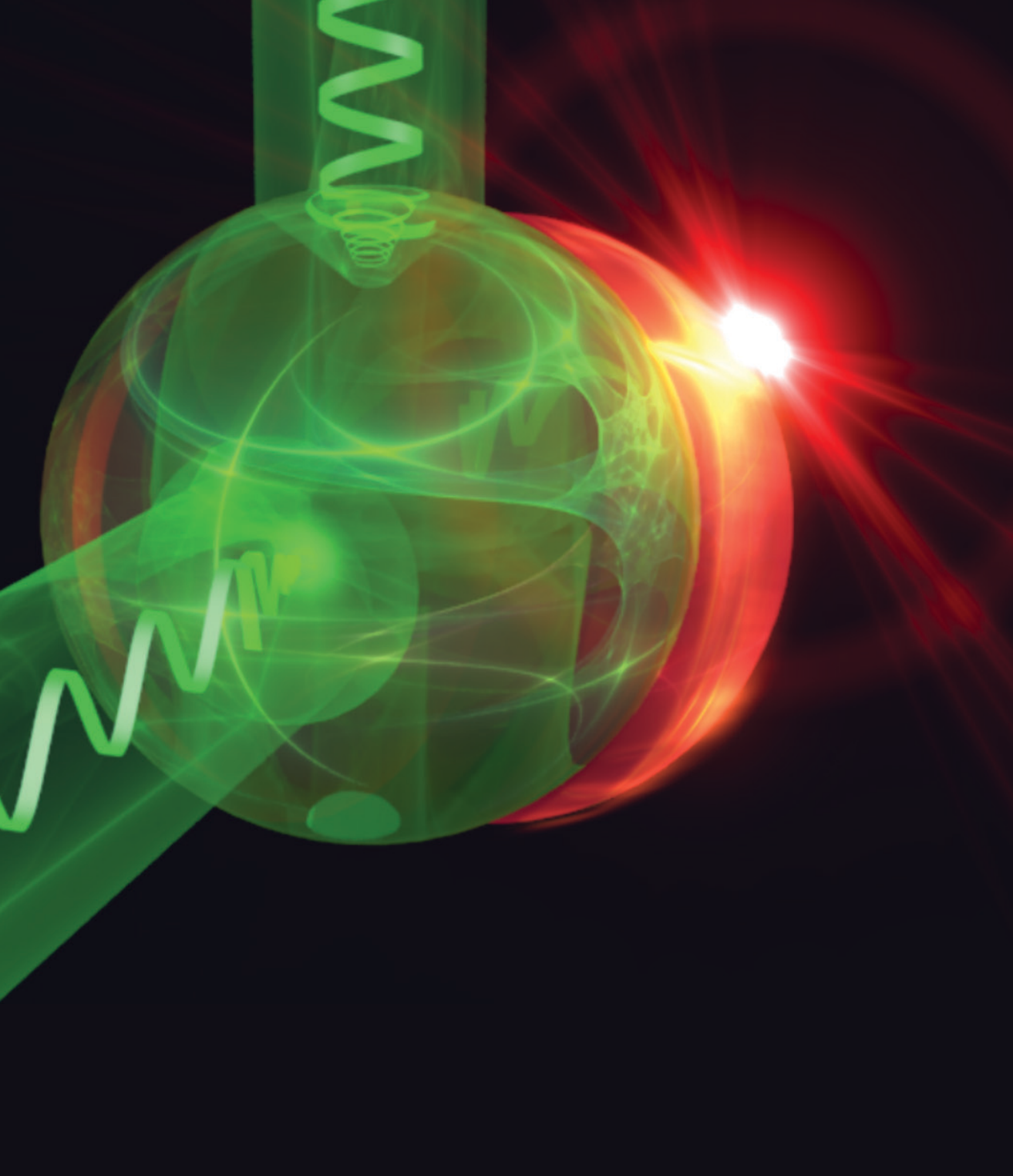




Annual Report



University of Central Florida
CREOL - The College of Optics and Photonics

2014



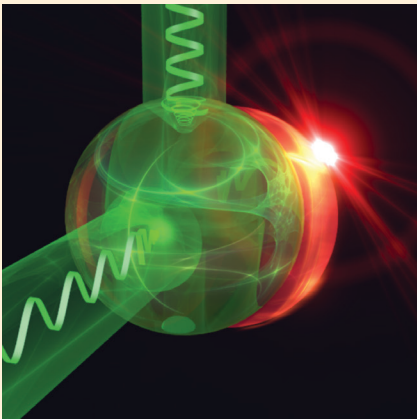
CREOL

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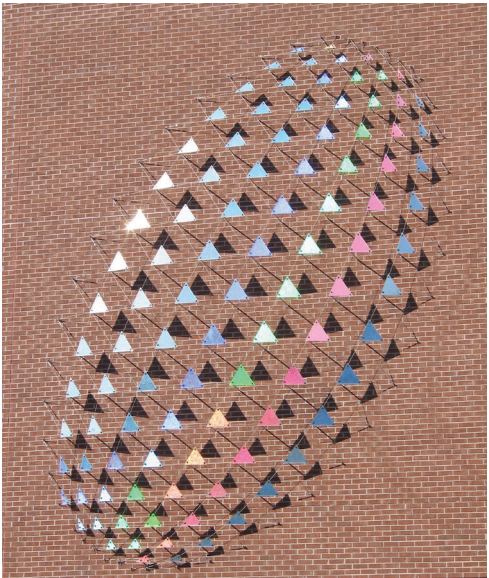
Students at Optics Day, April 4, 2014 .



Cover: An artistic rendition of an optical setting for observing nonconservative reaction force of light on matter. Prepared by Prof. Aristide Dogariu’s group.



Cover: Microring laser comprised of a pair of pumped and unpumped coupled rings. See description of Prof. Mercedeh Khajavikhan’s research on page 44.



Back cover: The *elliptic lens*: artwork by Ray King Studio placed on the facade of the CREOL building. The gonfalon of the College of Optics and Photonics, right, is inspired by this oeuvre.



CREOL, The College of Optics and Photonics, is one of the world's foremost institutions for research and education in optics and photonics. It started in 1987 as the Center for Research in Electro-Optics and Lasers (CREOL) and became a College in 2004, the first such college in the US. The College is home to the *Florida Photonics Center of Excellence* (FPCE), the *Townes Laser Institute*, and the *Institute for the Frontier of Attosecond Science and Technology* (iFAST).

During the last 27 years, CREOL has graduated 265 PhD and 370 MS students. World-renowned for their scholarly contributions to fundamental and applied optics and photonics, the faculty have published 28 books and more than 2,000 journal papers with close to 40,000 citations.

The college has been an exciting place for students to have an outstanding educational experience and to engage in research in a broad spectrum of programs covering materials, devices, and systems using technologies including lasers, optical fibers, integrated photonics, nonlinear and quantum optics, and imaging, sensing and display. These technologies have