Illumination Modeling: Simulation and Perception of Lit and Unlit Objects (IM)

Workshop at

Frontiers in Optics 2008, OSA's 92nd Annual Meeting and Exhibit

Monday, October 20, 2008
Rochester Riverside Convention Center, Rochester, NY, USA

Housing Deadline: September 17, 2008
Registration Deadline: September 25, 2008

About Illumination Modeling

There are an increasing number of applications that require a good understanding of ambient lighting and illumination of objects or scenes to create a desired effect or appearance. Applications such as 3-D virtual environment visualization, architectural lighting, computer animation and automotive lighting are some of the areas that deal with the effect of ambient lighting and a lit model's appearance. Complimentary to understanding such effects is the need for sources and optical designs to create the desired illumination while understanding human perceptual characteristics.

This workshop aims at bringing together communities such as lighting, computer graphics, color technologists, optical designers, light sources and virtual reality towards the common goal of design, production and understanding of ambient lighting and a lit model's appearance.

Invited Speakers

FMC2, **Modulating and Demodulating Projected Light,** *Oliver Bimber; Bauhaus-Univ. Weimar, Germany.*

FMC6, **Accurate Lit-Appearance Modeling of Illumination Systems,** *R. John Koshel; Photon Engineering LLC, USA, and College of Optical Sciences, Univ. of Arizona, USA.*

FMJ1, **An Overview of the Non-Visual Effects of Retinal Light Exposure,** *Mark S. Rea, Mariana G. Figueiro; Rensselaer Polytechnic Inst., USA.*

FMJ3, **Vision at Mesopic Light Levels,** *Alan L. Lewis; EPRI Lighting Res. Office, USA.*

2008 Meeting Chairs

Anurag Gupta, *Optical Res. Associates, USA*
Hong Hua, *Univ. of Arizona, USA*

Committee Members

G. Groot Gregory, *Optical Res. Associates, USA*
Jannick Rolland, *Univ. of Central Florida, USA*
John Koshel, *Photon Engineering LLC and College of Optical Sciences, Univ. of Arizona, USA*
Mark Rea, *Rensselaer Polytechnic Inst., USA*

Sponsor: The Optical Society

Illumination Modeling Program Committee

Program Chairs

Anurag Gupta, *Optical Res. Associates, USA*
Hong Hua, *Univ. of Arizona, USA*

Committee Members

G. Groot Gregory, *Optical Res. Associates, USA*
Jannick Rolland, *Univ. of Central Florida, USA*
John Koshel, *Photon Engineering LLC and College of Optical Sciences, Univ. of Arizona, USA*
Mark Rea, *Rensselaer Polytechnic Inst., USA*

Meeting Topics to Be Considered

The Illumination Modeling Workshop aims at bringing together communities such as lighting, computer graphics, color technologists, optical designers, light sources and virtual reality towards the common goal of design, production and understanding of ambient lighting and a lit model's appearance.

We welcome submissions in the following areas:

- Simulation of ambient lighting and rendering of lit scenes and objects.
- Applications in virtual reality and animation.
- Human factors in lighting and lighting perception.
- Aesthetic design for buildings.
- Light sources for architectural and vehicular lighting.
- Optical design for lighting applications and non-imaging optics.
- Material properties of paints and other optical surfaces and volumes.
- BSDF modeling, measurement and application.
- Color in lighting applications.

Illumination Modeling Invited Speakers

FMC2, **Modulating and Demodulating Projected Light,** *Oliver Bimber; Bauhaus-Univ. Weimar, Germany*

FMC6, **Accurate Lit-Appearance Modeling of Illumination Systems,** *R. John Koshel[1,2]; [1]Photon Engineering LLC, USA, [2]College of Optical Sciences, Univ. of Arizona, USA.*

FMJ1, **An Overview of the Non-Visual Effects of Retinal Light Exposure,** *Mark S. Rea, Mariana G. Figueiro; Rensselaer Polytechnic Inst., USA*

FMJ3, **Vision at Mesopic Light Levels,** *Alan L. Lewis; Electric Power Res. Inst. (EPRI) Lighting Res. Office, USA*

Exhibitor Information

For information about exhibitors, please see the archive for FiO 2008/LS XXIV.

