*, University of Texas at Austin, USA*
All-dielectric Optical Metamaterials, Jason Valentine, *Vanderbilt University, USA*
Ultrafast and Non-linear Optical Properties of Hyperbolic Plasmonic Metamaterials*, Greg Wurtz,* King's College London, UK
The U.S. Department of Energy's Office of Science established the Nanoscale Science Research Centers (NSRCs) as national user facilities to enable researchers to create, characterize and understand novel nanoscale materials. Since their inception five years ago, the NSRCs have enabled thousands of users to access state-of-the-art instrumentation, specialized facilities, and expertise at one or more locations: “Molecular Foundry” (Lawrence Berkeley Laboratory), “Center for Nanophase Materials Sciences” (Oak Ridge National Laboratory), “Center for Integrated Nanotechnologies” (Sandia National Laboratories and Los Alamos National Laboratory), “Center for Functional Nanomaterials (Brookhaven National Laboratory) and "Center for Nanoscale Materials (Argonne National Laboratory).
The nanophotonics projects conducted by staff and users at the NSRCs represent a microcosm of the cutting edge research being done in this vast discipline. In this symposium, we will highlight some of this research with a mix of invited talks from NSRC staff and external users in order to highlight science opportunities and to inspire the photonics community to fully exploit the NSRC capabilities available to them as users.

Nonlinear Terahertz Science and Technology

Joint CLEO: QELS–Fundamental Science/ CLEO: Science & Innovations

Symposium Organizer:
Junichiro Kono, *Rice Univ., USA,*
Peter Uhd Jepsen, *Danmarks Tekniske Universitet, Denmark*
Invited Speakers:
Nonlinear THz Optics in Cuprate Superconductors, Andrea Cavalleri, *Max Planck Hamburg, Germany*
Multi-THz Nonlinear Optics and Sub-cycle Control of Charge and Spin, Rupert Huber, *Univ. Regensburg, Germany*
Nonlinear Terahertz Spectroscopy and Coherent Control in Solid, Liquid, and Gas Phases, Keith Nelson, *MIT, USA*
Experimental Observation of Electron-Hole Recollisions in Semiconductors, Mark Sherwin, *UCSB, USA*

Optics and photonics at terahertz frequencies is entering the nonlinear regime with a fast pace, enabled by the emergence of high-intensity, ultrafast and broadband coherent light sources and the capability of time-resolved detection of the electric field of such sources. The symposium will bring together researchers from THz, ultrafast and nonlinear optics to highlight the historical development of nonlinear THz optics and recent exploration of non-perturbative light-matter interactions and strong-field physics at THz frequencies.

Novel Light Sources for Biomedical Applications

Joint CLEO: Applications & Technology/ CLEO: Science & Innovations

Symposium Organizers:
Nicusor Iftimia, *Physical Sciences Inc., USA*
Andy James Bayramian, *Lawrence Livermore National Labs, USA*

Invited Speakers:
Employing Supercontinuum Technology for Biomedical Applications, Thomsen Carsten, *NKT Photonics, USA*
Tailoring Lasers for Specific Swept Source OCT Applications, Brian Goldberg, *Axsun Technologies, USA*
Miniature, Fast Wavelength-swept Sources Based on External Grating Cavity with Resonant MEMS Mirror, Kevin Hsu, *Exalos, USA*
Multi-modal Imaging Using a Novel and Portable Ultrafast Laser Source, Tuan Le, *FEMTOLASERS, Inc, Austria*
Advances in Solid State and Semiconductor Sources for Biomedicine, Peter Moulton, *Qpeak Inc., USA*
High Speed Wavelength-swept Laser for Next Generation Optical Coherence Tomography, Wang-Yuhl (William) Oh, *KAIST, South Korea*
OCT Sources: Current Limitations and Future Development Needs, Ben Vakoc, *Massachusetts General Hospital, USA*
Nitride VECSELs as Light Sources for Biomedical Applications, Thomas Wunderer, *Palo Alto Research Center, USA*
This symposium will bring together researchers exploring various incoherent and coherent approaches for improving the performance of the light sources that can be used in biomedical imaging, as well as many researchers that are using these sources in the biomed area. High emphasis will be given to the Vertical-External-Cavity Surface-Emitting-Laser (VECSEL) sources, which show high promise in improving the performance of optical coherence imaging. New advances in the development of various fiber laser sources using supercontinuum generation, as well as ultrashort pulses laser sources that are used in nonlinear microscopy and spectroscopy will be presented as well. Typical challenges related to system improved speed, stability, and resolution will be discussed. The development of miniature light sources for highly portable tomographic imaging systems and for lab-on-a-chip (LOC) applications will be presented as well.

Optogenetics and Optical Control of Biological Processes

Joint CLEO: Applications & Technology/ CLEO: Science & Innovations

Symposium Organizers:
Ed Boyden, *Massachusetts Institute of Technology, USA*
Christopher Fang-Yen, *Univ. of Pennsylvania, USA*
Andrew M. Rollins, *Case Western Reserve Univ, USA*

Invited Speakers:
Shining Light on the Brain: Optogenetic Dissection of the Cortical Circuits of Vision, Hillel Adesnik[1];
[1]*Department of Molecular and Cell Biology, University of CA, Berkeley, United*
TBD, Jin-Hyung Lee, *Stanford, USA*
Mechanisms of Direct Neural Stimulation with Infrared Light, Mikhail Shapiro, *UC Berkeley, USA*
Optical Control of Protein-protein Interactions to Modulate Cellular Function, Chandra Tucker, *University of Colorado School of Medicine, USA*
Optical interactions with biological tissue have historically fallen into two broad categories in research and medicine: interactions intended either for observation/diagnosis (e.g., microscopy, imaging) or for intervention/therapy (e.g., laser ablation, photodynamic therapy.) This symposium will explore a third emerging branch in biomedical optics: the use of optics for nondestructive control of biological function. While the advent of optical tweezers allowed for physical manipulation of small particles and cells, control of intact, living systems requires other innovations, such as optogenetics, laser stimulation, and photo-uncaging. This new field is yielding new scientific advances (e.g., activating a set of neurons helps understand how they contribute to behavior or network function), and has the potential to enable new therapies (e.g., novel optical retinal and auditory prostheses, neural stimulators, and optical pacemakers). This symposium welcomes contributed work in applications of optical control and enabling technologies.

Quantum Simulators

CLEO: QELS–Fundamental Science

Symposium Organizers:
Alexander Lvovsky, *University of Calgary, Canada*

Morgan Mitchell, *ICFO-Institut de Ciencies Fotoniques, Spain*

Invited Speakers:
Quantum Simulation with Ultracold Quantum Gases, Stefan Kuhr, *Univ. of Strathclyde, MPQ, Scotland*
Quantum Simulation of Dirac Points, L. Tarruell, *ETH Zurich, Switzerland*
Photonic Quantum Simulators, *Philip Walther; Univ. of Vienna, Austria*
This symposium will bring together leading figures in the rapidly advancing field of Quantum Simulators (QS). In the last few years, QS have passed from a theoretical possibility, first suggested by Richard Feynman, to a demonstrated technology: the best quantum simulators now outperform the best computer simulations on difficult condensed-matter problems such as non-equilibrium dynamics. The symposium will present state-of-the-art experimental results from the major platforms for QS including ultra-cold atoms, trapped ions, single photons and superconducing circuits, as well as state-of-the-art theoretical results in designing/programming quantum simulators, including both the "analog" and "digital" simulation strategies.

The Path to Sustainable Energy: Laser Driven Inertial Fusion Energy*

CLEO: Applications & Technology

Symposium Organizer:
Constantin Haefner, *Lawrence Livermore National Laboratory, USA*

Laser-driven Inertial Fusion Energy (IFE) is one of the most promising approaches to bringing the power of the sun to earth. The completion of the National Ignition Facility at Lawrence Livermore National Laboratory, the world's most energetic pulsed laser system, in Livermore, California, makes laser fusion with energy gain a realistic goal. The NIF provides over 1.8 MegaJoules of ultraviolet laser energy at over 500 TeraWatts. NIF is capable of routinely delivering laser pulses with this energy and power onto IFE targets generating unprecedented conditions in the laboratory. Other similar NIF-like laser systems are being built or planned in France (Laser Megajoule), China (Shenguang IV), and Russia (UFL-2M). Smaller laser facilities such as OMEGA in the United States, GEKKO and LFEX in Japan, VULCAN and ORION in the United Kingdom, LIL in France, and many others have been conducting experiments supporting the development of the physics basis and key diagnostic capabilities for IFE.

This IFE symposium will review the physics of laser-driven IFE, the technology of the solid state IFE drive lasers, the various optical, X-ray, and nuclear diagnostics, the IFE target design and fabrication, and the perspective and technology challenges of IFE as a source of sustainable energy for the future.

Invited Speakers:

Physics of Laser Driven ICF

Progress Toward Ignition on the National Ignition Facility, John Lindl, *LLNL, USA*
Polar-drive Direct-drive Ignition,Thomas Craig Sangster, *UR, USA*
Progress in Ignition Experiments at the NIF, John Edwards, *LLNL, USA*
The LMJ Program: Overview and Status of LMJ & PETAL Projects, Jean-Luc Miquel, *CEA DAM, France*

Technology of ICF Drive Lasers and Laser Facilities

The NIF: An International High Energy Density and Inertial Fusion User Facility, Ed Moses, *LLNL, USA*
Orion Laser Update from AWE, Andrew Randwich, *Atomic Weapons Establishment, UK*
The Updated Advancements of Inertial Confinement Fusion program in China, Wanguo Zheng*, IAPCM, China*

Optical and Nuclear Diagnostics

NIF Ignition Diagnostics**,** Joe Kilkenny, *LLNL, USA*
Line-imaging Velocimetry for Shock Diagnostics (VISAR), Peter Cellier*, LLNL, USA*
Optical Probe Lasers for Characterizing High-temperature, High-density Plasmas,Siegfried Glenzer, *SLAC, Stanford Univ., USA*

ICF Target Design and Fabrication

NIF Target Fabrication, Alex Hamza, *LLNL, USA*
IFE Target Fabrication**,** Abbas Nikroo,*General Atomics, USA*
Hohlraum Designs for High Velocity Implosions on NIF,Nathan Meezan, *LLNL, USA*

Alternative Laser ICF Concepts

Fast Ignition With Laser-Driven Ion Beams: Progress On Ignitor Beam Development Based On A New Relativistic Laser-Plasma Regime, J. C. Fernandez, *LANL, USA*
Implosion and Heating Experiments of Fast Ignition Targets by GEKKOXII and LFEX Lasers, H. Shiraga, *ILE,*

Japan

Shock-ignition OMEGA Experiments and Target Design for the NIF, Kenneth S. Anderson, *Laboratory for Laser Energetics, U. of Rochester, USA*

Studies on Shock Ignition Targets for Inertial Fusion Energy, Stefano Atzeni, *Università di Roma, Italy*

Future Perspecitive of ICF as Sustainable Energy Source

Prospects and Time Frame for Inertial Fusion Energy, Robert Byer, *Stanford Univ., USA*

HiPER, The European Approach to Inertial Fusion Energy, Laser Driver Studies,
Jean-Christophe Chanteloup, *Ecole, Polytechnique, France*

Design of the LIFE Power Plant: Laser Inertial Fusion Energy**,** Mike Dunne*, LLNL, USA*

Laser Fusion Experimental Reactor LIFT Based on Fast Ignition and the Issue; Takayoshi Norimatsu, *Institute of Laser Engineering, Osaka University, Japan*

NIF Tour

*In conjunction with ***The Path to Sustainable Energy: Laser Driven Inertial Fusion Energy Symposium****,* a tour of the National Ignition Facility will be offered the morning of Wednesday, 12 June 2013. The NIF tour is limited to 200 people and you must be pre-registered to attend. Buses will depart the San Jose Convention Center at 15 minute intervals, starting at 10:45 a.m.

Plenary Sessions

Tuesday, 11 June 2013

Nonlinear Optics: Past Successes and Future Challenges

Tuesday, 11 June

Paul Corkum, Joint Attosecond Science Laboratory, University of Ottawa and National Research Council, Canada
CLEO: Science & Innovations

Biography: Paul Corkum received his B.Sc. (1965) degree in Physics from Acadia University (Nova Scotia) and completed his Master's degree (1967) and Ph.D. (1972) at Lehigh University. After a year at Lehigh as a postdoctoral researcher, he moved to the National Research Council in Ottawa. In 1990 he formed the Femtosecond Science Group within NRC's Steacie Institute for Molecular Sciences. Over the next 17 years he led the group to world leadership in the field. In 2008 he was named a Canada Research Chair of Attosecond Photonics at the University of Ottawa and appointed Director of the Joint NRC/University of Ottawa Laboratory for Attosecond Science. He holds adjunct professorships at McMaster University, the University of British Columbia and Texas A and M University.

Abstract:
Attosecond Photonics
I will show how attosecond pulses are formed and how they can be measured during production (in-situ) or after they have left the nonlinear medium (ex-situ). Through examples, I will illustrate that attosecond technology includes, but extends beyond, ultrafast measurement.

Tuesday, 11 June

Stephen Harris, Stanford University, USA
CLEO: QELS- Fundamental Science

Biography:
Steve Harris received his B.S. degree in electrical engineering from Rensselaer Polytechnic Institute in 1959. After a year at Bell Telephone Laboratories, he attended Stanford University and received the M.S. and Ph.D. degrees in electrical engineering in 1961 and 1963. Since 1963 he has been on the faculty of Stanford University where he is now Professor of Electrical Engineering and Applied Physics (Emeritus).

His research work has been in the fields of lasers, quantum electronics, nonlinear optics, and atomic physics. Some of his (and students and colleagues) inventions and contributions include: the FM laser, observation of parametric fluorescence, the tunable acousto-optic filter, VUV generation in phase matched metal vapors, experiments demonstrating laser induced collisions, generation of femtosecond MEV x-rays, a 41.8 nm laser, an early paper on lasers without inversion, the observation of electromagnetically induced transparency and slow light, the use of molecular modulation for generating a single cycle optical pulse, and more recently, the development of techniques for generating and modulating single photons.