applications in manufacturing, communication and information, biology and medicine, energy and lighting, and homeland security and defense. Advanced topics such as nanophotonics, attosecond optics, plasmonics, and biophotonics are embraced as areas of strength and future growth. We are well positioned to take advantage of the revolution that is taking place in several fields enabled by optics and photonics.

CREOL was initially founded to promote growth in optics and related fields here in central Florida and has maintained this tradition over the years. We provide the well-trained workforce that keeps the industry growing and we partner with the *Florida Photonics Cluster* to coordinate this industry's efforts and needs. We also receive strong support from the *Florida High Tech Corridor Council* and *Enterprise Florida*. The CREOL Industrial Affiliates Program has attracted more than 170 industrial members since its founding. The faculty have produced close to 270 patents, and spun off 25 photonics-based companies involving a wide variety of technologies. Five companies are incubated within the CREOL facilities.

Highlights of 2014 centered about the new undergraduate program – *BS degree in Photonic Science and Engineering*. This is a joint program with the College of Engineering and Computer Science designed to fill the growing need for photonics engineers. The first course, *Introduction to Photonics*, was offered in Fall 2013, along with a companion laboratory, and 5 new courses and 4 new labs debuted in 2014. Current enrollment is 40 accepted students and 30 pending.

Another key highlight is the appointment of Dr. Shuo (Sean) Pang who started in January 2015 as Assistant Professor. An expert in optical imaging, microscopy, and biomedical applications, Pang received his PhD from CalTech and was a postdoctoral fellow at Duke University. His appointment fills an important need in applied optics and image science.

