FiO/LS 2007 Highlights

Frontiers in Optics 2007, the longest-standing meeting in optics and photonics, closed Sept. 20 after a week of top-quality research presentations, symposium and special events.

Consisting of 157 sessions and nearly 800 technical presentations, talks honed in on some of the most innovative research in the field.

More than 1,300 attendees convened during the meeting’s keynote sessions, technical talks, exhibition and networking events. In addition, 50 companies participated in the exhibition, showcasing some of the newest technologies available.

For more information, view the 2007 conference press release.

- Award Winning Plenary Speakers
  John L. Hall, JILA, Univ. of Colorado, USA
  Eli Yablonovitch, Univ. of California at Berkeley, USA
- Cutting-Edge Presentations
- Expert Invited Speakers
- Special Events
- Networking Events
- Short Courses
- Special Symposia
- Student Activities
- An Exhibit Featuring Leading Optics and Photonics Companies
- TOUR: The National Ignition Facility at Lawrence
Livermore National Laboratory

Exhibit: September 18–19, 2007
Fairmont Hotel, San Jose, California, USA

Collocated With:

- Organic Materials and Devices for Displays and Energy Conversion (OMD)
- OSA Fall Vision Meeting 2007

2007 Frontiers in Optics Chairs

Connie J. Chang-Hasnain, Univ. of California at Berkeley, USA
Gregory J. Quarles, VLOC, USA

Laser Science XXIII Chairs

Frederick J. Raab, LIGO Hanford Observatory, USA
Charles A. Schmuttenmaer, Yale Univ., USA

Sponsors

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About The Meeting

Frontiers in Optics (FiO) 2007—the 91st OSA Annual Meeting—and Laser Science (LS) XXIII unite the Optical Society of America (OSA) and American Physical Society (APS) communities for five days of quality, cutting-edge presentations, fascinating invited speakers and a variety of special events. The FiO 2007 conference will also offer a number of Short Courses designed to increase participants’ knowledge of a specific subject while offering the experience of insightful teachers. An exhibit floor featuring leading optics companies will further enhance the meeting.

The LS XXIII meeting serves as the annual meeting of the Division of Laser Science of the APS and provides an important forum for the latest work on laser applications and development,
spanning a broad range of topics in physics, biology and chemistry. The conference will continue to be held in conjunction with OSA’s annual meeting.

Program Highlights

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Frontiers in Optics 2007/Laser Science XXIII Tutorials
SPRC Joint FiO/Stanford Photonics Research Center Symposium

Conference Program

This program for Frontiers in Optics 2007/Laser Science XXIII/Organic Materials and Devices for Displays and Energy Conversion will be available onsite in your registration bags.

Plenary Speakers

John L. Hall, JILA, Univ. of Colorado and NIST, USA
The Optical Frequency Comb: A Remarkable Tool with Many Uses

Climaxing more than 20 awards from his employer and major professional societies, Dr. Hall was awarded the 2005 Nobel Prize in Physics, sharing this honor with Theodor W. Hänsch of the Max-Planck-Institute and Roy J. Glauber of Harvard University. The Nobel was awarded for their contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique. The optical frequency comb can measure the frequency of another laser with extraordinarily high precision.

Eli Yablonovitch Univ. of California at Berkeley, USA
Nanophotonics: From Photonic Crystals to Plasmonics

Eli Yablonovitch graduated with the Ph.D. degree in Applied Physics from Harvard University in 1972. He worked for two years at Bell Telephone Laboratories and then became a professor of
applied physics at Harvard. In 1979 he joined Exxon to do research on photovoltaic solar energy. Then in 1984, he joined Bell Communications Research, where he was a Distinguished Member of Staff, and also Director of Solid-State Physics Research. In 1992 he joined the University of California, Los Angeles, where he was The Northrop Grumman Opto-Electronics Chair, Professor of Electrical Engineering. Now he Professor in the Electrical Engineering & Computer Sciences Dept., University of California, Berkeley.

His work has covered a broad variety of topics: nonlinear optics, laser-plasma interaction, infrared laser chemistry, photovoltaic energy conversion, strained-quantum-well lasers and chemical modification of semiconductor surfaces. Currently his main interests are in optoelectronics, high-speed optical communications, high-efficiency light-emitting diodes and nanocavity lasers, photonic crystals at optical and microwave frequencies, quantum computing and quantum communication.

Special Symposia at Frontiers in Optics 2007/Laser Science XXIII

- **Laser Science Symposium on Undergraduate Research**
  Monday, September 17, 12:00 p.m.–6:00 p.m.
  Fairmont Hotel, Empire Room

- **Joint FiO/Stanford Photonics Research Center (SPRC) Symposium**
  Monday, September 17, 1:00 p.m.–4:30 p.m.
  Fairmont Hotel, Club Regent

- **Optics for Energy**
  Monday, September 17, 1:30 p.m.–5:30 p.m.
  Fairmont Hotel, Empire Room

- **Joint FiO/LS Symposium: Optics and the Second “Magic Decade” of Quantum Mechanics**
  Wednesday, September 19, 8:30 a.m.–12:00 p.m.
  Fairmont Hotel, Belvedere Room

- **Special International Symposium on Optical Materials**
  Wednesday, September 19 and Thursday, September 20, various times
  Fairmont Hotel, Crystal Room

- **Organic Thin Films for Photonic Applications (OTF) Symposium**
  Wednesday, September 19, 12:00 p.m.–1:30 p.m. (posters) and 1:30 p.m.–6:00 p.m. (oral
Frontiers in Optics 2007/Laser Science XXIII Tutorials

- **FMA1, High-Power Fiber Sources: Recent Advances and Future Prospects**
  W. Andrew Clarkson; Optoelectronics Res. Ctr., Univ. of Southampton, United Kingdom.

  Strategies for scaling output power and brightness from rare-earth doped fiber lasers and amplifiers will be reviewed and the prospects for further improvement in performance will be considered.

- **FMB1, Engineering Nonlinearities in Optical Nanosystems**
  Richard Osgood; Columbia Univ., USA.

  This tutorial reviews the use of nanopatterning of materials to achieve enhanced optical nonlinear response and conversion. Nonlinear propagation in Si-wire waveguides and optical frequency conversion in metallic nanoarrays are used as illustrations.

- **JMC1, Single-Molecule Biophysical Imaging, Nanophotonics and Trapping**
  W. E. Moerner; Stanford Univ., USA.

  Single-molecule fluorescence imaging provides a powerful tool to explore individual biophysical systems, even in cells. Metallic nanoantennas improve the interaction between light and molecules, and a new electrokinetic trap improves single-molecule observation times in solution.

- **FTuB1, Silicon Photonics**
  Tom Koch; Lehigh Univ., USA.

  Silicon photonics has recently received heightened interest as a powerful vehicle for low-cost, high performance active integrated optical subsystems. This tutorial will review fundamental concepts, building blocks, and recent progress in the field.

- **FTuF1, Advances in Time Resolved Ultrafast X-Ray Science**
  Philip H. Bucksbaum; Stanford Univ., USA.
X-rays have probed atomic-scale structure for a century, but new ultrafast x-rays can record atomic motion as well. The sources, techniques, and science applications are discussed in this tutorial.

- **FTuO1, CARS Microscopy: Biomedical Imaging by Nonlinear Vibrational Spectroscopy**  
  Sunney Xie; Harvard Univ., USA.

  Coherent anti-Stokes Raman scattering (CARS) microscopy is a noninvasive imaging technique using vibration spectroscopy as a contrast mechanism. Recent advances have allowed significant improvements in sensitivity, robustness, and cost, opening a range of biomedical applications.

- **FWP1, Advances in Single Molecule Biophysics: Breaking the Nanometer Barrier with Optical Tweezers**  
  Steven M. Block; Stanford Univ., USA.

  Recent advances in optical trapping instrumentation for use in biophysical applications have reached atomic-level resolution for the motions of individual biomolecules. This tutorial will describe how it's done and some of what we've learned.

- **FWW1, Mountain Tops and Wilderness: A New Vision**  
  Jannick P. Rolland; CREOL, USA.

  In this tutorial, we will focus on emerging deployable displays and displays worn on the body to support mobile users. Designs suitable for integration into the eyeglasses form factor will also be discussed.

- **FThB1, Confocal Microscopy without a Pinhole**  
  Jerome Mertz; Boston Univ., USA.

  New fluorescence imaging techniques have been developed that provide confocal-like out-of-focus background rejection by simple widefield imaging with a CCD camera. I will review various techniques including structured illumination microscopy and dynamic speckle illumination microscopy.

- **FThH1, Devices for Optical Interconnects to Chips**  
  David A. B. Miller; Stanford Univ., USA.

  This tutorial will discuss the requirements for devices for optical interconnects to chips, and recent progress in devices that are integrable with silicon technology, including germanium quantum wells.

- **FThS1, Review of Progress in Photonic Band-Gap Fibers**  
  Karl Koch; Corning, Inc., USA.

  The unique properties of air-core photonic band-gap fibers and their underlying principles of operation are reviewed. In addition, applications and other opportunities for these fibers are reviewed.

- **FThU1, Optical Metamaterials: From Magnetics with Rainbow Colors to Negative-Index and Cloaking**  
  Vladimir M. Shalaev; Purdue Univ., USA.
Metamaterials 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 in the optical range.

- **SThB1, Qualification and Lessons Learned with Space Flight Fiber Optic Components**
  Melanie Ott; Sigma Res. and Engineering, USA.

  This tutorial will focus on qualification methods and guidelines, examples of hardware development challenges and lessons learned from the past ten years of development and testing of optical fiber components for space flight programs.

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**FiO 2007 Short Courses**

**SC235 Nanophotonics: Materials, Fabrication and Characterization**

*Joseph W. Haus, Andrew Sarangan, Qiwen Zhan; Univ. of Dayton, USA*

**Course Level**
Advanced beginner (basic understanding of topic is necessary to follow course material)

**Benefits and Learning Objectives**
This course should enable you to:

- Explain the basic linear and nonlinear optical properties of photonic crystals and metals.
- Learn how nanoscale effects are exploited in photonic devices.
- Discuss nanofabrication and design tools.
- Learn the principles of nanocharacterization tools.
- Describe computational and modeling techniques used in nanophotonics.
- Identify the latest advances in the field of nanophotonics.

**Intended Audience**
This course is intended for optics professionals who are interested in learning the fundamentals of nanoscale light-matter interactions, nanophotonic devices, fabrication, synthesis and nanocharacterization techniques.

**Course Description**
Nanophotonics is an emerging multidisciplinary field that deals with optics on the nanoscale. Recent progress in nanophotonics has created new and exciting technological opportunities. The interaction of light with nanoscale matter can provide greater functionality for photonic devices and render unique information about their structural and dynamical properties.
This nanophotonics course examines the key issues of optics on the nanometer scale. The course covers novel materials, such as photonic crystals, quantum dots, plasmonics, and metamaterials and their applications; it then identifies and explains selected fabrication and synthesis techniques. Photonic devices that exploit nanoscale effects, such as nonlinear optical effects and quantum confinement, will be discussed. Finally, various nanocharacterization techniques used in metrology, nondestructive evaluation and biomedical applications will be explained.

Biography
Joseph W. Haus is professor and director of the Electro-Optics Program at the Univ. of Dayton. His current research is concentrated on the linear and nonlinear optical properties of photonic crystals, especially novel photonic sensors, modulators and coherent light sources from THz to UV based on electromagnetic resonance effects. Andrew M. Sarangan is an associate professor of the Electro-Optics Graduate Program at the Univ. of Dayton. His research interests are in the general area of semiconductor devices, integrated optics and computational electromagnetics. His current research is focused on photonic crystals devices, specifically on novel nanophotonic resonator structures for applications in diode lasers and detectors. Qiwen Zhan is an assistant professor of the Electro-Optics Graduate Program at the Univ. of Dayton. He received his M.S. and Ph.D. in electrical engineering from the Univ. of Minnesota. Dr. Zhan's research interests are in the general area of physical optics, including nanophotonics, optical metrology and sensors techniques. His current research focuses on developing new polarization sensing and manipulation techniques for nanotechnology applications.

SC252 The Phase-Space Diagram: A New Paradigm for Analyzing Optical Signals and Systems

Markus Testorf¹, Jorge Ojeda-Castañeda²; ¹Dartmouth College, USA, ²Univ. de Guanajuato, Mexico

Course Level
Advanced beginner (basic understanding of topic is necessary to follow course material)

Benefits and Learning Objectives
This course should enable you to:

- Translate conventional signal representations into phase-space and particularly into phase-space diagrams.
- Associate simple optical elements with the corresponding phase-space transform.
- Know the phase-space representation of signals which are important in optics.
- Summarize the limitations of phase-space optics.
- Analyze paraxial optical systems and their response in terms of phase-space diagrams.
- List at least five applications for which phase-space diagrams are beneficial.
- Derive the phase-space diagram for a composite optical system from its generic components.
- Describe the relationship between signal descriptions in optics based phase-space concepts.
Intended Audience
The course is intended for graduate students and professionals who have some optics background and who want to familiarize themselves with the concepts of phase-space optics and diagrams. The content should be comprehensible for anybody working on optics-related research and development projects. While the course is largely designed without prerequisites, basic knowledge of Fourier optics or signal and systems theory is recommended. The course is not recommended for a non-technical audience.

Course Description
The terms joint time-frequency transformation and local frequency spectrum refer to mathematical tools for dealing with the inevitable tradeoff between two physical variables that form a Fourier transform pair. The first term is commonly used in signal processing; the latter term is employed for analyzing physical systems. For applications in optical sciences, we denote this type of tools as a phase-space representation, or as the Wigner distribution function. We show the signal representation in the phase-space domain not only facilitates the separation of different signal components, but also contains information about the evolution of the optical wave as it propagates through an optical system. Fundamental properties, such as geometrical optics invariants, which are useful when describing the light gathering power of optical instruments, as well as the space bandwidth-product, are intimately related to the phase-space representation of optical signals and systems.

This Short Course introduces optical phase space as a natural representation of optical rays. Based on heuristic arguments, the phase-space representation of optical signals is modified in several steps to incorporate the terminologies of radiometry and Fourier optics. From this exploration the Wigner distribution function emerges as central joint transform, which is subsequently used to develop a signal and system theory based on phase-space representations. We also discuss an alternative motivation for a phase-space description which takes Fourier optics as its starting point and which leads to the signal representation in terms of the Ambiguity function. A significant part of the course is devoted to applications of phase-space optics, including the design of novel imaging devices extending the depth of field of an imaging system, as well as phase retrieval and signal recovery.

Biography
Markus Testorf received his doctorate in physics from the Univ. of Erlangen in Germany. He has worked at the Natl. Inst. of Astrophysics, Optics and Electronics in Puebla, Mexico; at the Univ. of Hagen in Germany; and at the Univ. of Massachusetts-Lowell. Testorf is currently an assistant professor at the Thayer School of Engineering at Dartmouth College. He has written or co-authored more than 130 articles and conference proceedings, including numerous articles related to phase-space concepts in optics and electromagnetism. Testorf has taught undergraduate- and graduate-level optics courses for a number of years, which has allowed him to gain experience with the use of phase-space concepts for optics education. Jorge Ojeda-Castañeda earned his doctorate in applied optics, under the supervision of H. H. Hopkins, F.R.S., at Univ. of Reading, UK. He has written more than 200 papers in academic journals and conference proceedings. He has acted as invited speaker at more than 30 international meetings on optics. For more than 25 years, he has been teaching courses in physics and mathematics at both graduate and
undergraduate levels. In many of his oral and written contributions, he has pioneered the use of phase-space representations for extending the field of view of optical systems.

SC274 Polarization Engineering

Russell Chipman; Univ. of Arizona, USA

Course Level
Advanced beginner (basic understanding of topic is necessary to follow course material)

Benefits and Learning Objectives
This course should enable you to:

- Understand how to follow the polarization changes along a ray path through a series of lenses, mirrors, polarization elements and anisotropic materials.
- Learn to calculate the Jones matrices for ray paths through sequences of thin film coated optical elements and interpret the “instrumental polarization” or polarization aberrations associated with ray paths.
- Understand how polarization state dependent point spread functions and modulation transfer functions are calculated.
- Visualize the Maltese cross, linear polarization tilt, and other fundamental polarization aberration pattern which occur in many systems and picture configurations like the crossed folding mirror which reduce polarization aberrations.
- Develop appropriate polarization specifications for optical systems.

Intended Audience
This class is intended for optical engineers, scientists and managers who need to understand and apply polarization concepts to optical systems. Some prior exposure to optical design programs and to linear algebra would be helpful.

Course Description
This course provides a survey of issues associated with calculating polarization effects in optical systems using optical design programs. Many optical systems are polarization critical and require careful attention to polarization issues. Such systems include liquid crystal projectors, imaging with active laser illumination, very high numerical aperture optical systems in microlithography and data storage, DVD players, imaging into tissue and turbid media, optical coherence tomography and interferometers. Polarization effects are complex: Retardance has three degrees of freedom; diattenuation (partial polarization) has three degrees of freedom; and depolarization, the coupling of polarized into partially polarized light, has nine degrees of freedom. Due to this complexity, polarization components and the polarization performance of optical systems are rarely completely specified.

The polarization aberrations introduced by thin films and uniaxial crystals can be readily evaluated in several commercial optical design codes. These routines are complex and most optical engineers are unfamiliar with the capabilities and the forms of output, but these polarization ray tracing routines provide better methods to communicate polarization
performance and specifications between different groups teamed on complex optical problems. Better means of technical communication speed the development of complex systems.

The course emphasizes the practical aspects of polarization elements and polarization measurements. The basic mathematics of the Poincare sphere, Stokes vectors and Mueller matrices are presented and applied to describe polarized light and polarization elements. Polarizers and retarders are introduced and their principal uses explained. The nonideal characteristics of polarization elements, liquid crystals and birefringent films are discussed with examples.

Biography
Russell Chipman is a professor of optical sciences at the Univ. of Arizona in Tucson. He runs the Polarization Laboratory, which performs measurements and simulations of polarization elements, liquid crystals and polarization aberrations. He managed optics departments at JDS Uniphase and Johnson & Johnson and was also a physics professor at the Univ. of Alabama at Huntsville. He has developed many unique spectropolarimeters and imaging polarimeters and conducted studies into polarization in fiber components, waveguides, liquid crystals, polarization elements and natural polarization signatures. He holds 12 patents in optics. He received his B.S. from MIT and Ph.D. in optical science from the Univ. of Arizona. Chipman is a Fellow of OSA and SPIE and a topical editor for Applied Optics. He chairs the Polarization Engineering group within OSA.

SC303 Lighting and Illumination

William Cassarly; Optical Res. Associates, USA

Course Level
Advanced beginner (basic understanding of topic is necessary to follow course material)

Benefits and Learning Objectives
This course should enable you to:

- Define the meaning of luminance, intensity, illuminance and etendue.
- Compare the output characteristics of commonly used incoherent sources.
- Describe the principles for obtaining uniformity using mixing rods.
- Discuss the use of simulations to quantify the output of illumination systems.
- Compare different approaches used to obtain uniformity in lighting systems.

Intended Audience
Individuals who design illumination systems or need to interface with those designers will find this course appropriate. Previous exposure to optical fundamentals (reflection, refraction, lenses, reflectors) is expected.

Course Description
Lighting and illumination have received much attention in recent years because of advances in sources, especially LEDs. The design of lighting and illumination systems requires balancing
uniformity, collection efficiency and packaging requirements. Some of the fundamental building blocks for illumination system design include an understanding of etendue and the design principles behind lightpipes, lens arrays, faceted optics and diffusers. In this Short Course, these building blocks are discussed through a combination of compute simulations, hardware demonstrations and in-depth discussions.

**Biography**
William Cassarly is a driving force in the movement to develop the field of computer-aided illumination engineering. His efforts include illumination optimization, illumination engineering consulting, papers, talks and educational course development. Some highlights of his efforts include two SPIE illumination courses, submitting the winning solution for the 2006 IODC Illumination Design Problem, and authoring a chapter in the *OSA Handbook of Optics on Illumination Engineering*. In addition, William Cassarly is the inventor on 34 U.S. patents and 15 patents pending.

**SC306 Exploring Optical Aberrations**

*Virendra Mahajan; Aerospace Corp, USA*

**Course Level**
Advanced beginner (basic understanding of topic is necessary to follow course material)

**Benefits and Learning Objectives**
This course should enable you to:

- Acquire a working knowledge of aberrations and their effect on energy on detector, line of sight error and MTF.
- Determine aberration tolerance based on Strehl ratio and Rayleigh’s quarter wave rule.
- Specify fabrication and assembly errors based on a certain aberration tolerance.
- Understand the significance and use of the Zernike polynomials in optical design and testing.
- Develop effective working interface between system engineers/engineering managers and optical designers.
- Communicate effectively with optical engineers and designers.

**Intended Audience**
Anyone interested in acquiring a working knowledge of aberrations. Those who have a background in lens and optical system design or optical testing will also benefit from this course. Managers and system engineers will learn to communicate effectively with optical engineers and designers.

**Course Description**
The quality of an optical system is determined by its aberrations. This Short Course will explore the effect of aberrations on image quality. Starting with basic aberrations of optical systems, attendees will discuss how they affect central irradiance on a target, energy on a detector, and line of sight and resolution of a system. The importance of the use of Zernike polynomials in
optical testing and design, spot diagrams in optical system analysis and Strehl ratio for aberration tolerance will be covered. The chromatic aberrations and the polychromatic PSF and OTF will be explained.

Biography
Virendra (Vini) Mahajan is a graduate of the Optical Science Ctr., Univ. of Arizona, where he is an adjunct professor teaching courses on aberrations. He has 32 years of experience working on space optical systems, the last 23 with the Aerospace Corp. He is a Fellow of OSA, SPIE and the Optical Society of India. He is the author of _Aberration Theory Made Simple_ (1991), the editor of _Selected Papers on Effects of Aberrations in Optical Imaging_ (1993), and the author of _Optical Imaging and Aberrations, Part I: Ray Geometrical Optics_ (1998), _Part II: Wave Diffraction Optics_ (2001), all published by SPIE Press. He is also an Associate Editor of OSA’s _Handbook of Optics_ in the area of classical optics.

Frontiers in Optics/Laser Science

Special Events

Fall Vision Meeting

Sunday, September 16–Wednesday, September 19
_Doubletree Marina, Berkeley, California_
The Optical Society of America Fall Vision Meeting is a small, high-quality scientific meeting focused on all aspects of vision research. Talks are organized so that there is plenty of time for discussion. Additional meeting details can be found at [http://www.osavisionmeeting.org/2007_new/](http://www.osavisionmeeting.org/2007_new/).

Annual OSA Student Chapter Leadership Meeting

Sunday, September 16, 8:00 a.m.–5:00 p.m.
_Stanford University, Room AP 200_
Chapter leaders from 108 student chapters attend this invitation-only event. This meeting focuses on leadership training, chapter management issues, and education outreach opportunities.

Optics Overviews: What’s Hot in Optics Today?

Sunday, September 16, 4:00 p.m.–6:00 p.m.
_Regency Ballroom_
Find out what scientific and technical advances are being made over the entire field of optics. The OSA Technical Division Chairs will be presenting trends in their respective technical areas. The overviews highlight recent developments in optics and are designed to be informative and accessible even to the non-technical attendee.

- **What’s Hot in Optical Design and Instrumentation**, Scott A. Lerner, _Hewlett-Packard_, USA
• **What’s Hot in Optical Sciences**, Barry C. Walker, *Univ. of Delaware, USA*
• **What’s Hot in Optics in Biology and Medicine**, Greg Faris, *SRI Intl., USA*
• **What’s Hot in Optics in Information Science**, Eric Johnson, *Univ. of North Carolina at Charlotte, USA*
• **What’s Hot in Photonics**, Jay Wiesenfeld, *Bell Labs, Alcatel-Lucent, USA*
• **What’s Hot in Quantum Electronics**, Joseph W. Haus, *Univ. of Dayton, USA*
• **What’s Hot in Vision and Color**, Ione Fine, *Univ. of Washington, USA*

Participants’ presentations will also be placed on the OSA website ([www.osa.org](http://www.osa.org)) for viewing by the general public. Go to the technical groups areas of the membership section of OSA’s website to view the technical overviews from this conference as well as those presented during the OSA Leadership Conference in February 2007.

**Welcome Reception and Joint FiO/LS Poster Session I**

Sunday, September 16, 6:00 p.m.–7:30 p.m.
*St. Claire Hotel, Ballroom*
Kick off the FiO 2007/LS XXIII meeting by attending the welcome reception and opening poster session! Meet with your colleagues, kick off the technical program with close to 50 poster presentations, network with your peers and make new acquaintances. Light hors d’oeuvres will be served.

**FiO/LS Poster Presentations**

Sunday, September 16, 6:00 p.m.–7:30 p.m.
*St. Claire Hotel, Ballroom*

Wednesday, September 19 12:00 p.m.–1:30 p.m.
*Regency and Imperial Ballroom Foyer, Fairmont Hotel*

This year there are 95 FiO and nine LS posters scheduled for presentation. Poster presentations offer an effective way to communicate new research findings and provide an opportunity for lively and detailed discussion between presenters and interested viewers.

**OSA Division and Technical Group Meetings**

Network with peers, meet group leaders and get involved in planning future group activities by attending division meetings during FiO. The following divisions have planned group meetings at FiO:

**Sunday, September 16, 3:00 p.m.–3:30 p.m.**
Vision and Color, Doubletree Marina, Berkeley

**Sunday, September 16, 7:30 p.m.–8:30 p.m.**
Optical Sciences, Fairmont Hotel, Empire Room
Optics in Biology and Medicine, Fairmont Hotel, Crystal Room
Optics in Information Science, Fairmont Hotel, Gold Room
Photonics, Fairmont Hotel, Valley Room
Quantum Electronics, Fairmont Hotel, California Room

**Monday, September 17, 7:30 p.m.–8:30 p.m.**
Optical Design and Instrumentation, Fairmont Hotel, Empire Room

These division meetings will encompass the technical groups affiliated with the division. Should you have any suggestions for any of the technical group activities, contact the division chair with your input.

**2007 Joint FiO/LS Awards Ceremony and Plenary Session**

Monday, September 17, 8:30 a.m.–12:00 p.m.
*Regency Ballroom*

The 2007 Joint FiO/LS Awards Ceremony and Plenary Session will feature three world-renowned speakers. See the [plenary page](#) for detailed descriptions of the speakers and their presentations.

**Symposium on Undergraduate Research**

Monday, September 17, 12:00 p.m.–6:00 p.m. (or later)
*Glen Ellen Room (oral papers) and Fairfield Room (posters)*

This special DLS annual symposium is rapidly becoming one of the most successful DLS traditions (this year's is the seventh of a series that began at the Long Beach meeting in 2001). During the past three years the number of undergraduates presenting papers has grown from fewer than 20 to more than 30, and the talks have been of outstanding quality, some absolutely stellar. Last year's posters were outstanding as well, and generated a great deal of lively interest and on-the-spot discussion. This year's symposium will consist of afternoon poster and oral sessions, preceded by lunch for the presenters. The event provides an opportunity for some of the student members of our community, who are already among the finest young scientists to be found anywhere, to present their work before an audience of their peers as well as the larger optics community. All are invited and encouraged to attend the sessions. See the separate Symposium on Undergraduate Research program in your registration bag for speaker information.

**Going for the Goal Workshop! (sponsored by the OSA Foundation)**

Monday, September 17, 1:00 p.m.–3:00 p.m.
*St. Claire Hotel, Ballroom*

This session is ideal for students that are charting their professional course. The program will focus on strategies for defining and achieving career goals. This event is free of charge and open to all student attendees.

Speaker: Mitzi Weinman, President, TimeFinder, USA
OSA’s Annual Business Meeting

6:30 p.m.–7:30 p.m.
Monday, September 17
Fairmont Hotel, Belvedere Room

Learn more about OSA and join the OSA Board of Directors for the Society’s annual business meeting on Monday, September 17. The 2006 Activity Reports will be presented and the results of the Board of Directors election will be announced.

I. Welcome 2007 OSA President, Joseph H. Eberly

II. 2006 Activity Reports from Society Representatives
   Treasurer, Stephen Fantone
   Chair, Board of Editors, Tony F. Heinz
   Chair, Publications Council, James R. Fienup
   Co-Chair, Science & Engineering Council, Robert W. Boyd and
   Co-Chair, Science & Engineering Council, Edward A. Watson
   Chair, Membership/Education Services Council, Adam P. Wax
   Chair, Corporate Associates Committee, Paul M. Crosby
   Chair, International Council, Jonathan P. Marangos
   Chair, OSA Foundation, Gary C. Bjorklund

III. Election Results: Vice President and Directors at Large, Joseph H. Eberly

OSA Student Member Welcome Reception

Monday, September 17, 7:30 p.m.–9:30 p.m.
Smoke Tiki Lounge

OSA Student Members are invited to attend this social event that provides a perfect opportunity to meet new friends and have a good time. The reception is free of charge for OSA student members.

Minorities and Women in OSA (MWOSA) Networking Breakfast

You are invited to attend the Minorities and Women in OSA Networking Breakfast to meet and network with others in the optics industry.

This year’s event will feature Kate Pickle, Science Technology Engineering and Math (STEM) Project Manager for the Girl Scouts of the USA (GSUSA), who will discuss the approach the Girl Scouts have taken to help girls meet the growing need for skilled science and technology professionals. She will also highlight the partnership between the GSUSA and the OSA Foundation and the role professional societies and their members can play in engaging girls in science at an early age.
When: Tuesday, September 18, 8:00 a.m.–9:30 a.m.
Where: Fairmont Hotel, Club Regent

There is limited space. RSVP for this event by September 5 to KiKi L’Italien at klital@osa.org.

OSA Member Reception and JOSA 90th Anniversary Celebration

Tuesday, September 18, 6:30 p.m.–8:00 p.m.
St. Claire Hotel, Ballroom
The OSA Member Reception is a special tradition; it’s a time when members gather for great conversation, and lots of good cheer! This year’s reception includes a special 90th anniversary celebration for the Journal of the Optical Society of America (JOSA). All OSA members are encouraged to attend. Delicious refreshments will be served, admittance is free.

Division of Laser Science Annual Business Meeting

Tuesday, September 18, 6:30 p.m.–7:00 p.m.
Fairfield Room
All members and interested parties are invited to attend the Annual Business Meeting of the Division of Laser Science. The DLS officers will report on the activities of the past year and on plans for the future. Questions will be taken from the floor. This is your opportunity to help define the operations of the DLS and LS Conference.

Laser Science Banquet

Tuesday, September 18, 7:30 p.m.–10:00 p.m.
Gordon Biersch Brewery
Join your colleagues for the annual LS Banquet. Tickets are required for this event and can be purchased at registration for $50. Tickets must be purchased by 12:00 noon on Monday, September 17.

Meet the Editors of the APS Journals

Wednesday, September 19, 3:30 p.m.–5:30 p.m.
Fairmont Hotel, Bamboo Lounge

The Editors of the APS journals cordially invite you to join them for conversation and refreshments on Wednesday, September 19, 3:30 p.m.–5:30 p.m. in the Bamboo Lounge. Your questions, criticisms, compliments and suggestions about the journals are welcome. We hope you will be able to join us.

FiO Postdeadline Papers

Wednesday, September 19, 6:00 p.m.–7:00 p.m.
Rooms to Be Announced
Science Educators’ Day

Thursday, September 20, 5:30 p.m.–9:00 p.m.
Regency Ballroom
Sponsored by OSA, the Northern California Local Section, and the OSA Student Chapters at Stanford and Berkeley, Educator's Day is designed to provide middle and high school science teachers with optics teaching resources. This event features hand-on classroom experiment demonstrations lead by optics experts.

TOUR: The National Ignition Facility at Lawrence Livermore National Laboratory

FiO/LS Attendees are invited to participate in a tour of the Lawrence Livermore National Laboratory’s National Ignition Facility (NIF) on Thursday, September 20. Space is limited to 46 persons so sign up today. Please note that participants must meet requirements. For a list of requirements and to sign up email Bonnie McDonald at mcdonald39@llnl.gov. For Visitor Badging/Non DOE personnel, you must also send Bonnie your Social Security Number, Date of Birth, and Place of Birth. DOE Personnel, if you have a DOE Standard Badge, that will get you access onto the LLNL site. You must sign up for the tour no later than Close of Business on Thursday, September 13, 2007. The tour will depart from the San Jose Fairmont Hotel at 7:30 a.m. on Thursday, September 20 and return to the Fairmont at approximately 2:00 p.m. Transportation is provided by LLNL. All those interested must sign up by September 13 as tour participants must be confirmed in advance of the FiO Conference.

All tour participants must bring a valid U.S. issued driver's license.

Exhibitor List

4D Technology Corporation
Breault Research Organization
Cambridge University Press
Chroma Technology Corp.
Coherent Inc.
CVI Melles Griot
Del Mar Photonics
Femtolasers, Inc.
Hamamatsu Corporation
Institute of Optics, University of Rochester
IOP Publishing
Laser Focus World
Materials Research Society
Micro Laser Systems Inc.
Nature Publishing Group
New Focus
Newport Corporation
Novawave Technologies
SCIENCE EDUCATORS' DAY

Register Now!
Thursday, September 20, 2007 5:30 p.m.-9:00 p.m.
Regency Ballroom, Fairmont Hotel
170 South Market Street, San Jose, California

- Attend this free event for middle and high school science teachers sponsored by the Optical Society of America (OSA), the Northern California Local Section of OSA, and the OSA Student Chapters at Stanford and Berkeley
- Come see hands-on experiments and demonstrations on optical phenomena:
  - Fluorescence: Viewing Glowing Colors and Invisible Ink
- Splitting White Light: Prisms, Soap Bubbles and Rainbows
- Creating Colors from Polarization
- Waveguides: Water and Jell-O Light Pipes, Fiber Optics
- And Much More!

- Receive a participant packet of educational resources and lesson plans for replicating demonstrations in the classroom
- Meet Stanford and Berkeley graduate students, staff, and local educators interested in science outreach
- Enjoy a dinner with other local science educators

**Corporate Sponsors:**

- Lockheed Martin
- CORNING
- JK Consulting
  Thin Film Design & Application
# Agenda of Sessions — Sunday, September 16, 2007

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>8:00 a.m.–5:00 p.m.</td>
<td>OSA Student Chapter Leadership Meeting, Stanford University, Room AP200</td>
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</tbody>
</table>
| 9:00 a.m.–12:30 p.m. | **Short Courses, Locations will be provided at registration**  
SC235: Nanophotonics: Design, Fabrication and Characterization  
SC252: The Phase-Space Diagram: A New Paradigm for Analyzing Optical Signals and Systems  
SC253: Medical Imaging and Beyond  
SC304: Free-Form Optics Design for Illuminarian |
| 1:30 p.m.–5:00 p.m. | **Short Courses, Locations will be provided at registration**  
SC274: Polarization Engineering  
SC303: Lighting and Illumination  
SC305: Optical Materials for Advanced Photonic Applications  
SC306: Exploring Optical Aberrations |
| 3:00 p.m.–3:30 p.m. | OSA Vision and Color Business Meeting, Doubletree Marina, Berkeley                          |
| 4:00 p.m.–6:00 p.m. | Optics Overviews: What’s Hot in Optics Today?  Fairmont Hotel, Regency Ballroom            |
| 6:00 p.m.–7:30 p.m. | **JSuA:** Welcome Reception and Joint FiO/LS Poster Session, Sainte Claire Hotel, Ballroom   |
| 7:30 p.m.–8:30 p.m. | OSA Division and Technical Group Meetings  
Optical Sciences, Fairmont Hotel, Empire Room  
Optics in Information Science, Fairmont Hotel, Gold Room  
Photonics, Fairmont Hotel, Valley Room  
Quantum Electronics, Fairmont Hotel, California Room |

**KEY TO SHADING:**  
- Frontiers in Optics  
- Laser Science  
- Joint FiO/LS  
- OMD
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<tr>
<th>Time</th>
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<tr>
<td>8:30 a.m.–10:00 a.m.</td>
<td></td>
<td>JMA: 2007 Joint FiO/LS Awards Ceremony, <em>Fairmont Hotel, Regency Ballroom</em></td>
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<td>10:00 a.m.–10:30 a.m.</td>
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<td>Coffee Break, <em>Fairmont Hotel, Regency and Imperial Ballroom Foyers</em></td>
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<td>10:30 a.m.–12:00 p.m.</td>
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<td>JMB: 2007 Joint FiO/LS Plenary Session, <em>Fairmont Hotel, Regency Ballroom</em></td>
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<td>12:00 p.m.–1:30 p.m.</td>
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<td>Lunch Break</td>
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<td>12:00 p.m.–6:00 p.m.</td>
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<td>SMA: Symposium on Undergraduate Research Posters, <em>Fairmont Hotel, Fairfield Room</em></td>
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<td>1:00 p.m.–4:30 p.m.</td>
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<td>SMB: Joint FiO/SPRC Symposium, <em>Fairmont Hotel, Club Regent</em></td>
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<td>1:00 p.m.–3:00 p.m.</td>
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<td>Student Event: Going for the Goal! Workshop, <em>Sainte Claire Hotel, Ballroom</em></td>
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<td>3:30 p.m.–4:00 p.m.</td>
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<td>Coffee Break, <em>Fairmont Hotel, Regency and Imperial Ballroom Foyers</em></td>
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<td>4:00 p.m.–6:00 p.m.</td>
<td>SME: Optics for Energy II (ends at 5:30 p.m.)</td>
<td>FMF: Ultrashort-Pulse Fiber Lasers</td>
<td>FMG: NLO in Engineered Materials II</td>
<td>FMH: Computational Imaging I</td>
<td>FMI: Integrated Optic Devices II</td>
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<td>6:30 p.m.–7:30 p.m.</td>
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<td>OSA's Annual Business Meeting, <em>Fairmont Hotel, Belvedere Room</em></td>
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<td>7:30 p.m.–8:30 p.m.</td>
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<td>OSA Optical Design and Instrumentation Division Meeting, <em>Fairmont Hotel, Empire Room</em></td>
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<td>7:30 p.m.–9:30 p.m.</td>
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<td>OSA Student Member Welcome Reception, <em>Smoke Tiki Lounge, 152 Post St.</em></td>
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<td>JMD: Imaging and Microscopy—Biological II</td>
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<td>LMB: Space-Based Tests of Relativity (ends at 5:45 p.m.)</td>
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<td>SMD: Symposium on Undergraduate Research</td>
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<td>OMB: Materials and Devices for OLEDs I (ends at 5:45 p.m.)</td>
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<td>OMA: Organic Semiconductor Devices (ends at 3:15 p.m.)</td>
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<td>FMJ: Data Reduction Methods and Computational Imaging (ends at 5:45 p.m.)</td>
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<tr>
<td>8:00 a.m.—10:00 a.m.</td>
<td>FTuA: Optical Systems and Instrumentation for Short and Ultra Short Pulse X-Ray/VUV Sources I (ends at 9:45 a.m.)</td>
<td>FTuB: Silicon Photonics</td>
<td>FTuC: Propagation in Disordered Media</td>
<td>JTuA: Quantum Information</td>
<td>FTuD: Biosensors I</td>
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<tr>
<td>8:00 a.m.—9:30 a.m.</td>
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<td>Minorities and Women in OSA (MWOSA) Networking Breakfast, Fairmont Hotel, Club Regent</td>
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<tr>
<td>10:00 a.m.—10:30 a.m.</td>
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<td>Coffee Break, Exhibit Hall (Fairmont Hotel, Imperial Ballroom)</td>
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<tr>
<td>10:00 a.m.—5:00 p.m.</td>
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<td>Exhibit Hall Open</td>
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<tr>
<td>10:30 a.m.—12:30 p.m.</td>
<td>FTuF: Ultrafast Dynamics: THz to X-Rays</td>
<td>FTuG: Silicon Nanophotonics</td>
<td>FTuH: Coherence and Polarization I</td>
<td>FTuI: Quantum Sensing and Imaging I (ends at 12:15 p.m.)</td>
<td>FTuJ: Biosensors II (ends at 12:15 p.m.)</td>
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<td>12:30 p.m.—2:00 p.m.</td>
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<td>FTuK: Nonlinear Microscopy in Biology I</td>
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<tr>
<td>2:00 p.m.—4:00 p.m.</td>
<td>FTuL: Optical Systems and Instrumentation for Short and Ultra Short Pulse X-Ray/VUV Sources II</td>
<td>FTuM: Active Photonic Devices in Silica</td>
<td>FTuN: Coherence and Polarization II (ends at 3:45 p.m.)</td>
<td>JTuB: Quantum Sensing and Imaging II (ends at 3:45 p.m.)</td>
<td>FTuO: Nonlinear Microscopy in Biology I</td>
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<td>4:00 p.m.—4:30 p.m.</td>
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<tr>
<td>4:30 p.m.—6:30 p.m.</td>
<td>FTuQ: Ultrafast Science: X-Rays and Accelerators</td>
<td>FTuR: Short Pulse Fiber Lasers and Amplifiers (ends at 6:00 p.m.)</td>
<td>FTuS: Coherence and Polarization III</td>
<td>FTuT: Photonic Crystals and Emission</td>
<td>FTuU: Nonlinear Microscopy in Biology II</td>
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<tr>
<td>6:30 p.m.—7:00 p.m.</td>
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<td>Division of Laser Science Annual Business Meeting, Fairmont Hotel, Glen Ellen Room</td>
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<tr>
<td>6:30 p.m.—8:00 p.m.</td>
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<td>OSA Member Reception and JOSA 90th Anniversary Celebration, Sainte Claire Hotel, Ballroom</td>
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<tr>
<td>7:30 p.m.—10:00 p.m.</td>
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<td></td>
<td>Laser Science Banquet, Gordon Biersch Brewery, 33 E. San Fernando St.*</td>
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*Tickets must be purchased in advance. See Special Events section for more information.
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<tr>
<td><strong>FTuE</strong>: Precision Engineering in Optics</td>
<td><strong>LTuA</strong>: Time-Resolved X-Ray and Electron Diffraction (starts at 8:30 a.m.)</td>
<td><strong>LTuB</strong>: Precision Techniques at High Laser Power I</td>
<td><strong>LTuC</strong>: Properties and Dynamics of Interfaces and Surfaces I (starts at 8:45 a.m.)</td>
<td><strong>OTuA</strong>: OTFT Materials and Devices</td>
</tr>
<tr>
<td><strong>LTuG</strong>: Precision Techniques at High Laser Power II</td>
<td><strong>LTuH</strong>: Clocks, Navigation and Magnetometers</td>
<td><strong>LTuI</strong>: Imaging and Microscopy—Non-Biological I (starts at 2:30 p.m.)</td>
<td><strong>OTuC</strong>: Materials and Devices for Organic Photovoltaics (ends at 3:45 p.m.)</td>
<td><strong>OTuD</strong>: Materials and Devices for OLEDs II (ends at 6:15 p.m.)</td>
</tr>
<tr>
<td>Minorities and Women in OSA (MWOSA) Networking Breakfast, <em>Fairmont Hotel, Club Regent</em></td>
<td>Coffee Break, <em>Exhibit Hall (Fairmont Hotel, Imperial Ballroom)</em></td>
<td>Exhibit Hall Open</td>
<td>Exhibit-Only Time Lunch Break</td>
<td><strong>LTuJ</strong>: Precision Techniques on Short Time Scales II (ends at 5:45 p.m.)</td>
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<tr>
<td><strong>FTuP</strong>: Aberration Theory in Optical Testing</td>
<td><strong>LTuK</strong>: Laser-Based Space Missions</td>
<td><strong>LTuL</strong>: Imaging and Microscopy—Non-Biological II</td>
<td>Division of Laser Science Annual Business Meeting, <em>Fairmont Hotel, Glen Ellen Room</em></td>
<td>OSA Member Reception and JOSA 90th Anniversary Celebration, <em>Sainte Claire Hotel, Ballroom</em></td>
</tr>
<tr>
<td><strong>FTuV</strong>: General Optical Design and Instrumentation I</td>
<td><strong>LTuJ</strong>: Precision Techniques on Short Time Scales II (ends at 5:45 p.m.)</td>
<td><strong>LTuK</strong>: Laser-Based Space Missions</td>
<td><strong>LTuL</strong>: Imaging and Microscopy—Non-Biological II</td>
<td>Laser Science Banquet, <em>Gordon Biersch Brewery, 33 E. San Fernando St.</em></td>
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Note: * denotes additional locations.
### Agenda of Sessions — Wednesday, September 19, 2007

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<tr>
<td>8:00 a.m.–10:00 a.m.</td>
<td>FWA: Ultrafast Dynamics of Biological and Chemical Systems I</td>
<td>FWB: High Power Fiber Lasers and Amplifiers</td>
<td>FWC: Complex Light Fields</td>
<td>FWD: Metamaterials I</td>
<td>FWE: Clinical and Preclinical Imaging and Therapeutics</td>
</tr>
<tr>
<td>8:30 a.m.–12:00 p.m.</td>
<td>SWA: Joint FiO/LS Symposium: Optics and the Second “Magic Decade” of Quantum Mechanics, <em>Fairmont Hotel, Belvedere Room</em></td>
<td>Coffee Break, <em>Exhibit Hall (Fairmont Hotel, Imperial Ballroom)</em></td>
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<td>Exhibit Hall Open</td>
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<tr>
<td>10:00 a.m.–4:00 p.m.</td>
<td>FWG: Ultrafast Pulse Measurements I</td>
<td>FWH: Diffractive Micro- and Nanostructures for Sensing and Information Processing I</td>
<td>FWI: Light Interaction with Engineered Materials</td>
<td>FWJ: Metamaterials II</td>
<td>FWK: Optical Coherence Tomography</td>
</tr>
<tr>
<td>10:30 a.m.–12:00 p.m.</td>
<td>JWC: Joint FiO/LS Poster Session II, <em>Fairmont Hotel, Regency Ballroom</em></td>
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<td>12:00 p.m.–1:30 p.m.</td>
<td>FWM: RF Photonics I</td>
<td>SWB: Photonic Materials I</td>
<td>FWN: Quantum Light-Matter Interface</td>
<td>FWO: Plasmonic Metamaterials and Waveguides</td>
<td>FWP: Advances in Optical Trapping</td>
</tr>
<tr>
<td>1:30 p.m.–3:30 p.m.</td>
<td>FWR: Diffractive Micro- and Nanostructures for Sensing and Information Processing II, <em>Fairmont Hotel, Belvedere Room</em></td>
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<tr>
<td>3:30 p.m.–4:00 p.m.</td>
<td>FWS: RF Photonics II</td>
<td>SWC: Photonic Materials II and Structured Nonlinear Crystals</td>
<td>FWT: EIT and Quantum Information</td>
<td>FWU: Near Field Optics (ends at 5:45 p.m.)</td>
<td>FWV: Diffuse Imaging and Spectroscopy (ends at 6:15 p.m.)</td>
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<td>4:00 p.m.–6:00 p.m.</td>
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<td>6:00 p.m.–7:30 p.m.</td>
<td>FiO Postdeadline Papers, <em>Locations are listed in Postdeadline Papers program in registration bag</em></td>
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<tr>
<td><strong>FWF:</strong> Light-Confining Micro- and Nano-Structures</td>
<td><strong>IWA:</strong> Cavity Ringdown Spectroscopy I (starts at 8:15 a.m.)</td>
<td><strong>JWA:</strong> Radiation Pressure, Cooling and Quantum Cantilevers I</td>
<td><strong>LWB:</strong> Time-Resolved Photoemission, Photoionization and Photodetachment I (starts at 8:30 a.m.)</td>
<td><strong>OWA:</strong> Device Physics</td>
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<td><strong>FWL:</strong> Spectral Imaging and Holographic Storage</td>
<td><strong>IWC:</strong> Cavity Ringdown Spectroscopy II</td>
<td><strong>JWB:</strong> Radiation Pressure, Cooling and Quantum Cantilevers II</td>
<td><strong>LWD:</strong> Time-Resolved Photoemission, Photoionization and Photodetachment II</td>
<td><strong>OWB:</strong> Solution-Processed Organic Electronic Devices (ends at 12:15 p.m.)</td>
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<tr>
<td><strong>FWQ:</strong> Optical Vortices and Imaging Complex Media</td>
<td><strong>IWE:</strong> Slow and Stored Light (starts at 1:45 p.m.)</td>
<td><strong>LWF:</strong> Beyond the Simple Quantum Limit in Gravitational Wave Detectors (starts at 2:30 p.m.)</td>
<td><strong>LWG:</strong> 2-Dimensional Spectroscopy I</td>
<td><strong>TWA:</strong> Organic Thin Films for Photonic Applications I (ends at 3:15 p.m.)</td>
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<tr>
<td><strong>FWR:</strong> Diffractive Micro- and Nanostructures for Sensing and Information Processing II, <em>Fairmont Hotel, Belvedere Room</em></td>
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<tr>
<td><strong>FWW:</strong> Virtual/Mixed Environments and Interactivity (ends at 5:45 p.m.)</td>
<td><strong>LWH:</strong> Cold Atom and Molecule Systems (ends at 5:45 p.m.)</td>
<td><strong>LWI:</strong> Chip-Scale Atomic Devices</td>
<td><strong>LWJ:</strong> 2-Dimensional Spectroscopy II (ends at 6:15 p.m.)</td>
<td><strong>TWB:</strong> Organic Thin Films for Photonic Applications II</td>
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</table>

**SWA:** Joint FiO/LS Symposium: Optics and the Second “Magic Decade” of Quantum Mechanics, *Fairmont Hotel, Belvedere Room*

Coffee Break, *Exhibit Hall (Fairmont Hotel, Imperial Ballroom)*

Exhibit Hall Open

**JWC:** Joint FiO/LS Poster Session II, *Fairmont Hotel, Regency Ballroom*

**FWQ:** Optical Vortices and Imaging Complex Media | **IWE:** Slow and Stored Light (starts at 1:45 p.m.) | **LWF:** Beyond the Simple Quantum Limit in Gravitational Wave Detectors (starts at 2:30 p.m.) | **LWG:** 2-Dimensional Spectroscopy I | **TWA:** Organic Thin Films for Photonic Applications I (ends at 3:15 p.m.)