Professor Harris was elected to the National Academy of Engineering in 1977, to the National Academy of Sciences in 1981, and to the American Academy of Arts and Sciences in 1995. His awards include the 1978 David Sarnoff Award of the IEEE, the 1999 Frederic Ives Medal of the Optical Society of America, the 2002 (APS) Arthur L. Schawlow Prize in Laser Science, and the 2008 Harvey prize in Science and Technology.

Abstract:
Parametric Down Conversion Over Fifty Years: From Microwaves to X-rays
First predicted as a noise source for microwave parametric amplifiers, parametric down conversion (fluorescence) has become a primary source for generating entangled photons and, more recently, is emerging as a technique for x-ray diagnostics.

Wednesday, 12 June

Kumar Patel, Pranalytica, Inc., USA
CLEO: Applications & Technology

Dr. C. Kumar N. Patel is the president and CEO of Pranalytica, a Santa Monica based company that develops and manufactures leading edge quantum cascade lasers and laser systems and high sensitivity sensors for the detection of chemical warfare agents, explosives and industrial and environmental pollutants.

He is the inventor of the carbon dioxide, carbon monoxide, and the Spin-Flip Raman lasers. He pioneered the use of these and other lasers to measure trace gases in difficult environments. He was at AT&T (now Lucent Technologies) Bell Laboratories for thirty-two years and was Executive Director of the Physics Division and of the Materials Research Division. From 1993 to 1999 he was the Vice Chancellor for Research at UCLA. He is currently a Professor of Physics & Astronomy at UCLA.

Dr. Patel was elected to the National Academy of Science in 1974 and the National Academy of Engineering in 1978. He received the National Medal of Science given by the President of the United States in 1996. In recognition of the CO_2 laser's importance to the medical field, he has been elected as an Honorary Member of the Gynecologic Laser Surgery Society in 1980 and in 1985 he was elected an Honorary Member of the American Society for Laser Medicine and Surgery. He was inducted into the US National Inventors Hall of Fame in 2012.

He serves on the Board of Directors of Newport Corporation.

Abstract:
QCLs Revolutionizing MWIR and LWIR Applications
QCLs, operating at room temperature, converting electrical power directly into laser radiation and providing CW powers in excess of 4 W, have revolutionized laser applications in the MWIR and LWIR regions. Applications include infraredspectroscopy, protection of aircraft from shoulder fired missiles, target illumination, IR beacons, and high sensitivity detection of chemical warfare
agents and explosives.

Market Focus

The CLEO: Market Focus program focuses on the latest trends in the photonics marketplace. CLEO: Market Focus provides a forum to discuss new products and emerging technologies and markets while also providing a networking opportunity within the high-quality atmosphere of the CLEO Conference. All presentations and discussions will be focused on the latest in photonics products and services that have been playing an important role in the industry and those that potentially hold a future business opportunity. A key feature of this forum will be the survey of market trends and market sector outlook in the selected areas.

Market Focus Chairs

Merrill M. Apter, *Vice President of Sales, Telesis Technologies, USA*
Marcos Dantus, *President & CEO, BioPhotonic Solutions, USA*

Industrial Laser Outlook and Opportunities

Tuesday, 11 June 2013
10:30 - 12:30
Moderator: Mark Douglass, *Vice President and a Senior Research Analyst, Longbow Research, USA*

D. Mark Douglass, Ph.D. is a Vice President and a Senior Research Analyst for Longbow Research, an independent, equity research provider, and covers publicly-traded Industrial Technology companies. Mark's coverage responsibilities include electrical and electronic capital goods and equipment, including photonics. Prior to joining Longbow, he worked as a senior engineer at Preco, Inc. and Visteon Corp, specializing in laser-based manufacturing and joining technologies, developing both processes and equipment. He is a member of the LIA and the American Welding Society (AWS) and has sat on several industrial standards committees. Mark received his Ph.D. in Mechanical Engineering from the University of Michigan and his B.S. and M.S. degrees in Mechanical Engineering from the University of Illinois.

Panel Description:

This panel will discuss the expected outlook for industrial lasers as well as market trends and opportunities for lasers in industrial applications, and also provide time for Q&A from audience participants.

Industrial Laser Applications and Technologies: Trends and Impacts

Herman Chui, Senior Director of Product Marketing, *Spectra-Physics - Newport, USA*
As industrial lasers cost and performance dramatically improve, new applications are emerging to replace existing processes and enable novel applications. We discuss application and technology trends and specific examples to highlight the diversity and impact.

Herman Chui leads the marketing function for Spectra-Physics, the Lasers division of Newport. Previously, he served in various product marketing, strategic marketing, sales, business development, corporate development, operations and engineering roles at LumiLEDs / Agilent and New Focus. He received a Ph.D. in electrical engineering in the fields of nonlinear optics and semiconductors at Stanford University. He also studied business at Santa Clara University and completed a post-doctorate at Sandia National Laboratories.

Ultra-High Brightness Diode Lasers - The Next Generation of Industrial Lasers

Silke Pflueger, General Manager, *DirectPhotonics Inc., USA*
Ultra-high brightness direct diodes, enabled by new architectures accessing the inherent brightness of the diode material are leapfrogging current diode technology. Typically fiber

delivered, they can be used for all industrial applications such as cutting, welding and remote welding.

Silke Pflueger has over 20 years of experience in industrial lasers and their applications and is currently General Manager of DirectPhotonics Inc. She has worked for several companies in the laser industry including Laserline, SPI Lasers, JDSU and Fraunhofer. Silke holds a Ph.D. in mechanical engineering from the Technical University in Aachen.

Industrial Applications of Ultrafast Lasers
Sascha Weiler, *Program Manager - Micro Processing, TRUMPF Inc., USA*
Since half a decade ultrafast lasers have moved from scientific use to broadly adopted for industrial applications. The decisive factors for this development will be discussed and a conclusion for future paths will be made.

Sascha Weiler is a Program Manager for micro processing at Trumpf Inc. He has 13 years of experience in ultrafast lasers and laser micro machining. Dr. Weiler has a Ph.D. in Physics from the University of Kaiserslautern.

High-speed Micromachining with Ultrafast Lasers
Kurt Weingarten, CEO*, Time-Bandwidth, USA*
We discuss the outlook for continued growth in high-speed material processing with ultrafast lasers, including additional key aspects such as beam delivery, pulse synchronization, and process strategy, to achieve optimal results.

Kurt received his Ph.D. in electrical engineering at Stanford University, where he developed an ultrafast measurement tool for integrated circuits using picosecond lasers. After Stanford, Kurt worked at Lightwave Electronics where he pioneered one of the first commercial diode-pumped picosecond lasers. Kurt founded Time-Bandwidth Products in Zurich, Switzerland in the mid-1990's to develop simple, robust ultrafast mode-locked lasers for scientific and industrial applications. He then founded the VC-funded telecom start-up GigaTera in 2000, which was later acquired by TBP in 2003. Currently he serves as CEO of Time-Bandwidth.

Bio/Industrial Photonics Entrepreneurs

Tuesday, 11 June 2013
14:00 - 16:00
Moderator: Laura Smoliar, *USA*
Laura has 17 years experience bringing products to market in storage, semiconductor/MEMS, display, and lasers. Her global perspective comes from working in Taiwan and collaborating with Japanese companies, including NTT, Sony, and Hitachi. Laura has worked at Seagate, Silicon Light Machines (acquired by Cypress Semiconductor), Lightwave Electronics Corp. (acquired by JDSU), Mobius Photonics, Inc. (acquired by IPG Photonics), and Peppertree Engineering, Inc., which she recently sold. She writes a column for Inc.com *(http://www.inc.com/author/laura-smoliar)* and she serves on the Advisory Board of Open Photonics. Laura holds a Ph.D. from UC, Berkeley and an A.B., Summa Cum Laude, from Columbia University.

Panel Description:
The photonics industry is full of entrepreneurs, who bring new innovations from the lab to the marketplace. We will hear from photonics entrepreneurs who bring leading-edge products to market while navigating an uncertain economic climate. The discussion will cover how entrepreneurs view the current market and future market opportunity, how to meet product development challenges on a constrained budget, management of intellectual property and

licensing opportunities, and different approaches to funding emerging companies in the photonics space. The panel should be of interest to academics who want to see their inventions commercialized and who may be considering partnering with entrepreneurs, as well as to fellow entrepreneurs in the photonics industry.

Getting Funded!
Ken Arnold, President & CEO, *Precise Light Surgical, USA*
This presentation will provide a perspective on fundraising for early stage photonics based start-ups, with a focus on Precise Light's recent experiences in today's challenging environment.

Ken Arnold has held leadership roles and delivered innovative, commercially successful products in the medical laser industry for over 15 years. As VP of R&D at Laserscope Ken led the GreenLight development, for treating enlarged prostates, from concept through commercialization of two generations of products. Numerous innovations were made with respect to laser technology, clinical capabilities for mass tissue removal and in security features to control usage of disposables. Laserscope ramped from $30m to over $100m in revenue in about 4 years and sold for over $700m.

From the lab to worldwide deployment: Turn-key Instrumentation for Measurements of Trace Gases and Isotopes based on Cavity Enhanced Absorption Spectroscopy
Doug Baer, President, *Los Gatos Research, USA*
Laser-based analyzers now offer new capabilities for continuous measurements of trace gas concentrations and isotope ratios in real time at any location. In this discussion, we will offer perspectives on current markets and future opportunities of this technology.

Doug Baer has been president of Los Gatos Research since 2007. Dr. Baer started working at LGR in 2001 (employee #7) and is now responsible for strategic development, corporate operations, and general management. From 1999-2001, Dr. Baer was Director of Business Development and Laser Spectroscopist at Informed Diagnostics. From 1993-1999, Dr. Baer was a Senior Scientist at Stanford University where he managed Professor R.K. Hanson's Diode Laser Group (Mechanical Engineering Department). Dr. Baer has Ph.D. and M.S. degrees from Stanford University (Mechanical Engineering) and a B.S. degree from University of California Berkeley (Engineering Physics). He has authored over one hundred fifty technical publications and presentations, two invited book chapters and has six patents.

Birth and Rebirth of PPLN Technology
Ming Hsien Chou, Co-Founder & CEO, *HC Photonics, Taiwan*
With good application potentials and improvement of PPLN technology, numerous applications have been proposed and studied in the past decades. I will address the venture of PPLN Technology toward commercialization, including its birth and rebirth.

Ming Hsien Chou received his B.S. in Physics from National Taiwan University, Taiwan (1991) and Ph.D. with major in Applied Physics and minor in Electrical Engineering from Stanford University, Stanford, CA (1999). He also received his EMBA from Helsinki School of Economics, Finland (2008). He is the co-founder and CEO of HCP, Taiwan. Previously he was a member of technical staff at Optical LANs Research, Bell Labs, Lucent Technologies and was a senior member of technical staff at CTO group, Tellium Inc. He has served as technical advisor to Spectralane Inc. and adjunct faculty at National Tsinghua University.

Advances in Crystal Growth Technology and its Influence on the Photonics Markets
Gisele Maxwell, President & CEO*, Shasta Crystals, USA*

Single crystal fibers combine the advantages of laser crystals and glass fibers by guiding laser light and matching the efficiencies found in bulk crystals, making them ideal candidates for the next generation of fiber lasers.

Gisele Maxwell founded Shasta Crystals in 2006 to commercially develop crystals grown by the Laser Heated Pedestal Growth (LHPG) technology. Since its inception, Gisele has raised over $3M in equity investment and over $1M in NSF grants. Prior to founding Shasta Crystals Inc., Gisele worked as manager of lithium tantalate products at Silicon Light Machines. Gisele also worked as Engineering Manager at Crystal Technology, Inc.. She has patented one invention, published 25 articles in peer-reviewed journals, authored two books chapters, and delivered 23 presentations at conferences. Gisele holds a PhD in Physics from the University of Lyon II, France.

Medical and Aesthetic Lasers - The Future of Light-tissue Interactions

Wednesday, 12 June 2013
10:30 - 12:30
Moderator: Rick Frost, *Market Development Manager, Oclaro, USA*
Rick Frost holds a BS in Engineering Physics/Electrical Engineering from the University of Maine and an MBA from Long Island University in International Marketing. He has over 20 years of experience in solid state lasers and semiconductor lasers. With his extensive background in sales and product development, Rick has played a central role in launching numerous products based on emerging photonics technologies. Currently, Rick is employed by Oclaro as a Market Development Manager with responsibilities for North America. He specializes in medical lasers for therapy and diagnostics. Rick has managed Government programs from the National Institutes of Health, The Advanced Technology Program (National Institute of Standards and Technology), Ballistic Missile Defense Organization, and Naval Research Labs. He is recognized as a Fellow in the American Society for Laser Medicine and Surgery. His experience includes photonics applications in: urology, tumor imaging, dentistry, pigmented lesions, cardiology, consumer aesthetics, ophthalmology, neuroscience, x-ray generation, biophotonics, low level light therapy, and aesthetics.

Panel Description:
Thousands of years ago Hippocrates practiced heliotherapy—natural light based treatments. Since the time of the ancient Greeks until recently, we have seen only incremental progress in light therapy and diagnostics. But only in our generation—the past 25 years—has man become knowledgeable enough to tailor the temporal, spatial, and spectral properties of light to create tools for specific medical therapies. With advanced laser sources we can exploit non-linear effects in tissue including photo-acoustic effects, multiphoton absorption, and optical breakdown/ablation. Precision optics allows spatial resolution to the micron level. Recent studies have provided tissue absorption profiles and action spectra to enable spectrally targeted laser solutions.

Lasers and photonics technology have changed the landscape in medical treatments and diagnostics. From LASIK eye-surgery, photodynamic therapy, endoscopic illumination, to advances in Low Level Light Therapy, it has become clear that light is a central part of the future of healthcare. This session brings together some of the world’s leading technologists to offer a cross-sectional snapshot of technologies that enable the next generation of medical applications of light.

Applications for Ultrafast Lasers in the Medical Device Market
Michael Karavitis, Vice President of Research and Development, *Cutera, USA*
From Lasik to cataract surgery, ultrafast lasers have proven to be a useful tool in ophthalmology. More recently, ultrafast lasers have shown promise in reducing the number of treatments as well as improving efficacy for tattoo removal. These as well as future applications will be discussed.