The faculty continue to receive prestigious awards and recognitions at the national and international level. Michael Bass received the OSA R. W. Wood Prize for his discovery of optical rectification, which led to the development of terahertz wave sources. He is the fourth CREOL recipient of this prestigious award. S. T. Wu received the OSA Esther Hoffman Beller Medal, the third CREOL faculty to receive this honor. Wu was also inducted into the Florida Inventors

Hall of Fame for his pioneering work in liquid crystal display. Peter Delfyett was named Florida Academy of Science's 2014 Medalist. Martin Richardson received a Jefferson Science Fellowship and was also elected Fellow of APS. M.J. Soileau received the Economic Development Commission (EDC) Chairman's Award. Kathleen Richardson was elected 2014–2015 President of the American Ceramic Society.

At the university level, Demetrios Christodoulides, who was recently named to the Reuters list of Most-Cited Researchers, was named Cobb Family Endowed Chair Professor. Aristide Dogariu became Pegasus professor, the most prestigious honor given by UCF to a faculty member, and Ayman Abouraddy received the UCF Reach for the Stars Award.

In AY 2013-2014, 131 graduate students were enrolled, and 21 PhD degrees and 23 MS degrees were awarded. Graduate students are also recipients of national scholarships, fellowships, travel grants, and best papers or poster awards.

The research conducted by the faculty, students, and scientists was disseminated nationally and internationally in 2 books, 4 book chapters, 176 journal papers, 174 conference papers and presentations, and 44 invited lectures. This year, 9 papers were published in Nature journals, 2 in Science, and 4 papers in OSA new journal Optica. Research and educational programs were funded by contracts and grants totaling approximately \$14.6M in 2014. Our tradition of innovation has also continued. In 2014, the faculty were inventors or co-inventors of 17 issued patents.

Our partnership with industry continues to be strong. Approximately \$2.2M are received from industry or from federal grants flow through industrial partners, a connection that gives our students experience and a leg up on industry positions after they graduate. Several companies donated equipment for the new undergraduate laboratories. The 2014 Industrial Affiliates Day events were attended by 181 guests and 22 exhibitors, and the students presented 38 posters. Four short courses were offered.

CREOL maintains an ongoing relation with its alumni and holds regular alumni reunions at key conferences. Achievements of our successful alumni are highlighted in newsletters and on the CREOL website. This year's recipient of the Professional Achievement award is Michael Mielke, Ph.D.'03, Chief Scientist at Raydiance and principal architect of its laser platform. Mielke has brought ultrafast light to the industrial laser materials processing sector.

The CREOL Association of Optics Students (CAOS) continues to be involved in outreach and professional development. This year, a new student organization, Women in Lasers and Optics (WiLO) joined CAOS. Its mission is to promote professional growth for women and to prepare them for transition from student to professional life. Another highlight of 2014 was the 2014 National Science Olympiad, which was held at UCF and in which CREOL was an important participant.

This annual report provides an overview of the education, research, and partnership activities of the faculty, staff, and students in 2014. Key data are also compared to previous years to show progress and identify trends. Academic data are reported for the academic year AY2014 (Fall 2013, Spring 2014, Summer 2014). Fiscal data, grants, and patents are reported for the fiscal year FY2014 (July 2013–June 2014). Publications are reported for the 2014 calendar year. Selected research contributions are highlighted. Information on more recent activities are reported regularly in the College's website <http://www.creol.ucf.edu/>. We hope you can find the information you need in this Annual Report or in the website.

Bahaa Saleh

1. Faculty and Staff

1.1 Faculty



Ayman F. Abouraddy
Associate Professor of Optics and Photonics

PhD, Electrical Engineering, Boston University, 2003

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Research

Fabrication of multi-material micro-structured optical fibers, photonic band gap fibers, optical thermal, electric, and magnetic sensing using fibers, nonlinear fiber optics, supercontinuum generation, mid-infrared fibers, chalcogenide glass fibers, fibers for solar applications, quantum optics and quantum information processing, optical generation of entangled states for sensing and imaging, nanowire and nanoparticle synthesis

Other Experience

- Postdoctoral Fellow, 2003-05, Research Scientist, 2005-08, Research Laboratory of Electronics (RLE), M.I.T.