**FWR:** Diffractive Micro- and Nanostructures for Sensing and Information Processing II, *Fairmont Hotel, Belvedere Room*

Coffee Break, *Exhibit Hall (Fairmont Hotel, Imperial Ballroom)*

**FWW:** Virtual/Mixed Environments and Interactivity (ends at 5:45 p.m.) | **LWH:** Cold Atom and Molecule Systems (ends at 5:45 p.m.) | **LWI:** Chip-Scale Atomic Devices | **LWJ:** 2-Dimensional Spectroscopy II (ends at 6:15 p.m.) | **TWB:** Organic Thin Films for Photonic Applications II

FiO Postdeadline Papers, *Locations are listed in Postdeadline Papers program in registration bag***
## Agenda of Sessions — Thursday, September 20, 2007

<table>
<thead>
<tr>
<th>Time</th>
<th>Empire</th>
<th>Crystal</th>
<th>Gold</th>
<th>Valley</th>
<th>California</th>
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<tbody>
<tr>
<td>8:00 a.m.–10:00 a.m.</td>
<td>SThA: Best of Topicals I (ends at 10:10 a.m.)</td>
<td>SThB: Space-Qualification of Materials and Devices for Laser Remote Sensing Instruments I</td>
<td>SThC: (Guarded) Rational Exuberance: Renaissance after the Telecom Boom?</td>
<td>FThA: Ultrafast Dynamics of Biological and Chemical Systems II (ends at 9:30 a.m.)</td>
<td>FThB: Advanced Biological Microscopy and Tissue Ablation</td>
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<tr>
<td>10:00 a.m.–10:30 a.m.</td>
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<td>Coffee Break, Fairmont Hotel, Regency and Imperial Ballroom Foyers</td>
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<tr>
<td>10:30 a.m.–12:30 p.m.</td>
<td>SThD: Best of Topicals II (ends at 12:10 p.m.)</td>
<td>SThE: Space-Qualification of Materials and Devices for Laser Remote Sensing Instruments II and Ceramic Materials I</td>
<td>SThF: (Guarded) Rational Exuberance: Renaissance after the Telecom Boom?</td>
<td>FThD: Ultrafast Pulse Measurements II (ends at 12:15 p.m.)</td>
<td>FThE: Seeing the Invisible: Strategies for Imaging Transparent Cell Types I</td>
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<tr>
<td>12:30 p.m.–2:00 p.m.</td>
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<td>Lunch Break</td>
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<tr>
<td>2:00 p.m.–4:00 p.m.</td>
<td>FThH: Silicon and III-V Based Optoelectronics for Optical Interconnects</td>
<td>SThG: Ceramic Materials II</td>
<td>FThI: Nanoscale Concentration of Light I</td>
<td>FThJ: Microstructured and Novel Optical Fibers</td>
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<td>4:00 p.m.–4:30 p.m.</td>
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<tr>
<td>4:30 p.m.–6:30 p.m.</td>
<td>FThQ: Computational Imaging II</td>
<td>SThH: Nanocrystals and Quantum Dots (ends at 6:45 p.m.)</td>
<td>FThR: Nanoscale Concentration of Light II</td>
<td>FThS: Microstructured, Nonlinear and Novel Optical Fibers (ends at 6:15 p.m.)</td>
<td>FThT: Engineering the Eye: Advances in Retinal Prostheses II (ends at 5:45 p.m.)</td>
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<tr>
<td>5:30 p.m.–9:00 p.m.</td>
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### Coffee Break, Fairmont Hotel, Regency and Imperial Ballroom Foyers

**Lunch Break**

### Coffee Break, Fairmont Hotel, Regency and Imperial Ballroom Foyers

**Science Educators’ Day, Fairmont Hotel, Regency Ballroom**
<table>
<thead>
<tr>
<th>Hillsborough</th>
<th>Sacramento</th>
<th>Piedmont</th>
<th>Glen Ellen</th>
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<tr>
<td>FThC: Metamaterials-Based Devices</td>
<td>LThA: Cold Atoms and Degenerate Gases I (ends at 9:45 a.m.)</td>
<td>LThB: General Techniques</td>
<td>LThC: Terahertz Spectroscopy I</td>
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<td><strong>Coffee Break, Fairmont Hotel, Regency and Imperial Ballroom Foyers</strong></td>
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<tr>
<td>FThF: Optical Antennae</td>
<td>LThD: Cold Atoms and Degenerate Gases II (ends at 12:00 p.m.)</td>
<td>FThG: General Optical Design and Instrumentation II</td>
<td>LThE: Terahertz Spectroscopy II</td>
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<td><strong>Lunch Break</strong></td>
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<tr>
<td>FThL: Plasmonics and Nanocrystals (ends at 3:30 p.m.)</td>
<td>FThM: Diffractive Micro- and Nanostructures for Sensing and Information Processing III</td>
<td>FThN: Coherence and Polarization IV</td>
<td>FThO: Random Lasers and Disordered Media (ends at 3:45 p.m.)</td>
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<td><strong>Coffee Break, Fairmont Hotel, Regency and Imperial Ballroom Foyers</strong></td>
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<td>FThU: Cloaking</td>
<td>FThV: Diffractive Micro- and Nanostructures for Sensing and Information Processing IV</td>
<td>FThW: Coherence and Polarization V</td>
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<td><strong>Science Educators’ Day, Fairmont Hotel, Regency Ballroom</strong></td>
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</table>
Sante Claire Hotel, Ballroom

Oil Design and Instrumentation Posters

**JSuA1**
Experimental Investigation of Freedericksz Transition in Square Electric Pulse Sequence Field, Vardan Margaryan, R. B. Alaverdyan, A. L. Aslanyan, L. S. Aslanyan, G. S. Gevorgyan, E. A. Santsroyan; Yerevan State Univ., Armenia. Freedericksz transition is theoretically and experimentally investigated in square pulse sequence. The dependence of storage effect on filling coefficient is theoretically investigated in square pulse sequence. The Freedericksz transition is theoretically and experimentally investigated in square pulse sequence. The dependence of storage effect on filling coefficient

**JSuA2**
A Liquid-Crystal-Based Terahertz Polarizer, Cho-Fan Hsieh1, Yu-Chien Lai1, Ru-Pin Pan1, Ci-Ling Pan2; 1Dept. of Electrophysics, Natl. Chiao Tung Univ., Hsinchu, Taiwan, 2Dept. of Photonics and Inst. of Electro-optical Engineering, Natl. Chiao Tung Univ., Hsinchu, Taiwan. We demonstrate a liquid crystal phase grating as a beam splitter for the terahertz wave. The beam splitting ratio can be tuned from 1:1 to 1:1.

**JSuA3**
Mode Shape Analysis in Square Plate Using DSPI, Salva Mirza1, Chandra Shanker1, Safia Akhtar Kazmi2; 1Indian Inst. of Technology Delhi, India, 2Aligarh Muslim Univ., Aligarh, India. In this paper, the study of transverse vibrations, mode shape analysis in square plate free at all ends and wavelet-filtering scheme for the removal of speckle noise in speckle interferograms are presented using DSPI.

**JSuA4**
Terahertz Beam Splitting by Tunable Liquid Crystal Phase Grating, Chia-Jen Lin1, Yu-Tai Li2, Cho-Fan Hsieh1, Ru-Pin Pan1, Ci-Ling Pan2; 1Dept. of Electro-optics, Natl. Chiao Tung Univ., Hsinchu, Taiwan, 2Dept. of Photonics and Inst. of Electro-optical Engineering, Natl. Chiao Tung Univ., Hsinchu, Taiwan. We demonstrate a liquid crystal phase grating as a beam splitter for the terahertz wave. The beam splitting ratio can be tuned from 1:1 to 1:1.

**JSuA5**
Optical Fabrication of a Micro-Electron Column and Large Area Scanning Application, Won K. Jung1, Sung-soon Park1, Ho-Seob Kim2; 1Hansung Univ., Republic of Korea, 2Sunmoon Univ., Republic of Korea. Basic components of micro-electron column were assembled with optical alignment and laser bonding. Source and Einzel lenses were aligned with the diffraction method of laser beam and bonded simultaneously by laser welding.

**JSuA6**
The Single-Angle Plane-Wave Spectral Response of One-Dimensional Photonic Crystal Structures, Gregory R. Kilby1, James J. Raftery, Jr.1, Thomas K. Gaylord1, United States Military Acad., USA. One-dimensional (1-D) photonic crystal (PC) structures are measured. Regularization methods are applied to these measurements to determine the single-angle plane-wave spectral response of the structure.

**JSuA7**
Complete Polarization Conversion Using One Crystal Exhibiting Dual Transverse Pockels Effect, Changsheng Li1, Beihang Univ., China. The complete polarization conversion, which converts one arbitrary state of polarization into another arbitrary one, can be achieved by controlling only two voltages applied to one electroropic crystal exhibiting dual transverse Pockels effect.

**JSuA8**
Design of a Photon-Counting System for Raman Spectroscopy, F. R. Pérez1, C. Del Valle1, L. Reyes2, J. Tobar1, C. Barrero2, A. Velásquez2; 1Univ. de Antioquia, Colombia, 2Centro de Investigaciones en Óptica, México. This system uses a photo-multiplier. The counting photon system is conformed by 5 stages, which are: the detector, a pre-amplifier, a pulse shaper, a comparators and a communications interface in PC.

**JSuA9**
Alignment of Segmented Mirror with the Stitched Method, Ferrum S. Granados-Aguir, Severino Manzú-Aguirre, Georgina Beltrán Pérez; Benemérita Univ. Autónoma de Puebla, México. The results of an optical-system using the fringes-projection technique to measure the historic building relief are shown. This system will be used to get a historic memory of our historic buildings.

**JSuA10**
Data Fitting on a Sphere, J. J. Sanchez-Mondragón1, Abundio David2, M. Torres Céspedes1, D. A. May-Arriaga2, J. Escobedo-Alatorre3; 1Inst. Nacional de Astrofísica Óptica y Electrónica, México, 2Céntro de Investigaciones en Óptica, México, 3Electronics Dept., FIMEE, Univ. de Guanajuato, México. We obtain the semispherical polynomial data fitting and compare it with the Zernike polynomials fitting of the projection on a circle. We compare the fits and the one with the spherical harmonics.

**JSuA11**
Optical System to Measure and Record 3D Profiles the Architectural Heritage Relief in Historic Buildings of Puebla City, Juan Castillo-Mxicóatl, Severino Manzú-Aguirre, Georgina Beltrán Pérez; Benemérita Univ. Autónoma de Puebla, México. The results of an optical-system using the fringes-projection technique to measure the historic building relief are shown. This system will be used to get a historic memory of our historic buildings.
Optical Non-Contact Electric Field Mapping by LID in Cs Vapor, Marcos Auzinsh, Kasparas Blanius, Bartun Evert, Florian Gabbบาย, Andrey Karmola, Mairis Tamanics; Physics Dept., Univ. of Latvia, Latvia. We present experimental and theoretical studies of the possibility of using cesium vapor as a tracer gas for optical non-contact electric field mapping. Optical images of electric field distributions have been obtained.

Polarization Imaging in Shadow and Glare, Shih-Schin Lirr, Edward N. Pugl1, Nader Engheta2; Electrical and Systems Engineering Dept., Univ. of Pennsylvania, USA. In shadow and glare regions traditional imaging methods may yield inaccurate polarization information due to dynamic range limit, noise, and black-level fluctuations. This new method solves these issues and yields accurate polarization information.

Azimuth or Radial Polarized Beams from Axially Sampled Circularly Polarized Vortex Beams, Jonathan K. Moh, Bu Jing, Xiaocong Yuan; Nanyang Technological Univ., Singapore. A laser beam with circular polarization can be converted into cylindrical vector beams by a micro-fabricated spiral phase plate (SPP) and an azimuthal-type linear analyzer. This provides simple polarization conversion via a compact optical path.

Signal Analysis of Optical Frequency-Modulated Continuous-Wave Interference, Jesse Zheng; PhotonTech, Canada. I analyze the signal of optical frequency-modulated continuous-wave (FM/CW) interference. A general equation of optical FM/CW interference is derived, and three common versions of optical FM/CW interference (sawtooth-wave, triangular-wave and sinusoidal-wave FM/CW interference) are discussed.

Accurate polarization information. This new method solves these issues and yields dynamic range limit, noise, and black-level fluctuations. This method can be used for fabrication of high density optical connectors using polymer optical waveguides.

A novel method for blind deblurring for consecutive frames of a motion picture, Nobuhito Ishihara, Shinichiro Komatsu; Waseda Univ., Japan. A novel blind recovery method suitable for the motion pictures was proposed. Using dynamic masking for the images and the neural network, we are able to obtain PSF of each frame, to recover the images.

Correction of Discontinuous Phase Maps in Structured Light Periflometry, J. Gartzén, J. Gaaleno, C. López, D. Duque; Univ. Pontificia Bolivariana, Colombia. This work presents a comparative study between the methods of spatial unwrapping by means of reliability parameter and modified temporal unwrapping as a solution to the phase discontinuities presents in surface periflometry by fringe projection.

Passive Alignment Method for Micro Optical Connectors Using Lithographically Defined Features, Voichi Taira, Fumikazu Yamada, Hidetoshi Namura, Masaki Hanagano; IBM, Japan. We demonstrated the feasibility of high precision alignment method using mechanically defined structures and lithographically patterned features. This method can be used for fabrication of high density optical connectors using polymer optical waveguides.

A novel method of blind deblurring for consecutive frames of a motion picture, Nobuhito Ishihara, Shinichiro Komatsu; Waseda Univ., Japan. A novel blind recovery method suitable for the motion pictures was proposed. Using dynamic masking for the images and the neural network, we are able to obtain PSF of each frame, to recover the images.

Correction of Discontinuous Phase Maps in Structured Light Periflometry, J. Gartzén, J. Gaaleno, C. López, D. Duque; Pontificia Universidad Católica Bolivariana, Colombia. This work presents a comparative study between the methods of spatial unwrapping by means of reliability parameter and modified temporal unwrapping as a solution to the phase discontinuities present in surface periflometry by fringe projection.

Phase Contribution to the Dynamic Population Gratings Recorded in Rare-Earth Doped Optical Fibers, Sergi Gómez, Eirdeg Nerurkar, Patrick Mejere, Andrei Fetiúd1; CICESE, Mexico, Facultad Politécnica de Morelia, Belgium, A. F. Joffe Physico-Technical Institute, Russian Federation. Phase contributions to population dynamic gratings in Er-doped (in spectral region 1480-1570 nm) and Yb-doped (at wavelength 1064 nm) single-mode optical fibers were detected and characterized using two-wire mixing of phase modulated cw MW-scale recording waves.

Phase contribution to the dynamic population gratings recorded in rare-earth-doped optical fibers, Sergi Gómez, Eirdeg Nerurkar, Patrick Mejere, Andrei Fetiúd; CICESE, Mexico, Facultad Politécnica de Morelia, Belgium, A. F. Joffe Physico-Technical Institute, Russian Federation. Phase contributions to population dynamic gratings in Er-doped (in spectral region 1480-1570 nm) and Yb-doped (at wavelength 1064 nm) single-mode optical fibers were detected and characterized using two-wire mixing of phase modulated cw MW-scale recording waves.

Photonics Posters

Wavelength Selective Auxiliary C-Band ASE Pumping for L-Band EDFA, Vishnu Priya, Shubham Bhudawat, Subhash C. Arya; Indian School of Mines Dhanbad, India. The effect of wavelength selective auxiliary ASE pumping on L-band EDFA signal gain is investigated. It is shown that, gain increases by 14 dB when wavelength selective pumping of 55 nm bandwidth is used.

Investigation of Multichannel Characteristics of Raman/EDFA Hybrid Amplifiers, Umesh Tiwari, Krishna Rana, Krishna Thyagarajan; Indian Inst. of Technology, Delhi, India. Gain and noise figure characterization of multichannel Raman/EDFA hybrid amplifier is presented. It is shown that the characteristics are different from those obtained by single channel measurements.
Santé Claire Hotel, Ballroom

JSuA • Welcome Reception and Joint FiO/LS Poster Session I—Continued

JSuA32
Improvement of Raman Amplification Gain Tilt Using Incoherent Pump Sources, Paula S. Andrei, Ana M. Rocha, Berta Niter, Margarida Fiuza, 1Inst. de Telecomunicações, Univ. de Aveiro, Portugal, 2Dept. de Física, Univ. de Aveiro, Portugal. We report a Raman amplifier implemented with incoherent pumping. The experimental gain profile is compared with that of coherent pumping, showing a decrease of 0.028 dB/m on the gain spectra tilt.

JSuA33
Evaluation of Launch-Dependent Frequency Response of Multimode Fibers for Subcarrier-Multiplexing (SCM), Christian-Alexander Bunge, Winfried Liers, Dan Curtisapearl, Technische Univ. Berlin, Germany, Univ. of Applied Sciences, Germany. In this paper we present a measurement technique for the assessment of the launch-dependent frequency response of multimode fibers in subcarrier-multiplexed systems. Due to their irregular and launch-depending behavior, we propose SCM with adaptive carrier-frequencies.

JSuA34
Transient Two-Wave Mixing in Linear Interferometer Based on Er-Doped Optical Fiber with Saturable Absorption, Serguei Stepanov, Fernando Pérez Cota, Daniel García Casillas, Marcos Plata Sánchez, 1CICESE, Mexico, 2INAIE, Mexico. Transient two-wave mixing in Er-doped optical fibers with saturable absorption was shown to be nearly twice more efficient in linear interferometric configuration with significantly different powers of recording waves than in symmetric recording arrangement.

JSuA35
Fabrication and Characterization of Er-Doped ZnO Films Grown by Pulsed E-Beam Deposition, Zhengda Pan, S. H. Morgan, A. Ueda, R. Age, A. Steigerwald, Richard Ma, A. B. Hnle, L. Feldman, 1Fisk Univ., USA, 2Vanderbilt Univ., USA. Erbium-doped ZnO thin films with nano-size grains were grown on silicon substrate by pulsed e-beam deposition. The luminescence provides evidence that the Er ions have been incorporated inside the crystalline ZnO grains in film.

JSuA36
Fattened Fiber Filter, Alejandro Martínez-Ríos, I. Torres-Gomez, R. I. Mata-Chavez, Ctr. de Investigaciones en Óptica, Mexico. A method to fabricate optical fiber rejection-band filters based on optical fiber fattening is presented. Using this approach we have been able to fabricate fiber filters <3mm length and notch depths >20 dB.

JSuA37
2-D Thermal Imaging of VCSEL Arrays by Thermoreflectance Microscopy, Kathryn J. Greenberg, Maryam Farzaneh, Reja Amatya, Dietrich Lauersen, Janice A. Hodgkins, Mount Holyoke College, USA. High resolution thermoreflectance microscopy is used to profile thermal effects in single VCSELS and arrays. Relative thermal resistance, thermal lensing, and thermal coupling effects are reported.

JSuA38
Accurate Sensitivity Evaluation of Microring Resonators for Biochemical Sensing, Deepak Gupta, Arun Kumar, Indian Inst. of Technology Delhi, India. We examine the dependence of sensitivity of microring resonator based biochemical sensors on ring radius and input polarization state, and show that the predictions available in this regard (IEEE JLT, 24, 1395 (2006)) are incorrect.

JSuA39
Polysiloxane Thermo-Optic Side-Polished Fiber Variable Attenuator, Diego R. Tankenich, Asaf Vainsencher, Carl M. Auy, Andre Knoerzer, Behzad Moolshi, 1Dept. of Electrical Engineering, Univ. of California at Davis, USA, 2FOS Corp., USA. Polysiloxane and conductive polymers were integrated onto a side-polished optical fiber to implement a variable optical attenuator. A conductive polymer thermo-optically altered the refractive index of elastomer placed in close proximity to a fiber core.

JSuA40
Modeling Optical Micro-Ring Cavities with MMs, Yong-Woo Chung, Nam-Hsiang Sun, Natl. Sun Yat-sen Univ., Taiwan, 1Shou Univ., Taiwan. We combine FEMET (full eigen-mode expansion technique), frequency-domain FD method and a one-way, multi-mode theory to study optical micro-ring cavities with MMI (multi-mode interferometer) couplers. Improved tolerance of MRC parameters is demonstrated.

JSuA41
DOPA-Mediated Self-Assembled Biocompatible Plasmonic Nanocryystals, Kwar C. Black, Zhangyi Liu, Phillip B. Messersmith, Northwestern Univ., USA. Biocompatible plasmonic nanocrystals pattern scattering, absorbing and luminescent contrast for bioimaging, and act as photothermal therapeutic agents. We report DOPA-mediated self-assembly and surface stabilization of gold and silver nanoparticles with potentially-functionalized PEG polymers.

JSuA42

JSuA43
Optical and Electronic Properties of Diatoms, Jonathan JongWah, Scott Batchere, Marie Wintrebert-Fougere, Judith M. Dauwe, John Ferris, Dept. of Physics, Macquarie Univ., Australia, Australian Nuclear Science and Technology Organisation, Australia. The photoluminescence spectra and dielectric properties of diatoms, a biogenic source of porous silica, have been characterised. Results are compared with pure synthetic silica, and show low dielectric constants due to the porosity.

JSuA44
Interferometric Birefringent-Fiber Strain Sensor, Jesse Zheng, PhotomTech, Canada. This paper introduces a practical interferometric birefringent-fiber strain sensor, which is based on optical frequency-modulated continuous-wave (FMCW) interference and have the advantages of long gauge length, long leading fibers, and immunity from the environmental influence.
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<th>Time</th>
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<tr>
<td>8:30 a.m.–10:00 a.m., JMA: 2007 Joint FiO/LS Awards Ceremony</td>
<td>APS/DLS Award and Honor Presentations</td>
<td>Fairmont Hotel, Regency Ballroom</td>
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<td>Schawlow Prize Lecture: A New Method for Generation of Ultra-Intensive and Ultra-Short Laser Pulses</td>
<td>Szymon Suckewer, Princeton Univ., USA</td>
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<td>OSA Award and Honor Presentations</td>
<td>Regency Ballroom</td>
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<tr>
<td>10:00 a.m.–10:30 a.m., Coffee Break</td>
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<td>Fairmont Hotel, Regency and Imperial Ballroom Foyers</td>
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<tr>
<td>10:30 a.m.–12:00 p.m., JMB: 2007 Joint FiO/LS Plenary Session</td>
<td>Nanophotonics: From Photonic Crystals to Plasmonics, Eli Yablonovitch, Univ. of California at Berkeley, USA</td>
<td>Fairmont Hotel, Regency Ballroom</td>
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<td>The Optical Frequency Comb: A Remarkable Tool with Many Uses, John L. Hall, JILA, Univ. of Colorado and NIST, USA</td>
<td>Regency Ballroom</td>
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<tr>
<td>12:00 p.m.–1:30 p.m., Lunch Break</td>
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<tr>
<td>12:00 p.m.–6:00 p.m., SMA • Symposium on Undergraduate Research Posters</td>
<td>See Undergraduate Research Symposium program in registration bag.</td>
<td>Fairmont Hotel, Fairfield Room</td>
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<tr>
<td>1:00 p.m.–4:30 p.m., SMB • Joint FiO/SPRC Symposium</td>
<td>See Page 13.</td>
<td>Fairmont Hotel, Club Regent</td>
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<td>1:00 p.m.–3:00 p.m., Student Event: Going for the Goal Workshop</td>
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<td>Sainte Claire Hotel, Ballroom</td>
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The Monday abstracts are continued on Page 62.
From Microwatts to Gigawatts: What’s New Under the Sun, Greg P. Stonerud; Solar Energy Materials and Solar Cells, USA. The current interest in solar energy should be self-sustaining due to economies of scale, new materials and processes, and an understanding of the requirements for economical, efficient solar converters. A brief history will be presented.

“Plastic” Electronics and Optoelectronics, Alan Heeger; Univ. of California at Santa Barbara, USA. Semiconducting polymers are important as active materials in electronic and optoelectronic devices. I will focus on progress in two areas: a. “Plastic” Solar Cells fabricated from semiconducting polymers, b. Light Emitting Field Effect Transistors. Semiconducting polymers are important as active materials in electronic and optoelectronic devices. We describe nanophotonics process of creating components and devices utilized with metamaterials such as birefringent dielectrics, photonic crystals, and metal-dielectric composites. This approach enhances monolithic integration needed for realization of information systems for various applications.

High-Power Fiber Sources: Recent Advances and Future Prospects, W. Andrew Clarkson; Optoelectronics Res. Ctr., Univ. of Southampton, UK. Strategies for scaling output power and brightness from rare-earth doped fiber lasers and amplifiers will be reviewed and the prospects for further improvement in performance will be considered.

Engineering Nonlinearities in Optical Nanosystems, Richard Osgood; Columbia Univ., USA. This tutorial reviews the use of nanopatterning of materials to achieve enhanced optical nonlinear response and conversion. Nonlinear propagation in Si-waveguides and optical frequency conversion in metallic nanoarrays are used as illustrations.

Recent Progress in Quantum-Dot Semiconductort Optical Amplifiers for Slow and Fast Light, Temuyuki Akhayama, Y. Maeda, N. Yatsuoka, K. Kanaguchi, H. Eme, M. Segawa, Fujitsu Labs Ltd., Japan. Regeneration of 40-Gb/s signal with limiting amplification in a quantum-dot semiconductor optical amplifier is demonstrated. Polarization insensitivity we have realized recently is now ready to be combined to yield a high-speed polarization-insensitive regenerative amplifier.

Waveguide Electroabsorption Modulator on Si Employing Ge/3SiGe Quantum Wells, Onur Fukaner, Ali K. Özyay, Jonathan E. Roth, Yu-Hsuan Kuo, Krishna C. Saraswat, James S. Harris, David A. B. Miller; Stanford Univ., USA. We report the first waveguide optical modulator on Si that employs the quantum-confined Stark effect. For a 6 V swing, the contrast ratio is 7.72 dB at 1476nm, and exceeds 3 dB over 14nm bandwidth.

The current interest in solar energy should be self-sustaining due to economies of scale, new materials and processes, and an understanding of the requirements for economical, efficient solar converters. A brief history will be presented.

Semiconducting polymers are important as active materials in electronic and optoelectronic devices. We describe nanophotonics process of creating components and devices utilized with metamaterials such as birefringent dielectrics, photonic crystals, and metal-dielectric composites. This approach enhances monolithic integration needed for realization of information systems for various applications.

High-Power Fiber Sources: Recent Advances and Future Prospects, W. Andrew Clarkson; Optoelectronics Res. Ctr., Univ. of Southampton, UK. Strategies for scaling output power and brightness from rare-earth doped fiber lasers and amplifiers will be reviewed and the prospects for further improvement in performance will be considered.

Engineering Nonlinearities in Optical Nanosystems, Richard Osgood; Columbia Univ., USA. This tutorial reviews the use of nanopatterning of materials to achieve enhanced optical nonlinear response and conversion. Nonlinear propagation in Si-waveguides and optical frequency conversion in metallic nanoarrays are used as illustrations.

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### Monday, September 17

#### Hillsborough

**Frontiers in Optics**

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<tr>
<td>1:30 p.m.–3:30 p.m.</td>
<td>FME • Optical Design and Applications in General Lighting and Illumination</td>
<td>Anurag Gupta; Optical Res. Associates, USA, Presider</td>
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#### Sacramento

**Joint**

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<tr>
<td>1:30 p.m.–3:30 p.m.</td>
<td>JMC • Imaging and Microscopy — Biological I</td>
<td>Linda Peteanu; Carnegie Mellon Univ., USA, Presider</td>
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#### Piedmont

**Laser Science**

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<tr>
<td>1:45 p.m.–3:30 p.m.</td>
<td>LMA • Gravitational Wave Detectors</td>
<td>Slava Tureshev; JPL, USA, Presider</td>
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#### Glen Ellen

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<tr>
<td>1:30 p.m.–3:30 p.m.</td>
<td>SMD • Symposium on Undergraduate Research</td>
<td>Presider to Be Announced</td>
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#### Atherton

**OMD**

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<td>1:30 p.m.–3:15 p.m.</td>
<td>OMA • Organic Semiconductor Devices</td>
<td>Chun-Sing Lee; Ctr. of Super-Diamond and Advanced Films, City Univ. of Hong Kong, Hong Kong, Presider</td>
</tr>
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**FME1 • 1:30 p.m.** Invited

*Lit-Appearance Modeling, R. John Koshel*

Lit-appearance allows inspection of the appearance of an illumination system for position and angle. An overview is presented including perception issues. A new method called luminance modeling uses the BSDF and importance sampling.

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**FME2 • 2:00 p.m.**

*Illustration of Ambient Intelligence with Room Illumination, Roshy M. John; Natl. Inst. of Technology, India.* This paper deals with ultra bright LEDs of different colors for lighting applications. The mood of the lighting will change dramatically according to a context shown in a hand held device or a computer.

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**LMA1 • 1:45 p.m.** Invited

*Review of Operating Terrestrial Gravitational Wave Detectors, Gabriela Gonzalez; Dept. of Physics and Astronomy, Louisiana State Univ., USA.* Several km-long interferometric gravitational wave detectors are now in operation, including the LIGO detectors in the US. I will describe their configurations and show their sensitivities, better than 10^{-18}m/√Hz in a 50Hz-2kHz frequency band.

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The photovoltaic industry has been growing exponentially at an average rate of about 35%/year since 1979. Recently, multijunction concentrator cell efficiencies have surpassed 40%. Combined with concentrating optics, these can be used for electricity generation.

High Efficiency Solar Cells for Large-Scale Electricity Generation, Sarah Kartz; Natl. Renewable Energy Lab, USA. The photovoltaic industry has been growing exponentially at an average rate of about 35%/year since 1979. Recently, multijunction concentrator cell efficiencies have surpassed 40%. Combined with concentrating optics, these can be used for electricity generation.

Simultaneous Multiple-Color Light Generation Based on Broadband Optical Parametric Generation, Hwan Hong Lim, Ok Yeub Jeon, Byeong Joo Kim, Krishnamurthy Pandiyvan, Myungsook Cha; Pusan Natl. Univ., Republic of Korea. Simultaneous red, green and blue lights were generated from periodically poled lithium niobate pumped with a single picosecond laser. This process was realized by a broadband design of the optical parametric generation of participating infrared frequencies.

We present studies of second harmonic generation in planar waveguides using critically coupled resonators. Using the finite-difference time-domain method, large second harmonic generation is demonstrated when the coupling coefficient equals the second harmonic strength.

Modulation of Multilayer InAs Quantum Dots Waveguides under Applied Electric Field, Imran B. Akae, Aykaktu Duran, Atilla Aydindil, Marco Rossetti, Liangjie Li, Andrea Fiore, Nadir Dogan; 'Bilkent Univ., Turkey, 'Inst. of Quantum Electronics and Photonics, Ecole Polytechnique Federale de Lausanne EPFL, Switzerland, 'Univ. of California at Santa Barbara, USA. Electric field dependence of optical modulation in self-assembled InAs quantum dot waveguides has been studied at 1300 and 1500 nm. Electro-absorption and electro-optic coefficients of these waveguides have been obtained at both wavelengths.

We review the performance and applications of a recently demonstrated platform that utilizes higher-order modes in few-moded fibers to facilitate robust, bend-resistant, long-length light-propagation in ultra-large modal areas.

A parametric optical switch has recently been demonstrated by a periodic microcavity. We developed an optical switch that could switch between two claddings using a single optical pulse.

Very Large Fabrication Tolerance of VCSELs Using High-Contrast Subwavelength Grating, Ye Zhou, Michael C. Y. Huang, Johannes Kern, Connie J. Chang-Hasnain; Univ. of California at Berkeley, USA. A very large fabrication tolerance for the high-index-contrast subwavelength grating (HCG) integrated VCSELs is experimentally demonstrated, with similar performance over as large as ±20% variation in the HCG critical dimension.

Efficient On-Chip Second Harmonic Generation Using a Critically Coupled Resonator, Charles M. Reineke, Ali Aghaie, Yong Xie; 'Georgia Tech, USA. We present studies of second harmonic generation in planar waveguides using critically coupled resonators. Using the finite-difference time-domain method, large second harmonic conversion efficiencies are demonstrated when the coupling coefficient equals the second harmonic strength.

Simultaneous Multiple-Color Light Generation, Hwan Hong Lim, Ok Yeub Jeon, Byeong Joo Kim, Krishnamurthy Pandiyvan, Myungsook Cha; Pusan Natl. Univ., Republic of Korea. Simultaneous red, green and blue lights were generated from periodically poled lithium niobate pumped with a single picosecond laser. This process was realized by a broadband design of the optical parametric generation of participating infrared frequencies.

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Using a critically coupled resonator, Charles M. Reineke, Ali Aghaie, Yong Xie; Georgia Tech, USA. We present studies of second harmonic generation in planar waveguides using critically coupled resonators. Using the finite-difference time-domain method, large second harmonic conversion efficiencies are demonstrated when the coupling coefficient equals the second harmonic strength.

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Optical Design for LED Using Total Reflection, Edward Yuan, Fudan Univ., China. Progresses in LED regenerated the optical design technique for luminaires. The author found a way to using total reflection of transparent materials in optical design of LED lighting system.

Time-Dependent Spectroscopy of a Nanoparticle Freely Moving in 3-D, Hao Yang, Univ. of California at Berkeley, USA. To date, the powerful time-dependent single-particle spectroscopy can only be conducted on substrate-immobilized nanostructures. The new technique reported herein lifts this limitation and allows real-time correlation of the particle’s spectroscopic signatures with its spatial location.

Optimization of Freeform Non-Imaging Components for LED-Based Projector Light Engines, Florian R. Fournier, Jannick P. Rolland; College of Optics and Photonics, CREOL, Univ. of Central Florida, USA. Standard non-imaging components used to collect and integrate light in LED-based projector light engines such as tapered rods and compound parabolic concentrators are compared to optimized freeform shapes in terms of various application-driven metrics.

Second Generation Gravitational Wave Detectors, Rana Adhikari; Caltech, USA. I will describe the latest in laser interferometers for gravitational wave detection. These instruments are being designed to have CW circulating power levels of ~1 megawatt and sense mirror motions at the 10^{-20} meters/rHz level.

Molecularly Engineered Interfaces for Organic Optoelectronics, Zakya Kafafi; NRL, USA. The role that organic/metal (organic) interfaces play in optoelectronic devices is key to achieving high efficiency and stability. An overview is given on molecularly engineered surfaces/interfaces, and how their electronic structures affect device characteristics.
Empire  Crystal  Gold  Valley  California

Frontiers in Optics

SMC • Optics for Energy I—Continued

SMC4 • 3:00 p.m.  Invited
Optical Properties of Microalgae for Enhanced Biofuels Production, Tasios Melis; Univ. of California at Berkeley, USA. Research seeks to alter the optical properties of microalgae in order to improve solar-to-biofuels energy conversion efficiency in mass cultures under bright sunlight conditions.

FMA • Fiber Lasers—Continued

FMA4 • 3:15 p.m.
Study of Coreless Fibers for In-Phase Supermode Selection in Multicore Fiber Lasers, Hongbo Li, Maysey Brise, Li Li, Axel Schülzgen, Nasser Peyghambarian, Jerome Y. Moloney; Univ. of Arizona, USA. Coreless fibers as extra cavities for multicore fiber lasers are analyzed for their capabilities of mode selection. The difference between the mode-selection properties of coreless fibers and Talbot cavities is discussed and confirmed by experiments.

FMB • NLO in Engineered Materials I—Continued

FMB5 • 3:00 p.m.  Invited

FMC • Silicon Photonic Systems of Information Processing—Continued

FMC5 • 3:00 p.m.  Invited
Optics to the Chip: Enabling Standard IC Packaging Using Modular Optical Components, David Rolston, Robert Varano; Reflex Photonics, Canada. An IC packaging technology that integrates parallel optical sub-assemblies will be described for next generation computing and switching applications. Design and assembly methods for low-cost and volume production are demonstrated.

FMD • Integrated Optic Devices I—Continued

FMD6 • 3:00 p.m.
Systematic Design and Demonstration of Flat-Band Finite-Size Coupled Resonator Optical Waveguides, Qing Li, Siva Yegnanarayanan, Mohammad Solaimani, Ali Adibi; Georgia Tech, USA. Using techniques in LC circuit filters, a systematic method for the design of flat-band (finite-size coupled-resonator-optical-waveguides (CROWs) are developed. Based on this theory, finite-size CROWs with flat-band spectrum on silicon-on-insulator platform are fabricated and demonstrated.

FMD7 • 3:15 p.m.
Local Dispersion in 2-D Photonic Crystals Using Filter Diagonalization Method, Babak Dastmalchi, Abbas Mohtashami, Kurt Hingerl, Javad Zarbakhsh; ‘Dept. of Physics, Azarbaijan Univ. of Tarbiat Moallem, Iran, Johannes Kepler Univ. Linz, Austria. Local dispersion in Photonic Crystals (PC) is calculated using the advanced filter diagonalization method and compared to the traditional spatial Fourier transform of the field distribution.

3:30 p.m.–4:00 p.m., Coffee Break, Fairmont Hotel, Regency and Imperial Ballroom Foyers
FME • Optical Design and Applications in General Lighting and Illumination—Continued

FME5 • 3:00 p.m.
Implementation of a Programmable Field and Custom Coherence Illuminator for Extreme Ultraviolet Microlithography, Christopher N. Anderson1, Patrick P. Naulleau2; 1Univ. of California at Berkeley, USA, 2Lawrence Berkeley Natl. Lab, USA. Here we summarize recent upgrades to the existing Fourier-synthesis custom coherence Sematech Berkeley Micro Exposure Tool illuminator that provide increased illumination field uniformity and enable dual-domain control of illumination field size and spatial coherence.

FME6 • 3:15 p.m.
White-Light Single-Shot Digital Hologram Recording, Natan Tzvi Shaked, Joseph Rosen, Adrian Stern; Ben-Gurion Univ. of the Negev, Israel. A new technique, designated as integral holography, for recording holograms of three-dimensional objects under spatially incoherent white-light illumination, and in a single camera shot, is presented. Experimental results validate the correctness of the new technique.

JMC • Imaging and Microscopy—Biological I—Continued

JMC4 • 3:15 p.m.
Extracting Intrinsic Synchronous Fluorescence for Spectral Imaging, Quan Liu, Tuan Vo-Dinh; Duke Univ., USA. A ratio-metric method was proposed to extract intrinsic fluorescence from synchronous fluorescence spectra distorted by absorption and scattering. Its applicable range was investigated using Monte Carlo simulations and the accuracy was tested with phantom experiments.

LMA • Gravitational Wave Detectors—Continued

LMA4 • 3:00 p.m. Invited
Techniques for Third-Generation Gravitational-Wave Observatories, Harold Lueck, Leibniz Univ. Hannover, Germany. Third generation detectors aim to improve the sensitivity roughly by another order of magnitude beyond the second or advanced generation. This talk presents difficulties and possible solutions that may be used to reach this goal.

3:30 p.m.–4:00 p.m., Coffee Break, Fairmont Hotel, Regency and Imperial Ballroom Foyers
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<tr>
<td>4:00 p.m.–5:30 p.m.</td>
<td><strong>SME • Optics for Energy II</strong>&lt;br&gt;Greg P. Smestad; Solar Energy Materials and Solar Cells, USA, President</td>
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<td>4:00 p.m.–6:00 p.m.</td>
<td><strong>FMF • Ultrashort-Pulse Fiber Lasers</strong>&lt;br&gt;Johan Nilsson; Univ. of Southampton, UK, President</td>
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<td>4:00 p.m.–6:00 p.m.</td>
<td><strong>FMG • NLO in Engineered Materials II</strong>&lt;br&gt;Richard Osgood; Columbia Univ., USA, President</td>
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<tr>
<td>4:00 p.m.–6:00 p.m.</td>
<td><strong>FMI • Integrated Optic Devices II</strong>&lt;br&gt;Federico Capasso; Harvard Univ., USA, President</td>
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<td><strong>SME1 • 4:00 p.m.</strong></td>
<td>Recent Developments in Optics for Concentrator Photovoltaic (CPV) Systems&lt;br&gt;Patrick J. MaBuff, Xerox Palo Alto Res. Ctr., USA. No abstract available.</td>
</tr>
<tr>
<td><strong>FMF1 • 4:00 p.m.</strong></td>
<td>Status and Perspectives of Fiber Lasers and Amplifiers&lt;br&gt;Andreas Tonnevant; Jens Limpert, Thomas Schreiber; Friedrich Schiller Univ. Jena, Germany.</td>
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4:00 p.m.–5:45 p.m.
**FMJ • Data Reduction Methods and Computational Imaging**
Virendra Mahajan; Aerospace Corp., USA, Presider

**FMJ1 • 4:00 p.m.**
Wavefront Coding, W. Thomas Cathey; Univ. of Colorado, USA. Wavefront coding has been used in imaging systems to extend the depth of field or focus and to make the systems more tolerant to aberrations in cytology, cell-phone cameras, and telescopes.

**FMJ2 • 4:30 p.m.**
Wide-Field Feature-Specific Imaging, Michael D. Stenner, Premchandra Shankar, Mark A. Neifeld; Univ. of Arizona, USA. We present a computational sensor design for high-resolution wide-angle imaging by multiplexing multiple sub-fields-of-view onto a single image sensor using feature-specific imaging techniques.

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4:00 p.m.–6:00 p.m.
**JMD • Imaging and Microscopy — Biological II**
Jim Werner; Los Alamos Natl. Lab, USA, Presider

**JMD1 • 4:00 p.m.**
Integrative Imaging Techniques Applied to Live Cell Biophysics, Andrea Trache; Texas A&M Univ., USA. A novel hybrid imaging system that integrates Atomic Force Microscopy (AFM) with optical imaging methods such as TIRF (Total Internal Reflection Fluorescence) and IRM (Interference Reflection Microscopy) will be presented.

**JMD2 • 4:30 p.m.**
Raman Microscopy of Individual Cells and Cellular Components, Thomas Huser; Univ. of California at Davis, USA. I will present our most recent results in non-invasively characterizing and distinguishing individual cells, subcellular structures, and intracellular chemical concentrations by laser-tweezers Raman spectroscopy (LTRS) and coherent Anti-Stokes Raman scattering (CARS) microscopy.

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4:00 p.m.–5:45 p.m.
**LMB • Space-Based Tests of Relativity**
Gabriela Gonzalez; Louisiana State Univ., USA, Presider

**LMB1 • 4:00 p.m.**
LISA: A Space-Based Gravitational Wave Detector, Guido Mueller; Univ. of Florida, USA. The space-base detector LISA uses three spacecraft separated by 5Gm in a triangular formation to measure gravitational waves at sub Hz frequencies. LISA science and technology with an emphasis on laser interferometry will be discussed.

**LMB2 • 4:30 p.m.**
Laser Stabilization Using Diffractive Grating Angular Sensors, Ke-Xun Sun, Patrick Lu, Robert Byer; Stanford Univ., USA. Grating angle magnification enhanced angular sensor can be used for laser frequency stabilization. This robust method provides adequate frequency stability for numerous applications, such as absolute frequency stabilization for Laser-Interferometric Space Antenna.

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4:00 p.m.–6:00 p.m.
**SMF • Symposium on Undergraduate Research**
Presider to Be Announced
See Undergraduate Research Symposium program in registration bag.

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4:00 p.m.–5:45 p.m.
**OMB • Materials and Devices for OLEDs I**
Chun-Sing Lee; Ctr. of Super-Diamond and Advanced Films, Hong Kong, Presider

**OMB1 • 4:00 p.m.**
High-Performing Electron-Injecting and Transporting Layers for OLED Devices, William J. Begley, Tukaram K. Hatwar; Eastman Kodak Co., USA. A new electron-injecting layer for increasing the luminance efficiency while lowering the drive voltage of OLED devices has been developed. The performance of the new EIL, in combination with new electron-transporting layers, will be discussed.

**OMB2 • 4:30 p.m.**
High Efficiency Phosphorescent OLEDs, Jason Brooks, Julie J. Brown; Universal Display Corp., USA. Highly efficient phosphorescent organic devices are demonstrated. Direct charge trapping on the dopant and exciton confinement with adjacent charge transport layers are discussed as important mechanisms.
FMF • Ultrashort-Pulse Fiber Lasers—Continued

High Power Subpicosecond Pulse Generation From a Yb<sup>3+</sup>-Doped Fiber Laser Using Only Frequency Shifted Feedback, Alexander M. Heidt<sup>1,2</sup>, Johan P. Burger<sup>1</sup>, Jean-Noel Maran<sup>1</sup>, Hubertus M. von Bergenmann<sup>1</sup>, Nicholas Traynor<sup>3</sup>, Laser Res. Inst., Univ. of Stellenbosch, South Africa, <sup>2</sup>Physics Dept., Univ. of Konstanz, Germany, <sup>3</sup>PERFOS (Plate-forme d'Etudes et de Recherches sur les Fibres Optiques Spéciales), France. A frequency-shifted feedback fiber modelocked laser with 120 nJ pulse energy, increasing to 1 J with simultaneous Q-switching, is demonstrated. The pulses were compressed to <1 ps duration.

FMF3 • 5:00 p.m.
Optically Powered Video Camera Link, Gunnar Bottger<sup>1</sup>, Michael Dreschmann<sup>1</sup>, Christos Klamouris<sup>1</sup>, Michael Hübner<sup>1</sup>, Moritz Röger<sup>1</sup>, T. Kueng<sup>1</sup>, Jürgen Becker<sup>1</sup>, Wolfgang Freude<sup>1</sup>, Jurgen Leuthold<sup>1</sup>, Andreas W. Bert<sup>1</sup>, Univ. of Karlsruhe, Germany, <sup>2</sup>Fraunhofer-Institut für Solare Energie-Systeme, Germany. We implemented an optically powered video camera connected to a base station at 200 m distance. Power and 100-Mbps data-channel are multiplexed at 810 nm and 1310 nm into a standard 62.5 µm and 100-Mbps data-channel are multiplexed at 810 nm and 1310 nm into a standard 62.5 µm and 100-Mbps data-channel are multiplexed at 810 nm and 1310 nm into a standard 62.5 and 100-Mbps data-channel are multiplexed at 810 nm and 1310 nm into a standard 62.5 and 100-Mbps data-channel are multiplexed at 810 nm and 1310 nm into a standard 62.5 and 100-Mbps data-channel are multiplexed at 810 nm and 1310 nm into a standard 62.5 and 100-Mbps data-channel are multiplexed at 810 nm and 1310 nm into a standard 62.5 and 100-Mbps data-channel are multiplexed at 810 nm and 1310 nm into a standard 62.5 µm. The pulse duration is 52 fs with a spectral FWHM of 57 nm.

FMG • NLO in Engineered Materials II—Continued

Nonlinear Absorption in Glass-Ceramics Containing Sodium Niobate Nanocrystals, Tamara P. R. Oliveira<sup>1</sup>, Leonardo S. Menezes<sup>1</sup>, Cid B. Araújo<sup>1</sup>, Andrei A. Lipovskii<sup>2</sup>, University Federal de Pernambuco, Brazil, <sup>2</sup>Inst. for Solar Energy Systems, Germany.

A frequency-shifted feedback fiber modelocked laser with 120 nJ pulse energy, increasing to 1 J with simultaneous Q-switching, is demonstrated. The pulses were compressed to <1 ps duration.

FMG4 • 4:45 p.m.
Optical Switching through Nonlinearity of Nanoparticle Arrays, Rebecca Samidolu<sup>1</sup>, Tatiana V. Teperek<sup>1</sup>, Francisco Javier Garcia de Abajo<sup>2,3</sup>, Inst. de Optica - CSIC, Spain, <sup>2</sup>Donostia Intl. Physics Ctr., Spain. We propose to use nanoparticle arrays for all-optical transmission-switching based on the nonlinearity of the particles driven by field enhancement at a lattice resonance of the array.