Michael Karavitis has been Vice President of Research and Development at Cutera, Inc. since 2012. Prior to joining Cutera, Mr. Karavitis led a team of engineers and scientists at various successful early to mid-stage companies, including LenSx (acquired by Alcon), Newport Corporation and Intralase Corporation (acquired by Advanced Medical Optics). He holds multiple patents and is the author of several publications in the fields ranging from laser science to biotechnology.

Photobiomodulation: Current Trends and Future Applications
Brian Pryor, CEO, *LiteCure, USA*
Laser Therapy or Photobiomodulation has recently seen increased market penetration due to positive clinical studies and more consistent patient outcomes especially in the areas of muscular skeletal conditions. This presentation will review these positive trends and highlight some new exciting clinical applications.

Dr. Brian Pryor is co-founder and the Chief Executive Officer at LiteCure, LLC in Newark, Delaware. He holds bachelor degrees in Mathematics and Chemistry from Salve Regina University and a PhD in Physical Chemistry from the University of Pennsylvania. He has developed and taken to market several lasers and light based technologies. Dr. Pryor is well published (> 35 papers and several book chapters) in the areas of chemistry, physics, laser development and applications including lasers in medicine. He has recently published "Clinical Overview and Applications of Class IV Therapy Lasers". He has also recently written chapters on the subject of laser therapy in "Current Perspectives in Clinical Treatment and Management in Workers' Compensation Cases."

Semiconductor Laser Based Photo-Cosmetic Applications
Stewart Wilson, Vice President of Semiconductor Technology*, Palomar Medical Technologies, USA*
Semiconductor diode laser devices are well known to be used in a variety of industries and applications; such as telecommunication, military, medical and industrial such as car manufacturing. They are also seeing applications in photo-cosmetic industry as well. Historically, the photo-cosmetic applications have been limited to professional use only, but now some are making their way into home use consumer applications as well. An overview of both professional and home use applications will be presented.

Stewart W. Wilson is currently the VP of Semiconductor Technology for Palomar Medical Technologies and is responsible for semiconductor-based light emitting device development for both professional and consumer products, has 22 years of experience in the laser optic and optoelectronic product design, development and manufacturing. He has successfully introduced over 13 products to the market, Was a key team member that successfully obtained OTC FDA clearance for two home use semiconductor laser based consumer products, Has successfully implemented robust and cost-effective manufacturing methods for several products for six different companies, including more recently a consumer product for skin rejuvenation and a professional product for hair removal and skin rejuvenation, Has co-founded one company that manufactures high power semiconductor laser diodes, Has co/authored over 22 technical *publications, has obtained 7 patents in optoelectronic, including in consumer products, has been a co-recipient of a prestigious R&D100 award in 1999, Received both BSEE and MSEE degrees from the University of Maryland, College Park, MD.*

Optics & Innovation for Energy & the Environment

Wednesday, 12 June 2013
14:00 - 16:00

Moderator:
Steve Eglash, *Executive Director of the Energy & Environment Affiliates Program, Stanford University, USA*

Steve Eglash is Executive Director of the Energy & Environment Affiliates Program, Industry Liaison for the Bay Area Photovoltaic Consortium, and a staff member in the Precourt Institute for Energy. As Executive Director of the Energy & Environment Affiliates Program he is responsible for developing and managing interactions for corporations and other organizations having an interest in Stanford's research, faculty, and graduate students in energy, environment, materials, chemistry, and sustainability. Previously, Steve was President and CEO of Cyrium Technologies, a solar energy startup company, and a consultant and advisor to the National Renewable Energy Laboratory and the U.S. Department of Energy. He began his career as a research scientist at MIT Lincoln Laboratory. He received a PhD and MS from Stanford University, and a BS from the University of California at Berkeley. Steve is a member of the Board of Directors of the Materials Research Society, a Fellow of the SPIE, and a member of the IEEE and OSA.

Panel Description:
Optics innovations are having a major impact on energy and the environment. Advances in sensors, solar energy, solid state lighting, manufacturing, and communications are all being enabled by optics. This panel will look at the power of optics to transform the way society generates and uses energy and to protect the environment.

Speakers:
George Craford, *Philips Lumileds Lighting Company, USA*
M. George Craford is currently the Solid State Lighting Fellow of Philips Lumileds Lighting Company. Dr. Craford began his professional career as a research physicist at Monsanto Chemical Company. He joined Hewlett Packard in 1979 and was CTO of Lumileds until 2009. His research has focused primarily on the development of visible LEDs using a variety of compound semiconductor materials including GaAsP, AlGaAs, AlInGaP, and InGaN. He is a fellow of IEEE and a member of the National Academy of Engineering. He has received technical achievement awards from a variety of organizations and received the 2002 National Medal of Technology from the President of the United States. He has published over 50 papers and book chapters. He received a B.A. degree in physics from the University of Iowa and a Ph.D. degree in physics from the University of Illinois.

Noble Johnson, *PARC, USA*
Dr. Noble Johnson is Research Fellow and Manager of the Optoelectronics Program at the Palo Alto Research Center (a Xerox Company). He received his Ph.D. degree from Princeton University and has conducted experimental research in the general area of electronic materials and devices, with over 415 research papers in technical journals and conference proceedings and over fifty patents. He is a fellow of the American Physical Society and a fellow of the Institute of Electrical and Electronics Engineers. The Optoelectronics Program currently focuses

on optical sensing systems and novel nitride optical emitters. R&D for sensors includes innovative optical detector concepts for micro-fluidic analyzers, optical fiber sensors, pulsed laser monitoring, and optical cavity enhanced sensors. Applications for optical sensing technologies are wide ranging and include flow cytometry, bio-medical devices, structural health monitoring, and optical sensors for harsh environments.

Chris Norris, *Alta Devices, USA*
Chris Norris is President and CEO at Alta Devices. He joined the company in 2008 at its founding when he realized the potential of Alta's technology to change the way energy is generated from the sun. Since that time, Alta has raised over $100 million in financing and set world records for both cell and module efficiency based on its flexible solar cell technology. Chris was previously the CEO of MicroDisplay and a Venture Partner at the investment firm Blue Run Ventures. Before joining Alta, Chris spent much of his career in the semiconductor industry, first at Intel and then later at Cypress. He has seven issued patents, a Bachelor's degree in Electrical Engineering and a Master's degree in Computer Engineering. He previously served on the board of the SIA. Chris is also an amateur chef, a private pilot and enjoys wakeboarding, long distance running and riding off-road motorcycles with his four sons.

Alan E. Willner, *University of Southern California, USA*
Alan Willner is currently the Steven & Kathryn Sample Chaired Professor of Engineering at USC. He is a member of the Defense Sciences Research Council, and he was Founder and CTO of Phaethon Communications, a company acquired by Teraxion, that created the ClearSpectrum dispersion compensator product line. Prof. Willner received the International Fellow of U.K. Royal Society of Engineering, Guggenheim Foundation Fellowship, NSF Presidential Faculty Fellows Award from White House, Packard Foundation Fellowship, Fulbright Foundation Senior Scholars Award, OSA Forman Engineering Excellence Award, IEEE Photonics Society Engineering Achievement Award, IEEE Photonics Society Distinguished Lecturer Award, SPIE President's Award, USC University-Wide Creativity in Research (highest award), and Eddy Best Technical Paper Award from Pennwell. He is a Fellow of AAAS, IEEE, OSA, and SPIE. Prof. Willner was Co-Chair of National Academies Committee on Optics and Photonics, President of IEEE Photonics Society, OSA Science and Engineering Council Co-Chair, and Editor-in-Chief of Optics Letters, IEEE/OSA Journal of Lightwave Technology, and IEEE J. of Selected Topics in Quantum Electronics. He has >1000 publications, including one book and 24 U.S. patents, in the area of optical technologies and optical communications. He has worked at AT&T Bell Labs and Bellcore.

Technology Transfer Program

The Technology Transfer Program provides a forum for entrepreneurs and researchers from start-ups, major universities, businesses and national laboratories to present exciting new technologies which are ready and available for commercialization. The Program will kick off with a Tutorial for those that want to learn more about the licensing process – funding, entrepreneurship, technology transfer and intellectual property. During the Showcase, attendees will hear from several organizations about their latest license-ready optics and photonics technologies (intellectual property from universities and laboratories) that could lead to new commercial products or improve the efficiency, durability or availability of existing components or systems. In addition, organizations will feature their license ready technologies at tabletop displays in the exhibit hall.

Keynote Presentation

A Tale of Two Companies: It Was the Best of Times; It Was the Worst of Times
Robert A. Norwood, Professor, College of Optical Sciences, University of Arizona; formerly Vice President and Chief Technology Officer, Photon-X, Inc.

The talk will discuss the birth to near death story of a photonics startup, Photon-X, that the speaker cofounded. The presentation will focus on the series of significant personal decisions that the speaker needed to address from the founding to the eventual management buyout of the company. While the story takes place during the fiber optics boom of the late 1990's, the hard choices discussed are confronted by technology entrepreneurs in any era.

Speaker Profile

Robert A. Norwood is a Professor in the College of Optical Sciences at the University of Arizona, where he performs research on high speed electro-optic modulators and switches, integrated magneto-optic devices, polymer-based integrated optics, 3-D display technology, nanoimprinting, organic photovoltaics, nonlinear optical fibers, optical microresonators and ultrafast optical switching among other areas. Dr. Norwood was Vice President and Chief Technology Officer at Photon-X, Inc., a venture capital funded photonics startup company based in Malvern, PA and started in 1999; the company set the record for the lowest-loss single-mode polymer waveguides ever developed at 1550nm.

He led R&D groups at AlliedSignal (Honeywell) and Hoechst Celanese; his group at AlliedSignal developed aerospace qualified polymer waveguide technology that was the best in the world at the time; he helped to secure the sale of this business to Corning Photonics in 1999.

He is a world expert in polymer integrated optics and optical materials, with more than 75 refereed publications, 6 book chapters, 29 issued US patents, and 55 invited talks. Dr. Norwood has served as a conference chair or co-chair for *Organic Thin Films for Photonics Applications* (OSA) and *Linear and Nonlinear Optics in Organic Materials* (SPIE), and has served on the program committee for both OFC (subcommittee chair) and CLEO, among others. He is an Associate Editor of *IEEE Photonics Technology Letters* and *Optical Materials Express*. He is both an OSA fellow and an SPIE fellow, as well as a member of the American Physical Society and IEEE. He recently completed a term as the Chair of the OSA Fellows committee. He teaches courses on photonics, nonlinear photonics, and technology commercialization, as well as the senior photonics laboratory in the College of Optical Sciences. He holds a Ph. D. in physics from the University of Pennsylvania, and the B.S. in physics and mathematics from the Massachusetts Institute of Technology.

Company Overview

Photon-X is a customer driven, technology-based company dedicated to the research, development and manufacturing of advanced photonic devices for optical communications, biomedical sensors, RF/military applications and other emerging commercial markets. The company's products are based on its unique knowledge of nanofabrication technology, high performance/advanced photonic polymers, nanoparticle doping, photonic waveguide device design and manufacturing. The company is dedicated to producing high quality, high reliability products for its customers and to providing world-class customer support. The company's extraordinary achievements include exceptionally low-loss single-mode polymer waveguides (< 0.05 dB/cm at 1550nm) and compact optical amplifier technology.

9:30- Tutorial: Technology Transfer 101: Technology Licensing and Tech Startups

10:30 Commercializing University Innovations Through Entrepreneurship, Linda Chao, Senior Licensing Associate, *Office of Technology Licensing, Stanford University*

University of Arizona's Proof of Concept Funding Process, Eugene Cochran, Sr. Licensing Associate and Sector Director Physical Sciences, *University of Arizona*

Surviving the Valley of Death for A New Technology Company: Diffusion Model Prediction, Anis Rahman, Founder & Chief Technology Officer, *Applied Research & Photonics*

10:30-12:00 Technology Transfer Showcase

Substrate-Transferred Crystalline Multilayers: A New Paradigm in Optical Coating Technology, Garrett Cole, Co-Founder and Chief Technology Officer, Crystalline Mirror Solutions, *GmbH*

Molecular-Optic Modulator, Totaro Imasaka, Distinguished Professor, Kyushu University & Establisher & Advisor, *Hikari-GK Co.*

Quantum Cascade Laser Imaging for Molecular Recognition, Anadi Mukherjee, President & CEO, *INFRASIGN*

Direct Green Emitting Laser Diodes, George Powch, President & CEO, *VerLASE Technologies LLC*

Emerging Technologies for Optical Communication, Dave Sossen, Technology Licensing Officer, *Massachusetts Institute of Technology*

Short Courses

Short Course Schedule by Time

Sunday 9 June

Time	Code	Title
9:00 - 12:00	**SC302**	**MetaMaterials**
9:00 - 12:00	**SC189**	**Photonic Quantum-Enhanced Technologies**
9:00 - 13:00	**SC149**	**Foundations of Nonlinear Optics**
9:00 - 13:00	**SC182**	**Biomedical Optical Diagnostics and Sensing**
14:00 - 18:00	**SC221**	**Nano-Photonics: Physics and Techniques**
14:00 - 18:00	**SC270**	**High Power Fiber Lasers and Amplifiers**
14:00 - 18:00	**SC396**	**New Course! Frontiers of Guided Wave Nonlinear Optics**
14:00 - 18:00	**SC403**	**New Course! Nano-Cavity Quantum Electrodynamics and Applications**

Monday 10 June

Time	Code	Title
12:30 - 16:30	**SC378**	**Introduction to Ultrafast Optics**
12:30 - 16:30	**SC361**	**Coherent Mid-Infrared Sources and Applications**
12:30 - 16:30	**SC301**	**Quantum Cascade Lasers: Science, Technology, Applications and Markets**
12:30 - 16:30	**SC398**	**CancelledNew Course! Tabletop Coherent X-Ray Light Sources for Nano and Atto Science**
17:30 - 20:30	**SC379**	**Silicon Photonics Devices and Applications**
17:30 - 20:30	**SC375**	**Mid-Infrared Quantum Cascade Lasers: Applications in Health and the Environment**
17:30 - 20:30	**SC377**	**Cancelled Fundamentals of Lasers**