Agenda of Sessions — Monday, October 20

	Lilac Ballroom North	Highland A	Highland B	Highland C	Highland D	Highland E
7:00 a.m.–6:00 p.m.	**Registration,** *Galleria, Rochester Riverside Convention Center*					
8:00 a.m.–10:00 a.m.						
8:00 a.m.–12:00 p.m.	**2008 Joint FiO/LS Awards Ceremony and Plenary Session,** *Lilac Ballroom North and South, Rochester Riverside Convention Center*					
10:00 a.m.–10:30 a.m.	**Coffee Break,** *Lilac Ballroom Foyer, Rochester Riverside Convention Center*					
10:30 a.m.–12:30 p.m.						
12:00 p.m.–2:00 p.m.	**SMA: Laser Science Symposium on Undergraduate Research Posters,** *Riverside Court, Rochester Riverside Convention Center*					
12:30 p.m.–1:30 p.m.	**Lunch Break** *(on your own)*					
1:30 p.m.–3:30 p.m.	**SMB: Schawlow-Townes Symposium on 50 Years of the Laser: The Birth of the Laser**	**FMA: Nonclassical Light** (ends at 3:15 p.m.)	**SMC: Laser Science Symposium on Undergraduate Research I** (2:00 p.m.–4:00 p.m.)	**FMB: Intense Field Science** (ends at 2:45 p.m.)	**FMC: Illumination I: Modeling, Ray Tracing and Rendering**	**FMD: General Optical Sciences I**
3:30 p.m.–4:00 p.m.	**Coffee Break,** *Lilac Ballroom Foyer, Rochester Riverside Convention Center*					
4:00 p.m.–6:00 p.m.	**SMD: Schawlow-Townes Symposium on 50 Years of the Laser: Looking to Tomorrow**	**FMH: Photon Sources** (ends at 5:45 p.m.)	**SME: Laser Science Symposium on Undergraduate Research II** (4:30 p.m.–6:30 p.m.)	**FMI: Femtosecond Surface Science** (ends at 6:15 p.m.)	**FMJ: Illumination II: Vision and Measurement**	**FMK: General Optical Sciences II**
6:30 p.m.–8:30 p.m.	**OSA Student Member Welcome Reception,** *Abilene, 153 Liberty Pole Way, Downtown Rochester, Phone: 585.232.3230*					

Key to Shading

Frontiers in Optics | Laser Science | Joint FiO/LS | META | OF&T

Lilac Ballroom North	Highland A	Highland B	Highland C	Highland D	Highland E
		FiO			

1:30 p.m.–3:30 p.m.
SMB • Schawlow-Townes Symposium on 50 Years of the Laser: The Birth of the Laser

Robert W. Boyd; Univ. of Rochester, USA, Presider
Martin Richardson; CREOL, College of Optics and Photonics, Univ. of Central Florida, Presider

SMB1 • 1:30 p.m. Invited

Initiation and Development of the Laser, *Charles H. Townes; Univ. of California at Berkeley, USA.* A broad discussion of initiation and development of amplification by stimulated emission of radiation (lasers, masers). The field provides an example of how unexpected and tremendously important technology and science emerge from basic research exploration.

1:30 p.m.–3:15 p.m.
FMA • Nonclassical Light

Jiangrong "Frank" Cao; Canon USA Inc., Presider

FMA1 • 1:30 p.m. Tutorial

Nonclassical Light for Quantum Information Science, *H. Jeff Kimble; Caltech, USA.* Over the past several decades, the Quantum Optics community has generated a zoology of manifestly quantum or nonclassical states of the electromagnetic field. Beyond a historical significance in physics, nonclassical light is playing a leading role in Quantum Information Science, including for quantum computation, communication, and metrology. My tutorial will provide an overview of nonclassical light, from generation to identification to application.

H. Jeff Kimble is the William L. Valentine Professor and Professor of Physics at the California Institute of Technology. He completed his doctoral degree in 1977 at the University of Rochester under the supervision of Professor Leonard Mandel. After spending two years as a staff scientist at the General Motors Research Laboratories, he joined the faculty at the University of Texas at Austin in 1979, where he eventually held the Sid Richardson Regents' Chair of Physics before moving to Caltech in 1989. The

2:00 p.m.–4:00 p.m.
SMC • Laser Science Symposium on Undergraduate Research I

Jenny Magnes; Vassar College, USA, Presider

See Undergraduate Research Symposium program in registration bag.

1:30 p.m.–2:45 p.m.
FMB • Intense Field Science

Jeffrey Squier; Colorado School of Mines, USA, Presider

FMB1
Paper Withdrawn

FMB2 • 1:30 p.m.

The Formation of Metallic Nanoclusters at the Surface of Natural Silicates Induced by CO_2 Laser Radiation, *Anel F. Mukhamedgalieva, Anatolii M. Bondar; Moscow State Mining Univ., Russian Federation.* The continuous and pulsed CO_2 laser irradiation (10^5-10^7 W/cm^2) of silicates (nepheline - $Na[AlSiO_4]$, rodonite - $CaMn_4[Si_5O_{15}]$, zircon - $ZrSiO_4$ etc.) leads to the creation of metallic and silicon nanoclusters at the surface.

FMB3 • 1:45 p.m.