FMG5 • 5:00 p.m.
Optical Studies of Gel-Grown Magnesium Phosphate - An Inorganic NLO Crystal, S. Franklin, K. P. Bhawana, P. Balasubramaniam; Natl. Inst. of Technology, India. Gel-grown titled crystal has been characterized by FIR and UV-Visible spectral studies. Band gap (2ev) is determined. The study reveals the suitability of the crystal for fabrication of optoelectronic devices.

FMG6 • 5:15 p.m.
Fabrication of a Robust Phase-Shifting Moire Interferometer against Vibrations, Dae-Geun Kim, Hong-Gyu Ahn, Jae-Hyuk Kim, Kyung Hwan Kim, Seung-Han Park; Nonlinear Optics Lab, Yonsei Univ., Republic of Korea. We present a 3-D image measuring technology base to obtain surface profiles of objects using projection Moire method, and demonstrate its performance by obtaining surface profiles of a lens with 40µm and 80µm fringe patterns.

FMH • Computational Imaging I—Continued

Optical Switching through Nonlinearity of Nanoparticle Arrays, Rebecca Samidolu<sup>1</sup>, Tatiana V. Teperek<sup>1</sup>, Francisco Javier Garcia de Abajo<sup>2,3</sup>, Inst. de Optica - CSIC, Spain, <sup>2</sup>Donostia Intl. Physics Ctr., Spain. We propose to use nanoparticle arrays for all-optical transmission-switching based on the nonlinearity of the particles driven by field enhancement at a lattice resonance of the array.

FMH3 • 5:00 p.m.
Measurement of Surface Profiles of an Objective Lens by Using Fine Projection Moire Method, Seung-Su Park, Kewyoung Lee, Ewunggi Lee, Seung-Han Park; Yonsei Univ., Republic of Korea. We present a 3-D image measuring technology base to obtain surface profiles of objects using projection Moire method, and demonstrate its performance by obtaining surface profiles of a lens with 40µm and 80µm fringe patterns.

FMH4 • 4:45 p.m.
Estimation of Phase Shifts in Structured Illumination for High Resolution Imaging, Saptos A. Shroff, James R. Fienup, David R. Williams; Univ. of Rochester, USA. The application of structured illumination for enhanced resolution requires accurate knowledge of phase shifts in the sinusoidal illumination. This work proposes a method to estimate random, unknown phase shifts and subsequent image reconstruction.

FMH5 • 5:00 p.m.
High Power Subpicosecond Pulse Generation From a Yb<sup>3+</sup>-Doped Fiber Laser Using Only Frequency Shifted Feedback, Alexander M. Heidt<sup>1,2</sup>, Johan P. Burger<sup>1</sup>, Jean-Noel Maran<sup>1</sup>, Hubertus M. von Bergenmann<sup>1</sup>, Nicholas Traynor<sup>3</sup>, Laser Res. Inst., Univ. of Stellenbosch, South Africa, <sup>2</sup>Physics Dept., Univ. of Konstanz, Germany, <sup>3</sup>PERFOS (Plate-forme d’Etudes et de Recherches sur les Fibres Optiques Spéciales), France. A frequency-shifted feedback fiber modelocked laser with 120 nJ pulse energy, increasing to 1 J with simultaneous Q-switching, is demonstrated. The pulses were compressed to <1 ps duration.

FMH6 • 5:15 p.m.
Quantum Dot and Semiconductor Nanostructures for Photonic Signal Processing Devices, Osamu Wada; Kobe Univ., Japan. This paper covers recent development of nanostructured semiconductors, in particular, quantum dots for the application to photonic communication devices including semiconductor optical amplifiers and all-optical signal processing devices.

FMI • Integrated Optic Devices II—Continued

Quantum Dot and Semiconductor Nanostructures for Photonic Signal Processing Devices, Osamu Wada; Kobe Univ., Japan. This paper covers recent development of nanostructured semiconductors, in particular, quantum dots for the application to photonic communication devices including semiconductor optical amplifiers and all-optical signal processing devices.
Monday, September 17

**Frontiers in Optics Joint**

**FMJ** • Data Reduction Methods and Computational Imaging—Continued

**FMJ3** • 4:45 p.m.
Singular Beam Microscopy for Nanoscale Feature Analysis, Boris Spektor, Alexander Neronov, Joseph Shamir, Technion, Israel. Theoretical, numerical, and experimental investigations indicate that the high sensitivity, presented by the interaction of laser beams containing singularities with nanoscale objects, can mitigate classical diffraction limitations. Experimental sensitivity of 20 nm will be presented.

**FMJ4** • 5:00 p.m.
Compressive Measurements for Video, Mohan Shankar, Nikos Pitsianis, Xiaobai Sun, David Brady; Fitzpatrick Inst. for Photonics, Duke Univ., USA. Redundancies present in video streams could be used to implement compressive sampling to achieve low power video sensors. We explore the possibilities of using this in the design of compressive video sensors and corresponding algorithms.

**FMJ5** • 5:15 p.m.
Dynamic Range Compression Deconvolution, Bahareh Hajit-naeed', William D. Goodhue', Jed Khoury', Charles L. Woodl', John Kiersteadl; 'Electrical and Computer Engineering Dept., Univ. of Massachusetts at Lowell, USA, 'Physics Dept., Univ. of Massachusetts at Lowell, USA, 'AFRL, Sensors Directorate, Hanscom Air Force Base, USA, 'Solid State Scientific Corp., USA. In this paper a generic nonlinear dynamic range compression deconvolver (DRCD) is proposed. The DRCD outperforming well-established image restoration filters such as the inverse and the Wiener filters is demonstrated.

**JMD** • Imaging and Microscopy—Biological II—Continued

**JMD3** • 5:00 p.m.
Invited
Two-Photon Standing Wave Microscopy to Measure Small Scale Motions, Chris Bardeen, Kerry M. Harrison, Sara K. Davis; Univ. of California at Riverside, USA. A two-photon standing wave fluorescence experiment is used to look at the small-scale motions of fluorescently-labeled DNA in live cells and biological systems. Both photobleaching and fluorescence correlation spectroscopy versions of this experiment are presented.

**JMD4** • 5:15 p.m.
Invited
Laser-Enabled Tests of Relativistic Gravity in Space, Slava G. Turyshev; JPL, Caltech, USA. Existing capabilities in laser ranging, optical interferometry, precision frequency standards allow for major advances in space-based tests of relativistic gravity. We discuss recent experimental proposals relying on these technologies to address important fundamental physics questions.

**LMB** • Space-Based Tests of Relativity—Continued

**LMB3** • 4:45 p.m.
Invited
Shooting the Moon: Laser Ranging Pushes Tests of Einstein's Gravity, Tom Murphy, E. L. Michelena, H. E. Swanns, C. W. Stubbbs, J. E. Battat, K. Nordvedt, R. McMillar; 'Univ. of California at San Diego, USA, 'Univ. of Washington, USA, 'Harvard Univ., USA, 'Northwest Analysis, USA, 'Apache Point Observatory, USA. Decades of lunar laser ranging have produced superlative tests of Einstein’s general relativity. A new effort (APOLLO) seeks to extend these tests another order-of-magnitude via millimeter range accuracy between Earth and Moon.

**LMB4** • 5:15 p.m.
Invited
Material and Interface Engineering for High Efficiency Light-Emitting Devices, Alex Jen; Univ. of Washington, USA. We have employed an integrated interface engineering and materials development approach to produce bright, very efficient and stable light-emitting devices demonstrated for applications in displays and solid-state lighting.

**SMF** • Symposium on Undergraduate Research—Continued

**SMF3** • 5:00 p.m.
Material and Interface Engineering for High Efficiency Light-Emitting Devices, Alex Jen; Univ. of Washington, USA. We have employed an integrated interface engineering and materials development approach to produce bright, very efficient and stable light-emitting devices demonstrated for applications in displays and solid-state lighting.

**SMF4** • 5:15 p.m.
Laser-Enabled Tests of Relativistic Gravity in Space, Slava G. Turyshev; JPL, Caltech, USA. Existing capabilities in laser ranging, optical interferometry, precision frequency standards allow for major advances in space-based tests of relativistic gravity. We discuss recent experimental proposals relying on these technologies to address important fundamental physics questions.
### Frontiers in Optics

**FMF • Ultrashort-Pulse Fiber Lasers—Continued**

**FMG • NLO in Engineered Materials II—Continued**

**FMH • Computational Imaging I—Continued**

**FMI • Integrated Optic Devices II—Continued**

#### FMF5 • 5:30 p.m.

An Analytical Model Describing Multipeak Pulse Structure in Actively Q-Switched Fiber Lasers, François Brunet, Mathieu Drolet, Yves Taillon, Pierre Galarmeau, Sophie LaRochelle; INO, Canada, Cité d’Optique, Photonique et Laser, Univ. Laval, Canada. We present a simple analytical model describing the detailed structure of actively Q-switched fiber ring laser pulses. The predicted pulse shapes match experimental data with an accuracy comparable with a numerical traveling-wave model.

#### FMF6 • 5:45 p.m.

All-Fluoride Fiber Laser at 1480 nm Based on Fiber Bragg Gratings, Dominique Fauquier, Guillaume Androz, Martin Bernier, Réal Vallée; COPL, Univ. Laval, Canada. We report an all-fluoride fiber laser cavity using a fiber Bragg grating. The thulium-doped fiber laser yields a maximum output power of 350 mW at 1480 nm with a slope efficiency of 40%.

#### FMG7 • 5:30 p.m.

Experimental and Theoretical Study of the Nonlinear Optical Properties of III-V Ternary Semiconductor Alloy Crystals, Joel M. Murray, Vincent Cowan, Leonel P. Gonzalez, Partha S. Dutta, Geeta Rajagopalas, Srinivasan Krishnamurthy, Zhi-Gang Yu, Shekhar Gohde; General Dynamics Information Technology, USA, Rensselaer Polytechnic Inst., USA, United Semiconductors, LLC, USA, SRI Intl., USA, AFRL, USA. Nonlinear optical properties of novel ternary semiconductor crystals were determined at several wavelengths between 1 and 2 micrometers using a wavelength tunable, picosecond duration laser. Measured values were compared to theoretical calculations.

#### FMG8 • 5:45 p.m.

Plasmonic Laser Nanostructuring of Solid Materials, Daniel S. Everist, Boris Luk’yanchuk, Aleida S. Ben-Yakur; Univ. of Texas at Austin, USA, Data Storage Inst., Singapore. We report on the fabrication of nanoscale structures ablated on solid materials by the plasmonic scattering of 780 nm femtosecond laser pulses in the near-field of gold nanoparticles.

#### FMH7 • 5:30 p.m.

Fast Algorithm for Computational Imaging with Partially Coherent Illumination, Andrey S. Ostrovsky, Paulo C. Romero-Soria; Univ. Autonoma de Puebla, Mexico. The fast algorithm for calculating the image in optical system with partially coherent illumination is proposed. The algorithm is based on the coherent-mode representation of cross-spectral density function of illumination. The corresponding example is given.

#### FMH8 • 5:45 p.m.

Beam Mode and Diffraction Control by Conservation of Orbital Angular Momentum, Sabino Chávez-Cerda, Victor Arrieta, Pablo P. Castero, Jandir M. Hickmann, JIANODEO, Mexico, Inst. de Fisica, Brazil. We show that the propagation of Laguerre-Gauss and Bessel “forbidden” beams is dictated by the principle of conservation of optical orbital angular momentum that modifies their initial diffraction and mode properties.

#### FMI5 • 5:30 p.m.

Novel Vacuum Assisted Microfluidic Technique for Fabrication of Guided Wave Devices, Sangyup Song, Angel Florez, Sarfaraz Baig, Michael R. Weng; New Span Opto-Technology Inc., USA, Univ. of Miami, USA. A novel vacuum-assisted-microfluidic (VAM) fabrication technique is presented. The method results in lower propagation losses and improved waveguide structures. The technique is employed to develop optical interconnect and a color filter for OLED.

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**6:30 p.m.–7:30 p.m., OSA’s Annual Business Meeting, Fairmont Hotel, Belvedere Room**

**7:30 p.m.–8:30 p.m., Optical Design and Instrumentation Division Meeting, Fairmont Hotel, Empire Room**

**7:30 p.m.–9:30 p.m., OSA Student Member Welcome Reception, Smoke Tiki Lounge, 152 Post St.**
Towards 4-D+ Imaging, Volker Sider, Univ. of Michigan, USA. High-repetition rate solid-state lasers and CMOS camera technology allow simultaneous multi-dimensional measurements of scalar distributions and velocity fields at rates higher than 10 kHz. Extensions to three spatial dimensions are within reach.

On the Digital Holography Microscopy of Translucent Objects, Alejandro Restrepo-Martinez, Roman Castañeda, Univ. Nacional de Colombia Sede Medellin, Colombia. Some of the most important features present in digital holography microscopy of translucent objects are shown. Therefore, the phase reconstruction requires special procedures in this case, whose developments constitute an actual challenge in this field.

Compact Semiconductor Bioluminescence Biosensors, Thomas D. O’Sullivan, Alfred Weichselberger, Ofer Levi, James S. Harris, Stanford Univ., USA. We present design of bioluminescence detection systems using semiconductor detectors for rapid parallel diagnostic assays. Bioluminescence emission detection of 10^9 photons/sec was demonstrated using Silicon detectors. Improved GaAs-based bio-sensors were designed for improved detection sensitivity.

Synthesis and Characterization of Organic Materials for Near Infrared Applications, Zixing Wang, Xiaohui Yang, Sijesh Madakuni, Ghassan E. Jabbour, Jian Li, School of Materials, Arizona State Univ., USA. This presentation will highlight the development of novel heavy-metal complexes as phosphorescent emitters for efficient near infrared OLEDs.

6:30 p.m.–7:30 p.m., OSA’s Annual Business Meeting, Fairmont Hotel, Belvedere Room

7:30 p.m.–8:30 p.m., Optical Design and Instrumentation Division Meeting, Fairmont Hotel, Empire Room

7:30 p.m.–9:30 p.m., OSA Student Member Welcome Reception, Smoke Tiki Lounge, 152 Post St.
8:00 a.m.–9:45 a.m.
**FTuA** • Optical Systems and Instrumentation for Short and Ultra Short Pulse X-Ray/VUV Sources I
Lahsen Assoufid; Argonne Natl. Lab, USA, Presider

**FTuB** • Silicon Photonics
Presider To Be Announced

**FTuC** • Propagation in Disordered Media
Aristide Dogariu; College of Optics & Photonics, CREOL and FPCE, USA, Presider

8:00 a.m.–10:00 a.m.
**FTuA** • Optical Systems and Instrumentation for Short and Ultra Short Pulse X-Ray/VUV Sources I
Lahsen Assoufid; Argonne Natl. Lab, USA, Presider

**FTuB** • Silicon Photonics
Tom Koch; Lehigh Univ., USA. Silicon photonics has recently received heightened interest as a powerful vehicle for low-cost, high performance active integrated optical subsystems. This tutorial will review fundamental concepts, building blocks, and recent progress in the field.

**FTuC** • 8:00 a.m. **Invited**
**Tutorial**
**Silicon Photonics**, Tom Koch; Lehigh Univ., USA. Silicon photonics has recently received heightened interest as a powerful vehicle for low-cost, high performance active integrated optical subsystems. This tutorial will review fundamental concepts, building blocks, and recent progress in the field.

8:00 a.m.–10:00 a.m.
**FTuC** • Propagation in Disordered Media
Aristide Dogariu; College of Optics & Photonics, CREOL and FPCE, USA, Presider

**FTuD** • Biosensors I
Presider To Be Announced

8:00 a.m.–10:00 a.m.
**FTuA** • Quantum Information
Alexander Lvovsky; Univ. of Calgary, Canada, Presider

**JTuA1** • 8:00 a.m.
Efficient Quantum-Logic Circuits: Or, How I Learned to Stop Worrying and Love Hilbert Space, Andrew G. White*1, Marcelo Pereira de Almeida*1, Marco Barbieri*1, Devin N. Biggerstaff*1, Rohan R. Dahiri*1, Alexei Gilchrist*1, Geoffrey Gillett*1, Daniel E. V. Janner*1, Nathan K. Langford*1, Benjamin N. Langford*1, Kevin J. Resch*1, Till J. Weinhold*1; 1Univ. of Queensland, Australia; 2Univ. of Toronto, Canada, 3Univ. of Waterloo, Canada. We demonstrate significantly compacted quantum algorithms and demonstrate a Fock-state filter by going outside the qubit corner of Hilbert space. We obtain a complete error budget for an entangling gate when driven with independent photons.

**JTuA2** • 8:15 a.m.
Experimental Demonstration of Quantum Leader Election in Linear Optics, Yuta Okubo1,2, Xiang-Bin Wang1, Akitaka Tomita1; 1Dept. of Frontier Science, Univ. of Tsukuba, Japan, 2ERATO-SORST Quantum Computation and Information Project, Japan Science and Technology Agency, Japan. We propose and demonstrate a new implementation of a quantum protocol which can operate deterministically only with linear optics. This protocol, which is called quantum leader election, exhibits the quantum advantages over classical protocol.

**JTuA3** • 8:30 a.m.
Universal Control of Optical Quantum Information, Stephen D. Bartlett; Univ. of Sydney, Australia. We present a simple scheme for performing any quantum operation on a photonic qubit using weak measurement and feedback control. This scheme includes generalized measurements which balance the trade-off between information gain and disturbance.

8:00 a.m.–10:00 a.m.
**FTuB** • Silicon Photonics
Presider To Be Announced

**FTuC1** • 8:00 a.m. **Invited**
**Avoided Resonance Crossings in Optical Microcavities: Unidirectional Light Emission and Scar Formation**, Jan Wiersig*1, Martina Hentschke*2; 1Inst. for Theoretical Physics, Univ. of Bremen, Germany; 2Max-Planck-Inst. fur Physik Komplexer Systeme, Germany. Utilizing avoided resonance crossings we achieve unidirectional light emission from high-quality modes and give an explanation of the scarring phenomenon in deformed microdisks.

**FTuC2** • 8:30 a.m.
Mesoscopic Correlations in Disordered Waveguide: Dependence on Channel Indexes, Alexey G. Yamilov; Univ. of Missouri-Rolla, USA. Numerical simulation in quasi-1D disordered waveguide demonstrate that spacial field correlations strongly deviate from expectation based on random matrix theory (RMT). We relate the descrepancy to invalidity of RMT assumption of equivalence of different transmission channels.

8:00 a.m.–10:00 a.m.
**FTuC** • Propagation in Disordered Media
Aristide Dogariu; College of Optics & Photonics, CREOL and FPCE, USA, Presider

**FTuD1** • 8:00 a.m. **Invited**
Molecular imaging and Microspectroscopy of Live Cells Using Immunotargeted Nanoparticles, Adam Wax, Matthew Crow; Duke Univ., USA. We compare the expression of EGFR by epithelial carcinoma and neuroepithelial tumor cell lines using hyperspectral darkfield microscopy to measure the scattering spectra of immunolabeled plasmonic nanoparticles bound by cell surface receptors.

**FTuD2** • 8:30 a.m. **Invited**
Label-Free Detection of Cytokines, Andrea M. Armani; Scott E. Fraser, Kerry J. Vahala; Caltech, USA. Interleukin-2 (IL2) is a cytokine that regulates T-cell growth and is used in cancer therapies. By sensitizing the microcavity sensor surface with anti-IL2 and monitoring the resonant frequency, IL2 can be detected at therapeutic levels.

Tuesday, September 18

**Empire**

**Crystal**

**Frontiers in Optics**

**Gold**

**Valley**

**Joint**

**California**
FTuE • 8:00 a.m.
Precision Engineering in Optics
Peter Blake; NASA Goddard Space Flight Ctr., USA, Presider

FTuE1 • 8:00 a.m.
Precision Centering of Lenses, Robert E. Parks; Optical Perspectives Group, LLC, USA. We describe the alignment of centered lens systems using a precision rotary table and two autostigmatic microscopes plus auxiliary optics to extend the working distances to simultaneously view the centers of curvature of each lens.

FTuE2 • 8:15 a.m.
Volumetric Interferometry for Absolute Coordinate Measurements, Jiyoung Chu1,2; Quandou Wang1, Ulf Griesmann1, Johannes Soons1; NIST, USA; Korea Advanced Inst. of Science and Technology, Republic of Korea. A fiber point-diffraction interferometer is under development as a volumetric interferometer to measure x, y, and z coordinates simultaneously in free space with the goal to calibrate Coordinate Measuring Machines.

FTuE3 • 8:30 a.m.
Precision Motion and Control for Scanning Beam Interference Lithography, Andre Sharon; Fraunhofer Ctr. for Manufacturing Innovation, Boston Univ., USA. Precision motion and control is crucial in patterning nanometer-scale diffraction gratings over large optical substrates with sub-wave errors using scanning beam interference lithography. Innovative design and integration of commercial technologies can meet the strict requirements.

LtuA • 8:00 a.m.
Time-Resolved X-Ray and Electron Diffraction
Soren Keding; Aarhus Univ., Denmark, Presider

LtuA1 • 8:00 a.m.
Mode Selection in High-Power Single-Frequency Lasers, Dietmar Kracht, M. Hildebrandt, L. Windelmann, O. Puncken, B. Schulz, R. Wilhelm, M. Fride; Laser Zentrum Hannover e.V., Germany. We report on mode selection methods in high-power single-frequency laser systems for gravitational wave detection. That covers transversal selection in oscillators via resonator design as well as longitudinal by injection locking and different amplification schemes.

LtuB • 8:00 a.m.
Precision Techniques at High Laser Power I
Shailendhar Saraf; Rochester Inst. of Technology, USA, Presider

LtuB1 • 8:00 a.m.
Invited
Precision Motion and Control for Scanning Beam Interference Lithography
Andre Sharon; Fraunhofer Ctr. for Manufacturing Innovation, Boston Univ., USA. Precision motion and control is crucial in patterning nanometer-scale diffraction gratings over large optical substrates with sub-wave errors using scanning beam interference lithography. Innovative design and integration of commercial technologies can meet the strict requirements.

LtuB2 • 8:30 a.m.
Invited
Precision Optics for High Laser Power, David H. Reitze; Univ. of Florida, USA. The use of high power lasers in precision measurement applications places demands on optical components, particularly with respect to thermal management. We discuss methods to improve component performance, with an emphasis on gravitational wave interferometers.

LtuC • 8:45 a.m.
Properties and Dynamics of Interfaces and Surfaces I
Rob Walker; Univ. of Maryland, USA, Presider

OTuA • 8:00 a.m.
Invited
New Organic Materials and Processes for Thin Film Electronics, Zhenan Bao; Stanford Univ., USA. Heteroacene organic semiconductors and polymers will be presented. They have shown mobility as high as 0.75 cm²/V·s and on/off ratio greater than 10⁶. A crosslinked dielectric material, allowing low voltage operation will also be presented.

OTuA1 • 8:00 a.m.
Invited
Solution-Processed Organic Thin Film Transistors, Thomas N. Jackson; Pennsylvania State Univ., USA. Using TIPS-pentacene and F-TES-ADT we have demonstrated solution-processed organic semiconductor thin films with strong molecular ordering, transistors with mobility >1.5 cm²/V·s, and ring oscillators with propagation delay <5 µsec/stage.

OTuB1 • 8:00 a.m.
Invited
Ultrafast Molecular Dynamics with High-Harmonic Soft X-Rays, Stephen R. Leone; Depts. of Chemistry and Physics, Univ. of California at Berkeley, USA. High order harmonics of a Ti:Sapphire laser are used for molecular dynamics studies by time-resolved photoelectron spectroscopy and transient absorption. With few cycle carrier-envelope stabilized pulses the formation of attosecond pulses is investigated.

OTuB2 • 8:30 a.m.
Invited
Solution-Processed Organic Thin Film Transistors, Thomas N. Jackson; Pennsylvania State Univ., USA. Using TIPS-pentacene and F-TES-ADT we have demonstrated solution-processed organic semiconductor thin films with strong molecular ordering, transistors with mobility >1.5 cm²/V·s, and ring oscillators with propagation delay <5 µsec/stage.
FTuB2 • 8:45 a.m.
Wavelength Selective Coupler with Vertical Gratings on Silicon Chip, Kazeem Ileka, Hyo Chang Kim*, Maziar Nezhad, Ashok Krishnamoorthy, John Cunningham; University of California at San Diego, USA, San MicroSystems, USA. We demonstrate a wavelength selective coupler on a silicon chip using vertical grating structures, which possess simplicity in design and fabrication. The coupler can be used for add-drop filters and other functional devices.

FTuB3 • 9:00 a.m.
Invited
Silicon Photonic Integrated Circuits for Optical Interconnect, Ansheng Liu*, Ling Liao, Doron Rubin2, Juthika Basak1, Hat Nguyen1, Yoel Chetrit2, Rami Cohen 2, Nahum Izhaky 2, Mario Paniccia1; 1Intel Corp., USA, 2Intel Corp., Israel. We discuss integrated silicon photonic technologies that enable Tbit/s optical link for future VLSI interconnect applications. We also review recent advances in various fundamental building blocks, including 30 Gbit/s data transmission using silicon optical modulators.

FTuA • Optical Systems and Instrumentation for Short and Ultra Short Pulse X-Ray/VUV Sources I—Continued

FTuB • Silicon Photonics—Continued

FTuC • Propagation in Disordered Media—Continued

FTuC3 • 8:45 a.m.
Statistics of Random Signal Intensity in the Presence of Gaussian Noise, A. A. Chabanov; University of Texas at San Antonio, USA. The intensity probability distribution of a random field in the presence of a Gaussian noise has been derived to retrieve the statistics of microwave pulsed transmitted intensity from a noisy background at long delay times.

FTuC4 • 9:00 a.m.
Anderson Localization in Disordered Photonic Lattices, Mordechai Segev, Tal Schwartz, Gay Bartal, Shmuel Fishman; Technion — Israel Inst. of Technology, Israel. We present the first observation of Anderson Localization in disordered photonic lattices, and study the combined effects of nonlinearity and disorder, under normal and anomalous dispersion.

FTuC5 • 9:15 a.m.
Scalable Quantum Information Processing with Microwave Photons, Pavel Lougovski1,2, Carlos López, Juan Carlos Retamal2,3, Enrique Solano3; 1Oregon Ctr. for Optics, USA, 2Dept. de Física, Univ. de Santiago de Chile USACH, Chile, 3Physics Dep., Ludwig-Maximilians-Univ., Germany. We demonstrate how a scalable superconducting-qubit-based quantum computer can be realized by performing deterministic quantum gates on microwave photons. We discuss experimental feasibility of our approach.

FTuA • Quantum Information—Continued

FTuA4 • 9:00 a.m.
Observing the Spin Hall Effect of Light via Quantum Weak Measurements, Omar Hosten, Paul G. Kwan; Univ. of Illinois, USA. Using the techniques of “quantum weak-measurements” as a coherent amplification mechanism for small signals, for the first time we have measured the recently proposed “spin Hall effect” of light.

FTuA5 • 9:15 a.m.
Scalable Quantum Information Processing with Microwave Photons, Pavel Lougovski1,2, Carlos López, Juan Carlos Retamal2,3, Enrique Solano3; 1Oregon Ctr. for Optics, USA, 2Dept. de Física, Univ. de Santiago de Chile USACH, Chile, 3Physics Dep., Ludwig-Maximilians-Univ., Germany. We demonstrate how a scalable superconducting-qubit-based quantum computer can be realized by performing deterministic quantum gates on microwave photons. We discuss experimental feasibility of our approach.

FTuD4 • 9:00 a.m.
Surface Plasmon Resonance Nanohole Array Sensor and its Application on Protein Specific Binding, Lin Pang, Grace Huang, Yehualing Fainman1; 1Univ. of California at San Diego, USA, 2MITRE Corp., USA. A surface plasmon resonance biosensor based on two-dimensional metallic nanohole array is presented. The resonance is narrowed by a crossed polarizer-analyzer pair. Protein specific bindings are used to demonstrate real-time label-free microfluidic packaged sensor.

FTuD5 • 9:15 a.m.
DCDH Fluorophores Designed for Single-Molecule Cellular Imaging, Samuel J. Lord1, Hui Wang2, Kristie Cooper1, Asho Wang3; 1Univ. of Massachusetts Lowell, USA, 2Virginia Tech, USA. This paper presents a label-free DNA optical fiber sensor for detection of F. tularensis bacteria by detection of complementary deoxyribonucleic acid (DNA) sequences. The sensor features cost efficiency, speed, and ease of use.
**FTuE • Precision Engineering in Optics—Continued**

**FTuE4 • 9:00 a.m.**
Design Criteria for Combined Diffractive Optical Elements for Quasi-Absolute Testing of Aspherics, Gafur Sayeed Khan, Klaus Mantel, Irina Harder, Norbert Lindlein, Johannes Schwider; Inst. of Optics, Information and Photonics, Univ. of Erlangen-Nuremberg, Germany. Recently, we reported first experimental results of a three position quasi-absolute test for rotationally symmetric aspherics by using combined diffractive optical elements (Combo-DOEs). Here we investigate several systematic error sources and present an optimised Combo-DOE.

**FTuE5 • 9:15 a.m.**
A Finite-Element Analysis of Errors in Three-Flat Tests Caused by Rotation Dependent Flat Deformations, Nicholas Laurenchet1,2, Ulf Griesmann1, Johannes Soons1; 1NIST, USA, 2Inst. Français de Mécanique Avancée, France. Rotation of wedged flats as part of three-flat test procedures leads to rotation angle dependent deformations. We estimate the magnitude of the deformations and the effect on the test uncertainty using finite element modeling.

**LTuA • Time-Resolved X-Ray and Electron Diffraction—Continued**

**LTuA2 • 9:00 a.m.**
Chemical Dynamics Probed by Ultrafast X-Ray Absorption Spectroscopy, Xiaodi Li, Brian Ahn, Christopher M. Laperle, Taewoo Lee, Christian Reich, Christoph Rose-Petruck; Brown Univ., USA. Ultrafast laser pump-XAFS probe spectra of various organometallic complexes in solution have been measured using a laser-driven plasma x-ray source. A new x-ray source driven by a 15-W, 5-kHz laser system has been developed.

**LTuA3 • 9:30 a.m.**
Invited
Phenylenevinylene Oligomers and Poly-p-phenylenevinylene for Organic Field-Effect Transistors, Tetsuo Tsunashima1, Takeshi Yasuda2, Hiroshi Kayashima2, Katsuhiko Fujita2; 1Inst. for Materials Chemistry and Engineering, Kyushu Univ., Japan, 2Graduate School of Engineering Sciences, Kyushu Univ., Japan. For understanding of the roles of inter-chain and intra-chain charge transport in linear conjugated chains, field-effect mobilities of both oligophenylenevinylene and poly-p-phenylenevinylene were evaluated. Both p-channel and n-channel carrier transport was observed.

**LTuB • Precision Techniques at High Laser Power I—Continued**

**LTuB3 • 9:00 a.m.**
Adaptive Optical Elements for Future Gravitational Wave Interferometers, Mazammal A. Arain, Volkmar Quetschke, David B. Tanner, David H. Reitze; Dept. of Physics, Univ. of Florida, USA. Thermal lensing and beam deformation in next generation gravitational wave interferometer optical subsystems must be compensated to ensure efficient operation. Here we present two possible adaptive focusing elements which use heat-induced photothermal effects.

**LTuC • Properties and Dynamics of Interfaces and Surfaces I—Continued**

**LTuC1 • 8:45 a.m.**
Invited
Evidence for an Enhanced Proton Concentration at the Liquid Water Surface from SHG Spectroscopy, Richard J. Saykally; Dept. of Chemistry, Univ. of California, USA. Using resonant UV SHG spectroscopy, we have observed surface-enhanced concentrations of several ions in aqueous solutions, confirming theoretical predictions from several groups. Our experiments also support recent predictions of enhanced proton concentrations at aqueous surfaces.

**LTuC2 • 9:15 a.m.**
Invited
Going Nonlinear to Study Liquid Surfaces of Environmental Importance, Geri Richmond; Univ. of Oregon, USA. A summary of our most recent studies of environmentally important processes at liquid surfaces will be presented. The studies are a combination of vibrational sum frequency spectroscopy and molecular dynamics simulations.

**OTuA • OTFT Materials and Devices—Continued**

**OTuA3 • 9:00 a.m.**
Invited
Phenylenevinylene Oligomers and Poly-p-phenylenevinylene for Organic Field-Effect Transistors, Tetsuo Tsunashima1, Takeshi Yasuda2, Hiroshi Kayashima2, Katsuhiko Fujita2; 1Inst. for Materials Chemistry and Engineering, Kyushu Univ., Japan, 2Graduate School of Engineering Sciences, Kyushu Univ., Japan. For understanding of the roles of inter-chain and intra-chain charge transport in linear conjugated chains, field-effect mobilities of both oligophenylenevinylene and poly-p-phenylenevinylene were evaluated. Both p-channel and n-channel carrier transport was observed.
FTuA • Optical Systems and Instrumentation for Short and Ultra Short Pulse X-Ray/VUV Sources I—Continued

FTuA5 • 9:30 a.m.
Extreme Ultraviolet Polarimetry with High-Order Harmonics, Nicole Brimhall, Matthew Turner, Nick Herrick, David D. Allred, R. Steven Turley, Michael Ware, Justin Piarton; Brigham Young Univ., USA. High-order harmonic generation is utilized as a source of extreme ultraviolet light for polarization sensitive reflectometry.

FTuB • Silicon Photonics—Continued

FTuB4 • 9:30 a.m.
Intrinsic Losses in Silicon-On-Insulator Microring Bends, Shijun Xiao, Maroof Khan, Hao Shen, Minghao Qi; Birck Nanotechnology Ctr., Purdue Univ., USA. We demonstrate a new method to estimate intrinsic losses in silicon-on-insulator microring bends, which is based on the traveling wave theory and the accurate measurement of microring’s resonance response.

FTuC • Propagation in Disordered Media—Continued

FTuC5 • 9:30 a.m.
Vortex Interaction with Nonlinear Photonic Lattices of Varying Coherence, Anita Fors, Eugenia Eugenieva, Zhong Chen; San Francisco State Univ., USA. We study numerically interaction of a singly-charged vortex with nonlinear photonic lattices optically induced with varying spatial coherence. We observe that the dynamics of vortex phase evolution and lattice deformation is dependent on the coherence.

JTuA • Quantum Information—Continued

JTuA6 • 9:30 a.m.
Creation of a Two-Photon 4-Qubit Square Cluster in Optical Fibres, Yasaman Soudagar, Félix Bussières, José M. Fernandez, Nicolas Godbout; École Polytechnique de Montréal, Canada. We propose a scheme for building a 4-qubit square cluster using only two photons and two degrees of freedom: polarization and time-bin. This reduces the amount of resources required for optical cluster state computing.

FTuD • Biosensors I—Continued

FTuD6 • 9:30 a.m.
Covalent Attachment for Surface Enhancement of Lanthanide Emission, Abneesh Srivastava, Gregory W. Faris; SRI Intl., USA. We have used functionalized disulfide organic precursors for covalent linkage of labeled fluorophore to silver nanoparticles in solution. This approach is meant to optimize surface-fluorophore separation for plasmon enhancement applications in biological assay.

FTuD7 • 9:45 a.m.
Photonic Readout of Microcantilevers for Sensor Applications, Jong Wok Noh, Ryan R. Anderson, Seunghyun Kim, Gregory P. Nordin; Brigham Young Univ., USA. We have developed an in-plane photonic transduction method for microcantilever sensors that permits high sensitivity readout of microcantilever deflection and is scalable to large numbers of microcantilevers on a single chip.
FTuE • Precision Engineering in Optics—Continued

FTuES • 9:30 a.m. Invited
Advanced in Diamond-Turning Machines, Including Fast Tool Servos, Christian Brecher, Christian Wenzel; RWTH Aachen, Germany. Mass production of complex optics is enabled by replication methods. Fast Tool Servo turning can be used for machining the required moulds. The paper presents different process steps in off-axis machining of freeform surfaces using Fast Tool Servo assisted turning.

FTuA • Time-Resolved X-Ray and Electron Diffraction—Continued

LTuA3 • 9:30 a.m. Invited
Non-Thermal Collapse of the Silicon Lattice Observed with Femtosecond Electron Diffraction, Maher Harb, Ralph Ernststuerfer, Christoph T. Hebeisen, German Scuini, Thibault Dartigalongue, R J Dwayne Miller; Univ. of Toronto, Canada. Femtosecond electron diffraction was used to reveal the dynamics of laser induced melting in silicon. It is shown that at a fluence of 70 mJ/cm² diffraction peaks decay in 500 femtoseconds, indicating an electronically-driven disorder.

LTuB • Precision Techniques at High Laser Power I—Continued

LTuB6 • 9:45 a.m.
Effect of Transmitted Wavefront Error of Large Aperture Nd-glass Slab by Two Polishing Process on Beam Quality, Wenyi Wang, Jingqin Su, Fang Wang, Lianxin Liu, Runchang Zhao, Fuquan Li, Dongxia Hu, Zhitao Peng, Dong Yang, Hainiu Yu, Hai Zhou, Feng Jинг, Xiaogong Wei, Xiaomin Zhang; Laser Fusion Res. Ctr., China Acad. of Engineering Physics, China. Numerical modeling and experiment research for quantitative analysis of beam quality influenced by transmitted wavefront errors of large aperture Nd-glass slabs by conventional polishing and computer-controlled polishing processes were performed.

LTuC • Properties and Dynamics of Interfaces and Surfaces I—Continued

LTuC3 • 9:45 a.m.
Confinement or Properties of the Interface? Dynamics of Nanoscopic Water in Reverse Micelles, David E. Moilanen1, Nancy E. Levinger2, Michael D. Fayer1; 1Stanford Univ., USA, 2Colorado State Univ., USA. The dynamics of water in two different types of reverse micelles of the same water pool size are probed to study the effect of the surfactant headgroup (ionic vs. polar) on the water dynamics.

LTuC5 • 9:30 a.m.
Progress of Laser Amplifiers for TIL, Dong Yang, Shaobo He, Yuanbin Chen, Yong Liu, Jianguo Liu, Wenyi Wang; Laser Fusion Res. Ctr., China Acad. of Engineering Physics, China. The amplifier performance was studied at Technical-integration-line facility (TIL). Simulation and experimental results indicated that TIL amplifier satisfied design specification.

OTuA • OTFT Materials and Devices—Continued

OTuA4 • 9:45 a.m.
High Mobility Thin-Films of a Family of Disk-Like Organic Semiconductors by Weak Epitaxy Growth, Donghang Yan; Changchun Inst. of Applied Chemistry, Chinese Acad. of Sciences, China. We developed a weak epitaxy growth technology to fabricate high-quality organic semiconductor thin film. The carrier field-effect mobility of phthalocyanine compound film reaches 0.32 cm²/Vs.
### Tutorial

**10:30 a.m.–12:30 p.m.**

**FTuF • Ultrafast Dynamics: THz to X-Rays**

David A. Reis; Univ. of Michigan, USA, Presider

Advances in Time Resolved Ultrafast X-Ray Science, Philip H. Bucksbaum; Stanford Univ., USA.

X-rays have probed atomic-scale structure for a century, but new ultrafast x-rays can record atomic motion as well. The sources, techniques, and science applications are discussed in this tutorial.

**FTuG • Silicon Nanophotonics**

Presider to Be Announced

Plasmonic Laser Antennas, Federico Capasso; Harvard Univ., USA. Surface plasmon devices consisting of a resonant optical antenna on a semiconductor laser facet and of antenna arrays on an optical fiber facet are presented. Near-field applications in the near- and mid-IR are discussed.

### Session I: Ultrafast X-Ray Science

**10:30 a.m.–12:30 p.m.**

**FTuH • Coherence and Polarization I**

Torn Brown; Univ. of Rochester, USA, Presider

Unified Theory of Coherence and Polarization and Some of Its Applications, Emil Wolf; 1: Univ. of Rochester, USA, 2: Coll. of Optics, CREOL and FPCE, Univ. of Central Florida, USA. An account will be given of the unified theory of coherence and polarization formulated not long ago. It will be illustrated by examples which reveal the close relationship between the two phenomena.

### Session II: Quantum Sensing

**10:30 a.m.–12:15 p.m.**

**FTuI • Quantum Sensing and Imaging I**

Michael Vasyliev; Univ. of Texas at Arlington, USA, Presider

Quantum Optical Sensing: Single-Mode, Multi-Mode, and Continuous-Time, Jeffrey H. Shapiro; MIT, USA. Quantum limits on optics-based precision measurements are described, contrasting single-mode, multi-mode, and continuous-time paradigms. The latter suggests that 1/N, where N is the measurement’s average photon number, is not the ultimate quantum limit on precision.

### Session III: Biosensors

**10:30 a.m.–12:15 p.m.**

**FTuJ • Biosensors II**

Adam Wax; Dept. of Biomedical Eng., Duke Univ., USA, Presider

Femtosecond Stimulated Raman Spectroscopy, Richard A. Mathies; Univ. of California at Berkeley, USA. Femtosecond Stimulated Raman Spectroscopy is a new time-resolved vibrational technique that enables the recording of high resolution (10-20 cm⁻¹) vibrational spectra of dynamic and reactive chemical and biological systems with < 50fs time resolution.

### Session IV: Optical Spectroscopy

**10:30 a.m.–12:15 p.m.**

**FTuK • Optical Spectroscopy**

Arlington, USA, Presider

Interferometer Interferometry, Kostadinka K. Bizheva; 1: Free Univ., Netherlands, 2: Coll. of Optics, CREOL and FPCE, Univ. of Central Florida, USA. The method is a promising new approach to study emulsions at the micrometer length scale.

### Session V: Optically Driven Surfactant Coated Droplets

**10:30 a.m.–12:15 p.m.**

**FTuL • Optically Driven Surfactant Coated Aqueous Droplets**

Sanhita Dixit, Arseny Vasilyev, Gregory Faris; SRI Intl., USA. We demonstrate laser driven optical motion of surfactant coated water drops immersed in decanol using the thermal Marangoni effect. The method is a promising new approach to study emulsions at the micrometer length scale.
**Invited**

**Frontiers in Optics**

**10:30 a.m.–12:30 p.m.**

**FTuK • Photonic Crystals**

Presider to Be Announced

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**LTuD2 • 11:00 a.m.**

**Optical Spectroscopy of Individual Carbon Nanotubes**

Tony F. Heinz; Columbia Univ., USA.

Single-walled carbon nanotubes constitute a family of model 1-dimensional nanoscale materials. We describe recent progress in probing individual nanotubes using elastic and inelastic light scattering techniques to elucidate their electronic excitations, phonons, and their interaction.

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**LtuE2 • 11:00 a.m.**

**Femtosecond Lidar and Coherent Control**

Jean-Pierre Wolf; L. Bonacina, F. Courvoisier, M. Moret, P. Böttcher, J. Extermann, J. Kasparian; Ctr. for Adaptive Optics, Univ. of California at Santa Cruz, USA.

Femtosecond Lidar is revolutionizing astronomy by enabling large ground-based telescopes to image at the diffraction limit. This talk describes the status and future plans for this new technology.

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**LtuF1 • 10:30 a.m.**

**Nonlinear Optical Studies of Structure and Solvation across Liquid Surfaces**

Robert A. Walker; Univ. of Maryland, USA.

Vibrational sum frequency spectroscopy has become a widely used technique for probing the structure of liquid interfaces with molecular-level detail. We will discuss using VSFS to extract information about orientational changes across weakly and strongly associating liquid interfaces.

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**LtuF2 • 11:00 a.m.**

**Studying Reorientation with Surface-Selective Spectroscopy**

John T. Fourkas, Robert Walker; Univ. of Maryland, USA.

Vibrational sum frequency spectroscopy (VSFS) has become a widely used technique to identify bioagents in air.
Ultrafast Insulator–Metal Transition Induced in a Manganite by Stretching of a Metal–Oxygen Bond with THz Pulses, Matteo Rini1, Jiro Itatani1, Yasuhide Tomioka2, Yoshimori Tokura2, Robert W. Schoenlein1, Andrea Cavalleri3; 1Lawrence Berkeley Natl. Lab, USA, 2‘Correlated Electron Res. Ctr., Japan, ‘Univ. of Oxford, UK. The magnetoresistive manganite Pr0.7Ca0.3MnO3 becomes metallic when THz pulses are used to resonantly drive a stretching Mn-O vibration. A five-order-of-magnitude drop of the sample resistivity and ultrafast, nano-second-lived reflectivity changes are observed.


Polarization I—Continued

Imaging I—Continued
Bi–Chromatic Optical Fields. This Approach Has Applications to Coherent Raman Spectroscopy.

Biosensors II—Continued
Chirality Is an Excellent Indicator of Life, But Natural Samples Exhibit Massive Depolarizing Light Scattering, Rendering Conventional Polarimeters Useless. We Show that Rotating–Polarization Polarimeter Outperforms Conventional Polarimeters, by Operating on Samples 1000 Times More Scattering.
FTuK • Photonic Crystals—Continued

FTuK3 • 11:30 a.m.  
Gap-Edge Asymptotics of Defect Modes in 2-D Photonic Crystals, Kokou B. Dossou1, Lindsay C. Botter1, Ross C. McPhedran2, Ana A. Asatryan1, C. Martijn de Sterke1; 1Univ. of Technology, Sydney, Australia, 2Univ. of Sydney, Australia. We consider 2-D photonic crystal defect modes and deduce and demonstrate a simple exponential law linking the frequency difference of the mode and band gap edge to the relative change in modal electric energy.

FTuK4 • 11:45 a.m.  
Optimal Design and Analysis of the Multi-Mode Interference Based Photonic Crystal Demultiplexer, Dae-See Park, Jae-Hyun Kim, Beom-Hoon O, Se-Geun Park, El-hang Lee, Seung G0l Lee; Inha Univ., Republic of Korea. We proposed the ultra compact 1.31/1.55µm demultiplexer which composed of photonic crystal with a triangular lattice of air holes. Its operation was based on multi-mode interference effect and band gap property of photonic crystal.

LTuD • Optical Probes of Nanomaterials—Continued

LTuD3 • 11:30 a.m.  
Optical Measurements of the Electronic and Elastic Properties of Metal Nanoparticles, Gregory Hartland; Notre Dame Univ., USA. Time-resolved and single particle spectroscopy has been used to examine the properties of metal nanoparticles. The results provide information about the elastic constants and the plasmon dephasing times for particles with different sizes and shapes.

LTuD3 • 11:30 a.m. Invited  
Invited talk: Optical Measurements of the Electronic and Elastic Properties of Metal Nanoparticles, Gregory Hartland; Notre Dame Univ., USA.

LTuE • Precision Techniques at High Laser Power II—Continued

LTuE3 • 11:30 a.m.  
CW Rb Vapor Lasers Directly Pumped by Laser Diode Arrays with Volume Transmission Gratings, Randall J. Lane, Alan B. Petersen, John Glyld, Ray Patel; Spectra-Physics Lasers, USA. We describe CW atomic Rb vapor lasers, operating at 795 nm pumped by line-narrowed laser diode arrays using volume transmission gratings. Various laser architectures have been explored with output power up to 800 mW.

LTuE4 • 11:45 a.m.  
Narrow Linewidth High Power Semiconductor MOPA Achieved Using Optical Phase Lock Loops (OPLLs), Wei Liang1, Naresh Satyan1, Amnon Yariv1, Anthony Kewitch1, George Rakuljic1; 1Caltech, USA. Using an Optical Phase Lock Loop, a 1W semiconductor MOPA is locked to a -3dBm reference laser and its 20dB linewidth is reduced from 2.2MHz to 0.22MHz.

LTuF • Properties and Dynamics of Interfaces and Surfaces II—Continued

LTuF3 • 11:30 a.m.  
Time Resolved Measurements of Melting and Solidification in Si Using Third Harmonic Generation of Light, Bryan C. Gandrud, Robert S. Averback, David G. Cahill; Univ. of Illinois, USA. Time resolved measurements of melting and solidification on (001) Si using third harmonic generation (THG) were performed with subpicosecond time resolution. In addition, we show that the THG signal is sensitive to specimen temperature.

OTuB • Organic Laser and Other New Devices—Continued

OTuB3 • 11:30 a.m.  
Dendrimer Based NanoPhotonic Integrated Circuit for Terahertz Computing and Sensing, Aris Rahman; Applied Res. and Photonics, Inc., USA. At ARP dendrimer is utilized for a number of photonic devices including photonic integrated circuits. Dendrimer waveguides are created for multiple photonic functionalities that enable a wide range of applications in communication and sensing.

OTuB4 • 11:45 a.m.  
All Organic Photomemory Devices with High Efficiency, Kalpanakukal, R. Rajesh, Sang Hak Bae, In Ho Yoon, Choong Sup Yoon; KAIST, Republic of Korea. We report all organic thin film photomemory devices based on lead phthalocyanine and polyvinylpyridine fluoride, which show a very high efficiency of 1500%. Information in the form of light is effectively stored as electric polarization.
FTuF • Ultrafast Dynamics: THz to X-Rays—Continued

Chirped Multilayer Soft X-Ray Mirrors for Attosecond Soft X-Ray Pulses, Ulf Kleineberg1, Michael Hofstetter2, Alexander Apolonskiy1, Vladimir Pervak1, Eleftherios Goulielmakis1, Martin Schultze2, Matthias Uiberacker1, Vladimir Yakovlev2, Ferenc Krausz1; 1Ludwig Maximilians Univ. Munich, Germany, 2Max-Planck-Inst. of Quantum Optics, Germany.