Professional Activities

- Subcommittee member, CLEO, 2012-2013
- Program committee member, SPIE DSS, 2009

Honors and Awards

- Reach for the Stars Award 2014
- Teaching Incentive Program Award 2014
- College Excellence in Research Award, CREOL, 2013



Rodrigo Amezcua Correa
Research Assistant Professor of Optics and Photonics

Ph.D. Optoelectronics, University of Southampton, 2009

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Research

Advanced optical fiber design and fabrication, photonic crystal fibers, fiber laser development, optical fiber devices and components, optical fiber sensors, nonlinear propagation in optical fibers, optical fiber for biomedical applications

Other Experience

- **Laser Development** Engineer, 2009-11, Powerlase Photonics
- Postdoctoral Researcher, 2007-09, University of Bath

Professional Activities

- Technical Committee Member, "2nd Workshop on specialty optical fibers and their applications", Oaxaca, Mexico

Honors and Awards

- Graduate Student Scholarship, , Mexico, 2004



Matthieu Baudalet
Research Assistant Professor of Optics and Photonics

National Center for Forensic Science

Ph.D., Physics, Université Claude Bernard Lyon 1, France, 2008
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Research

Laser spectroscopy and sensing, analytical spectroscopy, atomic and molecular spectroscopy, chemometrics and quantitative spectral analysis, stand-off-detection, laser filamentation, molecular alignment, laser-induced plasmas, laser-matter interaction

Other Experience

- Section co-chair for SciX, conference of the Federation of Analytical Chemistry and Spectroscopy Societies (FACSS)
- Manager of the LinkedIn group "Laser-induced breakdown spectroscopy"

Professional Activities

- President-elect of the North-American Society of Laser-Induced Breakdown Spectroscopy
- Member, editorial advisory board of Spectroscopy magazine
- Chair-elect, Society for Applied Spectroscopy Lester Strock Award

Honors and Awards

- 2013 UCF Research Millionaire



Zenghu Chang
Distinguished Professor of Physics & Optics and Photonics

Ph.D., Optics, Xi'an Institute of Optics & Precision Mechanics, 1988
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Research

Attosecond science, terawatt femtosecond laser, ultrafast atomic physics, coherent XUV and x-ray sources, high order harmonic generation, X-ray streak camera and other detectors, near and mid-infrared femtosecond sources.

Other Experience

- Director, Institute for the Frontier of Attosecond Science and Technology (iFAST)
- Ernest & Lillian Chapin Chair Prof., Kansas State Univ, 2009-10
- Professor, Department of Physics, Kansas State Univ, 2006-09
- Associate Prof. Dept. of Physics, Kansas State Univ, 2001-06
- Assistant Research Scientist, University of Michigan, 1999-01

Professional Activities

- Guest editor, J of Physics B., Attosecond special issue, 2012
- Co-chair, 5th Intl. Symposium, Ultra-fast Phenomena and THz Waves, China, 2010
- Co-chair, International Conf on Attosecond Phys, Kansas, 2009

Honors and Awards

- Fellow, APS, OSA
- Mercator Professorship, DFG, Germany, 2007
- Huber Schardin Gold Medal, 1996



Demetrios Christodoulides

Pegasus Professor of Optics and Photonics
Cobb Family Endowed Chair
Ph.D., Electrical Engineering, Johns Hopkins University, 1986

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(407) 882-0074

Research

Nonlinear wave propagation, nonlinear optics, beam synthesis and dynamics, optical solitons, periodic and random optical structures, nonlinear optics in soft matter, quantum transport in arrays and photonic lattices.

Professional Activities

- QELS Program Chair, CLEO/QELS, 2012
- Committee Chair, CLEO/QELS—QELS5, 2011
- Committee Chair, CLEO/IQEC-IQEC5, 2010
- Committee Chair, CLEO/IQEC-IQEC5, 2009

Honors and Awards

- NSF Presidential Early Career Award for Scientists & Engineers
- Fellow, OSA, IEEE, APS
- APS Edward Bouchet Award
- UCF Pegasus Professor



Peter J. Delfyett

Trustee Chair and Pegasus Professor of Optics and Photonics, EE & Physics
Ph.D., Electrical Engineering, City University of New York, 1988
delfyett@creol.ucf.edu
(407) 823-6812

Research

Fundamental ultrafast laser physics, ultrafast semiconductor lasers, stabilized optical frequency combs, optoelectronic device development, quantum dot based semiconductor devices for optical networks, ultrafast photonic networks and systems, optical clock distribution, synchronization & recovery, photonics ADC's and DAC's, coherent optical signal processing, DWDM, OTDM, and OCDMA Links

Other Experience

- Member of Technical Staff, Bell Communications Research
- President, National Society of Black Physicists
- Founder - Raydiance, Inc.