Ultra-Intense 35fs Laser-Matter Interaction Physics in Nanostructured Ni-Nanowire Targets, *Robin S. Marjoribanks[1], Ludovic Lecherbourg[1], Patrick Audebert[2], Jean-Paul Geindre[2], Brett Teeple[1], Marina Servol[1,3], Anne Héron[4], Jean-Claude Adam[4], Gabor Kulcsár[1], John Sipe[1], Paul Forrester[1], Jean-Claude Kieffer[3], Luke McKinney[1], Simon Le Moal[1,5], Hart Levy[1]; [1]Univ. of Toronto, Canada, [2]Lab pour l'Utilisation des Lasers Intenses (LULI), France, [3]Inst. Natl. de la Recherche Scientifique, Énergie, Matériaux et Télécommunications (INRS), Canada, [4]Ctr. de Physique Théorique (CPhT), France, [5]Ecole des Mines de Paris, France.* Nickel nanowires present >90% absorption in an absorption depth ~1 µm, making efficient x-ray converters at high energy-densities. We present new theoretical and experimental results for intensities from small-signal up to relativistic ultrafast pulses.

1:30 p.m.–3:30 p.m.
FMC • Illumination I: Modeling, Ray Tracing and Rendering

Hong Hua; Univ. of Arizona, USA, Presider

FMC1 • 1:30 p.m.

Locating Illumination Sources from Lighting on Planar Surfaces in Paintings: An Application to Georges de la Tour and Caravaggio, *David G. Stork; Ricoh Innovations, USA.* We used maximum-likelihood methods to estimate the location and number of illuminants in tableaus in realist paintings from the pattern of illuminance on planar walls and floors to test for artists' use of optical projections.

FMC2 • 1:45 p.m. Invited

Modulating and Demodulating Projected Light, *Oliver Bimber; Bauhaus-Univ. Weimar, Germany.* Projector-camera systems allow measuring and compensating the modulation of projected light on surfaces that are not optimized for projections. This enables new applications in different domains, such as entertainment, visualization, film production and many more.

1:30 p.m.–3:30 p.m.
FMD • General Optical Sciences I

Gregory Quarles; VLOC, USA, Presider

FMD1 • 1:30 p.m.

Simple Models for Laser-Induced Damage of KH_2PO_4 Crystals by Nanosecond Pulses, *Guillaume Duchateau, Anthony Dyan; CEA, Ctr. d'Etudes du Ripault, France.* We present two approaches based on the heating of nanometric model defects. They allow one to find experimental results such as a particular scaling law. Information about the physical nature of these defects is provided.

FMD2 • 1:45 p.m.

The Effects of Radiation Waves on Dark Stripe Dynamics, *Christopher Barsi, Jason W. Fleischer; Princeton Univ., USA.* We study the evolution of a narrow dark stripe in a nonlinear defocusing medium. It is shown that radiation waves are shed during the evolution and should influence the interaction force between pairs of stripes.

SMB • Schawlow-Townes Symposium on 50 Years of the Laser: The Birth of the Laser—Continued

SMB2 • 2:00 p.m. Invited

The World in a New Light, *Steven Chu[1,2]; [1]Lawrence Berkeley Natl. Lab, USA, [2]Univ. of California at Berkeley, USA.* This fantastic light, which unified electronics with the quantum world, transformed our ability to measure and control matter and energy with unprecedented precision. After 50 years of a storied history, the best is yet to come.

FMA • Nonclassical Light—Continued

general areas of his research are quantum information science and the quantum dynamics of open systems, including quantum measurement, cavity quantum electrodynamics, and the realization of quantum networks. Professor Kimble is a Fellow of the American Association for the Advancement of Science, the American Physical Society, and the Optical Society of America, and is a Member of the National Academy of Sciences.

FMA2 • 2:15 p.m.

Resonant Enhancement of Quantum SFG, *Irfan Ali-Khan, S. Sensarn, G. Y. Yin, S. E. Harris; Stanford Univ., USA.* By resonating the sum frequency, the quantum term for sum frequency generation with incoming biphotons is enhanced by a factor of 12.

SMC • Laser Science Symposium on Undergraduate Research I—Continued

FMB • Intense Field Science—Continued

FMB4 • 2:00 p.m. Invited

Trapping and Destruction of Long Range High Intensity Optical Filaments by Molecular Quantum Wakes in Air, *S. Varma, Y. H. Chen, Howard Milchberg; Univ. of Maryland, USA.* We report the first observation of the strong trapping and extinguishing effects of quantum molecular rotational wavepackets in atmospheric air on long range filamentary propagation of intense femtosecond laser pulses.

FMC • Illumination I: Modeling, Ray Tracing and Rendering—Continued

FMC3 • 2:15 p.m.

Analysis of Second Order Light Fields in Closed 3-D Spaces, *Alexander A. Mury, Sylvia C. Pont, Jan J. Koenderink; Physics of Man, Dept. of Physics and Astronomy, Utrecht Univ., Netherlands.* We present a method for measurement and reconstruction of second order approximations of light fields in closed spaces. We visualized their structure using light tubes and rendered objects at several points along a tube.