Tuesday 11 June

Time	Code	Title
10:00 - 13:00	**SC376**	**Plasmonics**
10:00 - 13:00	**SC362**	**Cavity Optomechanics: Fundamentals and Applications of controlling and measuring nano- and micro-mechanical oscillators with laser light**
10:00 - 13:00	**SC402**	**New Course! Transformation Optics**
14:00 - 18:00	**SC318**	**Coherent and Incoherent Laser Beam Combining: Theory and Methods**
14:00 - 18:00	**SC352**	**Ultrafast Laser Shaping and Pulse Compression**

Short Courses by Topic

QELS 1. Quantum Optics of Atoms, Molecules and Solids

SC189 Photonic Quantum-Enhanced Technologies
Ian Walmsley, *Univ. of Oxford, UK*
SC302 MetaMaterials
Vladimir M. Shalaev, *Purdue Univ., USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
New Course! SC402 Transformation Optics
Ulf Leonhardt, *Weizmann Inst. of Science in Israel, Israel*
New Course! SC403 Nano-Cavity Quantum Electrodynamics and Applications
Jelena Vuckovic, *Stanford Univ., USA*

QELS 2. Quantum Science, Engineering and Technology

SC189 Photonic Quantum-Enhanced Technologies
Ian Walmsley, *Univ. of Oxford, UK*
SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*
SC301 Quantum Cascade Lasers: Science, Technology, Applications and Markets
Federico Capasso, *Harvard Univ., USA*
SC302 MetaMaterials
Vladimir M. Shalaev, *Purdue Univ., USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC362 Cavity Optomechanics: Fundamentals and Applications of controlling and measuring nano- and micro-mechanical oscillators with laser light
Tobia Kippenberg, *Swiss Federal Institute of Technology Lausanne, Switzerland*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*

New Course! SC402 Transformation Optics
Ulf Leonhardt, *Weizmann Inst. of Science in Israel, Israel*
New Course! SC403 Nano-Cavity Quantum Electrodynamics and Applications
Jelena Vuckovic, *Stanford Univ., USA*

QELS 3. Metamaterials and Complex Media

SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*
SC302 MetaMaterials
Vladimir M. Shalaev, *Purdue Univ., USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
New Course! SC396 Frontiers of Guided Wave Nonlinear Optics
Ben Eggleton, *Univ. of Sydney, Australia*
New Course! SC402 Transformation Optics
Ulf Leonhardt, *Weizmann Inst. of Science in Israel, Israel*
New Course! SC403 Nano-Cavity Quantum Electrodynamics and Applications
Jelena Vuckovic, *Stanford Univ., USA*

QELS 4. Optical Interactions with Condensed Matter and Ultrafast Phenomena

SC149 Foundations of Nonlinear Optics
Robert Fisher, *R.A. Fisher Associates, LLC, USA.*
SC182 Biomedical Optical Diagnostics and Sensing
Sebastian Wachsmann-Hogiu, *NSF Center for Biophotonics Science and Technology, Univ. of California Davis, USA*
SC302 MetaMaterials
Vladimir M. Shalaev, *Purdue Univ., USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
Cancelled SC377 Fundamentals of Lasers
Randy A. Bartels, *Colorado State University, USA*
SC378 Introduction to Ultrafast Optics
Rick Trebino, *Georgia Institute of Technology, USA*
New Course! SC396 Frontiers of Guided Wave Nonlinear Optics
Ben Eggleton, *Univ. of Sydney, Australia*
Cancelled New Course! SC398 Tabletop Coherent X-Ray Light Sources for Nano and Atto Science
Margaret Murnane, *JILA and Univ. of Colorado, USA*

QELS 5. Nonlinear Optics and Novel Phenomena

SC149 Foundations of Nonlinear Optics
Robert Fisher, *R.A. Fisher Associates, LLC, USA.*
SC189 Photonic Quantum-Enhanced Technologies
Ian Walmsley, *Univ. of Oxford, UK*

SC301 Quantum Cascade Lasers: Science, Technology, Applications and Markets
Federico Capasso, *Harvard Univ., USA*
SC302 MetaMaterials
Vladimir M. Shalaev, *Purdue Univ., USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
SC379 Silicon Photonics Devices and Applications
Michal Lipson, *Cornell Univ., USA*
New Course! SC396 Frontiers of Guided Wave Nonlinear Optics
Ben Eggleton, *Univ. of Sydney, Australia*
Cancelled **New Course! SC398 Tabletop Coherent X-Ray Light Sources for Nano and Atto Science**
Margaret Murnane, *JILA and Univ. of Colorado, USA*
New Course! SC403 Nano-Cavity Quantum Electrodynamics and Applications
Jelena Vuckovic, *Stanford Univ., USA*

QELS 6. Nano-Optics and Plasmonics

SC182 Biomedical Optical Diagnostics and Sensing
Sebastian Wachsmann-Hogiu, *NSF Center for Biophotonics Science and Technology, Univ. of California Davis, USA*
SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*
SC301 Quantum Cascade Lasers: Science, Technology, Applications and Markets
Federico Capasso, *Harvard Univ., USA*
SC302 MetaMaterials
Vladimir M. Shalaev, *Purdue Univ., USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
New Course! SC402 Transformation Optics
Ulf Leonhardt, *Weizmann Inst. of Science in Israel, Israel*
New Course! SC403 Nano-Cavity Quantum Electrodynamics and Applications
Jelena Vuckovic, *Stanford Univ., USA*

QELS 7. High-Field Physics and Attosciences

SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
SC378 Introduction to Ultrafast Optics
Rick Trebino, *Georgia Institute of Technology, USA*
SC302 MetaMaterials
Vladimir M. Shalaev, *Purdue Univ., USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*

SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*
Cancelled **New Course! SC398 Tabletop Coherent X-Ray Light Sources for Nano and Atto Science**
Margaret Murnane, *JILA and Univ. of Colorado, USA*

CLEO 1. Light-matter Interactions and Materials Processing

SC149 Foundations of Nonlinear Optics
Robert Fisher, *R.A. Fisher Associates, LLC, USA.*
SC318 Coherent and Incoherent Laser Beam Combining: Theory and Methods
James R. Leger, *Univ. of Minnesota, USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
New Course! SC403 Nano-Cavity Quantum Electrodynamics and Applications
Jelena Vuckovic, *Stanford Univ., USA*

CLEO 2. Solid-State, Liquid, Gas, and High-Intensity Lasers

SC149 Foundations of Nonlinear Optics
Robert Fisher, *R.A. Fisher Associates, LLC, USA.*
SC270 High Power Fiber Lasers and Amplifiers
W. Andrew Clarkson, *Optoelectronics Res. Ctr., Univ. of Southampton, UK*
SC302 MetaMaterials
Vladimir M. Shalaev, *Purdue Univ., USA*
SC318 Coherent and Incoherent Laser Beam Combining: Theory and Methods
James R. Leger, *Univ. of Minnesota, USA*
SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*
Cancelled**SC377 Fundamentals of Lasers**
Randy A. Bartels, *Colorado State University, USA*
Cancelled **New Course! SC398 Tabletop Coherent X-Ray Light Sources for Nano and Atto Science**
Margaret Murnane, *JILA and Univ. of Colorado, USA*

CLEO 3. Semiconductor Lasers

SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*
SC301 Quantum Cascade Lasers: Science, Technology, Applications and Markets
Federico Capasso, *Harvard Univ., USA*
SC318 Coherent and Incoherent Laser Beam Combining: Theory and Methods
James R. Leger, *Univ. of Minnesota, USA*
SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*
SC375 Mid-Infrared Quantum Cascade Lasers: Applications in Health and the Environment
Yamac Dikmelik, *Department of Electrical and Computer Engineering, Johns Hopkins Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*

New Course! SC403 Nano-Cavity Quantum Electrodynamics and Applications
Jelena Vuckovic, *Stanford Univ., USA*

CLEO 4. Nonlinear Optical Technologies

SC149 Foundations of Nonlinear Optics
Robert Fisher, *R.A. Fisher Associates, LLC, USA.*
SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*
SC302 MetaMaterials
Vladimir M. Shalaev, *Purdue Univ., USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
SC378 Introduction to Ultrafast Optics
Rick Trebino, *Georgia Institute of Technology, USA*
New Course! SC396 Frontiers of Guided Wave Nonlinear Optics
Ben Eggleton, *Univ. of Sydney, Australia*
Cancelled **New Course! SC398 Tabletop Coherent X-Ray Light Sources for Nano and Atto Science**
Margaret Murnane, *JILA and Univ. of Colorado, USA*
New Course! SC403 Nano-Cavity Quantum Electrodynamics and Applications
Jelena Vuckovic, *Stanford Univ., USA*

CLEO 5. Terahertz Technologies and Applications

SC149 Foundations of Nonlinear Optics
Robert Fisher, *R.A. Fisher Associates, LLC, USA.*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC378 Introduction to Ultrafast Optics
Rick Trebino, *Georgia Institute of Technology, USA*

CLEO 6. Optical Materials, Fabrication and Characterization

SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*
SC302 MetaMaterials
Vladimir M. Shalaev, *Purdue Univ., USA*
SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
New Course! SC396 Frontiers of Guided Wave Nonlinear Optics
Ben Eggleton, *Univ. of Sydney, Australia*

CLEO 7. Micro- and Nano-Photonic Devices

SC182 Biomedical Optical Diagnostics and Sensing
Sebastian Wachsmann-Hogiu, *NSF Center for Biophotonics Science and Technology, Univ. of California Davis, USA*
SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*
SC302 MetaMaterials
Vladimir M. Shalaev, *Purdue Univ., USA*
SC318 Coherent and Incoherent Laser Beam Combining: Theory and Methods
James R. Leger, *Univ. of Minnesota, USA*
SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*
SC362 Cavity Optomechanics: Fundamentals and Applications of controlling and measuring nano- and micro-mechanical oscillators with laser light
Tobia Kippenberg, *Swiss Federal Institute of Technology Lausanne, Switzerland*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
SC379 Silicon Photonics Devices and Applications
Michal Lipson, *Cornell Univ., USA*
New Course! SC396 Frontiers of Guided Wave Nonlinear Optics
Ben Eggleton, *Univ. of Sydney, Australia*
New Course! SC403 Nano-Cavity Quantum Electrodynamics and Applications
Jelena Vuckovic, *Stanford Univ., USA*

CLEO 8. Ultrafast Optics, Optoelectronics and Applications

SC149 Foundations of Nonlinear Optics
Robert Fisher, *R.A. Fisher Associates, LLC, USA.*
SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
Cancelled SC377 Fundamentals of Lasers
Randy A. Bartels, *Colorado State University, USA*
SC378 Introduction to Ultrafast Optics
Rick Trebino, *Georgia Institute of Technology, USA*
New Course! SC396 Frontiers of Guided Wave Nonlinear Optics
Ben Eggleton, *Univ. of Sydney, Australia*
Cancelled New Course! SC398 Tabletop Coherent X-Ray Light Sources for Nano and Atto Science
Margaret Murnane, *JILA and Univ. of Colorado, USA*

CLEO 9. Components, Integration, Interconnects and Signal Processing

SC189 Photonic Quantum-Enhanced Technologies
Ian Walmsley, *Univ. of Oxford, UK*
SC318 Coherent and Incoherent Laser Beam Combining: Theory and Methods
James R. Leger, *Univ. of Minnesota, USA*

SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
SC379 Silicon Photonics Devices and Applications
Michal Lipson, *Cornell Univ., USA*
New Course! SC396 Frontiers of Guided Wave Nonlinear Optics
Ben Eggleton, *Univ. of Sydney, Australia*

CLEO 10. Biophotonics and Optofluidics

SC182 Biomedical Optical Diagnostics and Sensing
Sebastian Wachsmann-Hogiu, *NSF Center for Biophotonics Science and Technology, Univ. of California Davis, USA*
SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*
SC379 Silicon Photonics Devices and Applications
Michal Lipson, *Cornell Univ., USA*
Cancelled New Course! SC398 Tabletop Coherent X-Ray Light Sources for Nano and Atto Science
Margaret Murnane, *JILA and Univ. of Colorado, USA*

CLEO 11. Fiber, Fiber Amplifiers, Lasers and Devices

SC270 High Power Fiber Lasers and Amplifiers
W. Andrew Clarkson, *Optoelectronics Res. Ctr., Univ. of Southampton, UK*
SC318 Coherent and Incoherent Laser Beam Combining: Theory and Methods
James R. Leger, *Univ. of Minnesota, USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*
Cancelled SC377 Fundamentals of Lasers
Randy A. Bartels, *Colorado State University, USA*

CLEO 12. Lightwave Communications and Optical Networks

New Course! SC396 Frontiers of Guided Wave Nonlinear Optics
Ben Eggleton, *Univ. of Sydney, Australia*

CLEO 13. Active Optical Sensing

SC182 Biomedical Optical Diagnostics and Sensing
Sebastian Wachsmann-Hogiu, *NSF Center for Biophotonics Science and Technology, Univ. of California Davis, USA*
SC189 Photonic Quantum-Enhanced Technologies
Ian Walmsley, *Univ. of Oxford, UK*
SC301 Quantum Cascade Lasers: Science, Technology, Applications and Markets
Federico Capasso, *Harvard Univ., USA*

SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*
SC375 Mid-Infrared Quantum Cascade Lasers: Applications in Health and the Environment
Yamac Dikmelik, *Department of Electrical and Computer Engineering, Johns Hopkins Univ., USA*

CLEO 14. Optical Metrology
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC378 Introduction to Ultrafast Optics
Rick Trebino, *Georgia Institute of Technology, USA*
Cancelled New Course! SC398 Tabletop Coherent X-Ray Light Sources for Nano and Atto Science
Margaret Murnane, *JILA and Univ. of Colorado, USA*

CLEO 15. LEDS, Photovoltaics and Energy-Efficient ("Green") Photonics
SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*

A&T 1. Biomedical
SC182 Biomedical Optical Diagnostics and Sensing
Sebastian Wachsmann-Hogiu, *NSF Center for Biophotonics Science and Technology, Univ. of California Davis, USA*
SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*
SC301 Quantum Cascade Lasers: Science, Technology, Applications and Markets
Federico Capasso, *Harvard Univ., USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*