Professional Activities

- Board of Directors, OSA; Board of Governors, IEEE - LEOS
- Editor in Chief, IEEE J. Selected Topics in Quantum Electronics
- General Chair, CLEO; General Chair IEEE LEOS Annual Meeting

Honors and Awards

- NSF Presidential Early Career Award for Scientists & Engineers
- Fellow, OSA, IEEE, APS
- APS Edward Bouchet Award
- UCF Pegasus Professor Award



Dennis Deppe

FPCE Endowed-Chair Professor of Optics and Photonics

Ph.D., Electrical Engineering, University of Illinois, 1988

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Research

Semiconductor devices, epitaxial crystal growth, nano-structures, nanophotonics.

Other Experience

- ECE Department, UT Austin, 1990-05
- Member Technical Staff, AT&T Bell Laboratories, 1988-90

Professional Activities

- Guest Editor, IEEE JSQE, 1999
- Associate Editor, IEEE Photonics Letters, 1999-02
- Technical Program Committees, IEEE LEOS Annual Meeting, SPIE Photonics West, IEEE
- IEEE Semiconductor Laser Workshop Chair, 1998
- SPIE Conference Chair on VCSELs, 1997
- IEEE, LEOS Chair of the Semiconductor Laser Technical Committee, 99-02

Honors and Awards

- IEEE LEOS Engineering Achievement Award, 2003
- IEEE LEOS Distinguished Lecturer Award, 2001-02
- Fellow, IEEE, OSA
- OSA Nicholas Holonyak Award 1999
- NSF Presidential Young Investigator Award, 1991
- ONR Young Investigator Award, 1991



Aristide Dogariu

Pegasus Professor of Optics and Photonics

Ph.D., Engineering, Hokkaido University, Japan 1994

adogariu@creol.ucf.edu
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Research

Optics of complex media, waves propagation and scattering, statistical optics, optical sensing and imaging, near field optics, biophotonics, optical systems analysis, modeling, and design.

Other Experience

- Chair, "Mesoscale Photonics Incubator Meeting", OSA, 2012
- Chair, "Computational Optical Sensing and Imaging", OSA, 2009
- Chair, Topical Meeting "Computational Optical Sensing and Imaging", OSA, 2007
- Chair Biosensing Committee, "Topical meeting Coherent Optical Technologies and Applications", OSA, 2006
- Chair, Topical Meeting "Photon Correlation and scattering", OSA, 2004

Professional Activities

- Division Editor, Applied Optics - Optical Technology
- Member OSA Board of Editors
- Editorial Board: Journal of Holography and Speckle

Honors and Awards

- Fellow, APS, OSA
- Florida Photonics Center of Excellence (FPCE) Professorship
- UCF Pegasus Professor



Sasan Fathpour

Associate Professor of Optics and Photonics & EE

Ph.D., Electrical Engineering, University of Michigan, 2005

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Research

Silicon photonics, heterogeneous integrated photonics, optical interconnects, nonlinear integrated optics, nonlinear photovoltaic effect in semiconductors, electronic-Photonics intergrated circuits.

Other Experience

- Senior Researcher, Ostendo Technologies, Carlsbad, CA 2008
- Visiting Assistant Professor, Electrical Engineering Dept., UCLA 2007
- Postdoctoral Research Fellow, Electrical Engineering Dept., UCLA, 2005-07

Professional Activities

- Senior Member, SPIE, IEE and OSA
- Vice-Chair of Short Courses at Conference on Laser and Electro-Optics (CLEO)

Honors and Awards

- ONR Young Investigator Award, 2013
- UCF Teaching Incentive Program (TIP) Award, 2013
- College of Optics and Photonics Excellence in Graduate Teaching Award, 2013
- NSF CAREER Award, 2012
- UCLA Chancellor's Award for Postdoctoral Research, 2007



Romain Gaume

Assistant Prof. of Optics and Photonics & NanoScience Technology

Ph.D., Materials Science; Paris VI University, France, 2002

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(407) 823-5683

Research

Fabrication of transparent ceramics: powder processing, shaping and sintering, applications of transparent ceramics to lasers and scintillators, gain-engineered solid state lasers, nuclear and radiological scintillation detectors, thermoelectric ceramic materials

Other Experience

- Postdoctoral Research scientist, Applied Physics Dept., Stanford University 2002-06
- Research Scientist, Applied Physics Dept., Stanford University, 2006-11
- Consultants: Shasta Crystals, Cyanto Corporation, Silicon Light Machines

Professional Activities

- Member, SPIE, ACerS

Honors and Awards

- Dissertation Thesis Award, 2002.



Leonid B. Glebov

Research Professor of Optics and Photonics

Ph.D., Physics, State Optical Institute, Leningrad, 1976

lbglebov@creol.ucf.edu
(407) 823-6983

Research

Optical properties of glasses, photosensitive glasses for hologram recording, nonlinear phenomena, including laser-induced damage, holographic optical elements, high Power laser systems.