FMD • General Optical Sciences I—Continued

FMD3 • 2:00 p.m.

Nonlinear Optics with Radio Frequency Field, *Hebin Li[1], Vladimir A. Sautenkov[1], Michael M. Kash[1,2], Yuri V. Rostovtsev[1], Marlan O. Scully[1,3]; [1]Texas A&M Univ., USA, [2]Dept. of Physics, Lake Forest College, USA.* Performing experiments with Rb-atoms and RF fields, we have demonstrated several nonlinear effects, such as multiphoton transitions and excitation of coherence using far-detuned field with different time-shape pulses. Our results agree with our theoretical predictions.

FMD4 • 2:15 p.m.

Precise Modal Decomposition in Multimode Optical Fibers by Maximizing the Sum of Modal Power Weights, *Zhuo Jiang[1,2], John R. Marciante[1,3]; [1]Lab for Laser Energetics, Univ. of Rochester, USA, [2]Dept. of Physics and Astronomy, Univ. of Rochester, USA, [3]Inst. of Optics, Univ. of Rochester, USA.* We determine accurate modal power weights of the optical field in multimode fibers without precise knowledge of fiber or imaging system parameters by maximizing the sum of modal power weights. Experimental results will be reported.

NOTES

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FiO					

SMB • Schawlow-Townes Symposium on 50 Years of the Laser: The Birth of the Laser—Continued

SMB3 • 2:30 p.m. Invited

My Time with Charlie, *James P. Gordon; Consultant, Bell Labs, Alcatel-Lucent, USA*. Quantum electronics came into being with the success of the first (ammonia beam) maser. I will recall my time at Columbia University where the maser was created, and the ideas that made it possible.

FMA • Nonclassical Light—Continued

FMA3 • 2:30 p.m.

Strongly Correlated Photon Transport in One-Dimensional Systems, *Jung-Tsung Shen, Shanhui Fan; Stanford Univ., USA*. We show that two-photon transport is strongly correlated in one-dimensional waveguide coupled to a two-level system. Moreover, we show that the two-level system can induce effective attractive or repulsive interactions in space for photons.

FMA4 • 2:45 p.m.

Classical and Quantum Correlations in Waveguide Lattices, *Yaron Bromberg[1], Yoav Lahini[1], Roberto Morandotti[2], Yaron Silberberg[1]; [1]Weizmann Inst. of Science, Israel, [2]Inst. Natl. de la Recherche Scientifique, Canada*. The propagation of correlated photon pairs in a lattice of coupled waveguides is studied. We calculate the evolution of quantum correlations along the lattice, and experimentally demonstrate a classical analogue using two incoherent sources.

SMC • Laser Science Symposium on Undergraduate Research I—Continued

FMB • Intense Field Science—Continued

FMB5 • 2:30 p.m.

Theory and Modeling of the Absorption of Laser Light in Nanostructured Metallic Nanowire ("Velvet") Surfaces, *Ludovic Lecherbourg[1], Brett Teeple[1], Patrick Audebert[2], Jean-Paul Geindre[2], Jean-Claude Adam[3], Anne Héron[3], John Sipe[1], Gabor Kulcsàr[1], Simon Le Moal[4], Robin S. Marjoribanks[1]; [1]Univ. of Toronto, Canada, [2]Lab pour l'Utilisation des Lasers Intenses (LULI), CEA, CNRS, Ecole Polytechnique, France, [3]Ctr. de Physique Théorique (CPhT), CEA, CNRS, Ecole Polytechnique, France, [4]Ecole des Mines de Paris, France*. Nanostructured metal targets exhibit low-intensity linear optical absorption > 95%. Is such absorption also possible for ultra-intense femtosecond laser pulses? Analytic theory (low intensities) and particle-in-cell simulations (high intensities) show similarities and remarkable differences.

FMC • Illumination I: Modeling, Ray Tracing and Rendering—Continued

FMC4 • 2:30 p.m.

Estimation of Illuminance Flow over Anisotropic Surfaces for Arbitrary Viewpoints, *Stefan M. Karlsson, Sylvia C. Pont, Jan J. Koenderink; Physics of Man, Dept. of Physics and Astronomy, Utrecht Univ., Netherlands*. The theory of illuminance flow estimation by structure tensors is generalized for oblique viewing of anisotropic texture. Previous theory is revised using general matrix formulations and predictions are compared with results on rendered images.

FMC5 • 2:45 p.m.

Differential Ray Tracing for an Improved Simulation of Incoherent Illumination Systems, *Oliver Stolz, Norbert Lindlein; Inst. of Optics, Information and Photonics, Max Planck Res. Group, Univ. of Erlangen-Nuremberg, Germany*. Analyzing intensity distributions is of great importance for today's illumination systems design. Contrary to Monte-Carlo techniques, differential ray tracing possesses great potential to improve simulation efficiency by reducing computational time while concurrently showing accurate results.