Aperiodic XUV multilayer coatings with broad spectral bandwidth and flat dispersion have been developed, fabricated and characterized as reflecting and spectrally filtering optical elements for attosecond XUV pulses from a High Harmonic Generation source.

FTuG • Silicon Nanophotonics—Continued

High-Performance Optical Receivers in CMOS Using Ge-on-SOI Detectors, Clint L. Schow, Steven J. Koester, Laurent Schares, Richard John; IBM T.J. Watson Res. Ctr., USA.

We have produced a family of high-speed, high-sensitivity hybrid optical receivers consisting of Ge-on-SOI photodiodes paired with CMOS ICs that illustrate the potential offered by future monolithically-integrated, silicon-based receivers.

FTuH • Coherence and Polarization I—Continued

Determining Anisotropic Polarizability of Optically Inhomogeneous Media in Near-Field Measurements, David P. Haefner, Jeremy Ellis, Sergey Sukhov, Aristide Dogariu; College of Optics and Photonics, CREOL, Univ. of Central Florida, USA.

Analyzing the fluctuations in near field polarimetric measurements, we show that it is possible to determine anisotropies in the effective polarizability of inhomogeneous materials.

FTui • Quantum Sensing and Imaging I—Continued

Towards Photonic Hybrid Entanglement, Félix Bussiéres, Allison Rubenok, Nicolas Godbout; 1IQIS, Univ. of Calgary, Canada, 2COPL, Polytechnique Montréal, Canada.

We propose a scheme to generate hybrid photonic entanglement which we define as entanglement between photonic qubits with different encodings, namely time-bin and polarization, using a PPLN crystal.

FTuJ • Biosensors II—Continued

Optical Biosensor Based on Morphology Dependent Resonances, Ansur Rahman, Sanil Kumar; Polytechnic Univ., USA.

A new optical biosensor based on MDR resonances is presented. An asymptotic expression is developed based on Maxwell equations to characterize WGM resonance shifts. The proposed biosensor is designed based on the theory developed.

FTuF5 • 12:15 p.m.
Electron Wave-Packet Dynamics in a Relativistic Laser Field, Justin B. Peatross, Carsten Müller; Brigham Young Univ., USA, 2Max Planck Inst. für Kerno Physik, Germany.

We present a closed analytical approximate solution to the Klein Gordon equation for a free electron in a strong plane-wave electromagnetic field. The 3-D expression is convenient for producing movies and exploring non-dipole behavior.

FTuG5 • 12:00 p.m.
High-Performance Optical Receivers in CMOS Using Ge-on-SOI Detectors, Clint L. Schow, Steven J. Koester, Laurent Schares, Richard John; IBM T.J. Watson Res. Ctr., USA.

We have produced a family of high-speed, high-sensitivity hybrid optical receivers consisting of Ge-on-SOI photodiodes paired with CMOS ICs that illustrate the potential offered by future monolithically-integrated, silicon-based receivers.

FTuH6 • 12:00 p.m.
Fourier Phase Contrast Microscope, Chandra S. Yelleswarapu, Alexey Veraksa, Samir Laoui, Devulapalli V. Rao; Univ. of Massachusetts Boston, USA, 2Novel Fourier phase contrast microscope is developed exploiting monochromaticity, intensity and phase coherence of laser and photo-induced birefringence of liquid crystals. As condenser annulus-phase plate is not required the images are free from artifacts.

FTuJ5 • 12:00 p.m.
Optical Biosensor Based on Morphology Dependent Resonances, Ansur Rahman, Sanil Kumar; Polytechnic Univ., USA.

A new optical biosensor based on MDR resonances is presented. An asymptotic expression is developed based on Maxwell equations to characterize WGM resonance shifts. The proposed biosensor is designed based on the theory developed.

12:30 p.m.–2:00 p.m., Exhibit-Only Time/Lunch Break
FTuK • Photonic Crystals—Continued

FTuK5 • 12:00 p.m.
Electrically Pumped Photonic Crystal Lasers, Zhaoyu Zhang, Victor Liu, Tint Heng, Axel Scherer; Caltech, USA. Visible electrically pumped 2-D photonic crystal lasers were fabricated within membranes of InGaP/InGaAlP quantum well material which has the PIN diode structure incorporated. They’re the first current driven lasers with ultrasmall mode volumes.

FTuK6 • 12:15 p.m.
Maximize the Input Angle for the Self-Collimation of Photonic Crystals Composed of Anisotropic Materials by Optimizing the Dispersion Surfaces, Mohammad M. Siaji, J. W. Haus, Paras Prasad; 1Univ. of Dayton, USA, 2SUNY Buffalo, USA. We found that the input angles of a photonic crystal composed of anisotropic constituents for self-collimation regime is maintained as materials become more birefringent. We model the optical properties of a photobleached DAST crystal.

LTuD • Optical Probes of Nanomaterials—Continued

LTuD4 • 12:00 p.m.
Dynamics of Quantum Dot Photonic Crystal Lasers, Bryan C. Ellis, Ilya Fushman, Dirk Englund, Bingyang Zhang, Yoshihisa Yamamoto, Jelena Vuckovic; Stanford Univ., USA. The large signal modulation rate of quantum dot photonic crystal lasers was investigated. The authors find that the modulation rate is limited by the rate of carrier capture into the dots to around 30GHz.

LTuD5 • 12:15 p.m.
Coherent Acoustic Phonon Generation in Exciton Self-Trapping, F. X. Morrissey, S. L. Dexheimer; Washington State Univ., USA. The dynamics of exciton self-trapping in quasi-one-dimensional systems are studied using femtosecond impulsive excitation techniques. Low temperature measurements reveal the generation of a coherent acoustic wave associated with the formation of the localized lattice deformation.

LTuD6 • 12:15 p.m.
Scaling Laws of Disk Lasers, Dil’tiri Kouznetsov, Jean-François Bisson, Ken-ichi Ueda; Inst. for Laser Science, Univ. of Electro-Communications, Japan. The general limit of power scaling of disk lasers comes from overheating, round-trip loss and the amplified spontaneous emission. The round-trip loss should scale inversely proportional to the cubic root of the desired output power.

LTuE • Precision Techniques at High Laser Power II—Continued

LTuE5 • 12:00 p.m.
Measurements of Power Distribution between Lateral Modes of Broad Area Laser Diode, Nikolai Stelmakh, Sheldon Fernandez; Univ. of Texas at Arlington, USA. Analysis of optical power of broad-area laser diode lateral modes is performed using spatially resolved spectrometer with 1GHz-spectral resolution. The lateral mode thresholds and slope efficiencies were compared with laterally resolved gain depletion model.

LTuE6 • 12:15 p.m.
Precision Techniques at High Laser Power II—Continued

12:30 p.m.–2:00 p.m., Exhibit-Only Time/Lunch Break
2:00 p.m.–4:00 p.m. 
FTuL • Optical Systems and Instrumentation for Short and Ultra Short Pulse X-Ray/VUV Sources II
Regina Soufl; Lawrence Livermore Natl. Lab, USA, Presider

FTuL1 • 2:00 p.m. Invited
Large-Scale, Long-Term Stable Femtosecond Timing Distribution and Synchronization, Jung-Won Kim; MIT, USA. Long-term stable and femtosecond-precision timing distribution and synchronization over 300 m distance is demonstrated based on the use of optical pulse trains generated from ultra-low-noise mode-locked lasers.

FTuL2 • 2:30 p.m. Invited
The Performance of the Advanced Light Source Slicing Beamline, ALS BL6.6, Philip Heimann, Ernie Glover, Marc Herlein, Bruce Rude, David Plate, Howard Padmore, Robert Schoenlein; Lawrence Berkeley Natl. Lab, USA. A beamline optimized for the bunch slicing technique has been constructed and commissioned at the Advanced Light Source (ALS). This beamline includes an in-vacuum undulator, soft and hard x-ray beamlines and a femtosecond laser system.

2:00 p.m.–4:00 p.m. 
FTuM • Active Photonic Devices in Silica
Presider to Be Announced

FTuM1 • 2:00 p.m. Optical Modulator on Si Employing Ge Quantum Wells, Jonathan E. Both; Omar Fidaner, Rebecca K. Schaefer1, Elizabeth H. Edwards, Yu-Hsuan Kuo2, Theodore I. Kamins1, James S. Harris Jr., David A. B. Miller1; Stanford Univ., USA, 2Dept. of Electrical Engineering and the Graduate Inst. of Electronics Engineering, Natl. Taiwan Univ., Taiwan, 3Quantum Science Res., Hewlett-Packard Labs, USA. We demonstrate the first electroabsorption modulator using the quantum-confined Stark effect in Ge. For 10 V swing, the contrast ratio is 7.3 dB at 1457 nm, and exceeds 3 dB over 20 nm bandwidth.

FTuM2 • 2:15 p.m. Efficient and Compact Coupler for Silicon-on-Insulator Rib Waveguide, Seungyun Kim, Seungmoon Yang, Hanul Kim, Gregory P. Nordin; Brigham Young Univ., USA. A compact taper coupler for SOI rib waveguide with vertical and horizontal silicon taper and SU8 waveguide structure has been designed and fabricated. For a taper length of only 73µm, simulation shows 79% coupling efficiency.

FTuM3 • 2:30 p.m. Invited
Silicon Evanescent Racetrack Laser, Alexander W. Fung, Hyunsook Park, John Bowerei, Richard Jones, Matti J. Pianciat, Oleed Cohen, Omri Raday; a. Univ. of California at Santa Barbara, USA, b. Intel Corp., USA, c. Intel Corp., Israel. We describe the utilization of hybrid silicon evanescent waveguides, consisting of III-V quantum wells bonded to silicon rib-waveguides for evanescently coupled gain, to achieve an on-chip racetrack laser integrated with photodetectors on a silicon platform.

2:00 p.m.–3:45 p.m. 
FTuN • Coherence and Polarization II
Miguel A. Alonso; Inst. of Optics, Univ. of Rochester, USA, Presider

FTuN1 • 2:00 p.m. Optical Vortex Coronagraph, Grover A. Swartzlander; Erin Ford, Rakshab Abdul-Malik, Joshua Kim, Liam Close1, Mary Anne Peter1, David Palacios; Daniel Wilson; ‘College of Optical Sciences, Univ. of Arizona, USA, ‘Steward Observatory, Univ. of Arizona, USA, ‘JPL, USA, The optical vortex coronagraph is a promising scheme for achieving high contrast low loss imaging of exoplanets. Observatory and laboratory measurements will be presented and analyzed. Procedures for achieving improved performance will be described.

FTuN2 • 2:30 p.m. Stress-Induced Focal Splitting: Effects of Higher Order Symmetry, Alexis K. Spilman, Thomas G. Brown; Inst. of Optics, Univ. of Rochester, USA, Double-focus systems may be constructed using a parallel-face window under symmetric stress of order m greater-than or equal-to three and illuminated with circularly polarized light. We describe comparisons of focal splitting under higher order stress.

2:00 p.m.–3:45 p.m. 
FTuO • Active Photonic Devices in Silica
Presider to Be Announced

FTuO1 • 2:00 p.m. CARS Microscopy: Biomedical Imaging by Nonlinear Vibrational Spectroscopy, Sunney Xie; Harvard Univ., USA. Coherent anti-Stokes Raman scattering (CARS) microscopy is a noninvasive imaging technique using vibrational spectroscopy as a contrast mechanism. Recent advances have allowed significant improvements in sensitivity, robustness, and cost, opening a range of biomedical applications.

FTuO2 • 2:00 p.m. Tutorial
CARS Microscopy: Biomedical Imaging by Nonlinear Vibrational Spectroscopy, Sunney Xie; Harvard Univ., USA. Coherent anti-Stokes Raman scattering (CARS) microscopy is a noninvasive imaging technique using vibrational spectroscopy as a contrast mechanism. Recent advances have allowed significant improvements in sensitivity, robustness, and cost, opening a range of biomedical applications.

Xiaoliang Sunney Xie received a B.S. in chemistry from Peking Univ. in 1985, followed by his Ph.D. in 1990 from the Univ. of California at San Diego. After postdoctoral research at the Univ. of Chicago, Xie joined Pacific Northwest Natl. Lab in 1992, where he later became a Chief Scientist. In 1999, he was appointed Professor of Chemistry at Harvard Univ. Xie has contributed to the emergence of room temperature single-molecule spectroscopy and its biological applications, both in vitro and in living cells. Xie’s team also has developed coherent anti-Stokes Raman scattering microscopy, a highly sensitive bioimaging technique that provides vibrational contrast with molecular selectivity. A Fellow of the American Association for the Advancement of Science and Biophysical Society, Xie was recipient of the 2007 Willis E. Lamb Award for Laser Science and Quantum Optics, a 2004 NIH Director’s Pioneer Award, the 2003 Sackler Prize, and the 1996 Coblentz Award.
2:00 p.m.–4:00 p.m.
**FTuP** • Aberration Theory in Optical Testing
Eric Novak; Veeco, USA, Presider

2:00 p.m.–4:00 p.m.
**LTuG** • Precision Techniques on Short Time Scales I
Jean-Pierre Wolf; GAP-Biophotonics, Univ. of Geneva, Switzerland, Presider

2:00 p.m.–4:00 p.m.
**LTuH** • Clocks, Navigation and Magnetometers
Presider to Be Announced

2:30 p.m.–4:00 p.m.
**LTuI** • Imaging and Microscopy — Non-Biological I
Chris Bardeen; Univ. of California at Riverside, USA, Presider

2:00 p.m.–3:45 p.m.
**OTuC** • Materials and Devices for Organic Photovoltaics
Jason Brooks; Universal Display Corp., USA, Presider

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**FTuP1** • 2:00 p.m.
**Invited**
Orthonormal Polynomials for Wavefront Analysis in Optical Testing, Virendra Mahajan, Guang-ming Dai; 1Aerospace Corp., USA, 2AMO Laser Vision Correction Group, USA. We have derived closed-form orthonormal polynomials over noncircular apertures using a new matrix approach. Isometric plots, interferograms and point-spread functions are illustrated. Their use in optical testing is discussed.

**LTuG1** • 2:00 p.m.
**Invited**
Science and Applications Based on Laser Control, Marcos Distante; Michigan State Univ., USA. Results from a systematic research on shaped-pulse fragmentation of isolated molecules will be presented. Interestingly, a single control parameter can cause order of magnitude changes, and guide us in predicting molecular fragmentation patterns.

**LTuH1** • 2:00 p.m.
**Invited**
Atom Optic Inertial and Gravitational Sensors, Brenton Young, D. Scott Bomini, Thomas Patteson, Frank Roller, Thang Tran, Artyom Vitouchkine, Todd Gustavson, Mark Kaevich; AiSense, Inc., USA. The exquisite accuracies of atom optic sensors hold great promise for demanding applications in navigation, guidance, pointing and geophysical exploration. We describe our efforts to transition these sensors from the laboratory into the field.

**OTuC1** • 2:00 p.m.
**Plenary**
The Use of Heavy Metal Complexes in Organic LEDs and Solar Cells, Mark Thompson, Stephen R. Forrest, Julie Brown, Tissa Sajoto, Peter Djurovich, Carsten Borek, Dolores Perez, Yiru Sun; Jason Brooks, Univ. of Southern California, USA, Univ. of Michigan, USA, Universal Display Corp., USA. We have investigated the use of heavy metal complexes in organic solar cells. The goal is to efficiently utilize triplet excitons to enhance efficiencies. I will discuss our most recent results in this direction.

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**FTuP2** • 2:30 p.m.
**Invited**
Pitfalls in Using Zernike Circle Polynomials over Noncircular Pupils, Guang-ming Dai, Virendra Mahajan; 1AMO Laser Vision Correction Group, USA, 2Aerospace Corp., USA. We discuss the disadvantages of using Zernike circle polynomials for analyzing non-circular wavefronts, such as ocular wavefronts over elliptical pupils and the main mirror of telescopes with obscuration.

**LTuG2** • 2:30 p.m.
**Invited**
Using Wavepackets to Explore and Control Non-Perturbative Interactions, Robert I. Jones, Univ. of Virginia, USA. The creation of well-characterized wavepackets enables the controlled investigation of non-perturbative dynamics in atoms and molecules, from time-dependent electron-electron interactions in atoms to molecular orientation-dependent processes in intense laser fields.

**LTuH2** • 2:30 p.m.
**Invited**
Atom Interferometry and Inertial Sensors, Philippe Bozor, CNRS – Lab Charles Fabry, Inst. d’Optique, France. We discuss the development of new atom interferometers using atom lasers as coherent atomic sources to improve their performances. We will discuss possible applications in navigation and fundamental physics on ground or in space.

**LTuI1** • 2:30 p.m.
**Invited**
Resonantly Tweezeing Single Plasmonic Objects to Controlling Plasmonic Excitations of Metal Nanoparticles, Norbert Scherzer; Univ. of Chicago, USA. No abstract available.
FTuL • Optical Systems and Instrumentation for Short and Ultra Short Pulse X-Ray/VUV Sources II—Continued

FTuM • Active Photonic Devices in Silica—Continued

FTuN • Coherence and Polarization II—Continued

FTu3 • 3:00 p.m. Invited
Short-Pulse X-Ray Optics: Effects and Considerations, Sarvjit D. Shastri; Advanced Photon Source, Argonne Natl. Lab, USA. Newer synchrotron radiation sources should provide sub-ps-second x-ray pulse durations. Various optics considerations for such short pulses will be addressed, including temporal broadening effects, pulse length preservation, and possibilities of further compression.

FTu4 • 3:00 p.m.
Coherent and Partially Coherent Vortex Beams in Turbulence, Greg Gbur; Univ. of North Carolina at Charlotte, USA. The evolution of the scintillation and topological charge of coherent and partially coherent vortex beams in turbulence is analyzed. The possibility of using such beams in optical communications is discussed.

FTu5 • 3:15 p.m.
Lithographic Control of Resonance Wavelengths in Micro-Resonators, Shijun Xiao, Marcoof H. Khan, Hao Shen, Minghao Qi; Purdue Univ., USA. We present and verify an analytical theory for the resonance wavelength shift due to resonator’s perimeter change.

FTu6 • 3:15 p.m.
Interference of Optical Beams with Topological Charge, Matt James Burch, Surendra Singh; Univ. of Arkansas, USA. Interference of optical beams carrying equal but opposite integer topological charge is studied using a modified Mach-Zehnder interferometer.

FTu7 • 3:15 p.m.
Radial Polarizers with an Azimuthally Transmitted Component of the E-Field, E. Frisn1, D. Tierney1, H. Schmitzer1, W. Dulitz1; Faculty of Engineering, J. Herrera y Reig 365, Uruguay; Xavier Univ., USA, 2Univ. Frankfurt (Main), Germany. Radial polarizers in the input of a lens can form the focus to a spot or ring like shape. We present two different radial polarizers which transmit the azimuthal component of the light field.

FTuL3 • 3:00 p.m. Invited
Ultra Short Pulse X-Ray/VUV Instrumentation for Short and Temporal Broadening Effects, Pulse Length Preservation, and possibilities of further compression.

FTuL4 • 3:00 p.m.
In Silica—Continued

FTuL5 • 3:15 p.m.
Compact High Quantum Efficiency Single Photon Detector in the Ultraviolet Wavelengths, Kyle S. McKay, Felix Lu, Jongseong Kim, Henry H. Haugue; 1Duke Univ., USA, 2EBS Sensors and Targeting Systems, USA. We apply a theory of an optical quantum state generator to quantum information and metrology problems. We demonstrate how different entangled states of light can be constructed in an optimal way for given resources.

FTuL6 • 3:15 p.m.
Infrared and Raman Spectroscopy, Andre Knoesen1, Israel Roca-Mendoza1, Diego R. Yankelevich1, Mingbo Wang2, Karen M. Reiser2; Univ. of California at Davis, USA, 3Imperial College London, UK. The molecular origins of second order nonlinear effects in collagen fibril assemblies have been identified with sum-frequency generation, infrared and Raman vibrational spectroscopies.

FTuL7 • 3:15 p.m.
Polarization II—Continued

FTuM3 • 2:45 p.m.
Interference of Optical Beams with Topological Charge, Matt James Burch, Surendra Singh; Univ. of Arkansas, USA. Interference of optical beams carrying equal but opposite integer topological charge is studied using a modified Mach-Zehnder interferometer.

FTuM4 • 3:00 p.m.
Interference of Optical Beams with Topological Charge, Matt James Burch, Surendra Singh; Univ. of Arkansas, USA. Interference of optical beams carrying equal but opposite integer topological charge is studied using a modified Mach-Zehnder interferometer.

FTuM5 • 3:15 p.m.
Local Dispersion Relation and Local Group Velocity in Micro-Resonators, Shijun Xiao, Marcoof H. Khan, Hao Shen, Minghao Qi; Purdue Univ., USA. We present and verify an analytical theory for the resonance wavelength shift due to resonator’s perimeter change.

FTuM6 • 3:15 p.m.
Radial Polarizers with an Azimuthally Transmitted Component of the E-Field, E. Frisn1, D. Tierney1, H. Schmitzer1, W. Dulitz1; Faculty of Engineering, J. Herrera y Reig 365, Uruguay; Xavier Univ., USA, 2Univ. Frankfurt (Main), Germany. Radial polarizers in the input of a lens can form the focus to a spot or ring like shape. We present two different radial polarizers which transmit the azimuthal component of the light field.

FTuN3 • 2:45 p.m.
Coherent and Partially Coherent Vortex Beams in Turbulence, Greg Gbur; Univ. of North Carolina at Charlotte, USA. The evolution of the scintillation and topological charge of coherent and partially coherent vortex beams in turbulence is analyzed. The possibility of using such beams in optical communications is discussed.

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Interference of Optical Beams with Topological Charge, Matt James Burch, Surendra Singh; Univ. of Arkansas, USA. Interference of optical beams carrying equal but opposite integer topological charge is studied using a modified Mach-Zehnder interferometer.

FTuN5 • 3:15 p.m.
Radial Polarizers with an Azimuthally Transmitted Component of the E-Field, E. Frisn1, D. Tierney1, H. Schmitzer1, W. Dulitz1; Faculty of Engineering, J. Herrera y Reig 365, Uruguay; Xavier Univ., USA, 2Univ. Frankfurt (Main), Germany. Radial polarizers in the input of a lens can form the focus to a spot or ring like shape. We present two different radial polarizers which transmit the azimuthal component of the light field.

FTuN6 • 3:15 p.m.
Sagnac Effect in Vortex Superposition States of Bose-Einstein Condensates, Sulakshana N. Thanvanthri1, Kishor T. Kapale1,2, Jonathan P. Dowling2; 1Louisiana State Univ., USA, 2Hearne Inst. for Theoretical Physics, USA, 3Tulane Univ., USA. Creating vortex state superposition in Bose-Einstein Condensates (BEC) has been studied by coupling BEC with superpositions of orbital angular momentum states of light. We study the Sagnac effect occurring in superpositions of BEC vortex states.

FTuO2 • 2:45 p.m.
Optical Second Order Nonlinearity in Collagen: Molecular Origins Determined by Sum-Frequency, Infrared and Raman Spectroscopy, Andre Knoesen1, Israel Roca-Mendoza1, Diego R. Yankelevich1, Mingbo Wang2, Karen M. Reiser2; Univ. of California at Davis, USA, 3Imperial College London, UK. The molecular origins of second order nonlinear effects in collagen fibril assemblies have been identified with sum-frequency generation, infrared and Raman vibrational spectroscopies.
FTuP • Aberration Theory in Optical Testing—Continued

FTuP3 • 3:00 p.m. Invited
A Fast Three-Step Phase Shifting Algorithm for Real-Time Three-Dimensional Shape Measurement, Peisen Huang; Stony Brook Univ., USA. A novel three-step phase shifting algorithm, which is more than three times faster than the traditional algorithm, is described and its application in a high-resolution, real-time 3-D shape measurement system discussed.

LTuG • Precision Techniques on Short Time Scales I—Continued

LTuG3 • 3:00 p.m. Invited
Molecular Control Experiments Using Ultrashort XUV Pulses, Per Johnson, Wing Kin Sau, Arjan Glasbergen, Marc Vukhting; AMOLF, Netherlands. We present results obtained using charged particle imaging of atomic and molecular processes, induced by extreme ultraviolet laser light, both in the form of attosecond pulses and as intense free electron laser pulses.

LTuH • Clocks, Navigation and Magnetometers—Continued

LTuH3 • 3:00 p.m. Invited
Optical Atomic Clocks Based on Neutral Atoms, Christopher W. Oates, Zeb Barber, Jason Stalnaker, Chad Hoyt, Yann LeCoq, Leo Hollberg; NIST, USA. We report on two optical clocks: one uses freely expanding calcium atoms, while the other is based on lattice-confined ytterbium. We measure a fractional instability between the clocks of $4 \times 10^{-16}$ at 100 s.

LTuI • Imaging and Microscopy — Non-Biological I—Continued

LTuI2 • 3:00 p.m. Invited
Near Field Optical and Infrared Imaging of Material and Metamaterial Surfaces, Gilbert Walker, Slava Romanov, Shell Ip, Toan Nguyen; 1Univ. of Toronto, Canada, 2Univ. of Pittsburgh, USA. We present IR near field imaging of organic and inorganic materials. Spatial resolution below 20 nm was achieved. Theoretical models for the optics are presented. We discuss apertureless imaging of light emerging from nanoholes.

OTuC • Materials and Devices for Organic Photovoltaics—Continued

OTuC2 • 2:45 p.m. Invited
Design of Conjugated Polymers for the Optimization of Solar Cell Performance, Barry C. Thompson, Jean M. J. Fréchet; Dept. of Chemistry, Univ. of California at Berkeley, USA. The influence of polythiophene structure on polymer fullerene bulk-heterojunction solar cells is described. Regioregularity is found to influence device stability and variation in the identity and distribution of alkyl substituents is found to affect device efficiency.

OTuC3 • 3:15 p.m. Invited
Plastic Bulk-Heterojunction Solar Cells and Near-Infrared Photodetectors, Yang Yang; Univ. of California at Los Angeles, USA. Polymer based solar cells and photodetectors have tremendous application in harnessing solar energy and photodetection in a cost-effective way. Here we studied self-organization effect in polymer solar cells and demonstrated plastic near-infrared photodetectors.
FTuL • Optical Systems and Instrumentation for Short and Ultra Short Pulse X-Ray/VUV Sources II—Continued

FTuL4 • 3:30 p.m.
Comparison of Titanium Dioxide and Silicon Nitride Chirped Mirrors for Femtosecond Pulse Compression, Olexiy V. Shulika1, Igor A. Sukhivatorov, Alla V. Kablyk1, Sergey O. Yakushev2; 1Natl. Univ. of Radio Electronics, Ukraine, 2Univ. Guanajuato, Mexico. We numerically compare properties of SiO2-TiO2 and SiO2-Si3N4 chirped mirrors oriented to λ = 800 nm. Silicon nitride mirrors provide better pulse compression. Numerical optimization of silicon nitride mirrors has also been made.

FTuM • Active Photonic Devices in Silica—Continued

FTuM6 • 3:30 p.m.
Invited
Active Plasmonic Structures and Metamaterials, Harry Atwater, Henri J. Lezec, Jennifer A. Dionne, Carrie E. Rau, Luke A. Sweatlock, Domenico Pacifici, Ken Dietz, Matthew Dicken, Vivian Ferry; Caltech, USA. Plasmonics has provided nanoscience researchers new control of optical dispersion and light localization at nanoscale dimensions. I will discuss plasmonic concepts that are yielding metamaterials designs and building blocks for chip-based optical device technology.

FTuN • Coherence and Polarization II—Continued

FTuN6 • 3:30 p.m.
Polarization Properties of Ince-Gaussian Beams, Adam M. Goldstein, Reeta Vyas, Surendra Singh; Univ. of Arkansas, USA. Longitudinal and crosspolarization properties of vector Ince-Gaussian light beams are studied when the light beams are linearly and circularly polarized by using the solutions of scalar paraxial wave equation in elliptical cylindrical coordinates.

JTuB • Quantum Sensing and Imaging II—Continued

JTuB6 • 3:30 p.m.
Development of Single-Photon Source Based on Single Trapped Barium Ions, Gang Shu, Nathan Kurz, Ryan Bowler, Sanghoon Chong, Matt Dietrich, Gary Howell, Adam Kleczewski, Viki Mirgon, Joseph Pirilie, Joanna Salacka, Li Wang, Boris B. Blinov; Dept. of Physics, Univ. of Washington, USA. A pulse laser driving Ba based single photon source has been proposed with its simple structure, high repetition rate and potential application in Quantum computation and communication.

FTuO • Nonlinear Microscopy in Biology I—Continued

FTuO4 • 3:30 p.m.
Two-Photon Luminescence Imaging of Cancer Cells Using Molecularly Targeted Gold Nanorods, Nicholas J. Durr1, Timothy Larson, Danielle K. Smith1, Brian Korgel1, Konstantin Sokolov2, Adela Ben-Yakar1; 1Univ. of Texas at Austin, USA, 2Univ. of Texas M.D. Anderson Cancer Ctr., USA. We demonstrate the ability to image cancerous cells in a three-dimensional tissue phantoms utilizing bright two-photon luminescence from molecularly targeted gold nanorods. Nanorod labeled cells provide three orders-of-magnitude more signal than autofluorescence from unlabeled cells.

JTuO5 • 3:45 p.m.
Two-Photon Luminescence Imaging of Cancer Cells Using Molecularly Targeted Gold Nanorods, Nicholas J. Durr, Timothy Larson, Danielle K. Smith, Brian Korgel, Konstantin Sokolov, Adela Ben-Yakar; Univ. of Texas at Austin, USA. We demonstrate the ability to image cancerous cells in a three-dimensional tissue phantoms utilizing bright two-photon luminescence from molecularly targeted gold nanorods. Nanorod labeled cells provide three orders-of-magnitude more signal than autofluorescence from unlabeled cells.

Computation and communication.
FTuP • Aberration Theory in Optical Testing—Continued

FTuP4 • 3:30 p.m.
Quantitative Phase Estimation with a Bright Field Microscope, Sri Rama Prasanna Pravani, Ariel R. Libertun, Carol J. Cogswell; Univ. of Colorado at Boulder, USA. We demonstrate quantitative phase imaging on a bright field transmission microscope with an amplitude mask in the field diaphragm and a post processing algorithm.

FTuP5 • 3:45 p.m.
Aberration Analysis of the Putative Projector for Lorenzo Lotto’s “Husband and Wife,” David G. Stork1,2; 1Ricoh Innovations, USA, 2Stanford Univ., USA. Geometrical constraints upon Lorenzo Lotto’s putative projector for “Husband and wife” lead to off-axis aberrations as severe as defocus arising from limited depth of field. This and other facts undercut claims Lotto used a projector.

LTuG • Precision Techniques on Short Time Scales I—Continued

LTuG4 • 3:30 p.m.
Controlling Fragmentation in Molecular Ions via Dynamic Resonances, Sarah Nichols1, Brett J. Pearson2, Thomas C. Weinacht1; SUNY Stony Brook, USA, 2Dickinson College, USA. We examine the role that ultrafast dynamic resonances in molecular ions play in controlling fragmentation. By creating wave packets on ionic potential energy surfaces, one can time-resolve ionic resonances leading to molecular fragmentation.

LTuG5 • 3:45 p.m.
Coherent Population Transfer in Heteronuclear Molecules, Michaela Tischerneck, Nicholas P. Bigelow; Univ. of Rochester, USA. We solve the time-dependent Schrödinger equation for molecular systems in the presence of short laser pulses and show that a high transfer efficiency between various molecular levels can be achieved.

LTuH • Clocks, Navigation and Magnetometers—Continued

LTuH4 • 3:30 p.m.
High Sensitivity Atomic Magnetometers and their Applications, Michael Romalis; Princeton Univ., USA. I will review recent progress in optical magnetometry techniques using spin-polarized alkali-metal atoms and discuss their applications for detection of nuclear magnetic resonance, biological magnetic fields, rotation sending, and fundamental physics tests.

LTuI • Imaging and Microscopy — Non-Biological I—Continued

LTuI3 • 3:30 p.m.
Invited
Strongly Emissive ss-DNA-encapsulated Ag Nanoclusters as New Single Molecule Fluorophores, Robert Dickson; Georgia Tech, USA. Highly emissive ssDNA-encapsulated Ag dimers and trimers have been created and studied in polymeric and biological systems. Fluorescence intensities and photostabilities greatly exceed those of existing organic dyes. Full photophysical characterization will be reported.

LTuI4 • 3:30 p.m.
Invited
High Sensitivity Atomic Magnetometers and their Applications, Michael Romalis; Princeton Univ., USA. I will review recent progress in optical magnetometry techniques using spin-polarized alkali-metal atoms and discuss their applications for detection of nuclear magnetic resonance, biological magnetic fields, rotation sending, and fundamental physics tests.

LTuI5 • 3:45 p.m.
Coherent Population Transfer in Heteronuclear Molecules, Michaela Tischerneck, Nicholas P. Bigelow; Univ. of Rochester, USA. We solve the time-dependent Schrödinger equation for molecular systems in the presence of short laser pulses and show that a high transfer efficiency between various molecular levels can be achieved.

4:00 p.m.–4:30 p.m., Coffee Break, Exhibit Hall (Fairmont Hotel, Imperial Ballroom)
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>4:30 p.m.</td>
<td>FTuQ1 • Ultrafast Coherent Diffraction X-Ray Imaging, Henry Chapman; Lawrence Livermore Natl. Lab, USA.</td>
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<tr>
<td>5:00 p.m.</td>
<td>FTuQ2 • Energy Gain of, and Re-radiated Power from, Initially Stationary Electrons Struck by a Sub-Joule Ultrashort Laser Pulse: An Exact Simulation, Hyun Min Cho, Robert W. Helwarth, Univ. of Southern California, USA.</td>
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<tr>
<td>4:30 p.m.</td>
<td>FTuR1 • Ultra-High-Power Fiber Amplifiers: Scope and Limitations, Martin Fermann; IMRA America Inc., USA.</td>
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<tr>
<td>5:00 p.m.</td>
<td>FTuR2 • Experimental Investigation of Self-Starting in a Passively Mode-Locked Fiber Laser Based on a Symmetrical NOLM, Ruben Grijalva-Coutinho, Baldeep S Bhra, Escamilla, Evgeny A. Kuzin, Olivier Pottiez, Joseph W. Haus; INAOE, Mexico.</td>
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<td>4:30 p.m.</td>
<td>FTuS1 • Depolarization Analyzed by Matrix Logarithms, Russell Chipman; Univ. of Arizona, USA.</td>
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<td>5:00 p.m.</td>
<td>FTuS2 • Light-Polarization Visualizer with Polymeric Composite Mixtures, Riccardo Castagna, Daniele E. Landfuga, Davide Vittorini, Francesco Simoni; Univ. Politecnica delle Marche, Dip. FIMET and CNISM, Italy.</td>
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<tr>
<td>4:30 p.m.</td>
<td>FTuT1 • Modified Spontaneous Emission Using Higher-Order Pseudogaps in 3-D Polymer Photonic Crystal at Telecommunication Wavelengths, Michael J. Ventura, Min Gu; Ctr. for Micro-Photonics, Swinburne Univ. of Technology, Australia.</td>
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<td>5:00 p.m.</td>
<td>FTuT2 • Effects of Refractive-Index Mismatch and Scattering on Simultaneous Spatial and Temporal Focusing, Michael E. Durst, Guanghao Zhu, Chris Xu; Cornell Univ., USA.</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>FTuT1 • Optics with Three-Dimensional Photonic Crystals, Willem Vos; FOM Inst. and Univ. Twente, Netherlands.</td>
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<tr>
<td>5:00 p.m.</td>
<td>FTuT2 • Simultaneous Spatial and Temporal Focusing in Nonlinear Microscopy, Chris Xu; Cornell Univ., USA.</td>
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</table>
For a 2-plano-aspheric lens laser beam shaper, the wavefront, the irradiance along rays, and the caustic surfaces when transforming a Gaussian beam into a flattened-Lorentzian beam.

We demonstrate a simple method to control spectrum and to generate synchronized double femtosecond pulses in a mode-locked Ti:Sapphire laser. And the difference of two wavelengths is easily tuned in large range.

The coherent control of energy transfer in different nanomaterials in solution.

We describe the use of time-resolved electrostatic force microscopy and photoconductive atomic force microscopy in order to study charge generation, transport, and trapping in donor/acceptor blend organic solar cells.

We discuss high-efficiency RGB and white organic light emitting diodes, utilizing doped transport layers for low-voltage operation and flexible configuration, and novel approaches for white emitting systems which allow high quantum efficiency and long lifetime.

We investigate the coherent control of energy transfer in different nanomaterials in solution.
FTuQ•Ultrafast Science: X-Rays and Accelerators—Continued

FTuQ3•5:15 p.m.
Invited
Laser Plasma Accelerators: High Quality and Tuneable Electron Beam, Victor Malka; Lab d’Optique Applique, Ecole Polytechnique ENSTA, France. A review of laser plasma accelerator and its related applications for medicine (radiotherapy), chemistry (femtolysis) and material science (radiography) will be presented.

FTuR•Short Pulse Fiber Lasers and Amplifiers—Continued

FTuR3•5:15 p.m.
Dynamics of Gain-Guided Solitons in a Fiber Laser, Luming Zhao1, Dingyuan Tang1, Tie Huang Cheng2, Hwa-Yen Tan2, Chao Lu2; School of Electrical and Electronic Engineering, Nanyang Technological Univ., Singapore. Department of Electrical Engineering, Hong Kong Polytechnic Univ., Hong Kong. Period-doubling of dispersion-managed soliton in Erbium-doped fiber lasers at around zero dispersion is experimentally observed, which suggests that the period-doubling is an intrinsic feature of the mode-locking fiber lasers.

FTuR4•5:30 p.m.
Period-Doubling of Dispersion-Managed Soliton in Erbium-Doped Fiber Lasers at around Zero Dispersion, Luming Zhao1, Dingyuan Tang1, Tie Huang Cheng2, Hwa-Yen Tan2, Chao Lu2; School of Electrical and Electronic Engineering, Nanyang Technological Univ., Singapore. Department of Electrical Engineering, Hong Kong Polytechnic Univ., Hong Kong. Period-doubling of dispersion-managed soliton in Erbium-doped fiber ring lasers operating at near zero net cavity group velocity dispersion was experimentally observed, which suggests that the period-doubling is an intrinsic feature of the mode-locking fiber lasers.

FTuS•Coherence and Polarization III—Continued

FTuS3•5:15 p.m.
Surface Plasmaoms in Young’s Experiment: Modulation of the Spatial Coherence of Light, Choon How Gan1, Greg Gbur1, Tao Visser2; Univ. of North Carolina at Charlotte, USA. Free Univ., Netherlands. We demonstrate theoretically that the coherence properties of light may be modulated by surface plasmons in Young’s interference experiment. This is promising for the development of “coherence converting” devices for applications such as coherence tomography.

FTuS4•5:30 p.m.
Theory of Reflection by Volume Gratings and Boundaries: Polarization and Interference Properties, Sergei Mokhov, L. B. Glebov, V. I. Smirnov, B. Ya Zeldovich; CREOL, College of Optics and Photonics, Univ. of Central Florida, USA. Fresnel and volume-holographic reflections are studied. Hyperbolic arctan of reflection amplitude is shown to be the sum of two contributions: due to impedance and volume-holographic reflections. Mutual interference of Fresnel and volume reflections is revealed.

FTuT•Photonic Crystals and Emission—Continued

FTuT3•5:15 p.m.
Terahertz Modulation-temperature Photonic Crystal Nanocavity Laser, Dirk R. Englund1, Ilya D. Fushman1, Jeleena D. Vuckovic1, Hatice F. Altug2; Stanford Univ., USA. We demonstrate a photonic crystal cavity laser with near-microwatt threshold and employing a surface-passivated InGaAs quantum well. The laser operates at room temperature and produces pulses with FWHM shorter than 3 ps (detector response limited).

FTuT4•5:30 p.m.
Linear and Nonlinear Localization of Light in Light-Induced Lattices, Zhouguo Chen1, Xiaoheng Wang2, Jianke Yang1; San Francisco State Univ., USA. We provide a brief overview of our recent work on linear and nonlinear localization of light in optically-induced photonic structures, including nonlinear self-trapping of discrete solitons and photonic bandgap guidance in lattices with structured defects.

FTuU•Nonlinear Microscopy in Biology II—Continued

FTuU3•5:15 p.m.
Two-Photon Fluorescence and Second-Harmonic Generation Microscopy for Minimally Invasive in vivo Imaging at the Cellular Scale, Mark Schmidt; Stanford Univ., USA. The combination of micro- and fiber-optics enables minimally invasive nonlinear optical imaging in live subjects by microendoscopy. I will describe the development and application of two-photon excited fluorescence and second-harmonic generation microendoscopy in the mammalian nervous system.

FTuU4•5:45 p.m.
A Miniature Microscope for Two-Photon Imaging and Femtosecond Laser Surgery, Christopher Hoy1, Nicholas Druyt2, Pengyu Shen2, Hyejoon Ra1, Wilbood Piyawattanameh2, Olav Solgaard2, Adele Ben-Yakar1; Univ. of Texas at Austin, USA. We present a miniaturized two-photon microscope system employing air-core photonic crystal fiber and a resonantly-driven two-axis MEMS scanning mirror for simultaneous cellular imaging and femtosecond laser microsurgery. We will present design analysis and performance characterization.
FTuV • General Optical Design and Instrumentation I—Continued

FTuV3 • 5:15 p.m.
Laser Projection Systems Design: Speckle Simulation Approaches, Nikolai I. Petrov; Unaffiliated, Russian Federation. The speckle patterns caused by different optical elements in laser projection systems are analyzed, methods for speckle reduction are proposed. Effects of partial coherence of light source and surface roughness of optical elements are considered.

FTuV4 • 5:30 p.m.
Interference Design of Diffractive Element for Resonant Scanner Angular Correction, Bahareh Haji-saeedi, John Kierstead, Jed Khoury, Charles L. Wood; Solid State Scientific Corp., USA; AFRL, Sensors Directorate, Hanscom Air Force Base, USA. This paper proposes an optical corrective element with zooming capability for converting nonlinear sinusoidal scanning to linear scanning. The design methodology is based on the classical equation for diffraction gratings.

FTuV5 • 5:45 p.m.
Principal Curvature Measurements: Towards Wavefront Optical Testing with Next Level Accuracy, Weiyao Zou, Jannick Rolland; College of Optics and Photonics, CREOL and FPCE, Univ. of Central Florida, USA. We demonstrate in this paper how the local wavefront principal curvatures and directions may be obtained with a Differential Shack Hartman (DSH) sensor.

FTuV • Precision Techniques on Short Time Scales II—Continued

LTu4 • 5:15 p.m.
Time-Domain Analysis of the Dipole-Dipole Interaction between Rubidium Atoms, Yan Xiao, Brian J. Riccomi, J. Gary Edens; Lab for Optical Physics and Engineering, Dept. of Electrical and Computer Engineering, Univ. of Illinois, USA. Rubidium atomic wavepackets are analyzed in the frequency domain to show a shift of the quantum beating from two rubidium atoms. Temporal analysis confirms this shift, which is attributed to dipole-dipole interactions between atoms.

LTu5 • 5:30 p.m.
Intracavity Phase Measurement Using Compact Mode-Locked All Solid-State Laser, Yule Zhang, Jean-Claude Diels; Ctr. for High Technology Materials, Univ. of New Mexico, USA. We generate two pulses in the Nd:Vanadate laser by using MQWs as the saturable absorber. The phase shifts of the two pulses caused by the electro optical modulation are measured through the beat frequency.

LTu3 • 5:30 p.m. Invited
Inter-Satellite Laser Mapping of the Gravitational Field of the Earth, Michelle Stephens1, James Leitch1, Robert Pierce1, R. Steve Nerem2, Peter Bender2, Michael Y. Osol, Nathan Hammer, Todd Emrick; Univ. of Massachusetts at Amherst, USA. Mapping of changes in the Earth’s gravity field from space can be improved by using laser ranging between two spacecraft. An interferometric laser ranging system that has been partially developed and tested will be described.

LTu2 • Laser-Based Space Missions—Continued

LTuK • Laser-Based Space Missions—Non-Biological II—Continued

LTuL • Imaging and Microscopy

OTuD • Materials and Devices for OLEDs II—Continued

OTuD3 • 5:30 p.m.
High Performance Organic Light-Emitting Diodes (OLEDs) with Molybdenum Oxide (MoOx) as the Buffer Layer, Zheng Chen, Zhenbo Deng, Denghui Xu, Chunjun Liang, Xiufang Li, Kai Zhao; Key Lab of Luminescence and Optical Information, Beijing Jiaotong Univ., China. An ultrathin molybdenum oxide (MoOx) layer was introduced into OLEDs as hole-injection buffer layer. The turn-on voltage of the device decreased from 3.8V to 2.8V and the maximum luminescence value increased from 6300cd/m² to 11000cd/m².

OTuD4 • 5:45 p.m.
Carrier Trapping: A Nature of High Device Efficiency of Phosphorescent Metal Complexes for Light-Emitting Diodes, Yuguang Ma; Jilin Univ., China. Our investigations for the electro-phosphorescent devices demonstrate that charge trapping-induced direct recombination on the phosphorescent metal complexes is the nature of very high device efficiency as these type of materials used for light-emitting diodes.
**Empire**

**Frontiers in Optics**

**FTuQ • Ultrafast Science: X-Rays and Accelerators—Continued**

**FTuQ5 • 6:00 p.m.**

*Invited*

Ultrafast X-Ray Measurements of Coherent Atomic-Motion and Bond Softening in Bismuth, David A. Reis; Univ. of Michigan, USA. We measure ultrafast dynamics of coherent atomic-motion and impulsive softening of the interatomic forces of photo-excited bismuth. Femtosecond and picometer resolution was achieved with random sampling of x rays from the Subpicosecond Pulse Source.

**FTuS • Coherence and Polarization III—Continued**

**FTuS5 • 6:00 p.m.**

High-Resolution Integrated Image Sensor with Polymer Micropolarization Array, Viktor Graue, Alessandro Ortu, Zheng Yang, Jan Van der Spiegel, Nader Engheta; Univ. of Pennsylvania, USA. A novel image sensor for high-resolution polarization imaging is presented. The image sensor combines polymer polarization filters with CMOS imaging technology in order to extract the first three Stokes parameters at the focal plane.

**FTuT • Photonic Crystals and Emission—Continued**

**FTuT5 • 6:00 p.m.**

Intense and Directional Emission from Three-Dimensional Photonic Crystal, Heeso Noh, Michael Scharrer, Hui Cao, Robert P. H. Chang; Northwestern Univ., USA. We observe intense and directional photoluminescence from the ZnO inverse opal. It originates from the stationary inflection point of high-order band structure, which enhances the density of states and coupling efficiency.

**FTuU • Nonlinear Microscopy in Biology II—Continued**

**FTuUS • 6:00 p.m.**

Ultrashort Pulse Excitation for Nonlinear Optical Microscopy, Abin T. Yeh, Adam M. Larson, Chao Wang, Kenneth E. Meisner; Dept. of Biomedical Engineering, Texas A&M Univ., USA. Two-photon absorption is characterized as a function of pulse duration for molecular systems. Enhancement in fluorescence intensity is observed for shorter pulses and depends on the relative spectral widths of two-photon absorption and pulse bandwidth.

**FTuU5 • 6:00 p.m.**

Ultrashort Pulse Excitation for Nonlinear Optical Microscopy, Abin T. Yeh, Adam M. Larson, Chao Wang, Kenneth E. Meisner; Dept. of Biomedical Engineering, Texas A&M Univ., USA. Two-photon absorption is characterized as a function of pulse duration for molecular systems. Enhancement in fluorescence intensity is observed for shorter pulses and depends on the relative spectral widths of two-photon absorption and pulse bandwidth.

**FTuU6 • 6:15 p.m.**

Multi-Photon Microscopy in Biological Tissue with Ultrashort Shaped Pulses, Peng Xi, Yair Andegeko, Lindsay R. Weissel, Bingwei Xu, John Pote, Rebekah M. Martin, Marcos Dantus; Michigan State Univ., USA. Multi-photon imaging with ultrashort (~10 fs) pulses has been limited by phase distortions introduced by microscope objectives. Here we present a number of advantages in biomedical imaging gained by phase-corrected and phase shaped femtosecond pulses.

**Valley**

6:30 p.m.–7:00 p.m., Division of Laser Science Annual Business Meeting, Fairmont Hotel, Fairfield Room

6:30 p.m.–8:00 p.m., OSA Member Reception, Sainte Claire Hotel, Ballroom

7:30 p.m.–10:00 p.m., Laser Science Banquet, Gordon Biersch Brewery, 33 E. San Fernando St.*

*Tickets must be purchased in advance. See Special Events section for more information.
Intracavity Mode Selection with Conical-Shaped Mirror, Boris Spektor, Yurij Parkhomenko, Joseph Shamir; Israel Inst. of Technology, Israel. This work extends to two dimensions an earlier work, where laser beam structuring was obtained in one dimension. The new model considers cylindrical symmetry where one resonator reflector is replaced by a conical-shaped mirror.