A&T 2. Environment/Energy
SC182 Biomedical Optical Diagnostics and Sensing
Sebastian Wachsmann-Hogiu, *NSF Center for Biophotonics Science and Technology, Univ. of California Davis, USA*
SC221 Nano-Photonics: Physics and Techniques
Axel Scherer, *Caltech, USA.*
SC301 Quantum Cascade Lasers: Science, Technology, Applications and Markets
Federico Capasso, *Harvard Univ., USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*

A&T 3. Government & National Science, Security & Standards Applications

SC182 Biomedical Optical Diagnostics and Sensing
Sebastian Wachsmann-Hogiu, *NSF Center for Biophotonics Science and Technology, Univ. of California Davis, USA*
SC189 Photonic Quantum-Enhanced Technologies
Ian Walmsley, *Univ. of Oxford, UK*
SC301 Quantum Cascade Lasers: Science, Technology, Applications and Markets
Federico Capasso, *Harvard Univ., USA*
SC318 Coherent and Incoherent Laser Beam Combining: Theory and Methods
James R. Leger, *Univ. of Minnesota, USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC361 Coherent Mid-Infrared Sources and Applications
Konstantin Vodopyonov, *Stanford Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*

A&T 4. Industrial

SC301 Quantum Cascade Lasers: Science, Technology, Applications and Markets
Federico Capasso, *Harvard Univ., USA*
SC318 Coherent and Incoherent Laser Beam Combining: Theory and Methods
James R. Leger, *Univ. of Minnesota, USA*
SC352 Ultrafast Laser Shaping and Pulse Compression
Marcos Dantus, *Michigan State Univ., USA*
SC376 Plasmonics
Mark Brongersma, *Stanford Univ., USA*

Short Course Descriptions

SC149 Foundations of Nonlinear Optics

Sunday, 9 June 2013
09:00–13:00

Instructor:
Robert Fisher; R.A. Fisher Associates, LLC, USA.
Level: Beginner (no background or minimal training is necessary to understand course material)

Description:
This introductory and intermediate level course provides the basic concepts of nonlinear optics. Although some mathematical formulas are provided, the emphasis is on simple explanations. It is recognized that the beginning practitioner in nonlinear optics is overwhelmed by a constellation of complicated nonlinear optical effects, including second-harmonic generation, optical Kerr effect, self-focusing, self-phase modulation, self-steepening, fiber-optic solitons, chirping, stimulated Raman and Brillouin scattering, and photorefractive phenomena. It is our job in this course to demystify this daunting collection of seemingly unrelated effects by developing simple and clear explanations for how each works, and learning how each effect can be used for the modification, manipulation, or conversion of light pulses. Examples will address the nonlinear optical effects that occur inside optical fibers, and those which occur in liquids, bulk solids, and gases.
Benefits:
This course will enable you to:
- Understand and manipulate the Slowly-Varying Envelope Approximation (SVEA)
- Recognize what nonlinear events come into play in different effects
- Appreciate the intimate relationship between nonlinear events which at first appear quite different
- Understand how a variety of different nonlinear events arise, and how they affect the propagation of light

- Understand how wavematching, phase-matching, and index matching are related
- Understand how self-phase modulation impresses "chirping" on pulses
- Understand basic two-beam interactions in photorefractive materials
- Develop an appreciation for the extremely broad variety of ways in which materials exhibit nonlinear behavior

Audience:
Although we start at the very beginning of each topic, we move quite rapidly in order to grasp a deep understanding of each topic. Therefore both beginners and intermediates will benefit greatly from this course. The material will be of interest to graduate students, to researchers, to members of the legal profession, to experts who are just transferring to this field, to managers, and to anyone else who just wants to learn how nonlinear optics works.

Instructor Biography:
Robert A. Fisher is a private consultant with interests in nonlinear optics, carbon dioxide lasers, molecular spectroscopy, X-Ray lasers, optical phase conjugation and modern optics. He is a fellow of OSA and SPIE, as well as a senior member of the IEEE. He was a member of the Board of Directors of SPIE (2002-2004). He has authored more than 60 publications. Fisher is the editor of the book Optical Phase Conjugation. He is a past associate editor for the journals Applied Optics, and Optics Letters; and he has chaired six SPIE Conferences on Nonlinear Optics. He served a 3-year term on the Board of Directors of SPIE. He was a topical editor for Optics Letters, the chair of OSA's Excellence in Engineering Award Committee, on SPIE's Scholarship Committee, and on the 2003, 2004, 2005, 2006 and 2007 CLEO Program Nonlinear Optics Subcommittees, which he chaired in 2006 and 2007. He was Program CoChair for CLEO 2010 and is General CoChair for CLEO 2012 (now renamed 2012 CLEO: Science and Innovations). He has served the legal community several times as an Expert Witness.

SC182 Biomedical Optical Diagnostics and Sensing

Sunday, 9 June 2013
09:00-13:00

Instructor: Sebastian Wachsmann-Hogiu; *NSF Center for Biophotonics Science and Technology, Univ. of California Davis, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:
This course provides an introduction to the basics of life sciences, followed by an introduction to the basic properties of photons and the spectroscopic properties of biological materials, i.e. absorbance, reflectance, polarization, fluorescence and light scattering. Modern optical imaging and sensing techniques, based on fluorescence, vibrational and nonlinear concepts and their medical applications will be discussed.

Benefits:
This course should enable the participants to:
1) Describe the interaction of light with tissue in terms of absorption, elastic scattering, fluorescence, and inelastic scattering;
2) Explain the basic principles of microscopy and imaging techniques such as wide-field fluorescence, confocal, two-photon excitation, second harmonic imaging, Raman (coherent and spontaneous), etc.
3) List various ways light can be used for medical diagnostics, including autofluorescence and Raman measurements;
4) Compare methods that use labels with label-free approaches to diagnostics and sensing;
5) Discuss various schemes of sensing, including well established techniques such as ELISA assays and not-yet-established that use plasmonics for detection;
6) Discuss the role of optical fibers in diagnostic and sensing;
7) Identify the advantages and disadvantages of optical diagnostic methods vs non-optical methods.

Audience:
Instructor Biography:
Sebastian Wachsmann-Hogiu has a background in biophysics, experimental physics, and biomedical optics. He is currently an Associate Professor in the Department of Pathology and Laboratory Medicine, and serves as Facility Director at the NSF Center for Biophtonics Science and Technology, University of California Davis. He previously served as Director of the Advanced Optical Imaging Laboratory within the Minimally Invasive Surgical Technologies Institute at Cedars-Sinai Medical Center in Los Angeles. His interests include optical diagnostics and biosensors, and point of care technologies.

SC189 Photonic Quantum-Enhanced Technologies

9 June 2013
09:00–12:00
Ian Walmsley, *Univ. of Oxford, UK*
Level: Advanced Beginner
Course Description
This course will provide a tutorial overview of the sorts of enhancements that quantum physics can provide for technology, and a short survey of applications and potential applications. These will include quantum interferometry and metrology, microscopy, communications, cryptography, frequency standards and clock synchronization, as well as computation and information processing. The rudiments of quantum mechanics needed to understand the technology will be covered, focusing particularly on quantum interference and entanglement in optics, as well as laboratory measurement methods. The ideas concerning the application of these principles to the enhancement of important technologies will then be discussed. One of the critical issues in this area is how to design schemes that are robust with respect to unavoidable environmental noise. The critical practical issues that confront real-world implementation of these concepts are many, and important performance parameters that might limit the utility of quantum enhanced technologies will also be examined.
Benefits and Learning Objectives
This course should enable you to:
• Summarize some basic ideas of quantum mechanics relevant to technology.
• Describe key issues related to several classes of applications.
• Explain fundamentals of the technological applications that can benefit from quantum enhancement.
• Discuss the limitations to performance.
• Follow the progress of the field in the future.
Intended Audience
The course is intended for those would like to gain a basic understanding of the ways and means by which quantum mechanics can be used to enhance technologies that are critical to the modern world. Some knowledge (a college course at an intermediate level) of quantum mechanical concepts and optics is recommended.

SC221 Nano-Photonics: Physics and Techniques

Sunday, 9 June 2013
14:00–18:00

Instructor: Axel Scherer; *Caltech, USA.*

Level: Intermediate (prior knowledge of topic is necessary to appreciate course material)

Description:
Students will learn about the applications of printed and integrated optical devices. In particular, optical microcavities and vertical cavity lasers, silicon photonics and plasmonic systems will be introduced and compared. Integrated opto-electronic and opto-fluidic systems for communications and biomedical sensing will be compared.

Benefits:
This course should enable the participants to:
1.) Compare dielectric (total internal reflection and Bragg reflectors) with metallic (surface plasmon) geometries for confining and guiding light
2.) Identify opportunities for using printed optical systems in silicon (silicon photonics)
3.) Describe methods for creating quantum-mechanical systems from optical nanostructures
4.) Design lithographically defined micro- and nanocavities for resonators and lasers
5.) Define applications of printed optics in biochemical sensing
6.) Summarize the evolution of printed optical integrated circuits and devices, such as modulators and switches
7.) Determine the applications of interdisciplinary integration of optics with electronics and fluidics
8.) Describe optical performance of semiconductor structures when these are made with nanoscale dimensions

Audience:
This course is designed for participants with interest in miniaturizing optical devices. Methods of microfabricating dielectric and plasmonic devices will be described, along with examples of their applications and description of future opportunities.

Instructor Biography:
Axel Scherer is the Bernard A. Neches professor of electrical engineering, applied physics and physics at Caltech and the Co-Director of the Kavli Nanoscience Institute. Professor Scherer's research focuses on the development

and application of microfabrication and design methods for optical devices. In the past, Professor Scherer pioneered the development of vertical cavity lasers, which have since become a commercial success. His group also developed some of the first silicon photonic circuits, optical nanocavities, and integrated optofluidic devices. Fundamentally new structures, such as photonic bandgap geometries resulted in some of the world's smallest lasers, modulators and waveguides. At the moment, Professor Scherer is also interested in the miniaturization and integration of microfluidic, magnetic and optical devices for applications in nano-biotechnology. His group also explores the limits of lithography at the nanometer scale. Professor Scherer has co-authored over 300 publications and holds over 65 patents in nanofabrication related areas.

SC270 High Power Fiber Lasers and Amplifiers

Sunday, 9 June 2013
14:00–18:00

Instructor: W. Andrew Clarkson; *Optoelectronics Res. Ctr., Univ. of Southampton, UK*
Level: Beginner (no background or minimal training is necessary to understand course material)

Description:
Recent advances in cladding-pumped fiber lasers and amplifiers have been dramatic, leading to unprecedented levels of performance in terms of output power, efficiency, beam quality and wavelength coverage. These achievements have attracted growing interest within the community and have fueled thoughts that fiber-based sources may one day replace conventional "bulk" solid-state lasers in many application areas. The main attractions of cladding-pumped fiber sources are derived directly from their geometry, which simultaneously allows very efficient generation of coherent light and almost complete immunity from the effects of heat generation, which are so detrimental to the performance of other types of lasers.

This course aims to provide an introduction to high power fiber lasers and amplifiers, starting from the basic principles of operation and ending with examples of current state-of-the-art devices and some thoughts on future prospects. The course will cover a range of topics, including basic fiber laser and amplifier theory, spectroscopy of the relevant rare earth ions for high power devices, a discussion of the factors influencing laser and amplifier performance, fiber design and fabrication, pump sources and pump launching schemes, fiber resonator design, master-oscillator and power-amplifier configurations, linewidth control and wavelength selection, transverse mode selection, nonlinear loss processes (SBS and SRS) and their impact on performance, and heat generation and its impact on power scalability. The course will also give an overview of techniques (e.g. coherent and spectral beam combining) for further scaling of output power and provide an introduction to hybrid fiber-bulk laser schemes for scaling pulse energy.

Benefits:
This course should enable you to:
1.) Calculate threshold pump power and slope efficiency, and estimate the maximum output power that can be obtained from a given fiber laser oscillator or amplifier configuration.
2.) Select the optimum pump source for a given rare earth ion transition and fiber design.
3.) Design the pump light collection and coupling scheme and estimate the pump launch efficiency.
4.) Specify the fiber parameters (e.g. cladding design, core size, rare earth ion concentration) required for a particular laser or amplifier configuration.
5.) Design the fiber laser resonator and select the operating wavelength.
6.) Estimate thermally induced damage limit.
7.) Measure fiber laser performance characteristics and relate these to fiber design and resonator parameters.

Audience:
This course is intended for individuals with a basic knowledge of lasers and optics who wish to learn about the basic principles and capabilities of fiber lasers and amplifiers when operating at high power levels. The course will also cover some of the practical issues of operating these devices and provide an update for those wishing to learn about some of the latest developments in this rapidly advancing field.
Instructor Biography:
W. Andrew Clarkson obtained his B.Sc. degree in physics from the University of Manchester (UK) in 1984 and his doctorate from the University of Southampton (UK) in 1991. He currently holds the position of professor at the Optoelectronics Research Centre, University of Southampton, where he leads a research group investigating power-scaling of fiber lasers and solid-state lasers. He has published more than 200 journal and conference papers in this area. He has also served on the program committees of numerous international conferences and as a topical editor for Optics Letters and is a Fellow of The Optical Society (OSA).