FMD • General Optical Sciences I—Continued

FMD5 • 2:30 p.m.

Goos-Hänchen Effect for High-Loss Materials, *Jörg B. Götte, Andrea Aiello, J. P. Woerdman; Leiden Univ., Netherlands*. We extend the analysis of the Goos-Hänchen shift on bare surfaces to high losses. In contrast to the low-loss case, for high losses the Goos-Hänchen shifts for metals and dielectrics are similar.

FMD6 • 2:45 p.m.

Goos-Hänchen Shift on Flat and Not-So-Flat Metal Surfaces, *M. Merano, A. Aiello, G. W. 't Hooft, M. P. van Exter, E. R. Eliel, J. P. Woerdman; Huygens Lab, Leiden Univ., Netherlands*. We report the first observation of the Goos-Hänchen shift in metallic reflection. The shift is found to be insensitive to surface flatness but it depends on the microscopic roughness of the metal surface.

NOTES

FMA • Nonclassical Light—Continued

FMA5 • 3:00 p.m.
Security of a Discretely Signaled Continuous Variable QKD Protocol against Collective Attacks, *Zheshen Zhang[1,2], Paul L. Voss[1,2]; [1]Georgia Tech, Ctr. Natl. de la Recherche Scientifique, France, [2]School of Electrical and Computer Engineering, Georgia Tech, USA*. We prove security against collective attacks of a four-state discretely signaled continuous variable quantum key distribution protocol with and without post-selection. This protocol is compatible with optical networks and high speed coding techniques.

SMC • Laser Science Symposium on Undergraduate Research I—Continued

FMC • Illumination I: Modeling, Ray Tracing and Rendering—Continued

FMC6 • 3:00 p.m. Invited
Accurate Lit-Appearance Modeling of Illumination Systems, *R. John Koshel[1,2]; [1]Photon Engineering LLC, USA, [2]College of Optical Sciences, Univ. of Arizona, USA*. Lit-appearance modeling of illumination systems is the determination of what that system looks like before costly fabrication. Methods using ray-tracing software will be presented through examples: spot projection, pupil sampling, and luminance modeling.

FMD • General Optical Sciences I—Continued

FMD7 • 3:00 p.m.
Partially Coherent Cyclostationary Pulses in Young's Interference Experiment, *Robert W. Schoonover[1], Brynmor J. Davis[1], Randy A. Bartels[2], P. Scott Carney[1]; [1]Univ. of Illinois at Urbana-Champaign, USA, [2]Colorado State Univ., USA*. Young's interference experiment is used to analyze the statistical properties of a certain class of spatially partially coherent, cyclostationary, optical fields.

FMD8 • 3:15 p.m.
Closed Form Formula for Mie Scattering of Generalized Gaussian Beams, *Nicole J. Moore, Miguel A. Alonso; Inst. of Optics, Univ. of Rochester, USA*. A closed form formula is found for the Mie scattering coefficients of an incident generalized Gaussian beam with any numerical aperture. This formula takes the simple form of multipoles evaluated at a complex point.

3:30 p.m.–4:00 p.m. Coffee Break, *Lilac Ballroom Foyer, Rochester Riverside Convention Center*