Invited CALIPSO: Polarization Performance of a Space-Based, Backscatter LIDAR, Paula Wamsley1, C. S. Weimer1, J. J. Applegate1, Bill Hunt1; Ball Aerospace and Technologies Corp., USA, 1NASA Langley Res. Ctr., USA. The CALIPSO satellite has completed nearly a year of on-orbit operation. This paper discusses development and on-orbit performance of the dual-wavelength, polarization sensitive LIDAR developed for NASA by prime contractor Ball Aerospace and Technologies Corp.

Effects of Aggregation on the Emission of PPV Oligomers, G. A. Sherwood1, R. Cheng1, T. M. Smith2, J. Wildeman3, D. J. Yaron1, Linda Peteanu1; 1Carnegie Mellon Univ., USA, 2Univ. of Richmond, USA, 3Univ. of Groningen, Netherlands. We present studies of MEH-PPV oligomer aggregates exhibiting highly structured emission at the single aggregate level. Trends in emission intensity and Franck-Condon structure with chain length and size are modeled to understand the inter-molecular interactions.

Ambipolar Transporting Naphtho[2,3-c][1,2,5]thiadiazole Derivatives for Non-Doped Red-Emitting OLEDs, Yong Qiu1, Ruiping Gao2,1; 1Tsinghua Univ., China, 2Natl. Natural Science Foundation of China, China. We reported a new type of red-emitting materials based on naphtho[2,3-c][1,2,5]thiadiazole (NTD). These materials not only showed high photoluminescent efficiency but also showed ambipolar charge transporting properties. Non-doped, pure-red OLEDs were prepared by using NTD derivatives.

6:30 p.m.–7:00 p.m., Division of Laser Science Annual Business Meeting, Fairmont Hotel, Fairfield Room

6:30 p.m.–8:00 p.m., OSA Member Reception, Sainte Claire Hotel, Ballroom

7:30 p.m.–10:00 p.m., Laser Science Banquet, Gordon Biersch Brewery, 33 E. San Fernando St.*
<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>8:00 a.m.--10:00 a.m.</td>
<td><strong>FWA • Ultrafast Dynamics of Biological and Chemical Systems I</strong></td>
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<td>Koichi Yamakawa; Advanced Photon Res. Ctr., Japan, Presider</td>
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<tr>
<td>FWA1 • 8:00 a.m.</td>
<td><strong>Invited</strong> Development of a Light-Driven Paradigm for Time-Resolved Investigations of Enzyme Mechanism: B_{12} Dependent Glutamate Mutase, Roseanne J. Sension; Univ. of Michigan, USA. Optical spectroscopies with time-resolution extending over 6 decades in time (10 fs to 10 ns) are used to investigate B_{12} cofactors in solution and bound to the AdoCbl dependent enzyme glutamate mutase.</td>
</tr>
<tr>
<td>FWA2 • 8:30 a.m.</td>
<td><strong>Invited</strong> Ultrafast Gigantic Photo-Response in Organic Salt (EDO-TTF):PF, Initiated by 20-fs Laser Pulses, Iiro Itatani, Matteo Rivi, Andrea Cavalleri, Ken Onda, Tadahiko Ishikawa, Shin-ya Koshihara, Hideki Yamochi, Guinti Saito, Robert W. Schoenlein; Lawrence Berkeley Natl. Lab, USA; ‘Univ. of Oxford, UK, ‘Tokyo Inst. of Technology, Japan, ‘Kyoto Univ., Japan. The early dynamics of a photo-induced phase transition in the charge-ordered organic salt (EDO-TTF):PF, was investigated with 10-fs resolution. The gigantic photo-response (</td>
</tr>
<tr>
<td>FWA3 • 8:50 a.m.</td>
<td><strong>Invited</strong> Short-Length, High-Power Multi-Core Coherently Coupled Fiber Lasers, Nasser Peyghambarian, L. Li, V. T. Lemyanova, H. Li, J. V. Moloney, P. Polynkivi, J. Albert, A. Schulzgen; ‘Univ. of Arizona, USA, ‘Carlton Univ., Canada. An all-fiber approach is utilized to phase lock and select the in-phase supermode of compact 19- and 37-core fiber lasers that are a few cm long, aligning-free in operation, and environmentally robust.</td>
</tr>
<tr>
<td>FWA4 • 9:15 a.m.</td>
<td><strong>Invited</strong> A Counter-Propagating Cascaded Raman Fiber Amplifier Pulsed Pumped with a 1.06 μm Source, Carl Farrell, Christophe Codemard, Johan Nilsson; Optoelectronics Res. Ctr., Univ. of Southampton, UK. We report gain and noise measurements for a pulsed pump cascaded Raman fiber amplifier with a counter-propagating signal. Gain is measured as high as the 7th order Stokes for different pulse duty cycles.</td>
</tr>
<tr>
<td>FWA5 • 9:30 a.m.</td>
<td><strong>Invited</strong> Optical Double Negative Metamaterial at 813 nm, Uday K. Chettiar, Alexander V. Kildishev, Hsing-Kuan Yuan, Weihuan Cai, Shumin Xiao, Vladimir P. Drachev, Vladimir M. Shalaev; Purdue Univ., USA. A negative index metamaterial demonstrating n~ -1.0 + 0.8i with both negative effective permittivity and permeability at 813 nm of linearly polarized light, is fabricated. It also exhibits a negative refractive index (n = -0.7 + 1.3i) at 772 nm for orthogonal polarization.</td>
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<td>8:00 a.m.–10:00 a.m.</td>
<td><strong>FWB • High Power Fiber Lasers and Amplifiers</strong></td>
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<td>Martin Fermann; IMRA America, Inc., USA, Presider</td>
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<tr>
<td>FWB1 • 8:00 a.m.</td>
<td><strong>Invited</strong> Short-Length, High-Power Multi-Core Coherently Coupled Fiber Lasers, Nasser Peyghambarian, L. Li, V. T. Lemyanova, H. Li, J. V. Moloney, P. Polynkivi, J. Albert, A. Schulzgen; ‘Univ. of Arizona, USA, ‘Carlton Univ., Canada. An all-fiber approach is utilized to phase lock and select the in-phase supermode of compact 19- and 37-core fiber lasers that are a few cm long, aligning-free in operation, and environmentally robust.</td>
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<td>FWB2 • 8:30 a.m.</td>
<td><strong>Invited</strong> A Counter-Propagating Cascaded Raman Fiber Amplifier Pulsed Pumped with a 1.06 μm Source, Carl Farrell, Christophe Codemard, Johan Nilsson; Optoelectronics Res. Ctr., Univ. of Southampton, UK. We report gain and noise measurements for a pulsed pump cascaded Raman fiber amplifier with a counter-propagating signal. Gain is measured as high as the 7th order Stokes for different pulse duty cycles.</td>
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<td><strong>Invited</strong> Optical Double Negative Metamaterial at 813 nm, Uday K. Chettiar, Alexander V. Kildishev, Hsing-Kuan Yuan, Weihuan Cai, Shumin Xiao, Vladimir P. Drachev, Vladimir M. Shalaev; Purdue Univ., USA. A negative index metamaterial demonstrating n~ -1.0 + 0.8i with both negative effective permittivity and permeability at 813 nm of linearly polarized light, is fabricated. It also exhibits a negative refractive index (n = -0.7 + 1.3i) at 772 nm for orthogonal polarization.</td>
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<td>8:00 a.m.–10:00 a.m.</td>
<td><strong>FWC • Complex Light Fields</strong></td>
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<td>Presider to Be Announced</td>
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<tr>
<td>FWC1 • 8:00 a.m.</td>
<td><strong>Invited</strong> Arbitrary 2-D Pattern Formation Beyond the Rayleigh Limit: Scani J. Bentley; Adelphi Univ., USA. A relatively simple new technique to generate arbitrary two-dimensional patterns in a multi-photon absorber with resolution exceeding the Rayleigh limit has been developed. This four-beam interference technique could greatly extend photolithography capabilities.</td>
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<tr>
<td>FWC2 • 8:15 a.m.</td>
<td>Analysis and Generation of Spatiotemporal Bessel Beams, Michael Dallaire, Michel Péich, Nathalie McCarthy; Ctr. d’Optique, Photonique et Laser (COPL), Univ. Laval, Canada. We describe theoretically and experimentally quasi-invariant wave packets characterized by a spatiotemporal Bessel function profile. These beams can propagate in an anomalous dispersion media, such that diffraction and dispersion compensate each other.</td>
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<tr>
<td>FWC3 • 8:30 a.m.</td>
<td>Huge Deformations of Laguerre-Gaussian Beams Reflected and Refracted at a Dielectric Interface, Hiroshi Okuda, Hiroyuki Sasada; Keio Univ., Japan. We observe intensity distributions of the reflected and refracted Laguerre-Gaussian beams near the critical incidence. Their transverse deformations were evident with the naked eye and agree well with those calculated using angular spectrum analysis.</td>
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<tr>
<td>8:00 a.m.–10:00 a.m.</td>
<td><strong>FWD • Metamaterials I</strong></td>
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<td>Nader Engheta; Univ. of Pennsylvania, USA, Presider</td>
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<tr>
<td>FWD1 • 8:00 a.m.</td>
<td>Stacked 3-D Metamaterials in the Optical Wave- length Range, Harold Giessen; Univ. Stuttgart, Germany. We manufactured vertically aligned stacked 4-layer split-ring metamaterials using a planarization technique. We measured the optical properties of these 3-D metamaterials in the near infrared. Plasmon hybridization is used to explain the optical spectra.</td>
</tr>
<tr>
<td>FWD2 • 8:30 a.m.</td>
<td><strong>Invited</strong> Optical Double Negative Metamaterial at 813 nm, Uday K. Chettiar, Alexander V. Kildishev, Hsing-Kuan Yuan, Weihuan Cai, Shumin Xiao, Vladimir P. Drachev, Vladimir M. Shalaev; Purdue Univ., USA. A negative index metamaterial demonstrating n~ -1.0 + 0.8i with both negative effective permittivity and permeability at 813 nm of linearly polarized light, is fabricated. It also exhibits a negative refractive index (n = -0.7 + 1.3i) at 772 nm for orthogonal polarization.</td>
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<tr>
<td>8:00 a.m.–10:00 a.m.</td>
<td><strong>FWE • Clinical and Preclinical Imaging and Therapeutics</strong></td>
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<td>Adam M. Zysk; Univ. of Illinois at Urbana-Champaign, USA, Presider</td>
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<tr>
<td>FWE1 • 8:00 a.m.</td>
<td>Molecular Response and Imaging-Based Combination Strategies for Optimal PDT, Tanya Popov; Massachusetts General Hospital, USA. Optical imaging is an increasingly useful tool in biomedical studies, in the investigations of cell biology mechanisms and in the detection and diagnosis of disease. An overview of studies from different laboratories will be presented.</td>
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<tr>
<td>FWE2 • 8:30 a.m.</td>
<td>In vivo Estimation of Total Hemoglobin Content and Hemoglobin Saturation in the Detection of Cervical Epithelial Pre-Cancers, Virile Tuan-Chyan Chang, Peter S. Cartwright; Nirmala Ramanujam; Duke Univ., USA. Total hemoglobin concentration, hemoglobin saturation and scattering coefficient were extracted from cervical diffuse reflectance spectra (400-600 nm) using a Monte Carlo-based model. Total hemoglobin was shown to distinguish pre-cancers from normal tissues (p &lt; 0.05).</td>
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8:00 a.m.–10:00 a.m.  
FWF • Light-Confining Micro- and Nano-Structures  
Presider to Be Announced

FWF1 • 8:00 a.m.  
Invited  
Light Confining Silicon Photonic Structures for Enhanced Nonlinearities, Michal Lipson; Cornell Univ., USA. No abstract available.

LWA • Cavity Ringdown Spectroscopy I  
Put Vaccaro; Yale Univ., USA, Presider

FWF2 • 8:30 a.m.  
Invited  
Recent Advances in Highly Nonlinear Microstructured Optical Fibers, David Richardson, F. Poletti, M. L. V. Tse, P. Horak, N. G. R. Broderick, J. Y. Leong, X. Feng, K. Frampton, W. H. Loh, S. Asimakis, P. Petropoulos; Univ. of Southampton, UK. Microstructured fiber technology offers the prospects of fibers with unique nonlinear and dispersive properties. We review the latest developments in the field and progress towards various application optimized fiber types.

LWA1 • 8:15 a.m.  
Invited  
Development of a cw Cavity Enhanced Instrument for Simultaneous Detection of Multiple Trace Species, Frank Keutsch, E. J. Mayer, B. S. Sayer, E. F. Hamiscer, L. Lapison, N. Allen, J. H. Krofl, J. G. Anderson; Univ. of Wisconsin at Madison, USA, Harvard Univ., USA. An instrument for simultaneous measurement of atmospheric water isotopes using cavity enhanced absorption spectroscopy has been developed. High precision and accuracy measurements (HDO <0.1 ppbv) were achieved by improved cavity design and data fitting algorithms.

LWA1 • 8:00 a.m.  
Invited  
Quantum Theory of Cavity-Assisted Cantilever Cooling, Florian Marquardt, J. P. Chen, A. A. Clerk, S. M. Girvin; Ludwig-Maximilians-Univ. Munich, Germany, Dept. of Physics, Cornell Univ., USA, Dept. of Physics, McGill Univ., Canada, Dept. of Physics, Yale Univ., USA. We present the quantum theory of optomechanical cooling, for a cantilever coupled to an optical cavity. The cantilever’s ground state may be reached if the mechanical frequency is larger than the cavity decay rate.

JWA • Radiation Pressure, Cooling and Quantum Cantilevers I  
Roman Schnabel; Leibnitz Univ. Hannover, Germany, Presider

JWA1 • 8:00 a.m.  
Invited  
Laser Cooling Micromechanical Structures with High-Finesse Optical Cavities, Jack Harris, J. D. Thompson, B. M. Zwickl, A. M. Jayich; Yale Univ., USA. We have realized a high-finesse optical cavity which incorporates a micromechanical cantilever. This cantilever’s response to radiation pressure can lead to optical nonlinearity, laser cooling, squeezing, and other quantum optical effects.

LWB • Time-Resolved Photoemission, Photoionization and Photodetachment I  
R J Dwayne Miller; Univ. of Toronto, Canada, Presider

LWB1 • 8:30 a.m.  
Invited  
Time-Resolved Photoelectron Spectroscopy of Clusters, Daniel M. Neumark; Univ. of California at Berkeley, USA. Time-resolved photoelectron-based techniques with femtosecond and attosecond resolution will be used to probe dynamics in clusters.

JWA2 • 8:30 a.m.  
Invited  
Carrier Transport Properties in Organic Phosphorescent Emissive Layer and Their Application to Efficient Organic Phosphorescent Devices, Changhee Lee, Heune-il Bae, Byung Doo Chun; Seoul Natl. Univ., Republic of Korea, Korea Inst. of Science and Technology, Republic of Korea. We studied electrical properties of OLEDs consisting of the emission layer doped with phosphorescent molecules. Different doping profile is necessary for better efficiency and lifetime due to different conduction properties of Ir(ppy)_3 and IrJr(acac)-doped CBP.

8:30 a.m.–12:00 p.m. SWA • Joint FiO/LS Symposium: Optics and the Second “Magic Decade” of Quantum Mechanics, Fairmont Hotel, Belevedere Room  
Joseph Eberly; Univ. of Rochester, USA, Symposium Organizer  
See Page 14.
Femtosecond spectroscopy reveals a picosecond quenching of the fluorescence and switches the conformation of the Major Radiation Product in DNA, determined the fate of singlet-excited states in DNA and its major photodimer product is fully formed ~1 picosecond after ultraviolet excitation.

Electromagnetic Momentum in a Dielectric, Michael E. Crenshaw, Thomas B. Bahader; US Army RDECOM, USA. A new momentum of the electromagnetic field in a dielectric is derived directly from the Fresnel relations. The new momentum is linear in the electric field and we compare it with other momentum-like electromagnetic quantities.

Electromagnetic Modified Bessel-Gauss Beams and Waves, S. R. Sehahdra; Unaffiliated, USA. By cylindrically symmetric transverse magnetic modified Bessel-Gauss beams and waves are treated. The rate of spreading of these waves on propagation reduces and approaches that of the Bessel waves as the beam shape parameter is increased.

Diffusion Approximation for Disordered Photonic Crystals, Lev I. Deych, Mikhail Erementchouk; State Univ. of New York at Buffalo, USA. An imaging polarimeter capable of measuring a complete Mueller matrix of the retina has been designed, built, calibrated, validated, and used on human subjects. Retardance, diattenuation, and depolarization images of normal retinas are presented. Analytical, numerical and experimental results reveal that coupling strength can be substantially reduced by choosing the proper configuration.

Fields with Maximum Focal Irradiance, Nicole J. Moore, Miguel A. Alonso, Colin J. R. Sheppard; ‘Univ. of Rochester, USA, ‘Natl. Univ. of Singapore, Singapore. Upper bounds on the focal irradiance of monochromatic fields (both scalar and electromagnetic), given their input power and directional spread, are found analytically. The fields that achieve these bounds are also calculated.

Diffusion Approximation for Disordered Photonic Crystals, Lev I. Deych, Mikhail Erementchouk, Alexander A. Lisyansky; 1Univ. of Illinois at Urbana-Champaign, USA, 2Pennsylvania State Univ., USA. We developed a theoretical framework for description of diffusive radiative transport in disordered photonic crystals. We define an inhomogeneous equilibrium distribution of light intensity inside photonic crystals and derive the static limit of diffusion equation.
### Laser Science

**LWA • Cavity Ringdown Spectroscopy I—Continued**

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<tr>
<td>8:45 a.m.</td>
<td>Invited Cavity Enhanced Spectroscopy with Novel Near- and Mid-Infrared Laser Sources, J. B. Paul, Jim Scherer; NovaWave Technologies, USA. Recent advances in cavity enhanced spectroscopy are presented, including results obtained with a rapidly scanned fiber laser at 1 micron, results at 2.23 microns using diode lasers, and results at 3.3 microns using difference-frequency generation.</td>
<td>Hillsborough</td>
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</table>

**LWA2 • 9:00 a.m. Invited Sub-Kelvin Optical Cooling of a Micro-mechanical Resonator, Dirk Bouwmeester; Univ. of California at Santa Barbara, USA. Using radiation forces, we demonstrate cooling of the vibrational mode of a micro-mechanical resonator made to support a tiny mirror of a resonator. Optical cooling to $135 \pm 15 \text{ mK}$ from room temperature is demonstrated.**

**LWA3 • 9:15 a.m. Invited Recent Advances in Cavity Enhanced Spectroscopy, Kevin K. Lehmann, Paul Johnston; Univ. of Virginia, USA. Broad bandwidth cavity enhanced spectroscopy provides a way to measure a wide absorption spectrum in parallel with very high sensitivity. Recent work, by use and other, in the field will be reviewed.**

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### Laser Science

**LWB • Time-Resolved Photoemission, Photoionization and Photodetachment I—Continued**

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<th>Time</th>
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<th>Location</th>
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<tr>
<td>9:00 a.m.</td>
<td>Invited Tracking Photoionization and Photodetachment Processes in Liquid Water, Stephen Bradforth; Univ. of Southern California, USA. Deposition of several eVs of energy into aqueous solutions leads to electron ionization processes from the solute or water. Experiments tracking these processes from their precursor molecular states will be described.</td>
<td>Hillsborough</td>
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</table>

**LWB2 • 9:00 a.m. Invited Sub-Kelvin Optical Cooling of a Micro-mechanical Resonator, Dirk Bouwmeester; Univ. of California at Santa Barbara, USA. Using radiation forces, we demonstrate cooling of the vibrational mode of a micro-mechanical resonator made to support a tiny mirror of a resonator. Optical cooling to $135 \pm 15 \text{ mK}$ from room temperature is demonstrated.**

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### Laser Science

**OWA • Device Physics—Continued**

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<th>Location</th>
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<tr>
<td>9:00 a.m.</td>
<td>Invited Impedance Spectroscopy of Conductively Doped Organic Carrier-Transport Materials, Chung-Chia Chen, Chung-Chih Wu; Graduate Inst. of Electro-Optical Engineering, National Taiwan Univ., Taiwan. We performed the impedance spectroscopy of the F$_2$-TCNQ-doped hole-transport layer. The difference in impedance spectra between undoped and doped materials were examined and the equivalent circuits were established with extracted parameters.</td>
<td>Hillsborough</td>
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### Laser Science

**FWF • Light-Confining Micro- and Nano-Structures—Continued**

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<td>9:00 a.m.</td>
<td>Invited Nonlinear Interactions in Nanowaveguides, Alexander Gaeta; Cornell Univ., USA. We demonstrate that nonlinear optical processes can be greatly enhanced by exploiting the ability to dramatically tailor the dispersion of waveguides whose cross-section is sub-wavelength in scale.</td>
<td>Hillsborough</td>
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**FWF3 • 9:00 a.m. Invited Nonlinear Interactions in Nanowaveguides, Alexander Gaeta; Cornell Univ., USA. We demonstrate that nonlinear optical processes can be greatly enhanced by exploiting the ability to dramatically tailor the dispersion of waveguides whose cross-section is sub-wavelength in scale.**

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### Laser Science

**JWA • Radiation Pressure, Cooling and Quantum Cantilevers I—Continued**

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<td>Invited Sub-Kelvin Optical Cooling of a Micro-mechanical Resonator, Dirk Bouwmeester; Univ. of California at Santa Barbara, USA. Using radiation forces, we demonstrate cooling of the vibrational mode of a micro-mechanical resonator made to support a tiny mirror of a resonator. Optical cooling to $135 \pm 15 \text{ mK}$ from room temperature is demonstrated.</td>
<td>Hillsborough</td>
<td></td>
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</tbody>
</table>
FWA • Ultrafast Dynamics of Biological and Chemical Systems I—Continued

FWA5 • 9:30 a.m. Invited
More Power to X-Rays: From Ultrafast Dynamics of Metal Complexes to Enhanced Damage to DNA, Ting Guo, Joshua D. Carter, Neal N. Cheng, Yongquan Qu, Brian Lee; Univ. of California at Davis, USA. X-ray spectroscopy was used to investigate charge transfer and subsequent events such as structural rearrangement and radical generation in metal complexes including metal nanoparticles. Several new phenomena were observed and the accompanying mechanisms were investigated.

FWB • High Power Fiber Lasers and Amplifiers—Continued

FWB5 • 9:30 a.m.
Noise Figure of Gain Controlled EDFAs with Extended Dynamic Gain Range, Joao B. Rosolem1, Júlio C. R. Oliveira1, Aldário C. Bordonalli 2; 1CPqD - Telecom & IT Solutions, Brazil, 2Univ. of Campinas, Brazil. Noise figure measurements for a newly proposed hybrid gain-controlled EDFAs with extended dynamic gain range were conducted. They showed a performance comparable to that of equivalent (booster, in-line or pre-amplifier) commercial EDFAs without gain control.

FWC • Complex Light Fields—Continued

FWC7 • 9:30 a.m.
Point Spread Function of Optical Systems with Asymmetric Apodization, Komala Ratanaka1, Karuna Sagar Dasari 1, Keshavulu Goud Matta1, Lacha Goud Sivagouni 2; 1Dept. of Physics, Nizam College, Osmania Univ., India, 2Dept. of Physics, Univ. College of Science, Osmania Univ., India. An asymmetric PSF has been obtained with ‘good’ and ‘bad’ sides. The asymmetry has been found to increase with the width of the edge-strips and is seen to decrease with an increased central region apodization.

FWD • Metamaterials I—Continued

FWD6 • 9:30 a.m.
Modeling the Propagation of Optical Beams in Three-Dimensional Photonic Crystals, Majid Badieirostami, Babak Momeni, Ali Adibi; Georgia Tech, USA. We show that the propagation of optical beams inside three-dimensional photonic crystals can be efficiently described by an approximate scalar diffraction model. Using this model, we discuss some unique diffractive phenomena inside the PC structures.

FWE • Clinical and Preclinical Imaging and Therapeutics—Continued

FWE5 • 9:30 a.m.
Invited
Rapid Therapy Evaluation Using Chronic, Wide-Field Optical Imaging of Microvascular Blood Flow Dynamics, Bernard Choi, Wangcun Jia, Jennifer Channual, Kristen M. Kelly, Justin Lotfi; Univ. of California at Irvine, USA. We employ speckle imaging and window chamber models to study vascular remodeling processes after light-based therapies. Our data demonstrate that the response involves substantial remodeling over a monitoring period of up to 30 days post-intervention.

FWB • High Power Fiber Lasers and Amplifiers—Continued

FWB6 • 9:45 a.m.
Laser Transmitter at 518nm for Optical Undersea Communications Using Efficient Nonlinear Conversion of a Picosecond Fiber-Laser System at 1.56µm, Pavel Polyakin1, ’N. Peryshbarnian1, Jerome Moloney2, Rastislav Rousav2, M. M. Fejer2; 1College of Optical Sciences, Univ. of Arizona, USA, 2Edward L. Ginzton Lab, Stanford Univ., USA. Visible laser transmitter for emerging optical undersea communications is reported. The high data-rate, picosecond fiber-laser system at 1.56µm is frequency-tripled into transparency window of seawater in cascade of two PPLN crystals operated at room temperature.

FWC • Complex Light Fields—Continued

FWC8 • 9:45 a.m.
Adaptation to the Edge of Chaos in a Self-Starting Soft-Aperture Kerr-Lens Mode-Locked Laser, Wen-Feng Hsieh, Chih-Chang Hsu, Ja-Hong Lin; Dept. of Photonics, Natl. Chiao Tung Univ., Taiwan. We experimentally and numerically demonstrate that the Kerr coefficient acts as a slow-varying control parameter for self-starting Kerr-lens mode-locking lasers that suppresses the chaotic state after transient relaxation to a stable mode-locking state.

FWD7 • 9:45 a.m.
Spontaneous Decay and Superradiance in a Two-Dimensional Resonance Photonic Crystal, Igor V. Mel’nikov1, Joseph W. Haus2, N. Kriégel3; 1Optolink Ltd., Russian Federation, 2Dept. of Electrical and Computer Engineering, Univ. of Dayton, USA; 3Brock Univ., Canada. The phase synchronization across a 2-D resonance photonic crystal with lateral confinement of the radiation is predicted. This builds up an emission anisotropy and excitation transfer along the Bragg planes along with pronounced excitation localization.

10:00 a.m.–10:30 a.m., Coffee Break, Exhibit Hall (Fairmont Hotel, Imperial Ballroom)

10:00 a.m.–4:00 p.m., Exhibit Hall Open
We introduce a new platform for studying spatial nonlinear effects in periodic photonic structures based on microstructured optical fibers infiltrated with high-index nonlinear liquids. Tunable beam diffraction is demonstrated experimentally in a two-dimensional photonic lattice.

We demonstrate precise measurement of absorption line width made possible with a high-precision wavelength monitor, enabling the determination of species concentration from the line area. We also demonstrate simultaneous measurement of multiple species concentrations.

The coherence lengths of organic light emitting diodes were measured using a Newton’s Ring apparatus. The results show that the coherence lengths are about 3–10 μm depending on the spectral width of the devices.

We report the first observation of surface soliton arrays at the edge of a semi-infinite optically-induced photonic lattice with both self-focusing and self-defocusing nonlinearity. Experimental results are corroborated by numerical simulations.

Analysis of Coherence Length of Organic Light Emitting Diodes, Chih-Hung Tsai1, Yuan-Chien Tien, Hao-Wu Lin, Ming-Chieh Chen; National Taiwan University, Taiwan. The coherence lengths of organic light emitting diodes were measured using a Newton’s Ring apparatus. The results show that the coherence lengths are about 3–10μm depending on the spectral width of the devices.
Invited

FWG • Ultrafast Pulse Measurements I
Franz X. Kärntner; MIT, USA, Presider

10:30 a.m.–12:00 p.m.
FWG • Ultrafast Pulse Measurements I
Franz X. Kärntner; MIT, USA, Presider
Invited

FWG1 • 10:30 a.m.
Measuring Everything You’ve Always Wanted to Know about an Ultrashort Pulse but Thought Couldn’t Be Done, Rick Trebino, Pamela Bowman, Pablo Gabolde; Georgia Tech, USA. We present two techniques for measuring the complete spatio-temporal intensity and phase, E(x,y,z,t), of an ultrashort pulse, one in and near a focus and the other for a single pulse.

FWH • Diffractive Micro- and Nanostructures for Sensing and Information Processing I
Jurgen Jahn; Fern Univ., Germany, Presider

10:30 a.m.–12:00 p.m.
FWH • Diffractive Micro- and Nanostructures for Sensing and Information Processing I
Jurgen Jahn; Fern Univ., Germany, Presider

FWH1 • 10:30 a.m.
Recent Advances in Scanning Holographic Microscopy, Gay Indebetouw; Virginia Tech, USA. The principles of scanning holography are reviewed. Results illustrating the capability of accessing different imaging modes (fluorescence, absorption, quantitative phase) are discussed, as well as the possibilities of synthesizing unconventional point-spread functions.

FWH2 • 11:00 a.m.
Spectral Phase Diagnostic for PETAL Laser: SPIRITED, Jacques Luneau, Claude Rouyer; CEa, France. SPIRITED stands for a high-performance user-friendly concept related to Spectral Phase Interferometry Resolved In Time Extra Dimensional. It helps measure the output temporal shape of femto to picosecond lasers.

FWI • Light Interaction with Engineered Materials
Hai Cao; Northwestern Univ., USA, Presider

10:30 a.m.–12:00 p.m.
FWI • Light Interaction with Engineered Materials
Hai Cao; Northwestern Univ., USA, Presider

FWI1 • 10:30 a.m.
Three-Photon Absorption in Semiconductors, Peter D. Okazaki; Claudia Cirloganu, Scott Webster; Lazaro A. Padilha; Milton Woodall; David J. Hagans; Eric W. Van Stryland; ‘College of Optics and Photonics, CREOL and FPCE, Univ. of Central Florida, USA, ‘DRS InfraRed Technologies, USA. The bandgap and wavelength scaling of three-photon absorption is studied in several semiconductors by the Z-scan technique. The 3PA coefficient is found to vary as Eg−1 as predicted by theory.

FWI2 • 10:45 a.m.
Microscopic Observation of Photodoping Process in Ag/GeS2 film, Tatsuya Sata; Moriki Wakisaki; Yoshifumi Murakami; Northilde Takeyama; Yoshikazu Kanai; ‘Tokai Univ., Japan, ‘Toshiba Univ. of Tech., Japan, ‘Geneva Corp., Japan. The photodoping process of Ag atoms in a Ag/GeS2 double layer film was studied through the microscopic and biopsy needle guidance.

FWJ • Metamaterials II
Paras N. Prasad, Sr.; SUNY at Buffalo, USA, Presider

10:30 a.m.–12:00 p.m.
FWJ • Metamaterials II
Paras N. Prasad, Sr.; SUNY at Buffalo, USA, Presider

FWJ1 • 10:30 a.m.
Progress in Negative Phase Metamaterials, Allan D. Boardman; Neil King; ‘Ortwin Hess; Yuriy Rapoport; ‘Univ. of Salford, UK, ‘Univ. of Surrey, UK, ‘Taras Shevchenko Kyiv Natl. Univ., Ukraine. A review of the state-of-the-art of negative phase metamaterials is presented for which the phase velocity and group velocity form a backward wave mode. The scenarios embraced include loss, gain, solitons and slow light.

FWJ2 • 11:00 a.m.
Examination of Energy and Group Velocities in Positive and Negative Index Chiral Materials with and without Dispersion, Monish R. Chatterjee, Pursha P. Banerjee; ‘College of Optics and Photonics, CREOL and FPCE, Univ. of Central Florida, USA. Concepts of energy and group velocities, Poynting and propagation vectors are examined for both positive and negative index materials. Known definitions for these entities are explored in terms of the interplay of chirality and dispersion.

FWK • Optical Coherence Tomography
Paras N. Prasad, Sr.; SUNY at Buffalo, USA, Presider

10:30 a.m.–12:00 p.m.
FWK • Optical Coherence Tomography
Paras N. Prasad, Sr.; SUNY at Buffalo, USA, Presider

FWK1 • 10:30 a.m.
Intraoperative Optical Biopsy of Breast Cancer, Adam M. Zysk, Stephen A. Boppart; Beckman Inst., Univ. of Illinois at Urbana-Champaign, USA. Optical coherence tomography (OCT) of breast tissue yields high-resolution optical biopsies that can be used to identify cancerous regions. We present intraoperative OCT studies of surgical margin scanning and biopsy needle guidance.

FWK2 • 11:00 a.m.
Time-Gated Fourier Domain Optical Coherence Tomography, Matthew S. Muller, Paul J. L. Webster, James M. Fraser; Queen’s Univ., Canada. A novel OCT system is presented that combines FDOCT with ultrafast time-gating. By processing backscattered light in the optical domain, the user can select a limited field of view for improved contrast and acquisition speed.

Polarization Resolved Cavity Ring-Down Spectroscopy as a Probe of Intrinsic Optical Anisotropies. Patrick H. Vacara; Yale Univ., USA. The ultrafast technique of Cavity Ring-Down Polarimetry (CRDP) will be discussed, with emphasis placed upon the extraction of molecular chiroptical properties in rarefied environments and the optical measurement of linear retardation with high intrinsic precision.

Opto-Mechanical Modal Spectroscopy of a Micro-Mechanical Oscillator Using Radiation Pressure Induced Dynamical Backaction. A. Schliesser1, N. Nooshi1, P. Del’Haye1, K. Vahala1, Tobias J. Kippenberg1; Max Planck Inst. of Quantum Optics, Germany; Dept. of Applied Physics, Caltech, USA. We demonstrate how dynamical backaction of radiation pressure can be exploited for passive laser-cooling of high-frequency (>50 MHz) mechanical oscillation modes of ultra-high-finesse optical microcavities from room temperature to below 10 K.

Laser-Induced Optical Delay Lines for Diode Laser Cooling of a MHz-Mode Cavity-Dumped Microcavity. Walter Pfeiffer1, Martin Aeschlimann2; Univ. of Bielefeld, Germany, 2Dept. of Applied Physics, Caltech, USA. We show experimentally that optimally polarized femtosecond laser pulses provide spatial control over electron photoemission from nanostructures. Emission patterns are manipulated with subdiffraction resolution, illustrating the potential of electric near-field control in nanophotonics.
FWG • Ultrafast Pulse Measurements I—Continued

FWH • Diffractive Micro- and Nanostructures for Sensing and Information Processing I—Continued

FWI • Light Interaction with Engineered Materials—Continued

FWK • Optical Coherence Tomography—Continued

FWJ • Metamaterials II—Continued

FWI4 • 11:15 a.m.
Observation of Superluminal of Light Propagation in Doped Phthalocyanine with PMMA Glass, Yundong Zhang, Qiuyan Ouyang, Hao Wang, Nan Wang, He Tian, Wei Qiu, Ping Yuan; Harbin Inst. of Technology, China. We observed the superluminal of light propagation by population oscillation technique in doped Phthalocyanine with polypropy methylacrylate (PMMA) glass. The maximum time advancement was 10.43ms, corresponding group velocity was -0.19m/s.

FWI5 • 11:30 a.m.
Enhanced Bandwidth Optical Parametric Amplifier Using Bragg Reflection Waveguide, Rintwick Das, Krishna Thyagarajan; Indian Inst. of Technology, Delhi, India. A novel design for optical parametric amplification using quasi-phase matching in Bragg reflection waveguide is proposed. The unique dispersion characteristics exhibited by Bragg reflection waveguides are exploited for enhancing the bandwidth with appreciable efficiency.

FWJ3 • 11:15 a.m.
Metal-Dielectric Composites with Dissipative and Active Components, Sergey Sukhov1, Sergey Matisev2, Aristide Dogariu1; 1College of Optics and Photonics, CREOL, Univ. of Central Florida, USA, 2Inst. of Radio Engineering and Electronics of RAS, Russian Federation. We consider optical properties of metal-dielectric composites with active laser medium as one of components. Using exact electrodynamical calculations, we investigate the behavior of amplification coefficient necessary to compensate the absorption at metallic inclusions.

FWJ4 • 11:30 a.m.
Compensating Losses in Doped Negative-Index Metamaterials via Four-Wave Mixing and Quantum Control, Alexander K. Popov1, Sergey A. Apfel2,3, Vitalii N. Gavanen4,5, Sergey Sukhov1; 1Univ. of Texas at Austin, USA, 2M. F. R. N. Amriti, Univ. of Roorkee, India, 3Univ. of Missouri at St. Louis, USA, 4Purdue Univ., USA, 5Russian Federation. We consider optical properties of the research is to develop integrated optofluidic microsystems which combine the microfluidic channels and parts of the optical functionality.

FWJ5 • 11:45 a.m.
Elongation of the Surface Plasmon Polariton Propagation Length without Gain, C. Zhou, M. F. Mao1, V. A. Podobiynik1, V. I. Gavrilenko1, M. A. Noginov2, 1Norfolk State Univ., USA, 2Oregon State Univ., USA. We have demonstrated that the presence of dye in an adjacent dielectric can elongate the propagation length of a surface plasmon polariton even without optical gain.

FWK3 • 11:15 a.m.
Evaluation of Blood Vessel Mimic Development with Optical Coherence Tomography, Garrett T. Buonemmi, Kristen G. Cardinal, Stuart K. Williams, Jennifer K. Barton; Univ. of Arizona, USA. An endoscope for optical coherence tomography was developed to acquire cross-sectional images of tissue engineered blood vessels. This device was used to examine how the scaffold material affects the development of the cellular lining.

FWK4 • 11:30 a.m.
Full Range Complex Ultrahigh Resolution Fourier Domain Optical Coherence Tomography, Prabakar Pananathanas, Kostadinka K. Bichara; Dept. of Physics and Astronomy, Univ. of Waterloo, Canada. A full-range ultrahigh resolution Fourier domain optical coherence tomography system based on fiberoptic frequency shutters, with axial resolution of 1.6 µm and dynamic range of 117dB is presented and used to image in-vivo biological tissue.

FWK5 • 11:45 a.m.
Mid-Infrared Spectroscopic Optical Coherence Tomography, Kazuhito Geoha, Ichiroh Ushinari, Kazuya Yamamoto, Masahiro Kondo, Takaki Harada; Kagawa Univ., Japan. We describe spectroscopic optical coherence tomography in the mid-infrared region as a method for separating and analyzing biological molecules. Such auto-correlation interferometry is capable of obtaining broadband spectra using low spatial coherence light.
Low-Density Permutation Codes for Optical and Digital Holographic Data Storage, Sergei S. Orlov¹, Kirill V. Stuchly², Hongtao Liu¹, Snehal L. Akbari²; ¹Stanford Univ., USA, ²NASA JPL, USA, ³Illinois Inst. of Technology, USA. We present new class of modulation codes based on permutation coding which satisfy channel coding constraint suitable for holographic and optical data storage, and simultaneously have strong error correction capability and high code rate efficiency.

In-Line Digital Holographic Microscopy with Improved Phase Reconstruction, Anith Nelleri, Joby Joseph, Kehar Singh; Indian Inst. of Technology, Delhi, India. A plane wave instead of spherical reference wave, and spectral method to avoid quadratic phase sampling are used in the reconstruction process of an in-line digital holographic microscopy. This results in non-erroneous phase reconstruction.

Angular Directivity of Diffracted Wave in Bragg-Mismatched Readout of Volume Holographic Gratings, Alexander Heifetz, John T. Shen, Shih C. Tseng, Gaur S. Patti, Jong-Kwon Lee, Selim M. Shahrar; Northwestern Univ., USA. We investigated angular directivity of a diffracted beam in a shift-invariant holographic correlator. We showed that the experimental results agree well with our theoretical model, while the prediction of coupled wave model is incorrect.
Optical Sciences Posters

JWC1 Optical Fiber Sensor with a Sol-gel Deposited TiO2 Sensing Film for Volatile Organic Compounds Detection, Severino Muñoz-Aguirre, Carlos Martinez-Hiput, José Ramos-Méndez, Juan Castillo-Mitchell, Georgina Beltrán-Pérez, Rodolfo Palominio-Marín; Benemérita Univ. Autonoma de Puebla, Mexico. An optical-fiber gas sensor was developed depositing a TiO2 film doped with organic dye by sol-gel. The light intensity change by interaction with volatile organic compounds (VOC) was measured. There are shown results for ethanol detection.

JWC2 Series of Corrections to Far-Field Estimates, Miguel A. Alonso, Ricardo Borgoh, 1Universit de Rech-ester, USA, 2Univ. Roma Tre, Italy. The complete series of corrections to far-field estimates (e.g. the Fraunhofer formula) is derived for scalar and electromagnetic monochromatic fields in free space. The series’ convergence depends on the smoothness of the angular spectrum.

JWC3 Influence of Process Conditions on the Optical Properties of Thin Films for High Power Laser Coatings, Kuo-Jui Hsiung1, Jose M. Blanco Rodriguez2, Jesse T. Jensen3, Dinoth Patel4, Dave Atley5, Eduardo Guitamado Matei6, Yong Wang7, Jorge J. Bocado8, Carmen S. Menont9, Peter Langtort10, Albert Ogioso11; 1Dept. of Electrical and Computer Engineering, Colorado State Univ., USA, 2Naval Air Warfare Cir., USA. The influence of process conditions on film optical properties is investigated. The results presented describe the light propagation properties at different other refractive indices and thicknesses of layers.

JWC4 Spectroscopic Features of Visible Radiation from Femtosecond Laser Induced Plasma in a Planar Water Microjet, M. Anjum, Raji Philip, Raman Res. Inst., India. Bremstraubhoring radiation, superposed characteristic emissions and spectral blue shifting are observed from femtosecond laser induced plasma in a planar water microjet. Characteristic emissions are not reported previously for aqueous plasmas excited by femtosecond laser.

Regency Ballroom

12:00 p.m.–1:30 p.m.  JWJ • Joint FiO/LS Poster Session II

JWC5 Photodetachment of Tribromocuprate(I) Anion: Observation of Vibrational Wave Packets, Diana M. Sutter, Victor Lenchenkov, Stephen E. Bradforth; Univ. of Southern California, USA. Electron photodetachment of the tribromocuprate(I) anion CuBr32- in water is achieved by ultrafast pump-dispersed-probe spectroscopy resulting in a transient absorption signal containing oscillatory features that correspond to the vibrational frequencies in the détached product.

JWC6 Modification of Directional Emission from a Deformed Microsphere by Surrounding Medium, Scott Lacey, Franklin & Marshall College, USA. Far field emission of a deformed glass microsphere is measured in two surrounding media. Dynamical coupling causes the emission pattern to exhibit qualitative differences where the sphere is immersed in water rather than air.

JWC7 Relevance Thin-Film Filter for Polychromatic Light, Nikolai I. Petrov; Istra, Russian Federation. The frustrated-total-internal-reflection spatial-frequency filtering devices operating in a visible spectral range are designed. Spectral shapes of transmitted light are calculated for different refractive indices and thicknesses of layers.

JWC8 Measurement of Birefringence in Nonlinear Crystals by Interferometry, Hee-Joo Choi, Byung-Joo Kim, Hwan Hong Lim, Myoung-Suk Cho, Poowanie Natl. Univ., Republic of Korea. We present a method to estimate birefringence of water-type materials by using Michelson interferometry. The difference between the ordinary and extraordinary refractive indices of a LiNBO3 wafer was determined with an accuracy of 10−6.

JWC9 Chirped Pulse Adiabatic Passage in CARs, Svetlana A. Malinovskaya; Dept. of Physics and Engineering Physics, Stevens Inst. of Technology, USA. We use adiabatic passage control schemes implementing chirped femtosecond laser pulses to maximize coherence of Raman transitions in CARs. We investigate energy and phase relaxation as factors of quantum decoherence.

JWC10 Optically Corrected Diode Laser for Confocal Scanning Microscope, Dmitry Ruzhenkov, Sugandha Jatunalmi, Yi King Liu; Univ. of Northern California, USA. We propose the use of optically corrected laser diode in the confocal scanning microscope. The resulted beam has no astigmatism and produces a round diffusion limited spot on a sample.

JWC11 Hybrid Ray Optics and Continuum Mechanics Modeling of Cell Deformation in the Optical stretcher, Andrew E. Ekenpoyom, Michael G. Nichol; Crichton Unih, USA. We present a method of modeling cell deformation in the optical stretcher. A hybrid computational method has been developed to quantify the deformation of living cells.

JWC12 Optical Micromanipulation and Force Spectroscopy of Ultrasound Contrast Agent Microbubbles for Targeted Molecular Imaging, Valeria Garbin1, Marlies L. J. Overvelde1, Benjamin Dellet2, Dan Caoe3, Enrico Ferrari4, Enze Di Fabrizio2, Nico de Jong3, Dietel Loft5, Michel Versluis4; 1Univ. of Twente, Netherlands, 2Lab Nazionale TASC, Italy, 3Univ. “Magna Graecia”, Italy. The conventional applications of optical tweezers (micromanipulation, force sensor) can be extended to low-index particles, to understand the dynamics of ultrasound contrast microbubbles for targeted molecular imaging.

JWC13 Speckle-Based Investigation of Light Propagation in Blood/Saline and Water/Water Mixtures, Dan P. Popescu1, Michael G. Sowa1; 1Natl. Res. Council of Canada, Canada, 2Univ. of Saskatchewan, Canada. A weak correlation exists between hematocrit concentration and scattering coefficients obtained by applying various models to optical coherence tomography results. Meanwhile, speckle intensity scales with the hematocrit concentration and can provide complementary information.

JWC14 A Multi-Objective Genetic Approach for Optimal Control of Photo-Induced Processes, Luigi Bonacina1, Jérôme Externmann1, Arianda Rondi1, Véronique Boulouu2, Jean-Pierre Wolf1; Univ. of Geneva, Switzerland, 3LASIM, Univ. of Lyon 1, France. We have applied a multi-objective genetic algorithm to the optimization of multiphoton excited fluorescence. Our study indicates the consistent advantages this method can offer to experiments based on adaptive shaping of femtosecond pulses.

JWC15 Infused Photonic Crystal Fibers for Protein Analysis, Eric J. Page, Jenna Knowles; Univ. of San Diego, USA. Light propagation through photonic crystal fibers infused with protein solutions was investigated. We concentrated on one protein and describe the light propagation properties at different protein concentrations and denatured states.

JWC16 Paper withdrawn.

JWC17 Dual-Wavelength NIR/SWIR Vein Imaging, Herbert D. Zeman, Gunnar Lohvaiden, Soumya Ganesh; Luminetx Corp., USA. The Luminetx VeinView is used to display NIR light to view veins and reduce the visibility of the skin. Skin visibility can be reduced further by combining two images, one with NIR and one with SWIR light.

JWC18 Numerical Simulations of the Chromatic Aberration and the Chromatic Optical Performance of Pseudophakic Eyes, Huimeng Zhao; Advanced Medical Optics, Inc., USA. Numerical simulations of the chromatic aberration and its effects on the optical performance of pseudophakic eyes in white light are presented using chromatic optical path difference equations with spherical aberration correcting aspheric IOLs.

JWC19 Analysis of Human and Chimpanzee Sperm Swimming Speed in Laser Trapping Experiments, James S. Tam, Jacky M. Nascimento, Linda Z. Shi, Michael W. Beres; Univ. of California at San Diego, USA. This study compares the velocity distributions of the sperm subpopulation analyzed in laser trapping experiments with that of the entire sperm population. The distributions are found equal for human sperm, yet unequal for chimpanzee sperm.

JWC20 Visualization of Birefringence in Tissue by Conventional Optical Coherence Tomography, Yingyi Feng1, Zheng Chang2; Beijing Inst. of Petrochemical Technology, Opto-Mechatronics, China, 2Beijing Inst. of Petrochemical Technology, Dept. of Mechanical Engineering, China. Changes of cartilage properties with dehydration, mechanical and chemical actions are presented and analyzed. The layer structures of cartilage tissues on OCT images provides birefringence information resulting primarily from tissues’ linear or fibrous structures.

JWC21 Influence of the Pi-Electrons Distribution on the Magneto-optical Activity Stimulation in Some Aromatic Liquids, Shukrat Egamov; Samarkand State Univ., Uzbekistan. Experimental results of Faraday rotation spectra in a range between 1.8 - 3.65 eV were obtained for H2O, CCl4, dimethylaniline, benzene, nitrobenzene, o-toluol, 4-nitrobenzene, 4-m-chloraniline and o-chloraniline. SCF-MINDO/3 calculations were chosen for evaluations.