SC301 Quantum Cascade Lasers: Science, Technology, Applications and Markets

Monday, 10 June 2013
12:30–16:30
Federico Capasso, *Harvard Univ., USA*
Level: Beginner
Course Description
Quantum Cascade Lasers (QCLs) are fundamentally different from diode lasers due to their physical operating principle, which makes it possible to design and tune their wavelength over a wide range by simple tailoring of active region layer thicknesses, and due to their unipolar nature. Yet they use the same technology platform as conventional semiconductor lasers. These features have revolutionized applications (spectroscopy, sensing, etc.) in the mid-infrared region of the spectrum, where molecules have their absorption fingerprints, and in the far-infrared or so called Terahertz spectrum. In these regions until the advent of QCLs there were no semiconductor lasers capable of room temperature operation in pulsed or cw, as well high output power and stable/ wide single mode tunability. The unipolar nature of QCL, combined with the capabilities of quantum engineering, leads to unprecedented design flexibility and functionality compared to other lasers. The physics of QCLs, design principles, supported by modeling, will be discussed along with the electronic, optical and thermal properties. State-of-the-art performance in the mid-ir and Terahertz will be reviewed. In particular high power CW room temperature QCLs, broadly tunable QCL, short wavelength MWIR QCLs and recent breakthroughs in THz room temperature operation will be presented. A broad range of applications (IR countermeasures, stand-off detection, chembio sensing, trace gas analysis, industrial process control, medical and combustion diagnostics, imaging, etc.) and their ongoing commercial development will be discussed.
Benefits and Learning Objectives
This course should enable the participants to:
• Describe underlying QC Laser physics, operating principles and fundamental differences between standard semiconductor lasers and QC lasers
• Explain quantum design of the key types of QC lasers, which have entered real world applications, and how their electrical and optical properties can be tailored to optimize performance in the mid-infrared and THz regions.
• Discuss experimental device performance, including physical limits, design constraints and comparison with theory and determine device characteristics (current voltage and light-current curves; differential and power efficiency, threshold, gain and losses; spectral behavior, single mode operation; high speed operation)
• Explain the basics of QC laser device technology: fabrication process, materials growth options
• Illustrate the basics of a chemical sensing system; discuss applications of state-of the-art mid-infrared QC lasers to sensing and present several examples of QC laser commercialization
• Discuss current and future markets of QC lasers
Intended Audience
Graduate students; qualified undergraduates (mostly senior level) majoring in EE or physics/applied physics; researchers in industry, academia and government labs; engineers, sales reps and technical managers.
Education: Undergraduate degree or a PH.D or pursuing a PH.D in EE, Physics or Applied Physics, with knowledge of introductory level semiconductor devices.

SC302 MetaMaterials

Sunday, 9 June 2013
09:00–12:00

Instructor: Vladimir M. Shalaev; *Purdue Univ., USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:
Metamaterials (MMs) are expected to open a gateway to unprecedented electromagnetic properties and functionality unattainable from naturally occurring materials. We review this new emerging field and recent progress in demonstrating metamaterials from the microwave to the optical range, including the artificial magnetism and negative-index in MMs. Various approaches for optical cloaking will be analyzed. The feasibility of engineering optical space with metamaterials by using the transformation optics will be discussed. A family of novel meta-devices, ranging from superlens and hyperlens to optical black hole and single-photon gun will be also considered.

Benefits:
This course should enable the participants to:
1.) Specify the new physics behind metamaterials (MMs) and transformation optics (TO)

2.) Identify most exciting applications for MMs and TO devices,
3.) Identify future directions for the development in the field of MMs,
4.) Identify the biggest challenges in the field fo MMs,
5.) Suggest new promising material components for the improved MMs,
6.) Bridge the new physics behind MMs with the recent developments in nanofabication and engineering that can enable the exciting applications of MMs,
7.) Characterize and specify the major physical properties of MMs,
8.) Predict the future impact of the field of MMs and TO on the future nanophotonics industry.

Audience:
The target audience includes R&D representatives from industry, defense and government Lab researchers, and students.

Instructor Biography:
Vladimir (Vlad) M. Shalaev, Scientific Director for Nanophotonics in Birck Nanotechnology Center and Distinguished Professor of Electrical and Computer Engineering at Purdue University, specializes in nanophotonics, plasmonics, and optical metamaterials. Vlad Shalaev received several awards for his research in the field of nanophotonics and metamaterials, including the Max Born Award of the Optical Society of America for his pioneering contributions to the field of optical metamaterials and the Willis E. Lamb Award for Laser Science and Quantum Optics. He is a Fellow of the IEEE, APS, SPIE, and OSA. Prof. Shalaev authored three books, twenty one book chapters and over 300 research publications.

SC318 Coherent and Incoherent Laser Beam Combining: Theory and Methods

Tuesday, 11 June 2013
14:00–18:00
James R. Leger, *Univ. of Minnesota, USA*
Level: Advanced Beginner

Course Description
The performance of conventional high power lasers is often compromised by one or more physical effects, limiting the maximum power that can be obtained from a single lasing element. To increase the power from these individual elements, laser beam combining can be employed to convert the outputs from several lower-power modules into a single, high-power beam. This short course establishes general beam combining principles relevant to all laser systems, and emphasizes the limits that are achievable with differ approaches. The practicing engineer and technical manager will be introduced to a wide variety of beam combining methods. Incoherent beam combining attempts to maximize the radiance of an array of incoherent sources. The theoretical limits of this approach will be derived, and a design methodology developed to achieve maximum radiance. Spectral and polarization beam combining techniques employ wavelength and polarization sensitive elements to sum laser power. Several practical issues of this technique will be discussed, and specific systems described. Coherent beam combining is introduced by exploring methods of establishing mutual coherence across laser arrays. The properties and characteristics of these coherent techniques are quantitatively analyzed using simple modal theories. Methods of converting arrays of coherent beams into a single beam are explored, and the sensitivity of these approaches to path length errors investigated.
Real-world examples will be used as case studies to illustrate design principles. This offering of the course will make use of recently developed material on coherent beam combining architectures.

Benefits and Learning Objectives
• This course should enable the participants to:
• Describe the requirements for laser beam combining of all types.
• Estimate the optimum brightness enhancement achievable from incoherent combining.

• Design an ideal incoherent beam combiner.
• Design spectral beam combiners and estimate performance limitations.
• Compare different architectures for establishing mutual coherence across laser arrays.
• Determine the effects of path length errors on beam combining performance.
• Design optical systems to convert coherent arrays of laser beams into a single beam.
• Describe the performance characteristics of several laser systems that utilize beam combining.

Intended Audience

The course is designed for students, engineers, scientists and technical managers who are interested in understanding the basics of laser beam combining. No advanced knowledge of laser systems is assumed.

SC352 Ultrafast Laser Shaping and Pulse Compression

Tuesday, 11 June 2013
14:00–18:00
Instructor: Marcos Dantus; *Michigan State Univ., USA.*
Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:
Ultrafast lasers have already enabled two Nobel Prizes and more can be expected. Ultrafast lasers permit time-resolved studies on timescales faster than atomic motion and are the gateway to numerous nonlinear optical processes. Ultrafast lasers enable attosecond pulse generation and can be converted essentially to any frequency from terahertz to X-rays. However, working with these lasers can be difficult. This course will introduce the pulse shaper as a versatile tool for controlling ultrafast laser pulses and ensure that they are as short as possible. The course will make emphasis on applications of pulse shapers that greatly enhance the capabilities of femtosecond laser sources for (a) pulse characterization, (b) pulse compression, (c) creation of two or more pulse replicas, and (d) control of nonlinear optical processes such as selective two-photon excitation and selective vibrational mode excitation. Each participant will receive a pulse shaping simulation program to explore the exciting opportunities opened by pulse shaping.
Benefits:
This course should enable participants to
1.) Design and build a pulse shaper based on a particular set of goals.
2.) Compare among different pulse shaper designs and to determine which one is best suited for a current or future research project.
3.) Simulate the output pulse from a pulse shaper given a particular phase and amplitude modulation.
4.) Define key concepts in pulse shaper design such as optical resolution and focal length.
5.) Describe the effect caused by introducing a simple phase such as a linear, quadratic or cubic function on a transform-limited pulse.
6.) Explain two different approaches to creating pulse replica that can be independently controlled in the time domain using the pulse shaper.
7.) Measure the spectral phase of laser pulses using the pulse shaper itself as the measurement tool, and eliminating phase distortions to compress the output pulses.
8.) Summarize the advantages of having an adaptive pulse shaper for controlling the output of ultrafast lasers.
Audience:
This course is intended for any individual from industry or academia, student or professor, interested in learning how pulse shapers can greatly enhance the performance and utility of ultrafast (femtosecond) laser sources. No prior knowledge about pulse shaping is required.

Instructor Biography:
Professor Dantus received his Ph.D. in Chemistry (1991 Caltech) where he worked on the development of Femtochemistry, and his postdoctoral work on the development of Ultrafast Electron Diffraction under Professor Zewail (1999 Nobel Prize). He is a University Distinguished Professor of Chemistry and Physics at Michigan State University. His interests include ultrafast laser pulse theory, development and control, control of nonlinear laser-matter interactions, and biomedical imaging. Dantus has more than 160 publications, 43 invention disclosures and 28 patents related to the characterization, compression and applications of ultrashort shaped laser pulses in the areas of nonlinear optics, communications, biomedical imaging, and analytical chemistry instruments. Dantus has founded three companies and is presently serving as the President and CEO of BioPhotonic Solutions Inc, and serves on the board of advisors for the Chemical Physics Letters and the Journal of Raman Spectroscopy.

SC361 Coherent Mid-Infrared Sources and Applications

Monday, 10 June 2013
12:30–16:30
Instructor: Konstantin Vodopyonov; Stanford Univ., USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:
The course covers fundamental principles of mid-IR generation and considers different approaches for producing coherent light in this important yet challenging spectral region. These techniques represent diverse areas of photonics and include rare earth and transition metal solid-state lasers, fiber lasers, semiconductor lasers (including intra- and intersubband cascade lasers), and laser sources based on nonlinear optical frequency conversion. The course reviews several emerging technologies such as supercontinuum generation in highly nonlinear fibers as well as frequency combs generation. We will discuss several important mid-IR applications including trace molecular sensing and standoff detection, coherent spectroscopy using frequency combs, infrared countermeasures, and medical applications.

Benefits:
This course will enable you to:
1.) Identify direct mid-IR laser sources including rare earth and transition metal solid-state lasers, fiber lasers, semiconductor heterojunction and quantum cascade lasers
2.) Identify laser sources based on nonlinear-optical techniques including optical parametric oscillators and amplifiers, and get the idea of emerging nonlinear materials such as quasi-phase-matched zinc-blende crystals
3.) Distinguish between different temporal formats of existing mid-IR laser sources, from continuous-wave to ultrafast
4.) Understand what are frequency combs and how they can be used for advanced mid-IR spectroscopic detection

Audience:
Students, academics, researchers and engineers in various disciplines who require a broad introduction to the subject and would like to learn more about the state-of-the-art and upcoming trends in mid-infrared coherent source development and applications. Undergraduate training in engineering or science is assumed.

Instructor Biography:
Konstantin L. Vodopyanov is a world expert in mid-IR solid state lasers, nonlinear optics and laser spectroscopy. He is a co-author of a book on the subject: I.T. Sorokina, K.L. Vodopyanov, “Solid-State Mid-Infrared Laser Sources”, Springer, 2003 and has both industrial and academic experience. Now he teaches and does scientific research at Stanford University, CA. Dr. Vodopyanov earned his Ph.D. in Physics at Lebedev Physical Inst. in Moscow. He is a Fellow of SPIE, OSA, American Physical Society (APS), the UK Institute of Physics (IOP), and is a Senior Member of IEEE. He serves on program committees for major laser conferences, including CLEO and Photonics West where he is a conference chair. Dr. K.L. Vodopyanov delivered numerous invited talks and tutorials at scientific conferences on the subject of mid-IR technology.

SC362 Cavity Optomechanics: Fundamentals and Applications of controlling and measuring nano- and micro-mechanical oscillators with laser light

Tuesday, 11 June 2013
10:00–13:00

Instructor: Tobia Kippenberg; *Swiss Federal Institute of Technology Lausanne, Switzerland*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:
Radiation pressure denotes the force that optical fields exert and which have wide ranging applications in both fundamental science and applications such as Laser cooling or optical tweezers. Radiation pressure can however also have a profound influence on micro- and nanophotonic devices, due to the fact that radiation pressure can couple optical and mechanical modes. This optomechanical coupling gives rise to a host of new phenomena and applications in force, displacement and mass sensing. This course is intended to give an introduction of the Physics and Applications of cavity optomechanics and highlight the rapid developments in this emerging field. Optomechanical coupling can be used to both cool and amplify mechanical motion and thereby allow new light driven

photon clocks. Optomechanical refridgeration of mechanical modes gives insights into the quantum limits of mechanical motion. In addition radiation pressure coupling enables new way of processing light all optically enabling optical mixers, delay lines or storage elements. Moreover, the basic limitations of optomechanical displacement measurements, due to quantum noise and practical laser phase noise limitations will be reviewed, relevant across a wide range of sensing experiments.
The course will make contact to practical applications of optomechanics in Metrology (force sensors, mass sensors and light driven optical clocks) and review fundamental design principles of optomechanical coupling and the design of high Q mechanical oscillators. The use of finite element simulations will be covered.

Benefits:
This course should enable you to:
1.) Understand gradient and scattering light forces in microcavities and micromechanical systems
2.) Design high –Q nano-and micro- mechanical oscillators (finite element modeling, FEM)
3.) Understand the fundamental limits of mechanical Q in NEMS/MEMS
4.) Understanding of the fundamental and practical limits of displacement sensors
5.) Applications of optomechanics in mass and force sensing
6.) Understand the basic optomechanical phenomena (amplification, cooling)
7.) Understand the standard quantum limit (SQL)
8.) Characterize radiation pressure driven oscillations in terms of fundamental oscillator metrics
9.) Phase and frequency noise of oscillators
10) Influence of phase and amplitude noise of a wide variety of laser systems (fiber lasers, TiSa, diode lasers) in optomechanical systems

Audience:
This course is intended for physicists and optical and electrical engineers desiring both focused fundamental knowledge of cavity optomechanical coupling (i.e radiation pressure coupling of light and NEMS/MEMS) but also a view of emerging applications of this new technology. The instruction will be at a level appropriate for graduate students and will assume some basic knowledge of laser.

Instructor Biography:
Tobias J. Kippenberg is Associate Professor of Physics and Electrical Engineering at EPFL and leads the Laboratory of Photonics and Quantum Measurement. He obtained his BA at the RWTH Aachen, and MA and PhD at the California Institute of Technology (Caltech in Pasadena, USA). From 2005- 2009 he lead an Independent Research Group at the MPI of Quantum Optics and obtained his Habilitation from the LMU with T.W. Haensch. His research area are the Physics and Application of ultra high Q resonators in Metrology and Quantum Measurements of mechanical motion (cavity optomechanics). Tobias Kippenberg is alumni of the “Studienstiftung des Deutschen Volkes” and winner of the 8th EU Contest for Young Scientists (1996) for his invention of an “Infrared-microwave radiation ice condition sensor for cars. For his invention of “chip-scale frequency combs” he is co-recipient of the Helmholtz Price for Metrology (2009). Moreover he is recipient of the EFTF Young Investigator Award (2010) and the EPS Fresnel Prize (2009).