Lilac Ballroom North	Highland A	Highland B	Highland C	Highland D	Highland E
FiO					
4:00 p.m.–6:00 p.m. **SMD • Schawlow-Townes Symposium on 50 Years of the Laser: Looking to Tomorrow** *Robert W. Boyd; Univ. of Rochester, USA, Presider* *Martin Richardson; CREOL, College of Optics and Photonics, Univ. of Central Florida, Presider*	**4:00 p.m.–5:45 p.m.** **FMH • Photon Sources** *Jason Fleischer; Princeton Univ., USA, Presider*	**4:30 p.m.–6:30 p.m.** **SME • Laser Science Symposium on Undergraduate Research II** *David Sukow; Washington and Lee Univ., USA, Presider*	**4:00 p.m.–6:15 p.m.** **FMI • Femtosecond Surface Science** *Oren Cohen; JILA, Univ. of Colorado, USA, Presider*	**4:00 p.m.–6:00 p.m.** **FMJ • Illumination II: Vision and Measurement** *Anurag Gupta; Optical Res. Associates, USA, Presider*	**4:00 p.m.–6:00 p.m.** **FMK • General Optical Sciences II** *Jason Schmidt; Air Force Inst. of Technology, USA, Presider*
SMD1 • 4:00 p.m. Invited **From Millisecond to Attosecond Laser Pulses,** *Nicolaas Bloembergen; Univ. of Arizona, USA*. Abstract not available.	**FMH1 • 4:00 p.m.** **Four-Wave Mixing in a Birefringent Semiconductor Waveguide for Correlated Photon Generation,** *Daniel J. Rogers[1], Julius Goldhar[1], Christopher J. K. Richardson[1], Charles W. Clark[2]; [1]Univ. of Maryland, USA, [2]NIST, USA*. We demonstrate birefringent phase-matched four-wave mixing in a III-V semiconductor waveguide as a potential source of correlated and ultimately entangled photon pairs for high-speed quantum key distribution.	See Undergraduate Research Symposium program in registration bag.	**FMI1 • 4:00 p.m.** Invited **Ultrafast Spin-Dependent Carrier Dynamics in Ferromagnetic Thin Films,** *Martin Weinelt[1,2]; [1]Max-Born-Inst., Germany, [2]Freie Univ. Berlin, Germany*. Spin-dependent carrier dynamics in ferromagnetic thin films is studied by time-, energy-, angle-, and spin-resolved photoelectron spectroscopy. We will discuss spin-flip scattering and its relation to femtomagnetism.	**FMJ1 • 4:00 p.m.** Invited **An Overview of the Non-Visual Effects of Retinal Light Exposure,** *Mark S. Rea, Mariana G. Figueiro; Rensselaer Polytechnic Inst., USA*. Comparisons will be made between light as a stimulus to the visual system and light as a stimulus to non-visual, biological effects that affect human behavior and well-being.	**FMK1 • 4:00 p.m.** **Conservation of Angular Momentum in Mie Scattering,** *David P. Haefner, Sergey Sukhov, Aristide Dogariu; CREOL, College of Optics and Photonics, Univ. of Central Florida, USA*. We show that the spin angular momentum carried by the incident wave is distributed between spin and orbital momentum of the wave scattered from a spherically symmetric scattering potential resulting in a spiral power flow.
	FMH2 • 4:15 p.m. **Towards Hyperentanglement via Semiconductor Two-Photon Emission,** *Alex Hayat, Pavel Ginzburg, Pavel Gurevich, David Neiman, Serge Rosenblum, Meir Orenstein; Technion - Israel Inst. of Technology, Israel*. We investigate a new phenomenon of semiconductor two-photon emission presenting the first experiments. This allows implementation of compact highly-efficient room-temperature sources of entangled (for microcavity interband transitions) and hyperentangled (for intersubband transitions) photons.				**FMK2 • 4:15 p.m.** **Study of the Persistent Laser-Induced Change in the Index of Refraction in Pr^{3+}-Doped Silicate Glass Using Pump-Probe X-Scan Technique,** *Abdullatif Y. Hamad, Seong Heon Kim; Southern Illinois Univ. Edwardsville, USA*. The profile, size, and magnitude of the change in the refraction index in Pr^{3+}-doped silicate glass were determined using the x-scan technique. The index profile was dependent on the exposure time of the pump beam.

Lilac Ballroom North	Highland A	Highland B	Highland C	Highland D	Highland E
FiO					

SMD • Schawlow-Townes Symposium on 50 Years of the Laser II: Looking to Tomorrow—Continued

SMD2 • 4:30 p.m. Invited

From Gas Lasers and Tunable Raman Lasers to Quantum Cascade Lasers, *Kumar Patel; Pranalytica Inc, USA*. I will describe my involvement in lasers from 1961 to present, encompassing high power carbon dioxide lasers, tunable spin-flip Raman lasers, and now high power CW room temperature quantum cascade lasers and their applications.

FMH • Photon Sources—Continued

FMH3 • 4:30 p.m. Invited

From a Single-Photon Source to a Single-Ion Laser, *Francois Dubin, Carlos Russo, Helena G. Barros, Andreas Stute, Piet Schmidt, Rainer Blatt; Univ. of Innsbruck, Austria*. A single Ca^{+} ion is trapped in a high finesse cavity. Under continuous excitation, our single-ion device shows signatures of a quantum laser. Under pulsed excitation, it acts as an efficient source of single photons.

SME • Laser Science Symposium on Undergraduate Research II—Continued

FMI • Femtosecond Surface Science—Continued

FMI2 • 4:30 p.m. Invited

Real Time Electronic Structure Investigated by Femtosecond Time- and Angle-Resolved Photoemission Spectroscopy, *Uwe Bovensiepen; Freie Univ. Berlin, Fachbereich Physik, Germany*. The real time evolution of electronic structure is analyzed for the Mott insulator TaS_2 and the charge density wave compound $TbTe_3$. The results facilitate unprecedented insight into the impact of collective modes and electronic correlation.

FMJ • Illumination II: Vision and Measurement—Continued

FMJ2 • 4:30 p.m.

A Perfect Illumination Spectral Ratio Effect on Microsaccades and Drift, *Richard Friedhoff[1], James Schirillo[1,2]; [1]Tandent Vision Science, Inc., USA, [2]Wake Forest Univ., USA*. Can eye movements differentiate illumination versus material borders? Stimuli containing a material edge bisected an illumination edge that contained a correct or incorrect spectral ratio. Microsaccades and drift were longer only across plausible illumination borders.