JWC22 Fluorescent Tissue Transglutaminase Substrates for Tumor Boundary Imaging, Chia-Pin Pan, Jeanne P. Hauschalter, Khalid Amin, Zishan Hanoom, Gregory W. Faris; SHI Intl., USA. A novel strategy is developed to image tumor boundaries optically by crosslinking fluorescent tissue transglutaminase substrates with tumor tissues.
JWC23
cell tracking by border-optical hybrid model, miguel torres-cisneros, oliver debet, javier Sanchez-Mondragon; univ. de guanajuato, mexico, 3univ. libre bruselas, belgium, 1inaoe, mexico. we propose an hybrid method (image processing and correlation) to obtain cells detection and cells migration tracking in order to analyze cells behaviors under different conditions.

quantum electronics posters

jwc24
all-optical defect and slow light in a superperiodic photonic crystal, igor v. mel'nikov; optnik ltd., russian federation, 4high q labs, inc., canada. an all-optical buildup control over a defect that mediates the light slowing, pinning, retrieval, and fusion is found in a resonance photonic crystal. the departures from the self-induced transparency are found and analyzed.

jwc25
approaches to modeling photonic crystal based structures, ian richter, paweł kwietsien, milan sistor; czech technical univ. in prague, czech republic. photonic crystal based structures are numerically modeled using different approaches. both mode matching and finite difference time domain techniques are applied and compared on several interesting examples of plc-structures, including plc waveguides and cavities.

jwc26
innovative micro-cavity resonator design using particle swarm optimization, jeremiah d. brown, eric j. johnson; 1univ. of central florida, college of optics, usa, 2univ. of north carolina at charlotte, cfr. for optoelectronics, usa. particle swarm optimization is used to design innovative geometries of micro-cavity optical resonators with very high q-factors at desired resonances. the quality factor and resonant frequency of the cavity are evaluated using eigenmode analysis.

jwc27
single layer guided-mode resonance polarizer, kyu j. lee, ronald lacomb, robert magnusson; univ. of connecticut, usa. optical characteristics of an e-beam patterned guided-mode resonance polarizer are presented. parameters of the fabricated device are confirmed by afm. experimental spectral response of the polarizer agrees qualitatively with theory.

jwc28
nonlinear optical properties of cdse using pump-probe x-scan technique, daniel probst, abdulatif y. hamad; southern illinois univ. edwardsville, usa. nonlinear refraction and two photon absorption coefficients of cdse were determined using the newly developed x-scan technique. the experiments were performed using a 1.06μm Nd:YAG laser with pulse duration of 11 ns.

jwc29
synthesis and characterization of ag nanoparticules, miguel torres-cisneros, celso velasquez-ordonez, javier sanchez-mondragon; jesús escobedo alatorre, david may-arrioja, francisco arregui; 1univ. de guanajuato, mexico, 2univ. autonoma del estado de morelos, mexico. we report results of chemical synthesis for silver particles of 2-10 nm size obtained by reduction of ag+. the material morphology was examined by electron microscopy (tem) and physical properties were studied by photoluminescence.

jwc30
beam energy exchange dependence on grating period in bismuth silicate (b1, s20), with optical activity and linear birefringence under strong nonlinear regime, fernando magana, isabel caur, jose murillo, rurik farrias, arturo zaittig; 1inst. de fisica, univ. nacional autonoma de mexico, mexico, 2cfr. de investigacion en materiales avanzados s.c., mexico, 3escuela superior de fisica y matematicas, inst. politecnico nacional, mexico. we calculated the energy exchange in rs0, considering different grating periods, optical activity, birefringence, absorption, polarization angle, nonlinear conditions and high dc fields. large beam energy exchange may occur in spite of absorption.

jwc31
stable propagation of bell shaped and vortex solitons in a quadratic-cubic tandem, erwin marti-panamete, angel vergara betancourt, luz gomez pavon, david iribar castillo; 1bennemeria univ. autonoma de puebla, mexico, 2buap, mexico, 3inst. nacional de astrofisica, optica y electronica, mexico. in this work, applying the numerical experiments, we demonstrate the stable propagation of (2+1)d spatial solitons, as well as vortex solitons with spin 1 and 2 in a cubic-quadratic nonlinear optical tandem.

jwc32
two-photon absorption spectra of selenal dye complexes, uhaldo m. neves, l. de bom, zhihong ye, xia r. bu, cleber r. meridona; 1univ. de são paulo, brazil, 2dept. of chemistry and nasa cfr. for high performance polymers and composites, clark arkansas univ., usa. this work reports the degenrated (2pa) spectrum for a series of selenal complexes possessing two azo dye units. the 2pa properties of these molecules were found to be additive effect of chromophores.

jwc33
pattern-dependence suppression in multi-section soas, claudio crognale, sante saracino; technofab s.p.a., italy, 1siemens s.p.a., italy. we numerically demonstrate how the optical gain pattern-dependence in long saturated soas working far from transparency can be suppressed with a proper management of the optical gain nonlinearities in a cascade of properly biased amplifiers.

jwc34
fiber-optic hysteric quantizer for analog-to-digital conversion, naznin hooqhoogi, sergii c. grunier, azad sahmakoum, rose-hulman inst. of technology, usa. an optical bistable device that exhibits hysteresis behavior is modeled and experimentally demonstrated. this device is based on cross-gain modulation in two coupled semiconductor optical amplifier ring resonators operating in the c-band region.

jwc35
characterization of erbium-doped fiber ring laser that uses polarization controllers, alberto varguez-flures, georgina beltrán-pérez, severino muñoz-aguirre, juan castillo-mexia-us, facultad de ciencias fisico matematicas, buap, mexico. the characterization of an all-fiber laser with different gain medium was performed. the polarization controllers were used to obtain the best emissions. the results showed that the laser emission bandwidth was reduced in 41%.

jwc36
magnetoplasmonic effects in 2-d magnetophotonic crystals, alexander g. zhulanov, a. a. fedyanin, a. v. burylev, a. b. khanikaev, h. uchida, m. inoue; 1m. y. lomonosov moscow state univ., russia; 2tayohashi univ. of technology, japan. magnetophotonic kerr effect in 2-d magnetophotonic crystals (slabs) formed from the array of nickel nanorods is considered. the peculiarities of optical properties have magnetoplasmonic nature. the experimental results are proved by numerical calculations.

jwc37
periodic intensity fluctuations in functionalized semiconductor quantum dots: correlation with ligand coverage, kevin t. early, kevin d. mccarthy, nathan i. hammer, michael y. odoi, ravi tangirala; 1inst. nacional de astrofisica optica y electronica, mexico, 2dept. of chemistry and nasa cfr. for high performance polymers and composites, clark arkansas univ., usa. the fluorescence intensity of functionalized semiconductor quantum dots is correlated with the ligand coverage. the experimental results are presented.

jwc38
guided-mode resonance filters fabricated in uv curable polymers, kyu j. lee, robert magnusson; univ. of connecticut, usa. guided-mode resonance devices fabricated by soft lithography are presented. the fabrication process using an elastomeric mold and uv curable polymers is simple and cost-effective. resonant photopolymer filters at 1550 nm are made and characterized.

jwc39
diffusive coordinate model for blinking suppression and intensity fluctuations in cdse-opv nanocrystals, kevin d. mccarthy, kevin t. early, nathan i. hammer, michael y. odoi, michael d. barnes, todd emrick, ravi tangirala; george m. richason jr. chemistry lab, univ. of massachusetts at amherst, usa; 2dept. of polymer science and engineering, univ. of massachusetts at amherst, usa. we describe here numerical simulation of a modified frantuzov-marcus diffusive coordinate (dc) model [1] which yields blinking suppression and low frequency fluctuations as observed [2] in oligo-(phenylene vinylene) (opv) coated cdse quantum dots.

jwc40
classical and quantum fresnel relations for left handed materials, jagdish ra luthra; univ. of los andes, colombia. fresnel relations are examined for the new class of materials with negative refractive index, also known as left handed materials. interesting new results are presented for bewster’s angle, total internal reflection and the goos-hanchen effect.

jwc41
analytical study of a 1-d metal-alloelectric photonic crystal, alejo molina, j. j. sanchez-mondragon, celso velasquez-ordonez, a. zamudio-luna, p. ojeda-may; 1inst. nacional de astrofisica optica y electronica, mexico, 2univ. autonoma metropolitana-iztapalapa, mexico; 3inst. for res. in engineering and applied sciences, uaeum, mexico, 4univ. kassel, germany. we analytically study a 1-d metal-alloelectric photonic crystal (pc) made out periodic extremely thin metal inlays in a dielectric pc substrate.

jwc42
similarities between the dynamic behavior of a random laser and that of a traditional q-switched laser, xingyu zhang, qingpu wang, jian chang, ping li, shuzhen fan, chen zhang; school of information science and engineering, shandong univ., china. we studied the dynamic characteristics of a random laser made of solution of rh6g dye in ethanol with ti02 microparticles pumped by 532-nm 40-ps pulses and compared them with those of a traditional q-switched laser.
**Vision and Color Posters**

**JWC45**
Adaptation of the Zernike’s Phase-Contrast Method for Retinal Imaging, Eric Logea, Chris Logea; Applied Optics Group, Experimental Physics, Natl. Univ. of Ireland, Galway, Ireland. An illumination suitable for phase imaging of the retina is proposed. Using this geometry we obtained images from glass objects and retinal samples. In situ phase imaging of the retina appears to be feasible.

**JWC46**
Intracamerla Camera for Retinal Prostheses: Design Constraints Based on Visual Psychophysics, Noel R. B. Stiles, Michelle C. Hauer, Pamela Lee, Patrick J. Nasiatka, Jc; Univ. of Southern California, USA. Optical system design constraints for an intraocular camera are determined by visual psychophysics techniques, including pixelation limits adequate for navigation and object identification, optimal pre- and post-pixelation blurring, and the elimination of gridding artifacts.

**JWC47**
Modulations in the Images of Periodic Square-Wave Targets by Human Eye in the Presence of Stiles-Crawford Effect of the First Kind, Sumit Tang1, Nils Fernelius2, Xiaoyi Wang1, Suning Tang1; 1Crystal Res., Inc., USA, 2AFRL, USA. A series of mixed vanadate crystals Nd:Y,Gd1-xVO4 with the same Nd3+ dopant level was investigated. The results revealed general characteristics and trends in laser performance at different Y/Gd ratios and at direct and indirect pumping.

**JWC48**
Laser Assisted Surface Layer Formation On AISI 304 SS With Preplaced Si,N2-Zr,Ni coating was laser treated for topological character modification. Smooth and cracks free surface conditions were observed. Highly hardened phases (1020HV) were found to be uniformly distributed.

**JWC49**
Microring Resonators Using Multiphoton Absorption Polymerization, Linjie Li1, Wei-Yen Chen, Tie-Nan Ding1, Warren Herman1, P-T Ho2; 1Inst. of Opto-Electronic Science and Engineering, Natl. Cheng-Kung Univ., Taiwan, 2John Fourkas1; Univ. of Maryland, USA, ‘Lab for Physical Sciences, USA. We present the fabric- cation of polymer micoring add-drop filters using multiphoton absorption polymerization and present the characterization of these devices.

**JWC50**
Mixed Vanadate Crystals Nd,Y,Gd1-xVO4 with Direct and Indirect Pumping Capabilities, Yuanji Tang1, Nils Fernelius2, Xiaoyi Wang1, Suning Tang1; ‘Crystal Res., Inc., USA, ‘AFRL, USA. We report an optical filter based on interconnects on PC boards. Zengzhong Leng, Vic- tor Yun, Warren N. Herman, Julius Goldhar; Univ. of Maryland at College Park, USA. Techniques for directly dispensing fluorinated polymer waveguides on printed circuit (PC) boards and for fabricating undercut couplers are presented. The dispensed fluorinated polymer waveguides and undercut couplers provide low loss transmission at 1550 nm.

**JWC51**
Intracavity Frequency-Doubled Nd:YAG:BaWO4, Raman Laser Generating Average Output Power of 3.1 W at 590 nm, Xingyu Zhang, Qingpu Wang, Jun Chang, Ping Li, Shutao Li, Zhenhua Cong, Xiaolei Zhang; School of Information Science and Engineering, Shandong Univ., China. We report an all solid state laser generating average output power of 3.1 W at 590 nm. The laser consists of a diode- side-pumped Nd:YAG module, an intracavity BaWO4, Raman crystal a KTP frequency doubling crystal.

**JWC52**
Accuracy of the ATR Method for Electro-Optic Measurement of Polycrystalline Thin Films in Multilayer Structures, Dong Hun Park, Chi H. Lee, Warren N. Herman; Lab for Physical Sciences, Univ. of Maryland, USA. We discuss advantages and ac- curacy of the attenuated total reflection (ATR) method for the measurement of the electro-optic coefficients of polycrystal thin films in multilayer structures containing transparent conduct- ing oxide layers.

**JWC53**
Optical Switching in Benzocyclobutene Microring Lattice, W. Y. Chen, T. N. Ding, W. Cao, S. Y. Tseng, W. N. Herman, P. T. Ho; Lab for Physical Sciences, Univ. of Maryland, USA. We demonstrate optical switching in a polymer lattice with more than 100 benzocyclobutene (BCB) microrings. The nonlinear refractive index n2 of BCB is estimated at 2x10-14 cm2/W.

**JWC54**
Organic Thin Films Posters

**JWC55**
Photo-Formation of Gold Nanoparticles in the Solid Monoliths of Au(III)-Chitosan-Silica Aerogels: Photoacoustic and Electro Micro- nescope Studies, Narayanan Kathirunam1, Adam Deant1, Chee Hua Yeo1, William Risen, Jr.2, ‘College of Charleston, USA, ‘Brown Univ., USA, Effect of 320-nm light on the solid monoliths of Au(III)-chitosan-silica aerogels (Au/NH3=1:5) has been investigated. A slight blue shift of about 7 nm is noticed in the plasmon resonance peak upon in- creasing the exposure duration.

**JWC56**
Dispensed Fluorinated Polymer Waveguides and Laser-Ablated Undercut Couplers for Optical Interconnects on PC Boards, Yongzhong Leng, Vic- tor Yun, Warren N. Herman, Julius Goldhar; Univ. of Maryland at College Park, USA. Techniques for directly dispensing fluorinated polymer waveguides on printed circuit (PC) boards and for fabricating undercut couplers are presented. The dispensed fluorinated polymer waveguides and undercut couplers provide low loss transmission at 1550 nm.
1:30 p.m.–3:30 p.m.

FWM • RF Photonics I
Presider to Be Announced

1:30 p.m.–3:30 p.m.

SWB • Photonic Materials I
Astrid Aksnes; Norwegian Univ. of Science and Technology, Norway, Presider

1:30 p.m.–3:30 p.m.

FWN • Quantum Light-Matter Interface
Andrew White; Univ. of Queensland, Australia, Presider

1:30 p.m.–3:30 p.m.

FWO • Plasmonic Metamaterials and Waveguides
Presider to Be Announced

1:30 p.m.–3:30 p.m.

FWP • Advances in Optical Trapping
Presider to Be Announced

FWM1 • 1:30 p.m.
Radio Frequency over Fibre Systems, Alwyn Seeds, C. P. Liu, T. Ismail; Univ. College London, UK. This paper reviews the technologies and applications of radio frequency (RF) analog optical links including direct and external intensity modulated approaches, frequency modulated links and millimetre-wave transmission systems. Wireless and other applications are discussed.

SWB1 • 1:30 p.m.
Recent Advances in Photonic Crystal Fibers, Philip Russell; Univ. Erlangen-Nuremberg, Germany. Through its unique and varied characteristics, PCF is creating many new possibilities in diverse areas of research and technology. Some recent advances will be discussed, including developments in nanoacoustics, gas-laser devices and compact supercontinuum sources.

FWN1 • 1:30 p.m.
Photonic Bus Connecting Atomic-Ensemble Spin-Wave Quantum Memories, Vladan Vuletic1,2, Richard V. Kaczkowski; MIT, USA, 1Harvard Univ., USA. A single spin-wave quantum (magnon) is transferred phase-coherently between two atomic ensembles via a dark state of an optical resonator. Partial transfer results in an entangled state, with the magnon shared between the two ensembles.

FWO1 • 1:30 p.m.
Plasmon Resonances in Photonic Chiral Metamaterials, Nikoley Zholudev; V. Fedotov; A. Schowenecke, E. Plum, N. Papasimakis, K. Martinov; Univ. of Southampton, UK. We report on the development of photonic 2-D- and 3-D-chiral metamaterials with intriguing properties including giant rotary power and asymmetric transmission which are due to the excitation of chiral and enantiomeric sensitive plasmons.

FWP1 • 1:30 p.m.
Advances in Single Molecule Biophysics: Breaking the Nanometer Barrier with Optical Tweezers, Steven M. Block; Stanford Univ., USA. Recent advances in optical trapping instrumentation for use in biophysical applications have reached atomic-level resolution for the motions of individual biomolecules. This tutorial will describe how it’s done and some of what we’ve learned.

Steven M. Block holds the Stanford W. Ascherman chair in Sciences in the Depts. of Applied Physics and Biology at Stanford Univ. He earned his B.A. and M.A. degrees in physics at Oxford Univ. (1974; 1978), a master’s in biology at Univ. of Colorado (1982); and a Ph.D. in biophysics at Caltech (1983). He was staff scientist at the Rowland Inst. in Cambridge and a lecturer at Harvard Univ. (1987-1993), then professor of molecular biology at Stanford Univ. (1994-1999), before joining Stanford Univ. in 1999. Block has been elected to the American Acad. of Arts and Sciences (2000), the American Association for the Advancement of Science (2006), and the Natl. Acad. of Sciences (2007). He received the Award for Research Excellence in Nanotechnology from the Nano/Bio Interface Ctr. at the Univ. of Pennsylvania in 2006.

FWM2 • 2:00 p.m.
Photonic Generation of RF and Microwave Frequencies, Lutieh Maleki1,2; 1JPL, USA, 2OEwaves, Inc., USA. Photonics technology has enabled the generation of highly spectrally pure and stable reference signals at frequencies ranging from 1-100 GHz, and beyond. This talk presents recent developments and future prospects in the field.

SWB2 • 2:00 p.m.
Advances in Photonic Crystal Structures, Richard De La Rue; Univ. of Glasgow, UK. Photonic crystals continue to command the interest of the optoelectronics research community. Translating the research results already demonstrated into practical devices depends critically on technological advances that are still incomplete. This situation will be analysed.

FWN2 • 2:00 p.m.
Deterministic Generation of Polarization-Entangled Photon Pairs from a Cavity-QED System, Ying Gu; Pengbo Li; Qihuang Gong, Guangcan Guo;2; State Key Lab for Mesoscopic Physics and Dept. of Physics, Peking Univ., China, Key Lab of Quantum Information, Univ. of Science and Technology, China. We propose a cavity-QED scheme that can deterministically generate polarization entangled photon pairs. A four-level tripod atom successively couples to two cavities possessing polarization degeneracy, and by the STIRAP process entangled photons are produced.

FWO2 • 2:00 p.m.
Theoretical Studies of Loss Compensation in Active Planar Plasmonic Structures, V. A. Podolskiy1,2, Haruka Tanji1,2, Saikat Ghosh1,2; 1MIT, USA, 2Harvard Univ., USA. We report on the development of plasmonic 2-D- and 3-D-chiral metamaterials with intriguing properties including giant rotary power and asymmetric transmission which are due to the excitation of chiral and enantiomeric sensitive plasmons.

Jonathan Simon1,2, Haruka Tanji1,2, Saikat Ghosh1; 1MIT, USA, 2Harvard Univ., USA. We propose a cavity-QED scheme that can deterministically generate polarization entangled photon pairs. A four-level tripod atom successively couples to two cavities possessing polarization degeneracy, and by the STIRAP process entangled photons are produced.

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FWQ1 • 1:30 p.m.
A Novel Technique for Determination of Optical Properties of Turbid Media, Mangalapudy R. Shenoy, Prerna Prerna, Vishnu P. Pul; Indian Inst. of Technology Delhi, India. Optical properties like anisotropy factor and scattering coefficient of complex turbid media were determined through laser light scattering experiment. Experimental results were matched to the corresponding Monte-Carlo simulation results to obtain the scattering parameters.

FWQ2 • 1:45 p.m.
Measuring of Spray Using Digital Holography, Yan Yang1, Kang Bo-seon2; 1Dept. of Mechanics, Chonnam Natl. Univ., Korea, 2Dept. of Chemical Engineering, Chonbuk Natl. Univ., Korea. Influence parameters of digital holography are discussed. The correlation coefficient method is introduced to locate the best focal plane. The spatial positions and velocities of droplets can be obtained by spray holograms.

FWQ3 • 2:00 p.m.
Investigations of the Attenuation Coefficient of a Narrow-Bandwidth Pulsed Laser Beam in Water, Dake Liu, Jianhui Bai, Yi Huang, Yinan Liu; Beijing Normal Univ., China. The attenuation coefficient of pulsed laser beam in water is investigated. It is found that the attenuation coefficient is dependent on the pulse energy and the line width of the laser, rather than a constant.

LWE1 • 1:45 p.m.
Optimizing Slow and Stored Light via EIT in Alkali Vapor, Irena Novikova1, Nate Phillips1, Alexey V. Gorshkov1, Mikhail D. Lukin1, Yinhong Xiao1, M. Klein2, David F. Phillips2, Ronald L. Walsworth3; 1Caltech, USA, 2Harvard-Smithsonian Ctr. for Astrophysics, USA, 3Harvard-Smithsonian Ctr. for Astrophysics, USA. We investigate the possibility to achieve high-efficiency quantum memory in atomic vapor. We demonstrate a procedure to obtain the maximum efficiency for the storage and retrieval of light pulses based on a pulse-shape optimization.

LWE2 • 2:00 p.m.
Automated 2-D IR Spectroscopy Using Mid-IR Pulse Shaping and Applications to Membrane Peptides, Sang-Hye Kim, David B. Straufeld, Yan L. Ling, Martin Zanni; Univ. of Wisconsin-Madison, USA. This presentation covers new advances in automating 2-D IR spectroscopy using a novel mid-IR pulse shaper. This shaper permits extremely rapid collection of highly accurate 2-D IR spectra. Applications to membrane peptides will be presented.

LWG1 • 1:30 p.m.
Ultrastable 2-D-IR Vibrational Echo Spectroscopy of Concentrated Salt Solutions Analyzed Using a New Experimental Observable, Michael D. Fayer, Sunnam Park, Kyungwon Kwak; Stanford Univ., USA. Ultrastable 2-D-IR vibrational echo spectroscopy is applied to the dynamics of water in concentrated aqueous salt solutions. A new experimental observable is introduced as a robust approach to extracting dynamics from 2-D-IR data.

LWG2 • 2:00 p.m.
Lasing Based on Multilayer Polymer Films, Christoph A. Bauss; Case Western Reserve Univ., USA. The stable asymmetric energy transfer of a multilayer all-polymer surface emitting diode was studied. The stable asymmetric energy transfer is introduced as a robust approach to extract the maximum efficiency for the storage and retrieval of light pulses based on a pulse-shape optimization.
### FWM • RF Photonics I—Continued

**Empire**

**SWB • Photonic Materials I—Continued**

**Gold**

**FWN • Quantum Light-Matter Interface—Continued**

**Valley**

**FWO • Plasmonic Metamaterials and Waveguides—Continued**

**California**

### FWP • Advances in Optical Trapping—Continued

**Empire**

**Crystal**

**Gold**

**Valley**

**California**

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**FWM3 • 2:30 p.m.**

**Invited**

**Optical Arbitrary Waveform Generation**, Andreas Leven1, Y. Yang1, R. Kopf1, A. Tate1, T. C. Hu1, J. Frackoviak1, R. Reyes1, N. G. Weimann1, Y. K. Chen1, S. Gee3, P. Delfyett3; 1Bell Labs, Alcatel-Lucent, USA, 2Harris Corp., USA, 3CREOL/College of Optics and Photonics, Univ. of Central Florida, USA. Optical means for generating arbitrary waveforms have attracted renewed interest because of the wide bandwidth. We will review different optical techniques for generating arbitrary waveforms and will present our latest results using a time-domain approach.

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**FWN3 • 2:15 p.m.**

**Controlled Optical Transitions between Optical Bistable States in Three-Level Atomic Bistability System**, Haibin Wu, Amitabh Joshi, Min Xiao; Dept. of Physics, Univ. of Arkansas, USA. We investigate noise-induced transitions between bistable states in a three-level atomic bistability system. Correlations between noises added on the coupling beam and the transition rate are systematically studied in detail.

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**FWO4 • 2:45 p.m.**

**Near-Field Study of Double-Layered Gold Nanorods**, Hyoung Kim, Hsiao-Kuan Yuan, Reuben M. Bakker, Vladimir P. Drachev, Vladimir M. Shalaev; School of Electrical and Computer Engineering, Purdue Univ., USA. An optical negative-index material, double-layered gold nanorods, is studied in the near-field for reflection and transmission modes at different near-field probes, wavelengths and polarizations of light. The enhanced transmission is observed under certain parameters.

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**FWP4 • 2:45 p.m.**

**Annuar Laser Trap: A Tool for High-Throughput Sperm Sorting and Analysis**, Bing Shao1, Linda Z. Shi1, Sadik C. Esener2, Michael W. Berns2; 1Beckman Laser Inst., Univ. of California at Irvine, USA, 2Univ. of California at San Diego, USA. A continuous, size-tunable 3-D annular laser trap based on axicons provides a way to sort sperm base on motility and chemotaxis, and study the effects of laser radiation, optical force and obstacles on sperm motility.
Study of Optical Vortex Beam Generated by Fabricated Optical Wedge in Continuous and Polychromatic Regimes, Balpreet Singh Ahluwalia, Jing Bu, Xiaocong Yuan; Nanyang Technological Univ., Singapore. Rare earth doped solids are used for slowing and storing light with and without EIT. Magnetic and electric fields and optical pumping are involved in improving inhomogeneous broadening, coherence times and enhancing the storage properties.

Detection of optical vortices in generation of optical vortex. The geometric stability of the optical vortices generated by wedge at the focal vicinity in continuous and femtosecond regime is investigated.

The transmittance followed and then departs from an exponential decay. Such delocalization effect depends on the transverse disorder of the layers and angular spread of incidence beam.

FWQ5 • 2:30 p.m.
The Generation of Structural Stable Optical Vortices in the Singular Beams Array, Yana V. Izdebskaya, Vladlen Chelkowski1,2, B. Hage1,2, A. Franzen1,2, K. Dümzmann2; 1Leibniz Univ. Hannover, Germany, 2Max-Planck-Inst. für Gravitationsphysik (Albert-Einstein-Inst.), Germany. This contribution reports the generation of a broadband squeezed field for Fourier frequencies down to 1Hz. Such fields will be used to improve the sensitivities of future gravitational-wave detectors beyond their quantum noise limits.

LWF1 • 2:30 p.m.
Preparation of Squeezed States for Gravitational Wave Detectors, Roman Schnabel2,3, H. Vahlbruch2, S. Chekowski2,3, B. Hage1,2, A. Franzen1,2, K. Dümzmann2; 1Leibniz Univ. Hannover, Germany, 2Max-Planck-Inst. für Gravitationsphysik (Albert-Einstein-Inst.), Germany. This contribution reports the generation of a broadband squeezed field for Fourier frequencies down to 1Hz. Such fields will be used to improve the sensitivities of future gravitational-wave detectors beyond their quantum noise limits.

LWF3 • 2:30 p.m.
Probing Peptide Structures by Two-Dimensional Infrared Spectroscopy, Nien-Hui Ge1, Hiroaki Maekawa1, Soohwan Sul1, Claudia Tonoli1; 1Univ. of California at Irvine, USA, 2Univ. of Padova, Italy. Femtosecond two-dimensional infrared spectroscopy reveals the multiple conformations of monomeric N-acetyl-L-prolinamide and the chain length dependence of the spectral features for \( \beta \)-helical homopeptides Z-(Alb)\( _n \)-OtBu with \( n = 3, 5, 8, 10 \) in CDCl3.

TWA3 • 2:15 p.m.
Double Cladding Optical Fiber Laser Externally Locked with Guided Mode Resonance Filter, Alok A. Mehta, Eric G. Johnson; 1College of Optics and Photonics, Univ. of Central Florida, USA, 2Univ. of North Carolina at Charlotte, Ctr. for Optoelectronics, USA. A cladding pumped fiber laser operated in an external cavity configuration is evaluated experimentally using a guided mode resonance filter as the external feedback element.

FWQ6 • 2:45 p.m.
Invited
Slow Light in Optical Fibers, Alexander Gaeta; Cornell Univ., USA. We describe our recent work on producing all-optical, tunable delays in optical waveguides, including schemes that can operate at high bandwidths suitable for telecommunications.

LWE2 • 2:15 p.m.
Invited
Slow and Stored Light by EIT in Solids, A. L. Alexander, M. J. Sellars, J. J. Longdell, Neil Manson; Australian Natl. Univ., Australia. Rare earth doped solids are used for slowing and storing light with and without EIT. Magnetic and electric fields and optical pumping are involved in improving inhomogeneous broadening, coherence times and enhancing the storage properties.

TWA4 • 2:45 p.m.
Faraday Rotation Measurements on Thin Films of Regioregular Alkyl Substituted Polythiophene, Palash Gangopadhyay1, Alejandra Lopez-Santiago1, Ramakrishna Voorakaranam1, Charles L. Greenlee1, Robert A. Norwood1, Martin Heeney1, Andre Persoons1, Nasser Peyghambarian1; 1College of Optical Sciences, Univ. of Arizona, USA, 2Univ. of North Carolina at Charlotte, Ctr. for Optoelectronics, USA. Faraday rotation has been measured in thin films of regioregular alkyl substituted polythiophene derivatives in their pristine state. These results could lead to a new frontier of conjugated polymer research.

FWR4 • 2:30 p.m.
Invited
Silicon Based Optoelectronics for Wave-length Routing, Sanjay Patel; Bell Labs, Alcatel-Lucent, USA. No abstract available.

LW3 • 2:45 p.m.
Slow Light in Optical Fibers, Alexander Gaeta; Cornell Univ., USA. We describe our recent work on producing all-optical, tunable delays in optical waveguides, including schemes that can operate at high bandwidths suitable for telecommunications.
3:00 p.m. • Invited
Electroabsorption Modulator for Analog Fiber Link Applications, Paul K. Yu, I. Shubin, X. B. Xie, W. S. C. Chang; Univ. of California at San Diego, USA. Design and performance of electroabsorption waveguide modulators for high gain and low noise figure analog fiber links are presented. Peripheral coupled waveguide design has led to electroabsorption modulator with high linearity and optical saturation power.

3:00 p.m. • Invited
Strong Photon-Photon Correlations in Photonic Crystals, Shanhui Fan, Jung-Tsung Shen; Stanford Univ., USA. We solve exactly two-photon transport in photonic-crystal waveguide coupled to a two-level system. Notable features include two-photon bound state that behaves as a composite particle, and effective attractive or repulsive interactions in space for photons.

3:00 p.m. • Observation of Raman Ramsey Fringes Using Delayed Optical Pulses in Atomic Vapor Medium, Gour S. Pati, K. Salit, M. S. Shahrwar; Northwestern Univ., USA. We report observation of high contrast Raman Ramsey fringes in atomic vapor medium using time delayed optical pulse pairs.

3:00 p.m. • Surface States in One and Two-Dimensional Photonic Crystals, Michael Bergmair, Kurt Hingerl; CD-Lab, Univ. Linz, Austria. One and two-dimensional metallic photonic crystals show for a certain polarization and frequency surface resonances. Their properties are investigated by analytic expressions for the energy velocity and the local density of states.

3:00 p.m. • Trapped Barium Ions for Quantum Computing, Gary T. Howell, R. Bowler, M. R. Dierich, A. Kleczewski, N. Kurz, V. Mirgon, J. S. Saliecka, G. Shu, L. Wang, B. B. Blinov; Univ. of Washigton, USA. We report progress on investigating $^{137}$Ba as a trapped ion qubit candidate. Internal-state manipulations have been performed on single trapped ions of $^{138}$Ba and progress has been made towards performing the same operations on $^{137}$Ba.

3:00 p.m. • Fundamental Limit to Optical Components, David A. B. Miller; Stanford Univ., USA. We prove an upper bound to performance for linear optical components, completely independent of detailed design. For one-dimensional dispersive and slow light structures, the bound depends only on length and maximum dielectric constant.

3:00 p.m. • Laserless Optical Trapping, Carlos López-Mariscal, Julio C. Gutiérrez-Vega, David McGloin, Kishan Dholakia; ’Photonics and Mathematical Optics Group, Tecnológico de Monterrey, Mexico, ’Univ. of St. Andrews, UK. We report the use of light from a thermal source for optical trapping and guiding of dielectric microscopic particles.
FWQ • Optical Vortices and Imaging Complex Media—Continued

FWQ7 • 3:00 p.m.
Signature of Photon Localization in Vortex Core Statistics, Sheng Zhang, Arie Z. Genack; Queens College of City Univ. of New York, USA. Theoretical expressions for the relations between the statistics of vorticity near phase singularities and total transmission are found and verified in microwave measurements. Variance of the vorticity characterizes the degree of photon localization.

FWQ8 • 3:15 p.m.
Two-Beam Coupling Nonlinear Deconvolution, Jed Khoury1, Charles L. Wood1, Bahareh Haj-saeed2, William D. Goodhue3, John Kierstead4; 1AFRL, Sensors Directorate, Hanscom Air Force Base, USA, 2Electrical and Computer Engineering Dept., Univ. of Massachusetts at Lowell, USA, 3Physics Dept., Univ. of Massachusetts at Lowell, USA, 4Solid State Scientific Corp., USA. We introduce a new technique for nonlinear image correction; the impulse response of the distorted function and the distorted image are jointly-Fourier transformed to pump a clean reference beam in a two beam coupling arrangement.

LWE • Slow and Stored Light—Continued

LWE4 • 3:15 p.m.
Distortion, Noise and Delay Study for Wavelength-Conversion and Dispersion Based Slow-Light System, Ravi Pant1, Michael D. Stenner1,2, Mark A. Neifeld1,2; 1College of Optical Sciences, Univ. of Arizona, USA, 2Dept. of Electrical and Computer Engineering, Univ. of Arizona, USA. For wavelength-conversion dispersion based slow-light system, large gain required for amplifying the incoming pulses increases delay at the expense of amplifier noise. We present the distortion, signal-to-noise ratio (SNR) and delay tradeoff in these systems.

LWF • Beyond the Simple Quantum Limit in Gravitational Wave Detectors—Continued

LWF2 • 3:00 p.m.
Quantum Measurement in Gravitational-Wave Detectors, Yanbei Chen; Max-Planck-Institut fuer Gravitationsphysik, Germany. Laser interferometric gravitational-wave detectors measure tiny motions of macroscopic mirrors. Complex interferometer configurations and quantum optical techniques will be used to enhance sensitivity in future interferometers, which will reach and surpass the Standard Quantum Limit.

LWF4 • 3:00 p.m.
Triply Resonant Hyper-Raman Spectroscopy, Anne M. Kelley, Weinan Leng; Univ. of California at Merced, USA. The normally weak process of hyper-Raman scattering should be greatly enhanced when the excitation is both one- and two-photon resonant. This triply resonant process is explored both theoretically and experimentally for organic nonlinear chromophores.

LWG • 2-Dimensional Spectroscopy I—Continued

LWG2 • 3:00 p.m.
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OTF

FWQ7 • 3:00 p.m.
Signature of Photon Localization in Vortex Core Statistics, Sheng Zhang, Arie Z. Genack; Queens College of City Univ. of New York, USA. Theoretical expressions for the relations between the statistics of vorticity near phase singularities and total transmission are found and verified in microwave measurements. Variance of the vorticity characterizes the degree of photon localization.

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118 FiO/LS/OMD 2007 Conference Program

Frontiers in Optics

FWS • RF Photonics II
Andreas Leven; Bell Labs, Alcatel-Lucent USA, Presider

4:00 p.m.–6:00 p.m.

Empire

SC • Photonic Materials II and Structured Nonlinear Crystals
Peter Moulton; Q-Peak Inc., USA, Presider

4:00 p.m.–6:00 p.m.

Crystal

FW • EIT and Quantum Information
Vladan Vuletic; MIT, USA, Presider

4:00 p.m.–6:00 p.m.

Gold

FW • Near Field Optics
Presider to Be Announced

4:00 p.m.–5:45 p.m.

Valley

FW • Diffuse Imaging and Spectroscopy
Presider to Be Announced

4:00 p.m.–6:00 p.m.

California

FW • Modulated Imaging in a Pre-Clinical Model of Wound Healing
David J. Cuccia1, Jae G. Kim2, Joon S. You1, Anthony J. Durkin 2; 1Modulated Imaging Inc., USA, 2Beckman Laser Inst. and Medical Clinic, Univ. of California at Irvine, USA. We present a wide-field spectral imaging modality called modulated imaging for quantitatively imaging superficial tissues. We apply this method to an animal skin-flap model to determine in vivo local concentrations of oxy- and deoxy-hemoglobin and water.

FW • Heterodyne Near-field Scanning Optical Microscopy with Spectrally Broad Sources
Maxim Aboshin, Robert E. Sapirstein, Yehshuahu Fuimann; Univ. of California at San Diego, USA. A differential optical mammography technique is discussed. The imaging modality uses infrared trans-illumination to image breast tissue. Preliminary imaging data demonstrate potential use in screening for breast cancer.

FW • Modulated Imaging
Sahista Dixit1, Christopher Comstock, Gregory Furt; SRI Intl., USA, ’Univ. of California at San Diego, USA. A differential optical mammography technique is discussed. The imaging modality uses infrared trans-illumination to image breast tissue. Preliminary imaging data demonstrate potential use in screening for breast cancer.

FWS1 • 4:00 p.m. Invited
An Overview of Analog Microwave Photonics, Keith Williams; NRL, USA. An overview of analog microwave photonics will be presented. The performance requirements for externally-modulated analog microwave photonic links will be reviewed with specific emphasis placed on modulator efficiency, laser noise, detected photocurrent and link linearity.

FWS2 • 4:30 p.m. Invited
High Power Quantum Dot Laser Diodes for RF Photonics, Dennis Deppe; Univ. of Central Florida, USA. It is shown that the relative intensity noise in laser diodes may be reduced to <-180 dB/Hz through use of a long cavity with ultra-low internal loss.

SWC1 • 4:00 p.m. Invited
Air-Clad Photonic Crystal Fibers for High-Power Single-Mode Lasers, Kent E. Mattsson; Crystal Fibre, Denmark. The talk presents basics and record-breaking experimental data of double-clad fiber structures, fiber lasers and multimode combiners based on photonic crystal fiber technology.

SWC2 • 4:30 p.m. Invited
Advances in Structured Nonlinear Semiconductor Crystals, Paulina S. Kuo1, Konstantin L. Vodopyanov2, J. E. Sauer1, A. Yariv1, A. C. Lin2, M. M. Fejer2, J. S. Harris1, David P. Bliss2, Candace L. Lynch2, Timothy Zeng2; Stanford Univ., USA, AFRIL, USA. Microstructured semiconductors, like orientation-patterned GaAs, achieve quasi-phase-matching through controlled, periodic inversions of the crystallographic orientation. These nonlinear optical materials are becoming more mature and are being used to generate mid-infrared and THz radiation.

FTV • EIT
Hebin Li, Vladimir Sautenkov, Yuri Rostovtsev, Marlan O. Scully; Inst. for Quantum Studies, Texas A&M Univ., USA. We study the EIT of Rb vapor under the condition when a microwave field resonant to the hyperfine transition has been applied. Developed theory and applications will be discussed.

FWT1 • 4:00 p.m. Invited
Electromagnetically-Induced Transparency with Classical and Nonclassical Light, J. Appel, F. Veyssiere, E. Figueroa, K.-p. Marzlin, Alexander Lvovsky; Univ. of Calgary, Canada. We present our progress towards storage of squeezed light by means of electromagnetically-induced transparency as well as protocols for routing, frequency conversion, and geometric steering of optical modes in atomic systems with multiple excited levels.

FWT2 • 4:30 p.m. Invited
Phase Dependent EIT, Hebin Li, Vladimir Sautenkov, Yuri Rostovtsev, Marlan O. Scully; Inst. for Quantum Studies, Texas A&M Univ., USA. We study the EIT of Rb vapor under the condition when a microwave field resonant to the hyperfine transition has been applied. Developed theory and applications will be discussed.

FWU1 • 4:00 p.m. Invited
Nonlinear Plasmonics with Coupled Gold Nanoparticles, Lukas Novotny; Univ. of Rochester, USA. We present a study of nonlinear frequency generation at coupled gold nanoparticles. Second harmonic generation, sum-frequency generation, and four-wave mixing (4WM) are investigated as a function of the distance between a pair of particles.

FWU2 • 4:30 p.m. Invited
Heterodyne Near-field Scanning Optical Microscopy with Spectrally Broad Sources, Maxim Aboshin, Robert E. Sapirstein, Yehshuahu Fuimann; Univ. of California at San Diego, USA. We propose and demonstrate the use of an inexpensive, low temporal coherence source in Heterodyne Near-field Scanning Optical Microscopy. This system is a simplified means for high-resolution group velocity measurements in nanophotonic devices.
### Tutorial

**Invited Tutorial**

Mountain Tops and Wilderness: A New Vision, Jannick P. Rolland, CREOL, USA. In this tutorial, we will focus on emerging deployable displays and displays worn on the body to support mobile users. Designs suitable for integration into the eyeglasses form factor will also be discussed.

Jannick Rolland received a Diploma from the Inst. D’ Optique, Graduate School in France in 1984, and the Ph.D. degree in optical science from the Univ. of Arizona in 1990. She is a Professor of Optics at the Univ. of Central Florida. After completing a Postdoctoral Fellowship, she joined the Research Faculty at Univ. of North Carolina at Chapel Hill in 1992 and headed the Vision Res. Group 1992-1996. She holds 13 patents, wrote 6 book chapters, and has over 60 peer-reviewed publications related to optical design, augmented reality, vision, and image quality assessment. Dr. Rolland served on the editorial board of the Journal Presence (MIT Press) 1996-2006, and as Associate Editor of Optical Engineering 1999-2004. She is a Guest Editor for a special issue of the IEEE Journal of Display Technology on medical displays. She is a Fellow of SPIE, IEEE, and SID.

### Laser Science

#### LWH1 • 4:00 p.m.

**Invited**

Ultrasound Collisions in Atomic Strontium, T. C. Killian, Y. N. Martinez, P. G. Mickelson, S. Nager, P. Pellegrini, R. Côté; Rice Univ., USA, ‘Univ. of Connecticut, USA. Photoassociative spectroscopy in an intercombination-line magneto-optical trap has determined the ground-state s-wave scattering lengths of $^{88}$Sr and $^{86}$Sr. Recent work with a crossed optical dipole trap allows us to study atoms in metastable states.

#### LWH2 • 4:30 p.m.

**Invited**

Cooling of an Atom in a Cavity to the Quantum Ground State of Axial Motion, H. Jeff Kimble, A. D. Boozer, A. Boca, R. Millier, T. E. Northup; Caltech, USA. Localization to the ground state of axial motion is demonstrated for a single, trapped atom strongly coupled to the field of a high-finesse optical resonator. Applications in Quantum Optics and Information Science will be discussed.

### Organic Thin Films for Photonic Applications II

#### TWB1 • 4:00 p.m.

Recent Advances in Organic Photovoltaic Cells and Integrated Modules, Bernard Kippelen, S. Yoo, W. J. Potschke, B. Domenag, J. Kim, J. Holt; Georgia Tech, USA. Efficient organic photovoltaic (OPV) modules with open-circuit voltages of 2.48 V have been fabricated from blends of poly(3-hexylthiophene) (P3HT) and a soluble C$_{60}$ derivative, [6,6]-phenyl C$_{71}$ butyric acid methyl ester (PCBM-70).

#### TWB2 • 4:30 p.m.

F8T2 Copolymer/C$_{60}$ Heterojunction Photovoltaic Devices, Mihaela Breban, Sundar Manoharan, Warren Hartman, Danilo Romer; ‘Univ. of Maryland, USA, ‘Indian Inst. of Technology, India. We explore poly(3,9-dioctylolohexylfluorene-codithiophene) copolymer (F8T2) for photovoltaic applications. Devices fabricated with F8T2/C$_{60}$ blend show open-circuit voltage of 1V and power conversion efficiency of 1.15% for operation in the short-wavelength region of the solar spectrum.
Continued

**FWS3 • 5:00 p.m.**
Bandwidth Enhancement by Optical Modulation of Injection-Locked Semiconductor Lasers, Erwin K. Lau, Hyuk-Kee Sung, Xiaoxue Zhao, Devang Parekh, Connie J. Chang-Hasnain, Ming C. Wu; Univ. of California at Berkeley, USA. We experimentally demonstrate optical modulation of injection-locked lasers, resulting in a resonant amplification of the transmitted signal. We enhance the 3-dB bandwidth of a 25-GHz electro-optic modulator to >59 GHz and demonstrate the system’s tunability.

**FWT3 • 4:45 p.m.**
Low Light Level V-Type Electromagnetically Induced Transparency Using Tapered Fiber Embedded in Rubidium Vapor, Gour S. Pati1, S. Spillane1, R. Beausoleil1, K. Salit1, M. Hall1, P. Kumar1, M. S. Shahriar1; Northwestern Univ., USA, 2HP Labs, USA. We report observation of V-type electromagnetically induced transparency (EIT) at a few nW of optical power, using tapered fiber (TF) embedded in a rubidium vapor.

Continued

**FWT4 • 5:00 p.m.**
Interplay Between Four-Wave Mixing and Six-Wave Mixing in Rubidium Atom, Blake L. Anderson, Yanpeng Zhang, Min Xiao; Univ. of Arkansas, USA. Interference between four-wave and six-wave mixing signals is observed in a four-level atomic system due to atomic coherence. The experimental and theoretical conditions for generating such interesting effects are investigated.

**FWU5 • 5:15 p.m.**
Polarization Mode Conversion and Near-Field Optical Coupling in Apertureless SNOM Probes, including polarization mode conversion and the interaction of the emitted optical fields with objects placed in the probe near-field zone.

**FWU3 • 4:45 p.m.**
Near-Field from 2-Dimensional Defects at Metallic Surfaces, Raúl García-Llamas, Jorge Garsp-Armenta, Judith Tánori-Cordova; Univ. de Sonora, Mexico. The diffraction of plane P-polarized electromagnetic waves from 2-D Gaussian defects is studied theoretically. The Near-Field shows that the defects act like surface nano-antenna as its dimensions are in the nanometric range.

**FWU4 • 5:00 p.m.**
Near-Field Imager Based on Nanophotodetector Array, Boyang Liu, Yining Huang, Ki Young Kim, Seng-Tiong Ho; Dept. of Electrical Engineering and Computer Science, Northwestern Univ., USA. A novel high-speed near-field imager is presented based on channelized nanoscale-pixel photodetector (NPD) array with metal-semiconductor-metal detector structure and graded In0.53Ga0.47As/In0.35Al0.65As superlattice as active medium. The NPD array can reach sub-wavelength spatial resolution of <λ/8.

**FWV3 • 4:45 p.m.**
Photoacoustic Imaging: High-Resolution Optical Image beyond the Quasi-Ballistic Regime, Lihong Wang; Washington Univ., USA. Photoacoustic imaging can penetrate beyond ~1 mm into scattering biological tissues. It is a hybrid functional imaging technology that combines high ultrasonic resolution and strong optical contrast in a single modality.

**FWV4 • 5:15 p.m.**
Intraoperative Needle-Based Refractive Index Measurement of ex vivo Human Breast Tissue, Adam M. Zysk1, Daniel L. Marks2, Fredry T. Nguyen1, Jan G. Kotyneck1, Frank J. Bellafore1, Patricia A. Johnson2, Kendrith M. Rowland2, Stephen A. Boppart1,2; 1Univ. of Illinois at Urbana-Champaign, USA, Carle Foundation Hospital, USA. Refractive index measurements offer high contrast between normal fatty tissue and diagnostically significant structures. We have developed a needle-based device capable of measuring internal tissue properties. We present preliminary clinical data from human specimens.
FWW • Virtual/Mixed Environments and Interactivity—Continued

FWW2 • 4:45 p.m.
Object Based Disparity Morphing Tool for Stereo Images and Video, Chiao Wang, Alexander A. Sawchuk; Signal and Image Processing Inst., Univ. of Southern California, USA. We develop a horizontal disparity morphing tool in which users can enhance/reduce the perceived stereo effect of selected objects for general stereo images and video, and view the results on autostereoscopic displays.

FWW3 • 5:00 p.m. Invited
Novel Approaches in Optical Imaging and Visualization of Early Cancer Screening, Diagnosis and Treatment, Eric J. Seibel; Univ. of Washington, USA. Ultrathin, flexible endoscopes are being developed for imaging cancer in previously inaccessible regions of the body, allowing image-guided biopsy and laser diagnostics/therapeutics. Cancer diagnosis at high sensitivity/specificity is achieved with optical tomography microscopes.

LWH • Cold Atom and Molecule Systems—Continued
LWI • Chip-Scale Atomic Devices—Continued
LWJ • 2-Dimensional Spectroscopy II—Continued

LWH3 • 5:00 p.m.