SC375 Applications of Mid-Infrared Quantum Cascade Lasers in Health and the Environment

New Course!

Monday, 10 June 2013
17:30–20:30

Instructor: Yamac Dikmelik; *Department of Electrical and Computer Engineering, Johns Hopkins Univ., USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:
Mid-infrared quantum cascade lasers (QCLs) have a unique advantage in their wavelength flexibility and are an enabling technology for trace gas sensing applications. Starting with the fundamental aspects of QCL operation, this short course will cover QCL based sensor systems and their spectroscopic applications. The course will first introduce the underlying physical concept of intersubband transitions in quantum wells, and will make the connection between the structure of QCLs and their electrical and spectral characteristics. The course will then present QCL based systems for spectroscopic sensing of trace gas species, and will provide application examples in environmental monitoring and medical diagnostics.

Benefits:
This course should enable the participants to:
1.) Understand the connections between the structure of mid-infrared QCLs and their electrical, optical, and temperature characteristics
2.) Compare various spectroscopic techniques and systems that use QCLs for trace gas sensing
3.) Learn about recent applications of QCL based systems in medical diagnostics and environmental monitoring

Audience:
The intended audience of this course includes scientists and engineers with an interest in laser based technologies for trace gas sensing applications.

Instructor Biography:
Yamac Dikmelik is an Assistant Research Scientist in the Department of Electrical and Computer Engineering at Johns Hopkins University (JHU). He received his Ph.D. degree in electrical engineering from JHU, and was subsequently a Postdoctoral Fellow in the Department of Materials Science and Engineering at JHU. He is also currently serving MIRTHE (Mid-InfraRed Technologies for Health and the Environment – an NSF Engineering Research Center) as a Research and Teaching Fellow.

SC376 Plasmonics

Tuesday, 11 June 2013
10:00–13:00

Instructor: Mark Brongersma; *Univ. of Stanford, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:
Plasmonics is an exciting new field of science and technology that aims to exploit the unique optical properties of metallic nanostructures to enable routing and active manipulation of light at the nanoscale. Nanometallic objects derive these properties from their ability to support collective electron excitations, known as surface plasmons (SPs). Presently we are witnessing an explosive growth in both the number and range of plasmonics applications; it is becoming eminently clear that both new fundamental science and device technologies are being enabled by the current plasmonics revolution. The intention of this tutorial is to give the participants a fundamental background and working knowledge of the main physical ideas used in plasmonics, as well as an overview of modern trends in research and applications.
The tutorial will begin with a general overview of the field of plasmonics. This will be followed by an introduction to the basic concepts that enable one to understand and design a range of plasmonic functionalities. This part will be followed by an in-depth discussion of a range of active and passive plasmonic devices that have recently emerged. Particular attention will be given to nanometallic structures in which surface plasmons can be generated, routed, switched, amplified, and detected. It will be shown that the intrinsically small size of plasmonic devices directly results in higher operating speeds and facilitates an improved synergy between optical and electronic components. The field of plasmonics is rapidly growing and has started to provide a whole range of exciting new research and development opportunities that go well beyond chipscale components. A number of such developments will be investigated, including new types of optical sensors, solar cells, quantum plasmonic components, non-linear, and ultrafast devices. At the end of the tutorial, a critical assessment of the entire field is given and some of the truly exciting new opportunities for plasmonics are identified.

Benefits:
This course should enable the participants to:
1.) Obtain a working knowledge of the key physical concepts used in Plasmonics that enable light manipulation at ultra small length- and time-scales.
2.) Understand choices of different metal types, shapes, and sizes to accomplish different plasmonic functionalities.
3.) Find out about common electromagnetic computational tools to design plasmonic structures and devices.
4.) Get a feel for the current state of the field in terms of fundamental understanding as well as device applications.
5.) Learn about the most recent trends and developments in research and applications.

Audience:
Optical engineers and scientists who are interested in learning about the rapidly emerging field of plasmonics and its potential impact. A basic knowledge of electromagnetism will be very helpful.

Instructor Biography:
Mark Brongersma is an Associate Professor and Keck Faculty Scholar in the Department of Materials Science and Engineering at Stanford University. He leads a research team of eight students and three postdocs. Their research is directed towards the development and physical analysis of new materials and structures that find use in nanoscale electronic and photonic devices. His most recent work has focused on Si-based light-emitting materials, light sources, modulators, detectors, and metallic nanostructures that can manipulate and actively control the flow of light at the nanoscale. Brongersma has given over 50 invited presentations in the last 5 years on the topic of nanophotonics and plasmonics. He has also presented 3 tutorials at International conferences on these topics. He has authored\co-authored over 85 publications, including papers in Science, Nature Photonics, Nature Materials, and Nature Nanotechnology. He also holds a number of patents in the area of Si microphotonics and plasmonics. He received a National Science Foundation Career Award, the Walter J. Gores Award for Excellence in Teaching, the International Raymond and Beverly Sackler Prize in the Physical Sciences (Physics) for his work on plasmonics, and is a Fellow of the Optical Society of America, the American Physical Society, and the SPIE. Dr. Brongersma received his PhD in Materials Science from the FOM Institute in Amsterdam, The Netherlands, in 1998. From 1998-2001 he was a postdoctoral research fellow at the California Institute of Technology.

SC377 Fundamentals of Lasers

New Course! Cancelled.

Monday, 10 June 2013
17:30–20:30

Instructor: Randy A. Bartels; *Colorado State University, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:
This course provides a review of the fundamentals of lasers, spanning from basic design principles, laser dynamics and stability, and an introduction to mode-locked laser operation. The course will begin with a description of the fundamental concepts of optical gain and Gaussian beam propagation. Application of these concepts to the design of both continuous-wave (cw) and modelocked ultrafast lasers will be discussed. Stability and noise performance of will also be covered in this course. The course participants will gain knowledge of the basic principles for laser design and operation; conditions for stable operation of cw and pulsed modelocked lasers; solid-state diode pumped laser design considerations; fiber laser design considerations; laser stability and noise; and power scaling.

Benefits:
This course should enable the participants to:
1.) Describe the fundamental principles of single frequency (cw) lasers and modelocked lasers.
2.) Determine sources of deviation of laser performance from theoretical optima and understand approaches to mitigating these problems.
3.) Design stable laser cavities for complex laser geometries.
4.) Describe the fundamental operating principles for producing short laser pulses, and methods used to produce shorter pulses.
5.) Explain the conditions for stable laser operation and limitations that destabilize single-frequency and modelocked lasers.
6.) Summarize the various types and classes of laser pumping scenarios and gain media types.
7.) Identify the unique capabilities and properties of laser light sources.
8.) List the applications of lasers in a diverse set of fields and applications.

Audience:
This course is designed for participants with interest in understanding the fundamental operational principles, design challenges, and practical issues of single frequency and modelocked lasers sources.

Instructor Biography:
Randy A. Bartels received his Ph.D. from the University of Michigan 2002. His Ph.D. work was performed at JILA in Boulder, CO, where he worked on ultrafast laser development, coherent control of quantum systems, and the study of extreme nonlinear optical processes. Randy is currently an Associate Professor of Electrical and Computer Engineering, with joint appointments in the Department of Chemistry and in the School of Biomedical Engineering at Colorado State University (CSU). Prof. Bartels has been awarded the Adolph Lomb Medal from the Optical Society of America, a National Science Foundation CAREER award, a Sloan Research Fellow in physics, a gold medal for the Human Competitive award for work in evolutionary computation, an Office of Naval Research Young Investigator

Award, a Beckman Young Investigator Award, an IEEE-LEOS (now Photonics Society) Young Investigator Award, and was named a Kavli Fellow of the National Academy of Sciences. Prof. Bartels was awarded a Presidential Early Career Award for Science and Engineering (PECASE. His current research involves the control and ultra-sensitive detection of molecular coherences for novel spectroscopy and microscopy applications, the development of VUV laser sources and optical systems, the development of ultrafast fiber lasers, as well as the development of stable optical combs sources in the mid infrared spectral region. Recently, Randy received a grant from the W. M. Keck Medical Research program. He is a Fellow of the Optical Society of America, a senior member of the IEEE, and a member of the APS. He also serves as Associate Editor for the IEEE Journal of Quantum Electronics.

SC378 Introduction to Ultrafast Optics

New Course!

Monday, 10 June 2013
12:30–16:30

Instructor: Rick Trebino; *Georgia Institute of Technology, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:
Ultrafast Optics—the science and technology of ultrashort laser pulses—is one of the most exciting and dynamic fields of science. While ultrashort laser pulses seem quite exotic (they're the shortest events ever created!), their applications are many, ranging from the study of ultrafast fundamental events to telecommunications to micro-machining to biomedical imaging, to name a few. Interestingly, these lasers are readily available, and they are easy to understand. But their use requires some sophistication. This course is a basic introduction to the nature of these lasers and the pulses they generate. It will discuss the principles of their generation and amplification and describe their most common distortions in space and time and how to avoid them—or take advantage of them. In addition, it will cover the nonlinear optics of ultrashort pulses for converting pulses to almost any color, as well as the additional interesting and potentially deleterious effects nonlinear optical processes can cause. Finally, it will cover techniques for ultrashort-pulse measurement.

Benefits:
This course should enable the participants to:
1.) Understand how ultrashort-pulse lasers and amplifiers work.
2.) Understand and describe ultrashort pulses and their many distortions.
3.) Use nonlinear optics to an convert ultrashort laser pulse to virtually any wavelength.
4.) Take advantage of—or avoid—nonlinear-optical high-intensity effects.
5.) Meaningfully measure ultrashort pulses.

Audience:
Any scientist or engineer interested in the science and technology of the shortest events ever created, especially those new to it.

Instructor Biography:
Rick Trebino is the Georgia Research Alliance-Eminent Scholar Chair of Ultrafast Optical Physics at the School of Physics at the Georgia Institute of Technology. His research focuses on the use and measurement of ultrashort laser pulses. He is best known for his invention and development of Frequency-Resolved Optical Gating (FROG), the first general method for measuring the intensity and phase evolution of an ultrashort laser pulse, and which is rapidly becoming the standard technique for measuring such pulses. He has also invented techniques for measuring ultraweak ultrashort pulses, ultracomplex pulses, ultrafast polarization variation, and the complete spatio-temporal measurement of ultrashort pulses. He has also developed pulse compressors and a general theory of spatio-temporal distortions of ultrashort pulses.

SC379 Silicon Photonics

New Course!

Monday, 10 June 2013
17:30–20:30

Instructor: Michal Lipson; *Cornell Univ., USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:
Silicon Photonics enables a platform for monolithic integration of optics and microelectronics for applications of optical interconnects where high data streams are required in a small footprint. The course will begin with an overview of optical communications and charts the birth of on-chip photonics from the meeting of the fiber optics and integrated circuit industries. This will be followed by an introduction to the basic concepts that enable one to understand and design a range of photonic functionalities. The fundamental physics of light confinement, carrier generation and transmission will be reviewed, and followed by a detailed review of key passive and active devices. The course will describe the state of art and research challenges of silicon photonic integration with microelectronics for interconnect applications. Silicon is evolving as a versatile photonic platform with multiple functionalities that can be seamlessly integrated. The tool box is rich starting from the ability to guide and amplify multiple wavelength sources at GHz bandwidths, to optomechanical MEMS and opto-fluidics devices. The course will describe these new research directions and novel applications.

Benefits:
This course should enable the participants to:

1. Explain the key physical concepts used in silicon photonics that enable light manipulation at ultra small length- and time- scales.
2. Explain choices of different materials, shapes, and sizes to accomplish different photonic functionalities.
3. Summarize the current state of the field in terms of device applications.
4. Describe the most recent trends and developments in research and applications.

Audience:
The course is intended for researchers or early graduate students with little or no background in silicon photonics or integrated optics. Those familiar with the subject area will experience a review of basic concepts and main applications, but will also learn about the most recent developments in the field.

Instructor Biography:
Michal Lipson is an Associate Professor at the School of Electrical and Computer Engineering at Cornell University, Ithaca NY. Her research focuses on novel on-chip Nanophotonics devices. She has pioneered several of the critical building blocks for silicon photonics including the GHz silicon modulators. Professor Lipson's honors and awards include MacArthur fellow, NYAS Blavatnik award, OSA Fellow, IBM Faculty Award, and NSF Early Career Award. More information on Professor Lipson can be found at nanophotonics.ece.cornell.edu

SC396 Frontiers of Guided Wave Nonlinear Optics

Sunday, 9 June 2013
14:00–18:00
Ben Eggleton, *Univ. of Sydney, Australia*
Level: Advanced Beginner
Course Description
This course will review recent research and applications in the field of nonlinear guided wave optics with emphasis on both fundamentals and emerging applications. Starting from a strong foundation in the principles of nonlinear optics, I will review recent progress in emerging nonlinear optical platforms with an emphasis on the different materials, including silicon, chalcogenide, III-V semiconductors, lithium niobate, photonic crystal fibres, nanophotonic circuits and others. I will establish key figures of merit for these different material systems and a general framework for nonlinear guided wave optics with emphasis on the applications in emerging areas of science and technology. I will then review recent progress and breakthroughs in the following areas: All-optical processing; Ultra-fast optical communications; Slow light; highly nonlinear and emerging waveguides; Ultrafast measurement and pulse characterization;
Frequency combs and optical clock; Optical parametric amplifiers and oscillators; Generation and applications of optical super-continuum; Nonlinear localization effects and solitons; Nonlinear optics for quantum information.

Benefits and Learning Objectives
This course should enable the participants to:
- State of the art knowledge of nonlinear optics in emerging waveguides and materials
- Understanding of the applications of nonlinear optics in key applications
- Foundation of nonlinear waveguide physics for emerging applications and science

Intended Audience
This course assumes some basic knowledge/familiarity of nonlinear optics. Individuals lacking such knowledge should consider taking SC149: Foundations of Nonlinear Optics first.