FMJ3 • 4:45 p.m. Invited

Vision at Mesopic Light Levels, *Alan L. Lewis; Electric Power Res. Inst. (EPRI) Lighting Res. Office, USA*. Lighting designers use photopic photometry even when applications call for lower adaptation levels. There is a need for a mesopic unit that will adequately predict visual performance for outdoor use under today's spectrally diverse lamps.

FMK • General Optical Sciences II—Continued

FMK3 • 4:30 p.m.

Topological Reactions of Correlation Vortices, *Yalong Gu, Greg Gbur; Univ. of North Carolina at Charlotte, USA*. The topological reactions of correlation vortices are investigated. They suggest the possible use of correlation vortices as a probe of the statistical properties of a field or a medium.

FMK4 • 4:45 p.m.

General Theory for Self-Healing Beams Applied to a Caustic Field, *Sabino Chávez-Cerda[1], Marcelino Anguiano-Morales[2], Marcelo D. Iturbe-Castillo[1]; [1]INAOE, Mexico, [2]Ctr. de Investigaciones en Optica, Mexico*. We present a general theory of self-healing beams and demonstrate that caustic optical fields generated by an axicon illuminated with a cylindrical wavefront are self-healing when they are partially obstructed by an opaque object.

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SMD • Schawlow-Townes Symposium on 50 Years of the Laser II: Looking to Tomorrow—Continued	**FMH • Photon Sources—Continued**	**SME • Laser Science Symposium on Undergraduate Research II—Continued**	**FMI • Femtosecond Surface Science—Continued**	**FMJ • Illumination II: Vision and Measurement—Continued**	**FMK • General Optical Sciences II—Continued**
SMD3 • 5:00 p.m. Invited **The Rejuvenation of Optical Spectroscopy,** *Boris Stoicheff; Univ. of Toronto, Canada.* In Canada, as in many countries, the advent of the laser has brought unprecedented growth in optical spectroscopy, resulting not only in precise determinations of atomic and molecular energy levels, but in detailed investigations of mechanisms having femtosecond and attosesond durations.	**FMH4 • 5:00 p.m.** **A Time Bandwidth Limited Fiber Pair Photon Source,** *John G. Rarity[1,2], Jeremie Fulconis[1], Alex Clark[1], Jeremy L. O'Brien[1], Matthaeus Halder[1], William J. Wadsworth[2], Chunle Xiong[2]; [1]Univ. of Bristol, UK, [2]Univ. of Bath, UK.* Using birefringent phase matching in microstructured fibers we have developed a pair photon source with bandwidth limited solely by pulse length.		**FMI3 • 5:00 p.m.** Invited **Generation and Time-Resolved Detection of Coherently Controlled Electric Currents at Surfaces,** *J. Gudde[1], M. Rohleder[1], T. Meier[2], S. W. Koch[1], Ulrich Höfer[1]; [1]Philipps-Univ. Marburg, Germany, [2]Univ. Paderborn, Germany.* We demonstrate an experimental technique for the generation and detection of electron currents at surfaces on a femtosecond time scale with a contact-free experimental setup based on a combination of coherent control and photoemission spectroscopy.		**FMK5 • 5:00 p.m.** **Generation of Maximal Coherence in a Two-Level System via Breaking Adiabaticity,** *Yuri Rostovtsev[1], Hichem Eleuch[1,2], Anatoly Svidzinsky[1], Marlan O. Scully[1,3]; [1]Inst. for Quantum Studies, Texas A&M Univ., USA, [2]Inst. Natl. des Sciences Appliques et de Technologie, Tunisia, [3]Princeton Inst. for the Science and Technology of Materials and Dept. of Mechanical and Aerospace Engineering, Princeton Univ., USA.* We study population transfer and the generation of quantum coherence in a two-level system interacting with a strong off-resonance ultra-short laser pulse. We derive analytical solutions for an ultra-short pulse of arbitrary shape.
	FMH5 • 5:15 p.m. **Increasing the Bandwidth of Quantum Light: A New Way towards the Generation of Narrow Temporal Biphoton,** *Xiaojuan Shi, Martin Hendrych, Alejandra Valencia, Juan Perez Torres; ICFO, Institut de Ciències Fotòniques, Spain.* We experimentally demonstrate a new method to enlarge the quantum light bandwidth. Paired photons with bandwidths more than 1000 THz could be obtained, which opens up a new way to generate narrow temporal biphoton states.			**FMJ4 • 5:15 p.m.** **Effectiveness of Various Light Sources on the Stimulation of Phosphorescent Safety Markings,** *David R. Wyble[1], C. Cameron Miller[2], Maria E. Nadal[2]; [1]Munsell Color Science Lab, Rochester Inst. of Technology, USA, [2]NIST, USA.* Commercially available phosphorescent materials are experimentally evaluated under conventional and solid-state lighting sources. The spectral and photopic properties of the sources are considered against the current ASTM test method for photoluminescent safety markings.	**FMK6 • 5:15 p.m.** **Propagation of Electromagnetic Waves in Non-Uniform Volume Bragg Gratings,** *Sergiy V. Mokhov, Leonid B. Glebov, Vadim I. Smirnov, Boris Ya Zeldovich; CREOL and FPCE, College of Optics and Photonics, Univ. of Central Florida, USA.* Spectral properties of reflective Volume Bragg Gratings (VBG) are studied with rigorous coupled wave approach. Similarities and differences between volume and fiber gratings are discussed. Simulation technique for VBG is proposed and compared with experiment.
SMD4 • 5:30 p.m. Invited **Looking back to the Laser of Schawlow and Townes, and Looking forward to the Generation of Gravitational Radiation,** *Raymond Chiao; Univ. of California at Merced, USA.* In 1958 Schawlow and Townes proposed the use of stimulated emission for generating macroscopically coherent light. I propose that the use of charged, macroscopically coherent quantum matter can lead to efficient generation of gravitational waves.	**FMH6 • 5:30 p.m.** **Measurement of Biphoton Wavefunctions Using Fast Amplitude Modulators,** *Chinmay Belthangady, Shengwang Du, Pavel Kolchin, Guang-Yu Yin, Stephen E. Harris; Stanford Univ., USA.* We demonstrate a proof-of-principle experimental realization of a novel technique that uses fast amplitude modulators to measure biphoton waveforms whose temporal lengths are shorter than the resolution time of present single photon counting modules.		**FMI4 • 5:30 p.m.** Invited **Ultrafast Dynamics of Electron Transfer at Polar Adsorbate/Metal Interfaces Studied with Time-Resolved Photoelectron Spectroscopy,** *Martin Wolf; Freie Univ. Berlin, Germany.* Interfacial electron transfer and solvation processes in thin layers of water and ammonia on metal surfaces are studied by femtosecond photoelectron spectroscopy to analyze the tunnelling barrier and solvation site of photoinjected excess electrons.	**FMJ5 • 5:30 p.m.** **Shape Recognition through Opto-Mechanical Scanning,** *Jenny Magnes[1], Trevor David[1], Rahul Khakurel[1], Margo Kinneberg[1], Derek Olson[1], Noureddine Melikechi[2]; [1]Vassar College, USA, [2]Delaware State Univ., USA.* We explore capabilities and limits of opto-mechanical knife-edge scanning methods for the purpose of shape recognition techniques that are scale invariant. Different algorithms for corner scanning, opto-mechanical integration and symmetry based shape recognition are discussed.	**FMK7 • 5:30 p.m.** **Paper Withdrawn**