LWI3 • 5:00 p.m. Invited
Technology and Applications of Miniature Atomic Magnetometers, Mark Proudy; Geometrics, Inc., USA. Recent work by Geometrics, NIST, and Sandia has shown the feasibility of producing total field magnetometers, widely used in geophysics, that are two orders of magnitude smaller and lower power than existing commercial sensors.

LWJ3 • 5:00 p.m. Invited
Optical 2-D Fourier Transform Spectroscopy of Semiconductors, Steven Candiff, Tianhao Zhang, Xiaoxin Li, Alan B. Bristow, Irina Kuznetsova, Torsten Meier, Peter Thomas, Lijun Yang, Igor V. Schweiger, Shaul Mukamel, Richard P. Mirin; JILA, NIST and Univ. of Colorado, USA; ‘Dept. of Physics and Materials Science Ctr., Philipps Univ., Germany; ‘Chemistry Dept., Univ. of California at Irvine, USA; ‘NIST, USA. Optical two-dimensional Fourier transform spectra of excitonic resonances in semiconductors are measured and calculated. They provide insight into many-body interactions in direct gap semiconductors by separating the contributions to the coherent optical nonlinear response.

LWJ4 • 5:15 p.m.
Rotating Three-Electron Wigner Molecules in Strong Magnetic and Circularly Polarized Field, Matt K. Kalinske; Utah State Univ., USA. We investigate the formation of rotating Wigner molecules in external magnetic and circularly polarized fields consisting of three-electrons in the analogy to recently discovered stabilized Langmuir states in strong magnetic and the circularly polarized fields.

FWB • Organic Thin Films for Photonic Applications II—Continued

TWB2 • 4:45 p.m.
Deep Blue Phosphorescent OLEDs with Improved Device Stability, Oliver Molt, Evelyn Fuchs, Christian Lennartz, Klaus Kahle, Nicole Moonen, Jens Rudolph, Christian Schlachter, Gerhard Wagenblast; BASF AG, Germany. Cyclometallated iridium N-heterocyclic carbene (NHC)-complexes have become known as efficient deep blue triplet emitters in OLEDs. Herein we discuss new materials and device setups for carbene-based deep blue OLEDs with improved stability and lifetime.

TWB3 • 5:00 p.m.
Hybrid Silicon Organic RCE LED for Optical Interconnects and Optical Communications Using Specialized Conductive Adhesives, Demetris L. Giddis, Justin E. Glover, Sean D. Cherry; Norfolk State Univ., USA. An RCE-infrared organic light emitting diode was fabricated using silicon as the anode and cathode. The erbium tris(8-hydroxyquinoline) emission layer was vacuum-deposited and the device was formed using unidirectional customized conductive adhesives in different configurations.

TWB4 • 5:00 p.m.
Pushing the Resolution Limit in Multiphoton Absorption Polymerization, John T. Fourkas; Univ. of Maryland, USA. Multiphoton absorption polymerization makes possible the fabrication of 3-D structures with features considerably smaller than the diffraction limit. We will discuss progress in improving resolution to the realm of a fortieth of a wavelength.
FWS5 • 5:30 p.m.
Tunable Optical Clock Pulse Generation from a Phase Modulated CW Light Using an SBS-Assisted Optical Filter, Masatoshi Saruwatari, K. Tsubi, M. Oiwa, K. Jumgmin, N. Onodera; Natl. Defense Acad., Japan. We propose tunable optical clock pulse generation from PM light using SBS-assisted optical filtering. With this method, tunable 20-GHz pulses are successfully generated from 10-GHz PM signal by filtering the first-sidebands in PM light.

FW6 • 5:45 p.m.
Channel Interference and Information Rate in an Orbital Angular Momentum Multiplexed Free-Space Optical Link, Jaime A. Anguita, Mark A. Neifeld; Univ. of Arizona, USA. The effect of atmospheric turbulence on the crosstalk among orbital angular momentum (OAM) states in an OAM-multiplexed free-space optical communication link is studied via numerical simulations. Information rates of the multi-channel system are computed.

FW5 • 5:30 p.m.
Invited
Advances in Structured Ferroelectric Nonlinear Crystals, Martin M. Fejer; Stanford Univ., USA. No abstract available.

FWU6 • Near Field Optics—Continued
Gold nanoantennas arrays are developed for sensing technology, nanolithography, nanolasers and imaging of field enhancement. Far and near-field spectroscopy supported by finite element simulations shows a strong resonance tunable in the visible.

FWV5 • 5:30 p.m.
Multiple Scattering Effects on Particle Sizing in Optical Characterization of Biological Tissues, Wendy Yip, Xu Li; Northwestern Univ., USA. We examine the validity of the independent-scattering assumption of particle sizing in biophotonics applications via full-wave solutions. We find a complex dependence of biological tissue's optical properties on its multi-scale organization of intracellular particles.

FWV6 • 5:45 p.m.
Understanding Cell Nano-Architecture and Its Alteration in Carcinogenesis via Partial-Wave Spectroscopy, Harisharan Subramanian, Prabhukar Pradhan, Vadim Backman; Northwestern Univ., USA. Single-cell partial-wave spectroscopy (PWS) provides unprecedented insights into the nanoscale architecture of living biological cells. We demonstrate that PWS enables diagnosis of precancerous changes in histologically normal cells far earlier than any existing detection technique.

FWV7 • 6:00 p.m.
Volume Holographic Gratings Using PQ/PMMA for Angle-Depth-Wavelength Filters, Yuan Luo, Paul J. Gelsinger, George Barbashitis, Jennifer K. Bartun, Raymond K. Kostuk; Dept. of Electrical and Computer Engineering, and College of Optical Sciences, Univ. of Arizona, USA. In this paper, we use angle multiplexing with in-plane reference beams to make gratings using PQ/PMMA. The hologram is applied to spectral-spatial imaging systems as a filter to obtain the depth sections of an object.
LWH5 • 5:30 p.m.
Long Range Cs Rydberg Molecules, Arne Schwettmann, K. Richard Overstreet, Jonathan Tallant, James Shaffer; Univ. of Oklahoma, USA. We present calculations of long range Cs Rydberg molecules. The molecules are formed by multipole interactions and can be controlled using an external electric field. Experimental progress on detecting these molecules will be reviewed.

LWI5 • 5:45 p.m.
Coupling to Trapped Atoms with a Magnetic Cantilever, Matthew D. Eardley1,2, Y.-J Wang1, J. Moreland1, L. Hollberg1, J. Kitching1; 1NIST, Boulder, USA, 2Dept. of Physics and Astronomy, SUNY at Stony Brook, USA. We are interested in using a magnetic microfabricated cantilever to both magnetically trap and drive transitions in laser-cooled Rb atoms. We ascertain the feasibility and show a possible scenario for such an experiment.

LWJ5 • 5:45 p.m.
Compression of Femtosecond Laser Pulses by Using Doubled-Line Density Gratings, Changhe Zhou, Jiangjun Zheng, Enwen Dai, Wei Jia; Shanghai Inst. of Optics and Fine Mechanics, China. We proposed and demonstrated a novel doubled-line density gratings structure for compression of femtosecond laser pulses, where a doubled-line density gratings structure means the second grating has a doubled density of the first one.

LWJ6 • 6:00 p.m.
Analysis and Fabrication of Fabry-Perot Interferometer Filters Using MEMS Technology, Srinu P. Sankisa, Bansali S. Rawat, Moncef B. Tayah; Univ. of Nevada, USA. The Fabry-Perot Interferometer (FPI) filters with phase reduction have been thoroughly analyzed and fabricated using micro electromechanical systems (MEMS) technology. The main advantages of these filters are: small power requirements, higher sensitivity and stability.
9:00 a.m.–10:00 a.m. StHb • Space-Qualification of Materials and Devices for Laser Remote Sensing Instruments I
Farzin Anzajerdian; NASA Langley Res. Ctr., USA, Presider

Qualification and Lessons Learned with Space Flight Fiber Optic Components, Melanie Ott; NASA Goddard Space Flight Ctr., USA. This tutorial will focus on qualification methods and guidelines, examples of hardware development challenges and lessons learned from the past ten years of development and testing of optical fiber components for space flight programs.

10:00 a.m.–10:30 a.m. FThB1 • Confocal Microscopy without a Pinhole, Jerome Mertz; Boston Univ., USA. New fluorescence imaging techniques have been developed that provide confocal-like out-of-focus background rejection by simple widefield imaging with a CCD camera. I will review various techniques including structured illumination microscopy and dynamic speckle illumination microscopy.

10:30 a.m.–11:00 a.m. FThB2 • Advanced Biological Microscopy and Tissue Ablation
Gregory Faris; SRI Intl., USA, Presider

FThA2 • 8:30 a.m.
Search for Pure Vibrational Dephasing of Electronically Excited Dye Molecules in Solution, Patrizia Klok, Ida Z. Koima, Markus Breuer, Stefan Lochbrunner, Eberhard Risseeuw; Lehrstuhl für Rœ-Molekulare Optik, Univ. of Munich, Germany. 10 fs pulses compressed with Brewster-angled chirped mirrors are used to measure the vibronic wavepacket motion in a perylene dye. The coherence lifetime of 1.0 - 1.5 ps indicates that vibrational relaxation and pure dephasing contribute equally.

11:00 a.m.–12:00 noon. FThB2 • Advanced Biological Microscopy and Tissue Ablation
Jennifer Mertz received an A.B. in physics from Princeton Univ. in 1984, and a Ph.D. in quantum optics from Univ. of California at Santa Barbara and the Univ. of Paris VI in 1991. Following postdoctoral studies at the Univ. of Konstanz, Germany (Jürgen Mlynek group) and at Cornell Univ. (Walt Webb group), he obtained a lecturer position at the Ecole Superieure de Physique et de Chimie Industrielle in Paris, where he became a CNRS research director. He is currently an associate professor of Biomedical Engineering at Boston Univ. His interests are in the development and applications of novel optical microscopy techniques for biological imaging.
FThC • Metamaterials-Based Devices
Partha P. Banerjee; Univ. of Dayton, USA, Presider

FThC1 • 8:00 a.m.  Invited
Surface Plasmon-Polariton Transport, Localization, and Detection, Mark Brongersma; Stanford Univ., USA. In this presentation I will discuss recent progress in the development of nanoscale plasmonic device structures capable of transporting, localizing, and detecting light. Exciting future directions in the field of nanoscale polaritonics will be highlighted.

8:00 a.m.–10:00 a.m.
LThA • Cold Atoms and Degenerate Gases I
Presider to Be Announced

LThA1 • 8:00 a.m.  Invited
Theory of Atom Number Statistics of Bose Condensates, Mark O. Scully, Anatoly Svidzinsky; Inst. for Quantum Studies, Texas A&M Univ., USA. We present a new method of calculating fluctuations of a Bose-Einstein condensate (BEC) of N interacting atoms. It is applicable both for ideal and interacting Bogoliubov BEC and yields remarkable accuracy at all temperatures.

LThB • General Techniques
Frederick J. Kauf; LIGO Hanford Observatory, USA, Presider

LThB1 • 8:00 a.m.
Fiber Optics Sensor for Measuring Fluid Flow, Anisur Rahman, Sunil Kumar; Polytechnic Univ., USA. A new fiber optics sensor for measuring fluid flow is presented. Numerical model with detailed fabrication processes are outlined. The flow sensor is designed at the end of multimode optical fiber based on Fabry-Perot interferometry.

LThB2 • 8:15 a.m.
Three-Dimension Frequency-Modulated Continuous-Wave Interferometric Fiber-Optic Displacement Sensor, Jesse Zheng; PhotonTech, Canada. A triple-sensor-multiplexed fiber-optic displacement sensor is discussed. The sensor is based on optical frequency-modulated continuous-wave (FMCW) interference and frequency-division multiplexing, and can measure the displacements of three objects or 3-dimension-displacement of a single object precisely.

LThB3 • 8:30 a.m.
Spectroscopy on Slow Molecules in Hollow-Core Photonic Bandgap Fibers, Jan Hald1, Jes Henningpeter, Jan C. Petersen1; 1Danish Fundamental Metrology Ltd., Denmark, 2Niels Bohr Inst., Denmark. We demonstrate saturation spectroscopy on the slow fraction of molecules in a gas-filled hollow-core photonic bandgap fiber. The gas-filling process is studied both theoretically and experimentally.

LThC • Terahertz Spectroscopy I
Masayoshi Tonouchi; Osaka Univ., Japan, Presider

LThC1 • 8:00 a.m.  Invited
Ingredients Analysis of Aqueous Solutions and Food Products with Reflection THz Spectroscopy, Peter Ulid Jepsen1, Uffe Møller1, David Cooke1, Jacob Ris Folkersen2; 1Technical Univ. of Denmark, Denmark, 2Foss A/S, Denmark. Reflection THz spectroscopy is useful for analysis of liquids and food products. We will illustrate this with examples from food science, liquid analysis, and identification of hazardous liquids.

LThC2 • 8:30 a.m.  Invited
Tertiary Structural Effects on Protein Picosecond Dynamics: Terahertz Dielectric Response, Joseph R. Knud1, Yunfen He1, Ferdinand Lipp2, Jing Yin Chen1, Benjamin Mueller1, Susan Gregurick1, Andreas Markelz1; 1Univ. of Alabama at Huntsville, USA. Terahertz time domain spectroscopy reveals hydration and temperature dependent ‘dynamical transitions’ in both native and denatured proteins. These transitions may arise from hydration dependent side chain motion with these picosecond transitions subsequently influencing tertiary dynamics.
FThA3 • 9:15 a.m.  
Invited  
Two-Dimensional Vibrational Spectroscopy: Hydrogen Bond Dynamics in Ionic Solutions, Sungnam Park1,2, Kyungwon Kwon1, Kelly J. Gaffney2, Michael D. Fayer1; 1Stanford Univ., USA, 2SSRL, Stanford Linear Acceleration Ctr., USA. Hydrogen bond dynamics in a series of NaBr solutions were investigated. Slopes of peak position in 2-D correlation spectra were used as a new experimental observable to extract FFCE. FFCE decays slower in ionic solutions.

FThB3 • 9:00 a.m.  
Superresolving Nonlinear Microscopy, Michael R. Beversluis, Stephan J. Shanick; NIST, USA. We are developing a coherent anti-Stokes Raman scattering (CARS) microscope that uses complementary pump and Stokes beam pupil phase masks to achieve superresolution. This allows chemically-specific imaging beyond the diffraction limit.

FThA4 • 9:15 a.m.  
Recent Developments in STED-Microscopy, Benjamin Barke, Katrin I. Willig, Gerald Dostert, Stefan W. Hell; Max-Planck-Inst. for Biophysical Chemistry, Germany. We present recent developments in high resolution stimulated emission depletion (STED) Microscopy concerning novel light sources, and discuss applications both for technical and biological samples.
**FThC • Metamaterials-Based Devices—Continued**

**FThC3 • 8:45 a.m.**
Tailoring Filtering Functions at Nanoscale: Optical Nanofilters, Nader Engheta, Andrea Alù, Univ. of Pennsylvania, USA. We have developed optical filter concepts in a subwavelength region, by forming collections of nanoparticles as optical lumped nanocircuits. Our numerical simulations reveal how such nanofilters can be designed in analogy with their RF filters.

**FThC4 • 9:00 a.m.**
Tunable Nanoelectromechanical RGB Pixels, Robert Magnusson, Mehrdad Shokooh-Sareri, Univ. of Connecticut, USA. Tunable leaky-mode resonant silicon-nitride pixels providing red/green/blue spectral lines are analyzed. Critical dimensions, rate of tuning, linewidths, and polarization properties are quantified.

**FThC5 • 9:15 a.m.**
Ultra-Compact On-Chip Photonic Crystal Interferometers with High Sensitivity, Maysamreza Chamanzar, Babak Momeni, Ali Adibi, Georgia Tech, USA. High group index property of photonic crystals (PCs) is used to enhance the spectral sensitivity of on-chip optical interferometry. A planar PC is used in a Young interferometer demonstrating one order of magnitude sensitivity improvement.

**FThC7 • 9:45 a.m.**
Tailoring Filtering Functions at Nanoscale: Optical Nanofilters, Nader Engheta, Andrea Alù, Univ. of Pennsylvania, USA. We have developed optical filter concepts in a subwavelength region, by forming collections of nanoparticles as optical lumped nanocircuits. Our numerical simulations reveal how such nanofilters can be designed in analogy with their RF filters.

**LThA • Cold Atoms and Degenerate Gases I—Continued**

**LThA3 • 9:00 a.m.**
Quantum Statistics of a Degenerate Bose Gas, Mark G. Raizen, Univ. of Texas at Austin, USA. We have observed atomic number squeezing by direct atom counting, and our results are consistent with many-body number state generation. Progress towards controlled entanglement and few-body tunneling will be discussed.

**LThB • General Techniques—Continued**

**LThB4 • 8:45 a.m.**
Two Wave Mixing Analysis in Rb:BaTiO₃, Using Bi₁₋ₓTiO₂ₓ, Arun Anand, Chittur S. Narayananmarthy; Inst. for Plasma Res., India, ‘M S Univ. of Baroda, India. A novel two wave mixing analysis in Rb:BaTiO₃, (Rohium doped Barium Titanate) using photorefractive BTO (Bismuth Titanium Oxide) along one of the writing beams and a small power red He-Ne laser is reported.

**LThB5 • 9:00 a.m.**
Measurement of Particle Size of Lycopodium Powder Using He-Ne Laser, Balusamy Renganathan, Alagan Viswanathan, D. Sastikumar, S. Sahul Hameed; Natl. Inst. of Technology, India, ‘Kings Engineering College, India. The present study describes the method of determining the particle size of the lycopodium powder using laser source. The observed values are found to be in good agreement with the standard values.

**LThB6 • 9:15 a.m.**
Defining the Degree of General Astigmatism of a General Astigmatic Beam, George Nemes, Julio Serna; ‘Astigmat, USA, ‘Complutense Univ., Spain. We define the degree of general astigmatism (DGA) of a general astigmatic beam, a measurable positive number expressing the departure of such a beam from more symmetrical beams, the latter having the DGA = 0.

**LThC • Terahertz Spectroscopy I—Continued**

**LThC3 • 9:00 a.m.**
Invited Solar Energy Conversion Processes in Nanostructured Materials Studied via Time-Resolved THz Spectroscopy, Matt Beard, Jeffery Blackburn, Michael Heben, Xin Ai, Garry Rumbles, Randy J. Ellingson, Arthur J. Nozik; Natl. Renewable Energy Lab, USA, ‘Dept. of Chemistry, Univ. of Colorado, USA. We discuss time-resolved THz spectroscopy measurements for three important solar energy conversion approaches: (1) electronically coupled semiconductor nanocrystals, (2) a bulk heterojunction formed between P3HT and PCBM, and (3) films of single walled carbon nanotubes.
**SThB • Space-Qualification of Materials and Devices for Laser Remote Sensing Instruments I—Continued**

**SThC • (Guarded) Rational Exuberance: Renaissance after the Telecom Boom? Part I—Continued**

**SThD • Advanced Biological Microscopy and Tissue Ablation—Continued**

10:00 a.m.–10:30 a.m., Coffee Break, Fairmont Hotel, Regency and Imperial Ballroom Foyers
### Laser Science

**LThA • Cold Atoms and Degenerate Gases I—Continued**

**LThB • General Techniques—Continued**

**LThC • Terahertz Spectroscopy I—Continued**

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**FThC • Metamaterials-Based Devices—Continued**

**LThA4 • 9:30 a.m.**  
Initial Designs and Simulated Performance of Coated Nano-Particle Lasers, Joshua A. Gordon, Richard W. Ziolkowski; Univ. of Arizona, USA. The optical properties of coated nanometer-sized spherical particles comprised of a gain medium core covered with a concentric plasmonic shell are investigated. Numerically predicted super-resonant radiative scattering suggests the possibility of realizing highly sub-wavelength lasers.

**LThB7 • 9:30 a.m.**  
Chopper Mediated Volume and Spherical Bragg Lasers, Nasrullah Khan, Zahid Saleem, Abdul Wahid, N. Abas; Comsats Inst. of Information Technology, Pakistan. We report the formation techniques of helically perforated chopper mediated varying period dynamic and thin film coated reflective ball permanent spherical Bragg gratings for tunable multiple wavelengths collinear and round cavity distributed feedback lasers.

**LThC5 • 9:45 a.m.**  
Enantiomeric Dependence of the Far-Infrared Spectra of Polycrystalline Tyrosine and Valine, Timothy A. French, Alan B. True, Konstanze Schroeck, Charles A. Schmuttenmaer; Yale Univ., USA, Ruhr Univ. of Bochum, Germany. The far-infrared spectra of polycrystalline samples of tyrosine and valine have been measured using THz time-domain spectroscopy. The crystal structures, vibrational frequencies, and intensities were calculated using CHARMM22b1.

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**FThC7 • 9:45 a.m.**  
Nanophotonic Quantum Dot Waveguides with Low Loss, Chia-Jean Wang, Ludan Huang, Babak A. Parviz, Lih Y. Lin; Univ. of Washington, USA. We present loss characterization results for nanophotonic quantum dot waveguides. Loss data measured over 10, 15, and 20 µm lengths using 500 nm wide structures show reduced loss compared to other sub-diffraction nanophotonic waveguides.

**LThB8 • 9:45 a.m.**  
Coupling Model for 2x1 Photonic Crystal Vertical Cavity Laser Arrays, Ann C. Lehman, Kent D. Choquette, P. Scott Carnay; Univ. of Illinois at Urbana-Champaign, USA. We derive a theory expressing the coherence properties of 2x1 photonic crystal vertical-cavity surface-emitting laser arrays. Using only the far-field interferogram, this theory predicts the frequency splitting between the lasers in agreement with spectral measurements.

**LThC4 • 9:30 a.m.**  
Terahertz Study of Trichloroanisole by Time-Domain Spectroscopy, Yew Li Hor, Hee C. Lim, John F. Federici, Eric Moore, Joseph W. Bizzell; New Jersey Inst. of Technology, USA. This work presents THz time-domain spectroscopy applied in transmission to three TCA compounds (2,3,4-TCA, 2,4,6-TCA and 2,5,6-TCA) in pellet form pressed with polyethylene. Experiment results would be compared to theoretical modeling of the vibrational modes.

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**NOTES**

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**10:00 a.m.–10:30 a.m., Coffee Break, Fairmont Hotel, Regency and Imperial Ballroom Foyers**
invited

10:30 a.m. - 12:10 p.m.

SThD • Best of Topicals II
Michael Duncan, Naval Res. Lab, USA, Presider

SThE • Space-Qualification of Materials and Devices for Laser Remote Sensing Instruments II and Ceramic Materials I
Gregory Quailes; VLOC, USA, President

10:30 a.m. - 12:30 p.m.

SThF • (Guarded) Rational Exuberance: Renaissance after the Telecom Boom? Part II
Ming Wu; Univ. of California at Berkeley, USA, Presider

10:30 a.m. - 12:15 p.m.

FThD • Ultrafast Pulse Measurements II
Barry C. Walker; Univ. of Delaware, USA, Presider

10:30 a.m. - 12:30 p.m.

FThE • Seeing the Invisible: Strategies for Imaging Transparent Cell Types I
Melanie C. Campbell; Univ. of Waterloo, Canada, Presider

10:30 a.m. - 12:55 p.m.

SThD2 • 10:55 a.m.
Optical Frequency Comb Generation from a Monolithic Micro-Resonator via the Kerr Nonlinearity, Pascal DelHaye, Albert Schliesser, Tobias Wilken, Ronald Holzwarth, Tobias Kippenberg, Max-Planck-Institut for Quantum Optics, Germany. It is shown that the cascaded optical sidebands generated via optical parametric oscillations in a monolithic microcavity are equidistant down to a resolution bandwidth limited level of 2 kHz. (Nonlinear Optics: Materials, Fundamentals and Applications, 2007)

10:30 a.m. - 12:15 p.m.

FThE2 • 11:00 a.m.
A Polychromatic High Sensitivity Double-Pass System to Measure Intraocular Scattering, Guillermo M. Pérez, Pablo Artal; Lab de Óptica, University of Valencia, Spain. We developed an instrument based on the double-pass technique to quantify intraocular scattering in the living eye by recording and analyzing retinal images with a large field of view.

10:30 a.m. - 12:15 p.m.

FThE3 • 11:15 a.m.
Mueller Matrix CSLO Polarimetry and Improved Imaging of Retinal Structures, Juan Bueno; Univ. de Murcia, Spain. The ocular optics and the retina present polarization properties that can be used to improve fundus imaging. In particular, Stokes-Mueller polarimetry will be shown as an alternative technique to image living retinal structures.

10:30 a.m. - 12:15 p.m.

FThD1 • 10:30 a.m.
The Long and the Short of Interferometric Pulse Measurements, Ian Walmsley, Piotr Wasylczyk, Simon-Pierre Goraz, Antoine Menyuk, Mac Raduansky; Univ. of Oxford, UK. We discuss recent developments in spectral shearing interferometry for ultrashort pulse characterisation. Long nonlinear crystals enable compact, highly sensitive devices for space-time measurements, and spatial encoding extends this capability to the single cycle regime.

10:30 a.m. - 12:30 p.m.

FThE1 • 10:30 a.m.
Post Bubble Entrepreneurial Paradigm! Milton Chang; Incubic, LLC, USA. Milton Chang has an exceptional investment track record, and founded Incubic to institutionalize this approach in a venture capital firm. Milton has personally built two businesses from zero to successful IPO, as CEO. The proven ability to build true business from zero is distinct from operating experience, and is critical to the start-up process and success.

10:30 a.m. - 12:15 p.m.

FThD3 • 11:15 a.m.
Spectro-Temporal Imaging by Sum Frequency Generation: Ultrafast Optical Oscilloscope, Aram Zeytunyan1, Tigran Mamuryan1, Meri Kalashyan1, Garegin Yagman1, Lorek Kh Mouradian1, Frederic Louradour1, Alain Barthélémy1; Yerevan State Univ., Armenia. "XILIM Inst. de Recherche, Faculté des Sciences, France. We experimentally demonstrate an aberration-free self-reference spectro-temporal imaging of femtosecond pulses through a new spectral compression/temporal lensing method based on second harmonic generation.
**Invited**

**FThF1 • 10:30 a.m.**
Surface Plasmon-Based Optical Manipulation: Towards Ultra Gentle Nano-Tweezers, Romain Goidan; Inst. de Ciencias Fotónicas, Spain. We investigate how enhanced surface plasmon fields bound to noble metal structures can be exploited to revisit optical manipulation and extend its applicability down to the nano-scale.

**FThF2 • 11:00 a.m.**
Far-Field Characterization of Gold Nanoantenna Arrays, Zhengtong Liu1, Alexandra Boltsassev2, Rebekah M. Bakker1, Samuel Grézillon1, Hao-Keun Yuan1, Alexander V. Kildishev2, Vladimir P. Drachev1, Lukas Novotny3; 1Purdue Univ., USA, 2TechUniv. of Denmark, Denmark, 3Michigan Technological Univ., USA. Elliptical gold nanoantenna arrays were studied. Their measured transmittance and reflectance spectra agree well with finite element simulation results. We varied the geometries in simulations and show their effects on the spectra.

**FThF3 • 11:15 a.m.**
Bowlie Nanoantennas as Substrates for Electrochemical Surface-Enhanced Raman Scattering (SERS), Frank Jäckel, Anika A. Kinkhabwala, W.E. Moerner; Stanford Univ., USA. Single gold bowlie nanoantennas are used for electrochemical SERS. Certain vibrational modes of para-mercaptoaniline show a switching-on behavior related to roughening of the nanostructure’s surface upon electrochemical cycling, underlining the importance of well-characterized SERS substrates.

**FThD1 • 10:30 a.m.**
Optical Lattice Experiments, David Weiss, Karl D. Nelson, Xiao Li; Penn State, USA. We have spatially resolved ~250 single, neutral atoms in a 3-D array. The atoms are trapped in a blue-detuned optical lattice, and can function as qubits in a quantum computer.

**FThD2 • 11:00 a.m.**
Coherent Control of Pairs of Cold Atoms in a Double-Well Optical Lattice, Patricia J. Lee, M. Anderlini, B. L. Brown, J. Sebby-Strabelj, W. D. Phillips, J. V. Porto; NIST, USA. We present techniques for coherent manipulation of an array of isolated atom pairs in a lattice of double-well potentials, and their potential applications in quantum information processing.

**FThD3 • 11:00 a.m.**
A Snap-Shot Dual-Dispenser Imager for Compressive Hyperspectral Imaging, Renu John1, David J. Brady1, Rebecca M. Willett1, Michael Gehm2, Matthais C. Hoffmann, János Hebling, Richard J. Gillmore, Y. Lim3; 1Duke Univ., USA, 2Univ. of Arizona, USA, 3Konkuk Univ., Republic of Korea. We describe associated multiscale reconstruction algorithms to retrieve hyperspectral data from single-shot image. We show simulated and experimental results.

**FThD4 • 11:15 a.m.**
Near Infrared Lidar System for Hazard Detection and Mitigation Onboard Aircraft, Mary E. Ludwig, Joseph D. Matchett, Elizabeth J. Billmers, Richard J. Billmers; RL Associates, Inc., USA. A near infrared range-gated Lidar system using polarization discrimination to mitigate aviation hazards is modeled and tested. Functionality is demonstrated in rain and fog conditions, and modeled for detection of water phase in cirrus clouds.

**FThG1 • 10:30 a.m.**
Miniature Computer-Tomography Imaging Spectrometer, Wei Zhou, James Legr1, Univ. of Minnesota, USA. A miniature computer-tomography imaging spectrometer (2mm) has been designed using a hybrid combination of diffractive, refractive, and graded-index optical elements. The diffractive elements are fabricated directly onto the ends of the micro-GRIN-lenses by focused-ion-beam etching.

**FThG2 • 10:45 a.m.**
A Slow-Light Fourier Transform Interferometer, Zhumin Shi, Robert W. Boyd; Inst. of Optics, Univ. of Rochester, USA. We propose a new type of Fourier-transform interferometer based on a tunable slow-light medium. Such a FT-interferometer requires no moving arm, can have very fine spectral resolution, and is more compact than a conventional FT-interferometer.

**FThG3 • 11:00 a.m.**
THz High Field Generation, THz Coherent Spectroscopy and THz Coherent Control, Ka-Lo Yeh, Matthias C. Hoffmann, János Hebling, Keith A. Nelson, MIT, USA. THz pulses with over ten microjoules of energy are generated and used to drive nonlinear material responses. Nonlinear THz coherent spectroscopy and coherent control are illustrated.
<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Speaker(s)</th>
<th>Abstract/Notes</th>
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<tr>
<td><strong>SThD • Best of Topicals II—Continued</strong>&lt;br&gt;StD3 • 11:20 a.m.</td>
<td>Fiber-Top Cantilevers: A New Generation of Micromachined Sensors for Multipurpose Applications</td>
<td>Davide Iannuzzi1, Stefano Delambri1, Herman Schraudenbrett1, Jan H. Rector2, Michael Everspacher1; 1Vrije Univ. Amsterdam, Netherlands, 2Univ. of Twente, Netherlands. Fiber-top cantilevers are new monolithic devices obtained by carving a cantilever out of the edge of a single-mode optical fiber. Here we report evidences of their potential impact as sensing devices for multipurpose applications. (18th International Conference on Optical Fiber Sensors, 2006)</td>
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<td><strong>SThE • Space-Qualification of Materials and Devices for Laser Remote Sensing Instruments II and Ceramic Materials I—Continued</strong>&lt;br&gt;StH3 • 11:30 a.m.</td>
<td>Advances in Ceramic Laser Media</td>
<td>Ken-ichi Ueda; Univ. of Electro-Communications, Japan.</td>
<td>No abstract available.</td>
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<tr>
<td><strong>SThF • (Guarded) Rational Exuberance: Renaissance after the Telecom Boom? Part II—Continued</strong>&lt;br&gt;FThD • Ultrafast Pulse Measurements II—Continued**&lt;br&gt;FhE • Seeing the Invisible: Strategies for Imaging Transparent Cell Types I—Continued**&lt;br&gt;FhD5 • 12:00 p.m.</td>
<td>Title to Be Announced</td>
<td>Richard Swanson; SunPower Corp., USA. No abstract available.</td>
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<tr>
<td><strong>SThD4 • 11:45 a.m.</strong></td>
<td>Two-Dimensional Spectral Shearing Interferometry (2-DSI) of Few-Cycle Laser Pulses</td>
<td>Franz X. Kaertner, J. Birge; MIT, USA.</td>
<td>We apply the new pulse measurement technique, two-dimensional spectral shearing interferometry, to the characterization of few-cycle laser pulses and discuss its limitations in approaching the single-cycle regime.</td>
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<td><strong>SThE4 • 12:00 p.m.</strong></td>
<td>Methods for Measuring Light Scatter in Intraocular Lenses</td>
<td>Marie H. van der Mooren1, Joris Coppens2, Tom van den Berg2, Patricia Piers1; 1AMO Groningen BV, Netherlands, 2Netherlands Inst. for Neuroscience, Netherlands.</td>
<td>Light scatter in intraocular lenses may be a significant factor in quality of vision for patients implanted with these lenses. This paper describes two quantitative methods for measuring light scatter in intraocular lenses in situ.</td>
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<td><strong>SThF4 • 12:00 p.m.</strong></td>
<td>The Application of Molecular Contrast Optical Coherence Tomography to Imaging Cells in the Living Retina</td>
<td>Joseph Izatt; Duke Univ., USA.</td>
<td>We describe molecular contrast optical coherence tomography and its potential applications for retinal imaging. Other functional contrast mechanisms including blood flow and cellular optical property fluctuations will also be discussed.</td>
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**Thursday, September 20**
FThF • 11:30 a.m.
Plasmon Guiding in Coupled Nanovoids, Isabel Romero1, Tatiana Teperek1, Francisco Javier García de Alba1,2; 1Donostia Int'l Physics Ctr., Spain, 2Inst. de Óptica - CSIC, Spain. Plasmon propagation is investigated in arrays of silica particles buried in gold. Long propagation distances are obtained, thus providing a realistic scenario for plasmonic circuits based upon buried structures.

FThF5 • 11:45 a.m.
Ideas for Optical Nanoantenna Design: From Microwave to Visible Frequencies, Jingjing Li, Alessandro Salandrino, Nader Engheta; Univ. of Pennsylvania, USA. We discuss how nanoantenna designs can be inspired and benefit from the conventional microwave antenna design techniques. Several optical nanoantenna ideas, analyzed numerically by transplanting the classic antenna concepts from microwaves to optics, are presented.

FThG • 11:30 a.m.
A Highly Compact Chaotic Cavity for Optical Trace Gas Sensing Applications, Dongxia Qu1, Allen Hea1, Abhishek Agarwal1, Tiffany Ko1, Evgenii Narimanov1, Claire Gmachl1; 1Princeton Univ., USA. We present a novel chaotic cavity for in situ trace gas sensing. The multi-pass cavity achieves ~15-m optical path length in a cavity of only 68 mL volume with little beam overlap on the mirror.

LThD • 11:30 a.m.
Fiber Optic Sensor for Measuring Refractive Index of Liquids, Govindan Gobi, Dillibabu Sastikumar; Natl. Inst. of Technology, India. A simple technique for determining the refractive index of liquids using reflective type of fiber optic displacement sensor is described. The refractive indices observed for the liquids range from 1.33 to 1.52.

FThG6 • 11:45 a.m.
Numerical Analysis of the Role of Core-Clad Index Contrast in a Multicore Fiber Bundle, Xianpei Chen, Chris Xu; Cornell Univ., USA. We demonstrate numerically that a large core-clad index contrast lowers couplings between neighboring cores, achieving a fiber bundle with a higher core density, less coupling, and effectively single mode propagation in each core.

FThG7 • 12:00 p.m.
Numerical Analysis of the Role of Core-Clad Index Contrast in a Multicore Fiber Bundle, Xianpei Chen, Chris Xu; Cornell Univ., USA. We demonstrate numerically that a large core-clad index contrast lowers couplings between neighboring cores, achieving a fiber bundle with a higher core density, less coupling, and effectively single mode propagation in each core.

LThE • 12:00 p.m.
Studies of Shift and Rectification Currents in GaAs(111) Using fs Fiber Laser at a Wavelength of 1.5 μm, Masayoshi Tonouchi; Osaka Univ., Japan. We review the development of THz-TDS with a 1.5-μm-fiber laser. A variety of emitters such as surfaces of InAs, InGaAs, and InSb, photoconductive switches, and DAST are examined.
<table>
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<th>Empire</th>
<th>Crystal</th>
<th>Gold</th>
<th>Valley</th>
<th>California</th>
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**Frontiers in Optics**

- **SThD • Best of Topicals II—Continued**
- **SThE • Space-Qualification of Materials and Devices for Laser Remote Sensing Instruments II and Ceramic Materials I—Continued**
- **SThF • (Guarded) Rational Exuberance: Renaissance after the Telecom Boom? Part II—Continued**
- **FThE • Seeing the Invisible: Strategies for Imaging Transparent Cell Types I—Continued**

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**12:30 p.m.–2:00 p.m., Lunch Break**
NOTES

12:30 p.m.–2:00 p.m., Lunch Break
A. B. Miller received the B.Sc. degree from St Andrews Univ., and, in 1979, the Ph.D. degree from Heriot-Watt Univ., both in Physics. He was with Bell Labs from 1981 to 1996, as a department head from 1987, latterly of the Advanced Photonics Res. Dept. He is currently the W. M. Keck Professor of Electrical Engineering, the Director of the Solid State and Photonics Lab, and a Co-Director of the Stanford Photonics Res. Ctr. at Stanford Univ., Stanford, California, USA. His research interests include physics and devices in nanophotonics, nanometalics, and quantum-well optoelectronics, and fundamentals and applications of optics in information sensing, switching, and processing. He has published more than 200 scientific papers, holds 62 patents, is a Fellow of OSA, IEEE, APS, and the Royal Societies of Edinburgh and London, holds honorary degrees from the Vrije Univ. Brussel and Heriot-Watt Univ., and has received numerous awards.

We report the growth of metal and semiconductor nanowires and nanowire lattices by a vapour deposition process, to create novel photonic, electronic and plasmonic functionality inside the fiber waveguide.

Two new ideas will be presented: (i) Spatio-temporal control in combination with adiabatic energy concentration and (ii) Time-reversal coherent control. We consider theory and experimental data on coherent control of nanoscale energy localization in nanosystems. Two new ideas will be presented: (i) Spatio-temporal control in combination with adiabatic energy concentration and (ii) Time-reversal coherent control.

Novel and Microstructured Fibres for Sensing Applications, William N. MacPherson, James S. Barton, Duncan P. Hand, Julian D. C. Jones; Heriot-Watt Univ., UK. Recent advances in novel optical fibers, including multicore and microstructured fibres, are enabling new sensing techniques. Here we consider the benefits and applications of these new fiber designs for practical sensor applications.

We consider theory and experimental data on coherent control of nanoscale energy localization in nanosystems. Two new ideas will be presented: (i) Spatio-temporal control in combination with adiabatic energy concentration and (ii) Time-reversal coherent control.

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2:00 p.m.–3:30 p.m.  
**FThL** • Plasmonics and Nanocrystals  
Qiwen Zhan; Univ. of Dayton, USA, Presider

**FThL1** • 2:00 p.m.  
Invited  
Hybrid Plasmons for Manipulating Molecular and Excitonic Energy Redistribution Pathways, Gary Wiederrecht1, Jeffrey E. Hall1, Alexandre Bouhelier1; 1Argonne Natl. Lab, USA, 2Dépt. Nano-sciences, Inst. Carnot de Bourgogne, USA. Strong coupling of molecular excitons and plasmons are used to manipulate molecular energy redistribution pathways on an ultrafast timescale. Ramifications for controlling energy decay pathways in molecules and excitons are discussed.

2:00 p.m.–4:00 p.m.  
**FThM** • Diffractive Micro- and Nanostructures for Sensing and Information Processing III  
Stefan Sinzinger; Technische Univ. Ilmenau, Germany, Presider

**FThM1** • 2:00 p.m.  
Invited  
Polarization Optimized 4-π Geometries for Microscopy, Gerd Leuchs, Hildegard Konermann, Robert Matulic, Markus Sonderegger, Susanne Quabis, Norbert Lindeiner, Ulf Peschel; Inst. für Optik, Information and Photonik, Univ. Erlangen, Germany. Tailored polarization can lead to a smaller focal spot in high numerical aperture focusing. The same radial polarization mode maximizes the coupling to an atom when using the correct 4π geometry.

2:00 p.m.–3:45 p.m.  
**FThO** • Random Lasers and Disordered Media  
Presider to Be Announced

**FThO1** • 2:00 p.m.  
Statistics of Lasing Peaks and ASE Spikes from Amplifying Random Media, Xiaohua Wu, Hui Cao; Northwestern Univ., USA. We studied experimentally the ensemble-averaged spectral correlation functions and statistical distributions of spectral spacing and intensity of ASE spikes and lasing peaks from weakly scattering systems under local pumping. Their differences revealed distinct physical mechanisms.

2:00 p.m.–4:00 p.m.  
**FThN** • Coherence and Polarization IV  
Presider to Be Announced

**FThN1** • 2:00 p.m.  
Invited  
Title to Be Announced, Aristide Dogariu; Univ. of Central Florida, USA. No abstract available.

2:15 p.m.  
**FThO2** • 2:15 p.m.  
Invited  
Theory of the Spatial Structure of Nonlinear Modes in Random Lasers, Habee E. Tureci1, Li Ge2, Stefan Ruter3, A. Douglas Stone2; 1ETH Zurich, Switzerland, 2Yale Univ., USA. A new formalism for calculating exact non-linear multi-mode lasing states for complex resonators is applied to a 2-D- random laser. We show the existence of novel “composite” random lasing states.

2:30 p.m.  
**FThL2** • 2:30 p.m.  
Size Dependent Surface Plasmon Scattering of Single Cu Nanowires, Sang-Youp Vim1, Hong-Gyu Ahn1, Dae-Geun Kim1, Koo-Chul Je1, Holyeol Ju1, Moohyun Choi1, Chang Wook Park1, Seung-Ham Park1; 1Natl. Res. Lab of Nonlinear Optics, Yonsei Univ., Republic of Korea, 2Dept. of Applied Chemistry, Hanyang Univ., Republic of Korea. Surface plasmon scattering spectra of single Cu nanowires were studied using total internal reflection microscopy. In particular, we have observed a strong surface plasmon peak in deep red and the red-shift with increasing the diameter.

2:30 p.m.  
**FThM2** • 2:30 p.m.  
Angle-Wavelength Matching Conditions for Multiplexed Three-Dimensional Spatial and Spectral Holographic Imaging, Raymond K. Kostuk1, George Barbastaath1, Paul Geisler1, Yuan Luo1, Jonathan M. Watton1; 1Univ. of Arizona, USA, 2MIT, USA. Angle-wavelength matching process in volume holograms using both rigorous coupled wave and scalar grating theories is evaluated. Rigorous coupled wave analysis indicates that high diffraction efficiency can be obtained over a very broad spectral-angle range.

2:30 p.m.  
**FThN2** • 2:30 p.m.  
Definitions of the Degree of Polarization of a Light Beam, Asma Al-Qasimi1, Daniel F. V. James1, Olga Korotkova2, Emily Wolf2; 1Univ. of Toronto, Canada, 2Univ. of Rochester, USA. We discuss conditions under which certain ad hoc expressions for the degree of polarization of a light beam, frequently used in the literature, are valid.
**FThH • Silicon and III-V Based Optoelectronics for Optical Interconnects—Continued**

2:45 p.m.  
**Optical Interconnects Using Injection-Locked VCSELs**, Lukas Chrostowski; Univ. of British Columbia, Canada. Injection-Locked Vertical Cavity Lasers exhibit drastically enhanced performance. The 3-dB bandwidth can be increased up to 40 GHz, due to a resonance frequency enhancement. Such VCSELs may play a role in future optical interconnects.

**FThG • Ceramic Materials II—Continued**

3:00 p.m.  
**Optical Ceramics: The Promise for a New Technology for High-Power Lasers and Nuclear Radiation Detection**, Romanus Gouma; Stanford Univ., USA. We will present the benefits offered by transparent polycrystalline materials for high-power laser and efficient nuclear detector applications over single-crystal and glass-based technologies. The current challenges in transparent ceramic fabrication will also be discussed.

**FThH3 • 2:45 p.m.**  
**Effect of Stoichiometry on Grain Growth and Transparency of Nd:YAG Ceramics**, Song-Ho Lee1, Elizabeth Kapp1, John Dumm1, Vida Castille1, Greg Quarter1, Gary Messing1; Pennsylvania State Univ., USA, 2II-VI Inc., USA, 3VLOC, USA. Polycrystalline 1 at% Nd:YAG ceramics were prepared by reactive sintering. We have measured in-line optical transmittance and scattering loss for several compositions near stoichiometric ceramics. The best optical transmittance (~84%) was obtained at stoichiometric composition.

**FThG3 • 3:00 p.m.**  
**ASE Characterization of an Er3+-Doped Microstructured Tellurite Fiber Sample**, Aldário C. Bordonalli; Univ. of Campinas, Brazil. A preliminary ASE spectral characterization of an Er3+-doped microstructured tellurite fiber sample is presented by using a 980-nm pump laser. The amplifier presented a 3-dB bandwidth of around 70 nm, centered at 1545 nm.

**FThI • Nanoscale Concentration of Light I—Continued**

2:45 p.m.  
**Microstructure-Fiber-Based Ultrafast Optical Parametric Oscillators**, Jay E. Sharping1, Jeremy R. Sanborn1, Mark A. Foster2, Daniel Broaddus1, Alexander L. Gaeta2, Jacob Laster1, Ove Lyngnes3, Kurt Vogel3; 1Univ. of California at Merced, USA, 2Cornell Univ., USA, 3Precision Photomomics, USA. We report on the generation ultrafast, high-power pulses using a microstructure-fiber-based optical parametric oscillators. This approach provides new opportunities for extending the functionality of mode-locked fiber lasers.

**FThI3 • 3:00 p.m.**  
**Localization and Correlation of Waves in the Time Domain**, Azriel Z. Genack1, Andrey A. Chabanov2, Chak-Him Wong1, Chak-Him Wong1, Sai-Ki Cheung1, Ping Sheng1, Zhao-Qing Zhang2; 1Queens College of CUNY, USA, 2Univ. of Texas at San Antonio, USA, 3Hong Kong Univ. of Science and Technology, Hong Kong. Measurements of the microwave spectrum for localized waves allow us to establish the connection between spatial localization, giant fluctuations and strong correlation in the time domain using a model of localized modes.

**FThJ • Microstructured and Novel Optical Fibers—Continued**

3:00 p.m.–4:00 p.m.  
**Microstructured Tellurite Fiber for Broadband Amplification at 1550 nm**, Enyes F. Chillice1, Carlos L. César1, Luis C. Barbosa1, Regionalde Da Silva1, Aldário C. Bordonalli1, Univ. of Campinas, Brazil. Novel photonic metamatals have been engineered from spatially periodic, strongly birefringent dielectric materials and have been studied with microwaves to demonstrate extraordinary field amplitude growth within their structure at the photonic band edge transmission resonances.

**FThJ3 • 3:00 p.m.**  
**ASE Characterization of an Er3+-Doped Microstructured Tellurite Fiber for Broadband Amplification at 1550 nm**, Enyes F. Chillice, Carlos L. César, Luis C. Barbosa, Regionalde Da Silva, Aldário C. Bordonalli; Univ. of Campinas, Brazil. A preliminary ASE spectral characterization of an Er3+-doped microstructured tellurite fiber sample is presented by using a 980-nm pump laser. The amplifier presented a 3-dB bandwidth of around 70 nm, centered at 1545 nm.

**FThP • Engineering the Eye: Advances in Retinal Prostheses I**

3:00 p.m.–4:00 p.m.  
**Quantitative Assessment of Spatial Vision in Second Sight Retinal Prosthesis Subjects**, Matthew J. McLarnon1, Avi Caspi1, Jenny D. Dorr1, Kelly H. McChure2, Mark S. Humayun1, Robert L. Greenberg1, 2Second Sight Medical Products, USA, 3Doheny Eye Inst., USA. Electrical stimulation of a grid of retinal electrodes produces localized spots of light that can be used to construct an image of the world with a resolution determined by the spacing between neighboring electrodes.
FThL • Plasmonics and Nanocrystals—Continued

Nanoparticles in Microcavities as All-Optical Tunable Systems, Rebecca Satindou, Francisco Javier García de Abajo; Inst. de Optica - CSIC, Spain. An all-optical tunable system is proposed consisting of metallic nanoparticles within open metallic cavities. Resonant nanoparticle-cavity interaction is observed through both electromagnetic forces, intended to move the nanoparticle, and light absorption of the combined system.

FThL3 • 2:45 p.m.