SC398 Tabletop Coherent X-Ray Light Sources for Nano and Atto Science

Cancelled.
Monday, 10 June 2013
12:30–16:30
Margaret Murnane, *JILA and Univ. of Colorado, USA*
Level: Beginner
Course Description
This short course will first discuss the state-of-the-art in tabletop coherent short wavelength light sources in terms of pulse energy, repetition rate, wavelength, coherence and time resolution from the nanosecond to the zeptosecond regime. Several approaches for nanoscale imaging, spintronics, materials science, thin film nano-metrology, materials characterization, and patterning will also be discussed. New capabilities include the ability to image opaque samples in 3D, the ability to capture nanoscale energy flow and phase transitions in materials, the ability to pattern free of defects near the wavelength limit, and the ability to capturespin transport relevant to next-generation electronic and data storage technologies.
Benefits and Learning Objectives
This course should enable the participants to:
- Better understand, optimize and apply unique extreme ultraviolet and soft x-ray light sources.
- Understand state-of-the-art, tabletop, short wavelength microscopy and other applications.
- Identify new, unique, and powerful applications of short wavelength light in materials characterization, metrology, and patterning.
- Compute the optimal characteristics of short wavelength sources for various scientific and technological applications.

Intended Audience
This course is aimed at scientists and engineers from academe and industry, including graduate students, who are interested in understanding the applications of coherent short-wavelength light in high-resolution biological and materials imaging.
Information on sources, optics and applications is intended to quickly update the audience on state-of-the-art, coherent, short-wavelength sources as well as demonstrated technological applications.

SC402 Transformation Optics

Tuesday, 11 June 2013

10:00–13:00
Ulf Leonhardt, *Weizmann Inst. of Science in Israel, Israel*
Level: Advanced Beginner
Course Description

Science Magazine listed transformation optics among the top 10 science insights of the decade 2000-2010. The course gives a selfconsistent primer into this subject that may, literally, transform optics. Transformation optics grew out of ideas for invisibility cloaking devices and exploits connections between electromagnetism in media and in geometries. Within a short time it grew into a lively research area with applications ranging from invisibility and perfect imaging to the quantum physics of black holes.

Invisibility has been a subject of fiction for millennia, from myths of the ancient Greeks and Germans to modern novels and films.

In 2006 invisibility turned from fiction into science, primarily initiated by the publication of first ideas for cloaking devices and the subsequent demonstration of cloaking for microwaves.

Perfect imaging is the ability to optically transfer images with a resolution not limited by the wave nature of light.

Advances in imaging are of significant importance to modern electronics, because the structures of microchips are made by photolithography; in order to make smaller structures, light with increasingly smaller wavelength is used, which is increasingly difficult.

Black holes are surrounded by horizons that create quantum particles from the virtual particles of the quantum vacuum, Hawking radiation. Understanding and testing this mysterious phenomenon will shed light on connections between quantum physics and general relativity.

Benefits and Learning Objectives

- This course should enable the participants to:
- Derive the foundations of transformation optics from Maxwell's equations
- Design transformation-optical devices
- Calculate the material properties of transformation-optical devices
- Analyze the performance of transformation-optical devices

Intended Audience

The audience should be mixed, coming from academia or industry at various levels, but prior knowledge of electromagnetism at the level of the Maxwell's equations is essential. The audience is not required to know differential geometry, as all required mathematical results will be clearly stated, but should not be afraid of mathematics.

SC403 Nano-Cavity Quantum Electrodynamics and Applications

Sunday, 9 June 2013

14:00–18:00

Jelena Vuckovic, *Stanford Univ., USA*

Level: Beginner

Course Description

Strong localization of light in nanophotonic structures leads to enhanced light-matter interaction, which can be employed in a variety of applications, ranging from improved (higher speed, lower threshold) optoelectronic devices, to biophotonics, quantum information, and low threshold nonlinear optics.

In particular, quantum dots in optical nanocavities are interesting as a test-bed for fundamental studies of such light-matter interaction (cavity quantum electrodynamics - QED), as well as an integrated platform for information processing. As a result of the strong field localization inside of sub-cubic wavelength volumes, they enable very large emitter-field interaction strengths (vacuum Rabi frequencies in the range of 10's of GHz – several orders of magnitude larger than in atomic cavity QED). In addition to the study of new regimes of cavity QED, this can also be employed to build devices for quantum information processing, such as ultrafast quantum gates, nonclassical light sources, and spin-photon interfaces. Beside quantum information systems, many classical information processing devices greatly benefit from the enhanced light matter interaction in such structures; examples include all-

optical switches operating at the single photon level, electro-optic modulators controlled with subfJ energy and operating at GHz speed, and lasers with threshold currents of 100nA.
This course will introduce cavity QED (e.g., strong and weak coupling regimes, Purcell effect, etc.), with particular emphasize on semiconductor nanocavities. We will also describe state of the art in solid state cavity QED experiments and applications.

Benefits and Learning Objectives:

This course should enable the participants to:

- Understand light matter interaction in optical nanostructures
- Discuss state of the art in solid state cavity QED
- Understand benefits of employing nano-cavity QED for certain applications

Intended Audience

Scientists and engineers interested in cavity QED and nanophotonic devices in general. Some background in electromagnetics, quantum mechanics, and optoelectronics is helpful, but not required.

Special Events

Check back frequently for updates. Special events currently planned include the following:

Discover Downtown San Jose

Receive great offers from downtown businesses with your "Discover Downtown San Jose Card." Cards can be picked up at Registration, Member Lounges, or the San Jose Tourist booth. To view special offers, visit www.sjdowntown.com/offers prior to arriving.

The Tech Museum
201 South Market Street
San Jose, CA 95113
(408) 294-8324
www.thetech.org

Open Daily from 10:00 AM – 5:00 PM

CLEO Offers:
Adult ticket for The Tech Museum Galley only for $8. (33% discount/Reg $12)
Child/Senior (3-17/65+) ticket for The Tech Museum Galley only for $7. (23% discount/Reg $9)

Adult ticket for The Tech Museum Galley and IMAX Combo for $12. (25% discount/Reg $16)
Child/Senior (3-17/65+) ticket for The Tech Museum Galley and IMAX Combo for $10. (24% discount/Reg $13)

Children's Discovery Museum of San Jose:
180 Woz Way
San Jose, CA 95110
(408) 298-5437
www.cdm.org/

Open Tuesday - Saturday from 10:00 AM - 5:00 PM and Sunday 12:00 PM - 5:00 PM

CLEO Offers:

“For the duration of the conference Children’s Discovery Museum of San Jose is excited to offer anyone who shows their OSA conference badge either $1 off general admission or $10 off a Family or Grandparent Membership.

Please note this offer cannot be combined with any other offers or discounts.”

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San Jose Museum of Art
110 South Market Street
San Jose, CA 95113
(408) 271-6840
www.sjmusart.org

Open Tuesday – Sunday from 10:00 AM – 5:00 PM

CLEO Offer:
Adult General Admission Ticket for $6. (25% discount/Reg $8)

Gordon Biersch Brewery & Restaurant
33 East San Fernando Street
San Jose, CA 95113
(408) 294-6785
www.gordonbiersch.com
Restaurant Hours:
Sunday: 11:30 AM - 11:00 PM
Monday: 11:30 AM - 11:00 PM
Tuesday: 11:30 AM - 11:00 PM
Wednesday: 11:30 AM - 11:00 PM
Thursday: 11:30 AM - 12:00 AM
Friday: 11:30 AM - 1:00 AM
Saturday: 11:30 AM - 1:00 AM

CLEO Offer:
10% off bill (not able to be combined with sales during Cleo Dine & Discover program on Monday, May 7th)

Mezcal: Mexican Restaurant & Bar
25 West San Fernando Street
San Jose, CA 95113
(408) 283-9595
www.mezcalrestaurantsj.com

Restaurant Hours:
Monday: 11:30 AM – 9:00 PM
Tuesday – Thursday: 11:30 AM – 10:00 PM
Friday: 11:30 AM – 11:30 PM
Saturday: 4:00 PM – 11:30 PM

Sunday: 4:00 PM – 9:00 PM

CLEO Offer:
15% off bill (not able to be combined with sales during Cleo Dine & Discover program on Monday, May 7th)

Loft Bar & Bistro
90 South 2nd Street
San Jose, CA 95113
(408) 291-0677
www.loftbarandbistro.com

Restaurant Hours:
Monday – Wednesday: 11:00 AM – 10:00 PM
Thursday – Saturday: 11:00 AM – 11:30 PM
Sunday: 12:00 PM – 10:00 PM

CLEO Offer:
Happy Hour Prices at any time (offer not available during CLEO Dine & Discover Program on Monday, May 7th)
$6 happy hour cocktails and house wine
$4 beers
$6 happy hour appetizers

Sonoma Chicken Coop (Downtown)
31 North Market Street
San Jose, CA 95113
(408) 287-4098
www.sonomachicken.com

Restaurant Hours:
Sunday – Thursday: 11:00 AM – 9:00 PM
Friday – Saturday: 11:00 AM – 10:00 PM

CLEO Offer:
15% off bill (not able to be combined with sales during Cleo Dine & Discover program on Monday, May 7th)

Broadway San Jose presents:

Million Dollar Quartet: the smash hit Broadway musical, inspired by the true story of the famed recording session that brought together rock 'n' roll icons Elvis Presley, Johnny Cash, Jerry Lee Lewis and Carl Perkins for the first and only time. On December 4, 1956, these four young musicians were gathered together by Sam Phillips, the "Father of Rock 'n' Roll" at Sun Records in Memphis for what would be one of the greatest jam sessions of all time. MILLION DOLLAR QUARTET brings that legendary night to life with an irresistible tale of broken promises, secrets, betrayal and celebrations featuring timeless hits including “Blue Suede Shoes,” “Fever,” “That’s All Right,” “Sixteen Tons,” “Great Balls of Fire,” “I Walk the Line,” “Whole Lotta Shakin’ Goin’ On,” “Who Do You Love?,” “Matchbox,” “Folsom Prison Blues,” “Hound Dog” and more.

San Jose Center for the Performing Arts
255 Almaden Blvd.
San Jose, CA 95113
(408) 792-4111 (SJ Tix Box Office)
www.broadwaysanjose.com

Performances:
Tuesday, May 8th – Thursday, May 10th: 7:30 PM (Curtain)

CLEO Offer:
40% off tickets if purchased online using promo: **CLEO**
$10 off tickets purchased from the SJ Tix Box Office located on the ground floor of the Convention Center or in person at the Theatre Box Office on performance nights.

San Jose Repertory Theatre presents:
The Understudy: The star he's working with doesn't get the play; the stage manager just happens to be his ex-fiancée; and the set technician seems to be high-just another day in the life of an understudy. This laugh-out-loud look at the battle for stage credibility between a typecast action movie star and a “real“ actor with a very large chip on his shoulder will give you insight into the complicated relationships that form in the stressful and emotional world backstage. Pulitzer Prize nominee Theresa Rebeck, one of the most produced female playwrights in America, returns to the Rep stage with this latest Off-Broadway hit.

San Jose Repertory Theatre
101 Paseo de San Antonio
San Jose, CA 95113
(408) 367-7255
www.sjrep.com

Performances:
Thursday, May 10th - Friday, May 11th: 8:00 PM (Curtain)

CLEO Offer:
“Pay what you will” on Thursday, May 10th
$6 off tickets on Friday, May 11th
*Tickets for Thursday’s “pay what you will” are only available at the SJ Rep Box Office one hour before the performance starts. Tickets for Friday may be purchased online using promo code: **CLEO** or in person from the SJ Rep Box Office using your convention badge.

CLEO: 2012 Welcome Reception

Tuesday, 8 May 2012

Free to all Technical Conference Attendees. Connect with colleagues and network with presenters and luminaries from around the world over light hors d'oeuvres and beverages.

Power Lunch

Attend the Power Lunch, sponsored by Precision Photonics, and participate in high-level discussions. You will have the opportunity to speak one-on-one with experienced leaders representing different markets who will share their wisdom on surviving and growing a business during difficult economic times. In addition, the leaders will share their insights on how to strategically position yourself in an uncertain market.

This is a ticketed event. Check back for more details.

Sponsored by:

precisionphotonics

The American Physical Society Booth

The American Physical Society is the publisher of the world's most prestigious and widely-read physics research publications: *Physical Review Letters*, *Reviews of Modern Physics*, *Physical Review A-E*, *Physical Review X*, *PR-Special Topics-Accelerators and Beams*, *PR-Special Topics-Physics Education Research*, and *Physics.* Please stop by the APS booth for details on the newest journal, *Physical Review X*, an entirely open access journal for all areas of pure, applied, and interdisciplinary physics.

IEEE Photonics Society Booth and Member Lounge

Come visit the IEEE Photonics Society booth located in the registration area and see all we have to offer. Members are also welcome to visit our members-only lounge where you can sit down, relax, and connect to the internet. Not a member? Let us sign you up at the booth and you may start enjoying the benefits of IPS membership today!

OSA Member Lounge

If you are attending CLEO: 2012, to be held 6-11 May in San Jose, CA, USA, be sure to visit the OSA Member Lounge, where you can relax, unwind, access the Internet and meet with OSA colleagues. Located in the San Jose Convention Center, Concourse Lobby, the lounge will offer comfortable seating, meeting tables, wireless Internet, computer/printer access and light refreshments. Staff will be on hand to answer your questions.

The OSA Member Lounge will be open Monday, 7 May – Wednesday, 9 May from 8:30 am-5:00 pm, and Thursday, 10 May from 8:30 am-noon.

Winery Tour and Tech Musem Visit Planned For OSA Members

OSA members attending CLEO: 2012 and their families are invited to participate in two Members, Family and Friends (MFF) events during the conference.

On Monday 7 May, OSA guests will visit the historic Testarossa Winery in Los Gatos, California. Participants will tour the winemaking facilities, learn about wine production, and be treated to a private wine tasting. After the tour, spend the afternoon exploring the many boutiques, shops and restaurants in the picturesque town of Los Gatos before returning to San Jose. Space is limited, so pre-registration is encouraged. Contact edreaz@osa.org to reserve a spot.

On Tuesday 8 May, OSA members and their families are invited to visit The Tech Museum in downtown San Jose. After viewing the IMAX film "Roving Mars," participants can see a full-scale model of the Mars Science Laboratory Mission's "Curiosity" rover, on display through July 2012. Launched into space in November 2011, the "Curiosity" rover's mission is to land on Mars in August 2012 to search for conditions favorable to life. The rover is the size of an SUV, weighs 1 ton and is filled with features including a geology lab, a rock-vaporizing laser and multiple cameras.