Lilac Ballroom North	Highland A	Highland B	Highland C	Highland D	Highland E
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SME • Laser Science Symposium on Undergraduate Research II—Continued

FMI • Femtosecond Surface Science—Continued

FMI5 • 6:00 p.m.
Enhanced Nonlinear Photoelectron Emission by Surface Plasmons from Nanostructure-Covered Periodic Grooves, *Taek Yong Hwang, Anatoliy Y. Vorobyev, Chunlei Guo; Inst. of Optics, Univ. of Rochester, USA.* We find that surface plasmon excitation on nanostructure-covered periodic grooves can significantly enhance photoelectron emission, leading to a 4-photon process that is absent without surface plasmons within the intensity range in our experiment.

FMJ • Illumination II: Vision and Measurement—Continued

FMJ6 • 5:45 p.m.
Application of Imaging Sphere for BSDF Measurements of Arbitrary Materials, *Hubert Kostal, Doug Kreysar, Ronald Rykowski; Radiant Imaging, USA.* BSDF measurements are broadly applicable to material characterization, quality assessment, and computer modeling. The Imaging Sphere is novel optical measurement technology that allows BSDFs to be obtained quickly and accurately for a wide variety of materials.

FMK • General Optical Sciences II—Continued

FMK8 • 5:45 p.m.
Diffraction Effects in Wigner Functions for Paraxial and Nonparaxial Fields, *Seongkeun Cho, Jonathan C. Petruccelli, Miguel A. Alonso; Univ. of Rochester, USA.* The diffraction effects caused by apertures are described in terms of Wigner functions for paraxial and nonparaxial fields. This description is numerically advantageous in the case of partially coherent fields.

6:30 p.m.–8:30 p.m. OSA Student Member Welcome Reception, *Abilene, 153 Liberty Pole Way, Downtown Rochester, Phone: 585.232.3230*

This Workshop was part of FiO 2008/LS XXIV.

A consolidated program including information on this workshop and all collocated meetings (FiO, LS, OF&T and META) is available with the FiO 2008 meeting archive and includes the complete agenda of sessions, abstracts, subject index, and key to authors and presiders.