Kwon Kim, David S. Citrin; Georgia Tech, USA. Tunable Systems, Nanoparticles in Microcavities as All-Optical Tunable Systems, Rebecca Satindou, Francisco Javier García de Abajo; Inst. de Optica - CSIC, Spain. An all-optical tunable system is proposed consisting of metallic nanoparticles within open metallic cavities. Resonant nanoparticle-cavity interaction is observed through both electromagnetic forces, intended to move the nanoparticle, and light absorption of the combined system.

FThL4 • 3:00 p.m.

Wavelength-Dependent Blinking Statistics of CdSe Nanocrystals Studied by Fluorescence Microscopy, Kenneth L. Knappenberger, Daryl B. Wong, Stephen B. Leone; Univ. of California, USA. Blinking statistics of CdSe nanocrystals are studied as a function of excitation wavelength, surface passivation and particle aspect ratio. The on/off events exhibit an excitation-dependent behavior that limits the duration of on events.

FThL5 • 3:15 p.m.

Effects of Field-Induced Exciton Anticrossing and Line-Broadening on the Analog Characteristics of InGaAsP Optical ADQW-EAM’s, Dong Kwon Kim, David S. Citrin; Georgia Tech, USA. Theoretical estimation of the InGaAsP optical ADQW-EAM’s yielded ~4.5 times enhancement of slope efficiency at much reduced operating bias-field against comparable SQW EAM’s, which is attributed to field-induced exciton anticrossing and line-broadening in ADQW’s.

FThM • Diffractive Micro- and Nanostructures for Sensing and Information Processing III—Continued

Holographic Optical Tweezer Driven with Real-Time Multi-Focus Iterative Fourier Transform Algorithm, Marek Skeren, Ondrej Komenda; Czech Technical Univ., Czech Republic. Holographic optical tweezer is presented based on the liquid crystal spatial light modulator operated in phase-only regime. Synthetic diffractive structures projected on this modulator are generated using new real-time multi-focus iterative Fourier transform algorithm.

FThM3 • 2:45 p.m.

Characterization of Femtosecond Laser Induced Nanogratings in Fused Silica, Nathan Lemke, Timothy D. Gerke, Ariel R. Libertun, Rafael Pastor; Univ. of Colorado, USA. Parameters such as writing power, speed, polarization and the number of written layers can control the resulting retardance and orientation.

FThM4 • 3:00 p.m.

Polychromatic Vortex: An Interferometric Investigation, Ravindra Pratap Singh, Virendra Kumar Jaiswal; Physical Res. Lab. India. A polychromatic vortex was produced and its properties were studied using interferometry. We confirmed the charge of the vortex and obtained its positions for red, green and blue colors, which were found to be different.

FThM5 • 3:15 p.m.

Measurement of the Coherency Matrix of a Stochastic Electromagnetic Broadband Beam, Panomsak Meemon, Maryam Chopra, Mohamed Salem, Kye Sung Lee, Jannick Rolland; Univ. of Central Florida, USA. Measurement of the coherency matrix. Here we present a method to measure the matrix elements of a broadband beam.

FThN • Coherence and Polarization IV—Continued

Focusing of Partially Coherent Light, Thomas van Dijk, Taco D. Visser; Free Univ., Netherlands. We investigate the focusing of partially coherent light and show that for certain types of correlation functions the intensity distribution can exhibit a local minimum at the geometrical focus.

FThN5 • 3:15 p.m.

Variable Coherence Sensing, Aristide Dogariu; Univ. of Central Florida, USA. Manipulating the statistical properties of the radiation provides means for developing robust sensing approaches. Controlling the coherence properties of light offers new possibilities for solving inverse problems and allows stochastic sensing with subwavelength resolution.

FThN4 • 3:00 p.m.

Coherent-Mode Representation of Partially Coherent and Partially Polarized Optical Fields, Oleg Zaitsev; Univ. of Duisburg-Essen, Germany. The coherent-mode representation of partially coherent, partially polarized optical field is defined on the basis of the unified theory of coherence and polarization. An example of the coherent-mode representation of the imaging process is given.

FThO • Random Lasers and Disordered Media—Continued

FThO4 • 3:15 p.m.

Mode Statistics in Random Lasers, Oleg Zaitsev; Univ. of Duisburg-Essen, Germany. Random lasers are modeled with non-Hermitian random matrices. The mean and variance of the number of lasing modes and the frequency spacing distribution in the two-mode regime were computed.

FThO3 • 2:45 p.m.

Variable Coherence Sensing, Aristide Dogariu; Univ. of Central Florida, USA. Variable Coherence Sensing, Aristide Dogariu; Univ. of Central Florida, USA. Manipulating the statistical properties of the radiation provides means for developing robust sensing approaches. Controlling the coherence properties of light offers new possibilities for solving inverse problems and allows stochastic sensing with subwavelength resolution.
FThH • Silicon and III-V Based Optoelectronics for Optical Interconnects—Continued

SThG • Ceramic Materials II—Continued

FThl • Nanoscale Concentration of Light I—Continued

FThJ • Microstructured and Novel Optical Fibers—Continued

FThP • Engineering the Eye: Advances in Retinal Prostheses I—Continued

FThH4 • 3:45 p.m.
Integration of Polymer Pins, Volume Gratings and Waveguides for Chip-to-Board and Board-to-Chip Optical Interconnects, Justin L. Stay, Muhammad S. Bakir, Ricardo Villalaz, Rohit Ogra, Thomas K. Gaylord, James D. Metinli; Georgia Tech, USA. Polymer pins, waveguides, and volume gratings are integrated together to provide optical input/output (I/O) between printed-wiring/waveguide board and chip. The fabrication processes needed to enable these configurations are described and experimentally evaluated.

SThG5 • 3:30 p.m.

FThl5 • 3:30 p.m.
Fabrication and Characterization of Plasmonic Nanolenses for Applications in Biophotonics, Francesco De Angelis, G. Das, C. Liberale, F. Macarini, E. Di Fabrizio; Univ. della Magna Graecia, Italy. In this work we present the fabrication of a novel plasmonic nanostructure for Surface Enhanced Raman Scattering for single molecule detection. High sensitivity measurements of a few hundred molecules will be presented.

FThJ5 • 3:30 p.m.
Chalcogenide Optical Fibre Nanowires, Benjamin J. Eggleton, Eric C. Mägi, Libin Fu, Dong-Il Yeom, Hong C. Nguyen; Univ. of Sydney, Australia. We experimentally demonstrate enhanced Kerr non-linear effects in tapered highly nonlinear As2Se3 chalcogenide fibre with sub-wavelength waist diameter. We observe enhanced non-linearity of 68.4 W⁻¹m⁻¹, which is 45,000 times larger than standard silica single-mode fibre.

FThP2 • 3:30 p.m.
A Model of Temporal Integration during Electrical Stimulation of the Human Retina, Alan Horsager¹, Scott H. Greenwald², James D. Wetland³, Mark S. Humayun¹, Robert J. Greenberg³, Matthew J. McMahone¹, Geoff M. Beynon³, Ione Fine³; ¹Univ. of Southern California, USA, ²Univ. of Washington, USA, ³Second Sight Medical Products, Inc., USA. We will describe how the high temporal sensitivity of the visual system allows for the ability to control the quality of the percept through manipulation of the timing properties of the electrical signal.

FThH5 • 3:30 p.m.
Integration of Polymer Pins, Volume Gratings and Waveguides for Chip-to-Board and Board-to-Chip Optical Interconnects, Justin L. Stay, Muhammad S. Bakir, Ricardo Villalaz, Rohit Ogra, Thomas K. Gaylord, James D. Metinli; Georgia Tech, USA. Polymer pins, waveguides, and volume gratings are integrated together to provide optical input/output (I/O) between printed-wiring/waveguide board and chip. The fabrication processes needed to enable these configurations are described and experimentally evaluated.

FThI6 • 3:45 p.m.
Experimental Confirmation of Backscattering Enhancement Induced by a Photonic Jet, Alexander Heifetz, Kevin Huang, Alan V. Sahakian, Xu Li, Allen Tafove, Vadim Backman; Northwestern Univ., USA. Our microwave-scaled experiments confirmed the properties of a sub-wavelength waist photonic jet emitted by a dielectric sphere, and associated enhanced position-dependent backscattering perturbations by a λ/10 diameter metal particle. The results were supported by FDTD simulations.

4:00 p.m.—4:30 p.m., Coffee Break, Fairmont Hotel, Regency and Imperial Ballroom Foyers
FThM • Diffractive Micro- and Nanostructures for Sensing and Information Processing III—Continued

FThM6 • 3:30 p.m.
Wavelength-Multiplexed Microholographic Data Storage with Diffraction-Limited Pit Size, Pengfei Wu1, Zhiqiang Liu2, Jame J. Yang3, Angel Flores4, Michael R. Wang5; 1New Span Opto-Technology Inc., USA, 2Univ. of Miami, USA. Micro-grating multiplexing is obtained by using a single beam containing multiple wavelengths from white light coded with a wavelength combiner. In addition, we have successfully recorded micro-grating array with diffraction-limited pit size.

FThN • Coherence and Polarization IV—Continued

FThN6 • 3:30 p.m.
Evolution of 3-D Polarization in Inhomogeneous Medium, Nikolai I. Petrov; Unaffiliated, Russian Federation. Generalized Stokes parameters consisting of nine real parameters in terms of irreducible tensor operators are considered. The degree of polarization by these parameters is defined and operator method for calculation of polarization evolution is developed.

FThO • Random Lasers and Disordered Media—Continued

FThO5 • 3:30 p.m.
Effect of Local Pumping on 1-D Random Laser Modes, Xiaohua Wu1, Jonathan Andreasen1, Hui Cao1, Alexey Yamilov2; 1Northwestern Univ., USA, 2Univ. of Missouri, USA. We calculated the quasimodes in one-dimensional random systems and the lasing modes under a global (or local) gain. Local pumping could make the lasing modes differ drastically from the quasimodes of a weakly scattering system.

FThM7 • 3:45 p.m.
Nano-Structured Metal-Dielectric Resonant Waveguide Filters, Ashifi Gogo1, Kristen Pudenz2, Markus Testorf1; 1Dartmouth College, USA, 2Iowa State Univ., USA. A parametric study of resonant waveguide filters is presented. The spectral and angular response of pure dielectric filter designs is compared with devices consisting of nano-structured combinations of metal and dielectric structures.

FThN7 • 3:45 p.m.
Simultaneous Measurement Method of Birefringence and Optical Rotation Using Spectroscopic-Polarized Modulator, Bari Kato, Toshitaka Wakayama, Yukitoshi Otani, Nishihara Umeda; Tokyo Univ. of Agriculture and Technology, Japan. A purpose of this study is to evaluate orientation of functional polymers. A channelled spectrum is generated by two pairs of spectroscopic-polarized modulators. We demonstrate to measure birefringence and optical rotation dispersion by single-shot measurement.

4:00 p.m.–4:30 p.m., Coffee Break, Fairmont Hotel, Regency and Imperial Ballroom Foyers
### Tutorial

**FThT1 • 4:30 p.m.**

**Engineering the Eye: Advances in Retinal Prostheses II**

Joseph Carroll; Univ. of Rochester, USA, Presider

Intraocular Camera for Retinal Prostheses: Optical Design, Michelle C. Hauer; Patrick J. Nasiatka, Noelle R. B. Stiles, Jaw-Chyng (Lormen) Lue, Rajat Agrawal, James D. Weiland, Mark S. Humayun, Armand R. Tanguay, Jr.; Univ. of Southern California, USA. Optical system design considerations are presented for an intraocular camera that is intended for use in conjunction with an epiretinal microstimulator array to form an intraocular retinal prosthesis for restoring functional vision to the blind.

**FThT2 • 4:45 p.m.**

**Mechanisms for Functional Vision Recovery in People with RP and the Subretinal ASR Retinal Prosthesis, Ronald A. Schuchard**; Emory Univ., USA, "VA Rehabilitation R&D COE, USA. Understanding the mechanisms of functional vision recovery by retinal prosthetic technology (e.g., neurotrophic for ASR) will optimize efforts to maximize everyday function and training of visual skills evaluated with appropriate and accurate outcome measures.

### Invited

**FThQ1 • 4:30 p.m.**

**Depth of Field with Multi-Aperture LWIR Imagers, Andrew D. Portnoy**, Mohan Shankar, Nikon Pitsianis, David Brady, Robert Gibbons, Alan Silver, David Keller, Caihua Chen, Dennis Prather; 1Dept. of Electrical and Computer Engineering, Univ. of Arizona, USA, 2College of Optical Sciences, Univ. of Arizona, USA, 4Univ. of Delaware, USA. We use a multiaperture approach to design a thin LWIR camera. Having a shorter focal length, the microlens array provides an extended depth of field over the conventional system.

**FThH1 • 4:30 p.m.**

**Invited**

**Nanocrystals for Optical Bio-Sensing, A. Paul Alivisatos; Univ. of California at Berkeley, USA.** No abstract available.

**FThR1 • 4:30 p.m.**

**Invited**

**Extraordinary Optical Properties of SiC Membranes: Superlensing, Sub-Surface Imaging, and Enhanced Transmission through Hole Arrays in Mid-IR, Gennady Shvets, Dmitriy Korobkin, Yaroslav Urzhumov, Burton Neuner III, Christopher Pietz, Christian Zornani, Thomas Taubner, Rainer Hillenbrand; Univ. of Texas at Austin, USA, Case Western Reserve, USA, 3Stanford Univ., USA, *Max-Planck-Institue für Biochemie, Germany. We have demonstrated a mid-IR superlens fabricated from a SiC membranes and incorporated into an NSOM for subsurface imaging. Enhanced transmission/absorption through hole arrays in a perforated SiC membranes will also be reported.**

### Crystal

**FThQ2 • 5:00 p.m.**

**Compressive Imaging Using Random Active Illumination, Panwar K. Baheti**, Mark A. Neifeld; *Dept. of Electrical and Computer Engineering, Univ. of Arizona, USA, College of Optical Sciences, Univ. of Arizona, USA. We present experimental results to demonstrate a compressive imaging system based on the use of structured light. Illumination patterns are defined using binary-valued random vectors and reconstruction is done using projection onto convex sets.

**FThH2 • 5:00 p.m.**

**Invited**

**Ordered Quantum Wire and Quantum Dots Systems for Nanophotonics Applications, Eli Kapon, Fredrik Karlsson; Ecole Polytechnique Federale de Lausanne, Switzerland. Fabrication technology and optical properties of site- and spectrally-controlled quantum wires and quantum dots grown on patterned substrates are described. Applications in generation of non-classical light, quantum cavity electrodynamics and ultra-low threshold lasers are discussed.**

**FThR2 • 5:00 p.m.**

**Nanofunctional Nanostructures and Quantum Dots, Martin M. Fejer; Stanford Univ., USA, Presider**

Nanoconnectors at Optical Frequencies, Andreas Ali, Nader Engheta; Univ. of Pennsylvania, USA. Following our paradigm for nanocircuit elements at optical frequencies, here we introduce the concept of ‘short-circuit’ optical nanocconnectors, consisting of plasmonic waveguides with a high-permittivity core surrounded by a low-permittivity concentric shell.

### Frontiers in Optics

**FThS1 • 4:30 p.m.**

**Tutorial**

**Review of Progress in Photonic Band-Gap Fibers, Karl Koch; Corning, Inc., USA.** The unique properties of air-core photonic band-gap fibers and their underlying principles of operation are reviewed. In addition, applications and other opportunities for these fibers are reviewed.

After graduating from the Univ. of Rochester’s Inst. of Optics in 1990, Karl worked at the Air Force Weapons Lab in Albuquerque, New Mexico on nonlinear frequency conversion and high-power lasers until 1998 when he joined Corning Inc. in Corning, New York where, as part of the Optical Physics group, he has led the photonic crystal fiber research effort and worked in the general area of optical physics and waveguides. He has over 50 publications in refereed journals and has served on numerous technical program committees including ASSL, CLEO, QELS, OFC and is currently associate editor for the Journal of Lightwave Technology and will Co-Chair the Frontiers in Optics meeting in 2008.
4:30 p.m.–6:30 p.m.
FThU • Cloaking
Presider to Be Announced

FThU1 • 4:30 p.m. Tutorial
Optical Metamaterials: From Magnetics with Rainbow Colors to Negative-Index and Cloaking, Vladimir M. Shalaev; Purdue Univ., USA. Metamaterials 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 in the optical range.

Vladimir M. Shalaev, the Robert and Anne Burnett Professor of Electrical and Computer Engineering and Professor of Biomedical Engineering at Purdue Univ., specializes in nano-photonics, nano-plasmonics, and optical metamaterials. Dr. Shalaev has several awards for his research in the field of nano-photonics and metamaterials. He is a Fellow of the American Physical Society (APS), Fellow of The International Society for Optical Engineering (SPIE), and a Fellow of the Optical Society of America (OSA). Dr. Shalaev is editor/co-editor for a number of journals and book series in the area of nanoscale optics. He has authored and edited 7 books, published 20 invited book chapters, and over 250 research papers.

FThV • 4:30 p.m.
New Holographic 3-D Light Shaping, Laura C. Thomson, Graeme Whyte, Michael Maslou, Johannes K. Courtaul, Univ. of Glasgow, UK, ‘Univ. of Cambridge, UK, ‘Univ. of St. Andrews, UK. Holograms can shape the 3-D intensity distribution of light beams. Here we describe work on 3-D intensity shaping of various kinds of beams, including monochromatic travelling waves, evanescent waves and self-reconstructing beams.

FThV1 • 4:30 p.m. Invited
Retinal Birefringence Changes Associated with Exudative Eye Disease, Ann E. Elsner, Dean A. VanNasdale, Yanming Zhao, Manahiro Miura, Anke Weber, Karen Tietmeyer, Russell Chipman; Indiana School of Optometry, USA, ‘Tokyo Medical Univ., Japan, ‘Univ. Eye Hospital, Germany, ‘Univ. of Arizona, USA. The polarization properties of light returning from normal and diseased retinas provides information beyond that available from intensity variations, including both the increased depolarized light in lesions and their higher contrast in depolarized light images.

FThW1 • 4:30 p.m. Invited
Retinal Birefringence Changes Associated with Exudative Eye Disease, Ann E. Elsner, Dean A. VanNasdale, Yanming Zhao, Manahiro Miura, Anke Weber, Karen Tietmeyer, Russell Chipman; Indiana School of Optometry, USA, ‘Tokyo Medical Univ., Japan, ‘Univ. Eye Hospital, Germany, ‘Univ. of Arizona, USA. The polarization properties of light returning from normal and diseased retinas provides information beyond that available from intensity variations, including both the increased depolarized light in lesions and their higher contrast in depolarized light images.

FThW • 4:30 p.m.
Coherence and Polarization V
Greg Gbur; Univ. of North Carolina at Charlotte, USA, Presider

FThW1 • 4:30 p.m. Invited
Retinal Birefringence Changes Associated with Exudative Eye Disease, Ann E. Elsner, Dean A. VanNasdale, Yanming Zhao, Manahiro Miura, Anke Weber, Karen Tietmeyer, Russell Chipman; Indiana School of Optometry, USA, ‘Tokyo Medical Univ., Japan, ‘Univ. Eye Hospital, Germany, ‘Univ. of Arizona, USA. The polarization properties of light returning from normal and diseased retinas provides information beyond that available from intensity variations, including both the increased depolarized light in lesions and their higher contrast in depolarized light images.

FThW2 • 5:00 p.m.
Measuring Human Macular Birefringence by Applying Mueller Calculus to Scanning Laser Polarimetry, Yanming Zhao, Dean A. VanNasdale, Bryan F. Haggerty, Benno L. Petrig, Ann E. Elsner; School of Optometry, Indiana Univ., USA. A scanning laser polarimeter was employed to acquire birefringence images of human retinas. The corneal retardance was mathematically compensated by using Mueller calculus, and the influence of age on macular retardance was studied.

FThV2 • 5:00 p.m.
Synthesis and Implementation of 3-D Wavefields for Ranging Applications, Markus Tesch, Canh Ly, Joseph N. Mait; Dartmouth College, USA, ‘Army Research Lab, USA. Superpositions of Laguerre-Gaussian modes are used to measure range. Beam patterns are experimentally realized using a spatial light modulator. Fundamental and practical limits of the 3-D beam synthesis problem are investigated.
Non Uniform Sampling Generalizations of Nyquist and Shannon’s Theorems Based on an Investigation of Phase Space, Bryan Hemmelky1, Markus Testorf2; 1Natl. Univ. of Ireland, Maynooth, Ireland, 2Dartmouth College, USA. A novel sampling theorem is presented based on a heuristic view of signals in phase space. The optimum non-uniform sampling distribution for a given compact shape of the signal in phase space is derived.

Quantum Dot Fluorescence Antibunching in Chiral Photonic Bandgap Hosts as a Single Photon Source, Luke J. Bisel1, Zhimin Shi1, Heeouk Shint1, Svetlana G. Lukishova1, Sean M. White2, Nicholas H. Oh2, Robert W. Boyd1, Carlos R. Stroud1, Todd D. Krauss2; 1Dept. of Chemistry, Univ. of Rochester, USA, 2Dept. of Physics, Stanford Univ., USA. Photoluminescence of a-axis and c-axis GaN nanowires demonstrates that the blue-shifted ultraviolet photoluminescence of a-axis and c-axis GaN nanowires demonstrate that the blue-shifted ultraviolet photoluminescence of a-axis and c-axis GaN nanowires can be attributed to surface state emission.

Propagating Modes with Large Bandwidth in Nanoscale Cylindrical Holes, Peter B. Catrysse1, Shanthi Fan1, Stanford Univ., USA. Subwavelength cylindrical holes in optically thick metallic films always support propagating modes near the surface plasmon frequency, regardless of how small the holes are. Here, we design nanoscale holes supporting modes with very large bandwidth.

Single-Channel 2R Regeneration in Quasi-Continuous Dispersion-Managed Nonlinear Medium, Pallavi G. Patki1, Veronika Stelmakh1, Muthiah Annamalai1, Michael Vasilyev1, Taihui Hu2, Nan Li3, Seiki Ohana1, Aoshi Glass Co., Japan. We demonstrate single-channel 1.5-DB eye-opening improvement in a dispersion-managed configuration. This is a first step toward realization of multi-channel 2R regeneration via dispersion management.
FThU • Cloaking—Continued

FThU2 • 5:15 p.m.
On Perfect Invisibility and Cloaking, David A. B. Miller; Stanford Univ., USA. Perfect invisibility even to pulses is possible in principle using sensors and sources around a volume and a new calculation formula, though would always be challenging for broadband electromagnetic waves and usually discoverable quantum-mechanically.

FThU3 • 5:30 p.m.
Cloaking at Optical Wavelengths, Uday K. Chettiar, Wenshan Cai, Alexander V. Kildishev, Vladimir M. Shalaev; Purdue Univ., USA. A design for a cloak based on coordinate transformation at optical wavelengths is presented. A possible realization is proposed and the design performance is studied using finite element method simulations.

FThU4 • 5:45 p.m.
IR and Optical Cloaking with Metamaterials with Plasmonic Implants: Theory and Simulations, Mario Silverinna, Andrea Ali, Naider Engheta; Univ. of Pennsylvania, USA. In our recent works, we suggested that plasmonic layers may provide cloaking for an object. Here we discuss how such plasmonic covers may be designed at terahertz, infrared and optical frequencies using metallic implants.

FThV • Diffractive Micro- and Nanostructures for Sensing and Information Processing IV—Continued

FThV3 • 5:15 p.m.
Finite-Number-of-Periods Gratings: Analysis Using the Total-Field/Scattered-Field Finite-Difference-Time-Domain Method, Aristides D. Papadopoulos, Elias N. Glytsis; Technical Univ. of Athens, Greece. Finite-number-of-periods holographic/surface-relief gratings are analyzed using the total-field/scattered-field finite-difference-time-domain (TF/SF-FDTD) method. Second-order and fourth-order TF/SF-FDTD formulations are used with various averaging schemes to treat permittivity/permeability discontinuities. TF/SF-FDTD results are compared with alternative methods.

FThV4 • 5:30 p.m.
Linear Spectral Estimation and the Design of Superresolution Filters, Markus Teterf, Michael Puddy; Dartmouth College, USA, 'Univ. of North Carolina at Charlotte, USA. A linear spectral estimation technique, the PDFT algorithm, is presented as a promising design strategy for superresolution filters. This non-iterative algorithm is applied to synthesize filters with rotational symmetry and compared with other approaches.

FThW • Coherence and Polarization V—Continued

FThW3 • 5:15 p.m.
Retinal Artery and Vein Diameters in Diabetic Retinopathy and Normal Eyes by Polarimetric Imaging, Benno L. Petrig1, Ann E. Elsner1, Dean A. VanNasdale1, Bryan P. Haggerty1, Yuming Zhao1, Brian Hanson1, Masahiro Miura2, Anke Weber3; 1Indiana Univ., USA, 2Tokyo Medical Univ., Japan, 3Univ. Hospital Aachen, Germany. Superior temporal retinal artery and vein diameters of patients with diabetic retinopathy were measured using near infrared light with crossed and parallel detectors and compared to normal age- and sex-matched controls.

FThW4 • 5:30 p.m.
Spectral Depolarization and Roughness Measurements of Painted Metal Surfaces, Dennis Goldstein; Consultant, USA. Mueller matrices for commercially painted metal surfaces have been measured with a spectropolarimeter. A profilometer has been used to collect roughness measurements of the samples as well. Measures of depolarization of the samples are presented.
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<th>Time</th>
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<tr>
<td>6:00 p.m.</td>
<td>Redistibution of Information for Imaging Systems with Increasing Numerical Aperture</td>
<td>Redistribution of Information for Imaging Systems with Increasing Numerical Aperture, Arthur S. van de Nes, Peter Török; Imperial College London, UK.</td>
<td>We describe a redistribution from entrance pupil to focal region of information contained in conserved quantities such as energy, linear- and angular-momentum, for imaging systems with increasing numerical aperture; allowing for system optimization.</td>
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<td>6:00 p.m.</td>
<td>Invited Quantum Dots for Advanced Semiconductor Lasers</td>
<td>Quantum Dots for Advanced Semiconductor Lasers, Dennis Deppe; Univ. of Central Florida, USA.</td>
<td>Efficiency and power limitations in laser diodes caused by internal optical loss, threshold, and resistivity are analyzed to show how epitaxial nanostructures can increase efficiency and power.</td>
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<td>6:00 p.m.</td>
<td>Invited Experimental Demonstration of Sub-Wavelength Imaging by Left-Handed Metamaterials</td>
<td>Experimental Demonstration of Sub-Wavelength Imaging by Left-Handed Metamaterials, Ekmel Ozbay; Bilkent Univ., Turkey.</td>
<td>We review the studies conducted in our group concerning electromagnetic properties of metamaterials and photonic crystals with negative refraction, subwavelength focusing, and flat lens phenomena.</td>
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<td>6:00 p.m.</td>
<td>Invited Slow, Fast, and Backwards Light Propagation in Erbium-Doped Optical Fibers</td>
<td>Slow, Fast, and Backwards Light Propagation in Erbium-Doped Optical Fibers, Robert W. Boyd1, George M. Gehring1, Giovanni Piredda1, Aaron Schweinsberg1, Katie Schwertz, Zhimin Shi1, Heedeuk Shin1, Joseph Vornehm, Jr.1, Petros Zerom1, Paul Narum2; 1Univ. of Rochester, USA, 2Norwegian Defence Res. Establishment, Norway.</td>
<td>Erbium-doped optical fiber can serve as either a saturable absorber or (when pumped) as a saturable amplifier, leading to slow or fast light propagation respectively. Exotic propagation effects are observed in this system.</td>
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<td>6:00 p.m.</td>
<td>The Phase-Space Interpretation of Self-Imaging and Discrete Representations of Paraxial Optical Systems</td>
<td>The Phase-Space Interpretation of Self-Imaging and Discrete Representations of Paraxial Optical Systems, Markus Testorf1, Bryan Hennelly2; 1Dartmouth College, USA, 2Natl. Univ. of Ireland, Maynooth, Ireland.</td>
<td>Phase-space diagrams of the Talbot effect and the spectral Talbot effect are used to construct discrete representations of linear canonical transformations. Their importance is illustrated in the context of diffractive optics and compressive imaging.</td>
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<td>6:30 p.m.</td>
<td>Luminescence Properties of Doped Nanostructures</td>
<td>Luminescence Properties of Doped Nanostructures, Amitava Patra; Indian Association for the Cultivation of Science, India.</td>
<td>Here, we report the role of crystal phase and surface coating on the modification of the radiative and nonradiative relaxation mechanisms of rare-earth doped nanocrystals and study their local structure by EXAFS.</td>
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### Frontiers in Optics

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<tr>
<td>6:00 p.m.</td>
<td>FThU5</td>
<td>Cloaking an Object Near an Obstacle with Plasmonic Materials, Andrea Alù, Nader Engheta; Univ. of Pennsylvania, USA. We have recently explored theoretically the possibility of using anomalous properties of plasmonic materials to cloak dielectric and metallic objects. Here we numerically analyze this setup in presence of an obstacle or a ground plane.</td>
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<tr>
<td>6:00 p.m.</td>
<td>FThV6</td>
<td>Rigorous Diffraction and Imaging by Multilayer Phase Structures in Extreme UV Lithography, Aura M. Nagrowati, Joseph J. M. Braat; Delft Univ. of Technology, Netherlands. A rigorous model of projection system for extreme UV lithography will be presented to image multilayer phase structures. These structures have the potential of achieving better image resolution than the commonly used absorbing structures.</td>
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<tr>
<td>6:00 p.m.</td>
<td>FThV7</td>
<td>Deep-Etched Grating for Polarization Separation, Changhe Zhou, Bo Wang, Jiun Feng, Huayi Ru; Shanghai Inst. of Optics and Fine Mechanics, China. We designed and fabricated a deep-etched subwavelength fused silica grating for polarization separation, which has etched depth of 2.0µm and period of 890nm, for polarization efficiency &gt;80% and polarization isolation &gt;30 for wavelength at 1550nm.</td>
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<tr>
<td>6:15 p.m.</td>
<td>FThU6</td>
<td>Invisible Lenses with Isotropic Materials, Juan C. Miñano, Pablo Benitez, Zarko Gacvić; Univ. Politécnica de Madrid, Spain. A perfect invisible lens (within the Geometrical Optics approximation) made of isotropic spherical-graded-index material is introduced. This unique lens is compared with other known invisible lenses (Pendry-Schurig-Smith’s and Leonihart’s).</td>
<td></td>
</tr>
<tr>
<td>6:15 p.m.</td>
<td>FThW5</td>
<td>Scattered Intensity Fluctuations for Characterizing Inhomogeneous Media, Sergey Sukhov, David P. Haefner, Aristotle Dogariou; College of Optics and Photonics, CREOL, Univ. of Central Florida, USA. When near field sensing is performed in reflection-emission configuration, statistical analysis of data provides information about the dielectric contrast and composition of inhomogeneous media. We report on modeling the statistical properties of this scattered intensity.</td>
<td></td>
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**5:30 p.m.–9:00 p.m., Science Educators’ Day, Fairmont Hotel, Regency Ballroom**
Yao, Fengfeng—TWA2
Yao, Hejun—JSuA17
Yariv, Amnon—FTuG2, LTuE4
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Zeldovich, B. Y.—FTuS4, FTuV7
Zeman, Herbert D.—JWC17
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Zwickl, B. M.—JWA2
Zysk, Adam M.—FWK1, FWV4
Presentation Time Change

The following paper’s presentation time has been moved up by 30 minutes, to Thursday, September 20, at 4:45 p.m. FThT3, High Resolution Optoelectronic Retinal Prosthesis, Daniel Palanker, Stanford Univ., USA

Session Time Change

All four FiO Postdeadline Paper sessions will begin at 6:15 p.m. on Wednesday, September 19, and end by 8:00 p.m. The full program for these sessions is available in your registration packet.

Presentation Times for SMB

Joint FiO/SPRC Symposium, Monday, September 17, 1:00 p.m.–4:30 p.m.
1:00 p.m. Commercialization of Printed Thin Film Solar Cells, Jim Sheats, Nanosolar, USA
1:45 p.m. Electronic Retinal Prostheses for Restoration of Sight, Dan Palanker, Stanford Univ., USA
2:15 p.m. IC Inspection Technology: Present Status and Future Challenges, Mehdi Vaez-Irvani, KLA-Tencor, USA
3:00 p.m. Fundamentals and Applications of Photonic Crystals and Metamaterials, Shanhui Fan, Stanford Univ., USA
3:45 p.m. Optical Mapping of Neuronal Circuity in a Living Brain, Mark Schnitzer, Stanford Univ., USA

Symposium on Undergraduate Research

The full program for this symposium is available in your registration packet. Please note that the time of session SMD has changed since the FiO/LS/OMD Conference Program was printed. The correct times are listed in the separate six-page program in your packet.

Abstract for Invited Paper SThF4

High Efficiency Silicon Solar Cells, Richard M. Swanson, SunPower Corp., USA. Conversion efficiency has emerged as an important contributor to further reducing photovoltaic system cost. This presentation will discuss the various improvements that have increased the efficiency of commercial products by over 50% in the last 5 years, as well as the impact of these developments on system cost.

Presider Updates

Joseph P. Culver, Washington Univ. in St. Louis, USA, will preside over FWV: Diffuse Imaging and Spectroscopy.
Rosalind M. Wynne, Villanova Univ., USA, will preside over FThJ: Microstructured and Novel Optical Fibers.
John L. Hall, JILA, Univ. of Colorado, USA, will preside over LTuH: Clocks, Navigation and Magnetometers.
Jack Harris, Yale Univ., USA, will preside over JWB: Radiation Pressure, Cooling and Quantum Cantilevers II.
Urs Utzinger, Univ. of Arizona, USA, will preside over session FTuD Biosensors I.

Withdrawn Oral Presentations

FME6 FThT2
FMF1 FThW4
FTuH3 LTuK1
FTuM2 LWI2
FWH3 LThA5
FWN2 OTuA5
FWU2 TWA5

Withdrawn Posters

JSuA40
JWC16

Short Course Cancellations

SC253
SC304
SC305

The organizers of FiO 2007 gratefully acknowledge the support of the Air Force Office of Scientific Research (AFOSR).

The organizers of OMD 2007 gratefully acknowledge the support of the Universal Display Corporation.
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PDP-A1 • 6:15 p.m.
Optics with Superhydrophobic Surfaces—a New Class of Switches and Sensors, Helmut Rathgen1, Kazuyasu Sugiyama2, Frieder Mugele3; 1Physics of Complex Fluids, Univ. of Twente, Netherlands, 2Physics of Fluids, Univ. of Twente, Netherlands. We introduce the use of structured hydrophobic surfaces for optical switches and sensors and demonstrate an ultra sensitive ultrasound sensor based on a superhydrophobic diffraction grating. Superhydrophobic photonic crystals promise devices with tunable stop band.

PDP-A2 • 6:27 p.m.
Lens Designs of High NA Objectives for Page-Based Holographic Data Storage Systems, Yuzuru Takashima, Lambertus Hesselinck; Stanford Univ., USA. High NA (0.7 – 0.8) objective lens in which both object and pupil aberrations are compensated for are designed in two-element configurations, and are usable for a combination of holographic and surface recordings.

PDP-A3 • 6:39 p.m.
Nonlinear Self-Filtering via Modulation Instability, Dmitry V. Dylov, Jason W. Fleischer; Princeton Univ., USA. We consider the nonlinear propagation of a mixture of coherent and spatially-incoherent light. We derive a diffraction/dispersion relation for the coupling and show experimentally how joint modulation instability can recover signals from a noisy background.

PDP-A4 • 6:51 p.m.
Production and Detection of Atomic Hexadecapole at Earth’s Magnetic Field, Victor Acosta; Univ. of California at Berkeley, USA. We report a novel method that allows selective creation and detection of a macroscopic long lived hexadecapole polarization in the $F = 2$ ground state of $^{87}$Rb atoms at Earth’s magnetic field (510 mG).

PDP-A5 • 7:03 p.m.
Nanoimprinted Circular Grating Distributed Feedback Dye Laser, Yan Chen; Caltech, USA. A surface emitting polymer dye laser is fabricated by nanoimprint lithography. The laser cavity consists of a 2nd-order circular grating distributed-feedback structure. This nanoimprinted dye laser offers a low-cost coherent light source for lab-on-chip microsystems.

PDP-A6 • 7:15 p.m.

PDP-A7 • 7:27 p.m.
Creating Vortex Retarders Using Photo-Aligned Liquid Crystal Polymers, Scott McEldowney1, David Shemo2, Russell Chipman3, Paula Smith4; 1JDSU, USA, 2College of Optical Sciences, Univ. of Arizona, USA. We present developments using photo-aligned liquid crystal polymers for creating vortex retarders. Polarization properties of devices with different modes and theoretical and experimental point spread functions in Mueller matrix format for these components are presented.

PDP-A8 • 7:39 p.m.
Achievement an Arbitrary Bandwidth of 4-skip-0 Bandpass Filters, Cheng-Chung Lee, Sheng-Hui Chen; Natl. Central Univ., Taiwan. By varying the refractive index of the thin film material the bandwidth can be fine tuned to an arbitrary value. A 4-skip-0 bandpass filter for 100GHz DWDM system of optical communication was designed and fabricated.
PDP-B1 • 6:15 p.m.
Ultrafast Dynamics of the Vibrations of Aqueous Azide Ion and the O-H Modes of Bound Water Molecules, Frank C.H. Kuo, Dmitriy Yu. Vorobyev, Jianxin Chen, Robin M. Hochstrasser; Univ. of Pennsylvania, USA. Dual frequency two dimensional infrared spectroscopy has been used to investigate the dynamics of the azide-water solvation shell. A positive correlation of the two frequency distributions is found and decays on the ultrafast timescale.

PDP-B2 • 6:27 p.m.
Noise and Electromagnetically Induced Transparency, Yanhong Xiao1, Tun Wang2, Maria Baryakhtar2, David F. Phillips2, Susanne F. Yelin1,2, Ronald L. Walsworth1,3; 1Harvard-Smithsonian Ctr. for Astrophysics, USA, 2Univ. of Connecticut, USA, 3Harvard Univ., USA. We report coherence-induced conversion of laser phase noise to intensity noise via interaction with an atomic medium. The spectrum of intensity fluctuations exhibits a narrow linewidth, that is immune to power broadening.

PDP-B3 • 6:39 p.m.
Observation of Accelerating Airy Beams, John Broky, Georgios Siviloglou, Aristide Dogariu, Demetrios Christodoulides; College of Optics and Photonics, CREOL, USA. We report the first observation of Airy optical beams. These wavepackets have been realized in both one- and two-dimensional configurations. It is demonstrated experimentally that these non-diffracting Airy beams tend to freely accelerate during propagation.

PDP-B4 • 6:51 p.m.
Two-Photon Absorption by H2 Molecules: Origin of the 2175A Astronomical Band? Peter P. Sorokin1, James H. Glownia2; 1IBM Res. (Emeritus), USA, 2Los Alamos Natl. Lab, USA. The UV spectra of OB stars are oftentimes dominated by a broad extinction band peaking at 2175 angstroms. We show that two-photon absorption by H2 molecules in clouds enveloping such stars fully explains this band.

PDP-B5 • 7:03 p.m.
Studies of Halo Nuclei by Laser Spectroscopy, Gordon W. F. Drake; Dept. of Physics, Univ. of Windsor, Canada. This paper describes recent progress in techniques for the determination of the nuclear charge radius for exotic “halo” nuclei such as 6He by the use of high precision laser spectroscopy to measure the isotope shift.

PDP-B6 • 7:15 p.m.
Nonlinear Terahertz Pump-Terahertz Probe Measurements of Semiconductor Carrier Dynamics, Haidan Chen1, Michael Wiczer1, Aaron Lindenberg1,2; 1PULSE Ctr., Stanford Linear Accelerator Ctr., USA, 2Dept. of Physics, Univ. of Illinois at Urbana-Champaign, USA. The field dependence of THz absorption in semiconductors is studied. Nonlinear absorption of ultrafast THz pulses is observed and can be attributed to free carrier excitation by the intense THz field.

PDP-B7 • 7:27 p.m.
Two-Beam Optical Trap in a Waveguide, Sergei Kuehn1, Philip Measor1, Holger Schmidt1, Evan J. Lunt1, Aaron R. Hackins2; 1Univ. of California at Santa Cruz, USA, 2Brigham Young Univ., USA. We demonstrate a novel dual-beam particle trap relying on waveguide loss instead of beam divergence. The implementation of this trap on an optofluidic chip opens numerous possibilities for on-chip particle control and manipulation.

PDP-B8 • 7:39 p.m.
Room-Temperature Polaritons in InGaN Microcavities, Yuh-Jen Cheng1, Jung-Tang Chu2, Hao-Chung Kuo2, Tien-Chang Lu2, Shing-Chung Wang2; 1Academia Sinica, Taiwan, 2Dept. of Photonics and Inst. of Electro-Optics, Natl. Chiao Tung Univ., Taiwan. We report the observation of room-temperature strong exciton-photon coupling in InGaN multiple quantum well microcavities. A 9 meV Rabi splitting with >60% peak to valley contrast was demonstrated. The anticrossing spectra were also observed.
PDP-C1 • 6:15 p.m.
Cavity Nonlinear Optics at Low Photon Numbers from Collective Atomic Motion, Subhadeep Gupta1, Kevin L. Moore2, Kevin W. Murch3, Dan M. Stamper-Kurn4; 1Univ. of Washington, USA, 2Univ. of California at Berkeley, USA. We report on nonlinear optical phenomena from collective motion of ultracold atoms within a strong-coupling cavity. The nonlinearity arises from probe-induced atom displacement. Longevity of motional coherence allows nonlinearity at extremely low cavity photon numbers.

PDP-C2 • 6:27 p.m.
Generation of Subnatural Linewidth Biphotons, Shengwang Du, Pavel Kolchin, Chinmay Belthangady, Guang-Yu Yin, Stephen E. Harris; Stanford Univ., USA. We describe the generation of time-energy entangled bipotons with a subnatural linewidth and a correlation time of about 100 ns. We use electromagnetically-induced transparency in a 87Rb two-dimensional magneto-optical trap.

PDP-C3 • 6:39 p.m.
Quantum Tomography of a Bright Phase-Stable Polarization-Entangled Single-Mode-Fiber Two-Photon Source, Jingyun Fan, Matthew D. Eisaman, Alan Migdall; Natl. Inst. of Standards and Technology, USA. We have demonstrated a bright single-mode-fiber source of polarization-entangled photon pairs with visibility > 97% and fidelity > 95% at a detected coincidence rate of 7 kHz/nm over a 3 dB, 10THz bandwidth.

PDP-C4 • 6:51 p.m.
Controlling Cavity Reflectivity with a Single Quantum Dot, Dirk R. Englund, Andrei Faraon, Ilya Fushman, Jelena Vuckovic; Stanford Univ., USA. We demonstrate that a single quantum dot coherently alters the reflectivity spectrum of an optical cavity. At higher power, we measure giant optical nonlinearity. The QD-controlled reflectivity opens the door to quantum information processing applications.

PDP-C5 • 7:03 p.m.
High-Flux Hyperentangled Photon-Pairs from a Microstructure-Fiber Sagnac Interferometer, Jun Chen, Jingyun Fan, Matthew D. Eisaman, Alan Migdall; Natl. Inst. of Standards and Technology, USA. We generate hyperentangled (time-bin and polarization) photon-pairs using a microstructure-fiber Sagnac interferometer. Two-photon-interference visibilities in both degrees of freedom are >83%, and the Bell’s inequality is violated by 25 σ at a 1-kHz coincidence rate.

PDP-C6 • 7:15 p.m.
A Slow Light Beam Splitter, Yanhong Xiao1, Mason Klein1, Michael Hohensee1, Liang Jiang1, David F. Phillips1, Ronald L. Walsworth1; 1Harvard-Smithsonian Ctr. for Astrophysics, USA, 2Harvard Univ., USA. A slow-light beamsplitter using the rapid transport of coherence in a wall-coated atomic vapor cell under electromagnetically-induced-transparency is presented. Such a beamsplitter may improve quantum repeater performance and be useful in quantum and classical optics.

PDP-C7 • 7:27 p.m.
Measurement of Intracavity Quantum Fluctuations of Light Using an Atomic Fluctuation Bolometer, Kater W. Murch, Kevin L. Moore, Subhadeep Gupta, Dan M. Stamper-Kurn; Univ. of California at Berkeley, USA. We present measurements of the spectral noise power of photon number fluctuations inside a high-finesse Fabry-Perot optical resonator, measured through the resonator-enhanced momentum diffusion of ultracold atoms trapped within.

PDP-C8 • 7:39 p.m.
Four-Wave Mixing and Two-Photon Interference in a Three-Level Atomic Ensemble, Shengwang Du1, Eun Oh2,3, Jianming Wen1, Morton H. Rubin1; 1Stanford Univ., USA, 2NRL, USA, 3Univ. of Virginia, USA, 4Univ. of Maryland, Baltimore County, USA. Interference of degenerate four-wave mixing in a three-level atomic ensemble is studied in both classical and quantum regimes. Biphoton interference shows photon anti-bunching or bunching effect under different situations.
Valley Room
6:15 p.m.—7:51 p.m.
PDP-D • FiO Postdeadline Papers IV
Presider to Be Announced

PDP-D1 • 6:15 p.m.
High-Power Broadband THz Emission from GaP Waveguides Pumped by High Power Ultrafast Fiber Lasers, Charles J. Dievin, Guoqing Chang, Malakeh A. Musheinish, Almantas Galvanauskas, Theodore B. Norris; Univ. of Michigan, USA. Broadband THz generation is demonstrated using optical rectification in 6 mm GaP waveguides pumped by a high power ultrafast Yb-doped fiber amplifier. 120 μW THz radiation is obtained from 14 W pump power.

PDP-D2 • 6:27 p.m.
Ultrafast Nonlinear Switching Dynamics in Metallic Photonic Crystals, Tilman Höner zu Siederdissen1, Tolga Ergin1, Jürgen Kuhl1, Markus Lippitz1, Harald Giessen2; 1Max Planck Inst., Germany, 2Univ. of Stuttgart, Germany. Time-resolved studies of the nonlinear transmission in one-dimensional metal-dielectric photonic crystals using femtosecond pump-probe spectroscopy at room temperature reveal its sub-picosecond switching dynamics and exhibit a surprising intensity dependence.

PDP-D3 • 6:39 p.m.
Metal Nanowire Arrays in Photonic Crystal Fibres, Luis N. Prill Sempere, Markus A. Schmidt, Hemant K. Tyagi, Chris G. Poulton, Philip St. J. Russell; Max-Planck Res. Group (IOIP), Germany. Nanowire arrays are produced by pumping molten metal into the holes of silica PCF. Distinct dips in the transmitted spectra coincide with the coupling of the core-guided light to leaky plasmonic resonances in the nanowires.

PDP-D4 • 6:51 p.m.
Measurements of the Gouy Phase Shift for Surface Plasmons, Wenhui Zhu, Amit Agrawal, Ajay Nahata; Univ. of Utah, USA. We directly measure the Gouy phase shift of converging surface plasmon-polaritons using terahertz (THz) time-domain spectroscopy. We perform numerical simulations to determine the surface electric field distribution and associate it with Gouy phase shift.

PDP-D5 • 7:03 p.m.
Photomodification of Semicontinuous Silver Films with ps Pulses—New Spectrum-Structure Optimization Technique, Piotr Nyga, Mark D. Thoreson, Vashista de Silva, Vladimir P. Drachev, Vladimir M. Shalaev; Purdue Univ., USA. Semicontinuous silver films were photomodified with picosecond laser operating at 10.6μm. Slow spectral and structural changes were obtained. This technique allows the creation of filters for mid-IR wavelengths and optimization of films for sensing applications.

PDP-D6 • 7:15 p.m.
Low-Loss Ultra-Compact SOI Microring Add-Drop Filters, Shijun Xiao, Maroof Khan, Hao Shen, Minghao Qi; Purdue Univ., USA. We demonstrate low propagation loss ~ 0.07dB/round-trip in SOI microring resonators with a radius of 2.5 μm (FSR ~ 32 nm) and ultra-compact 3rd microring add-drop filters with box-like channel dropping responses.

PDP-D7 • 7:27 p.m.
Loss Determination of Hollow-Core Waveguides by Optically-Induced Particle Transport, Philip Measor1, Sergei Kühn1, Holger Schmidt1, Evan J. Lunt2, Aaron R. Hawkins3; 1Univ. of California at Santa Cruz, USA, 2Brigham Young Univ., USA. A new method for loss measurements in hollow-core waveguides utilizing radiation pressure induced transport of dielectric microspheres is introduced and experimentally demonstrated.

PDP-D8 • 7:39 p.m.
Modeling and Testing of Electro-Refractive Coupled Quantum Well Modulators, Chia-Juan Wang, Elizabeth T. Kunkee, Chun-Ching Shih, QiSheng Chen, Larry J. Lembo; Northrop Grumman Space Technology, USA. We present a comprehensive theoretical model for coupled quantum well modulators and use the results to guide device fabrication. Test measurements for InP Mach-Zehnder intensity modulators show agreement with the simulation.
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