Other Experience

- Founder, Vice President and CTO of OptiGrate Corporation

Professional Activities

- Member, American Ceramic Society
- Member, Directed Energy Professional Society

Honors and Awards

- Dennis Gabor Award in Holography
- Fellow; SPIE, OSA, ACS, NAI
- Florida Photonics Center of Excellence (FPCE) Professorship



David J. Hagan

Associate Dean of Academic Programs, Professor of Optics and Photonics & Physics

Ph.D., Physics, Heriot Watt University, 1985

hagan@creol.ucf.edu
(407) 823-6817

Research

Nonlinear optics, fundamental limits for nonlinear optical coefficients, nonlinear optical switching, semiconductors and quantum dots, organics and polymers, optical limiting and suppression, ultrasensitive techniques for measuring optical nonlinearities, ultrafast spectroscopy.

Other Experience

- Founder, Polara, LLC.
- Photonics consultant, National Research Council "Defense After Next"

Professional Activities

- Editor-in-Chief, Optical Materials Express (current)
- Topical Editor, J. Opt Soc. Am B., (2006-10)
- Principal Editor, Journal of Materials Research (2001-06)
- Program Chair, Frontiers in Optics (2013)
- Senior Member, IEEE

Honors and Awards

- Fellow, OSA
- Ranked by ISI as "Highly Cited Researcher"
- College of Optics & Photonics Excellence in Research Award (2010-11)



Aravinda Kar

Professor of Optics and Photonics, MMAE, EECS & Physics

Ph.D., Nuclear Engineering, University of Illinois at Urbana-Champaign, 1985

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Research

Laser-Advanced materials Science (LAMS), lasers in manufacturing (LIM), thermal science for LAMS and LIM, laser and optical science and technology, process modeling and diagnostics, semiconductor and optoelectronic materials processing, materials synthesis and development of new materials, medical materials, novel sensors, detectors and light-emitters

Other Experience

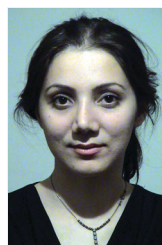
- Interdisciplinary science and technology
- Cross disciplinary courses (thermal science, materials and optics)
- Technology transfer from research to industrial implementation

Professional Activities

- Member, LIA
- Editorials Board Member

Honors and Awards

- Fellow, LIA
- Numerous Patents



Mercedeh Khajavikhan

Assistant Professor of Optics and Photonics

Ph.D., Electrical Engineering, University of Minnesota, 2009

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(407) 823-6829

Research

Nanophotonics and silicon photonics, plasmonics and applied electromagnetics, laser physics, quantum optics, Non-Hermitian Photonics.

Other Experience

- Post-Doctoral Researcher, University of California, 2009-11
- Staff Researcher, University of California, 2012

Professional Activities

- Member, OSA, SPIE
- Reviewer, Optics letters, Optics Express, Applied Physics letter, IEEE Photonics Technology Letter, Applied Optics, Optical Communication, Journal of Optical Society A and B

Honors and Awards

- Norton Fellowship, University of Minnesota, 2005



Pieter G. Kik

Associate Professor of Optics and Photonics & Physics

Ph.D., Physics, FOM Institute of Atomic Molecular Physics, Amsterdam (AMOLF), 2000

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Research

Nanophotonics and near-field optics, near-field scanning optical microscopy, nanostructured optical waveguides, nanolithography, tunable plasmon optical nanosensors for biochemical detection, numerical modeling of nanophotonic integrated circuits, surface enhanced Raman spectroscopy, rare earth doped optical materials, waveguide amplifiers

Other Experience

- Post-Doctoral Researcher, California Institute of Technology, 2001-03

Professional Activities

- Editor, Optics Communications
- Member, MRS, IEEE, SPIE

Honors and Awards

- 2014 Excellence in Graduate Teaching Award (College Level)
- 2009 Teaching Incentive Award Program
- 2008 Excellence in Graduate Teaching Award (College Level)
- 2007 NSF Career Award



Stephen Kuebler

Associate Professor of Chemistry & Optics and Photonics

D.Phil, Chemistry, University of Oxford, 1998

Stephen.kuebler@ucf.edu
(407) 823-3720

Research

Laser-based patterning and material processing, laser beam shaping, nanophotonic structures and devices, 3D nano and microfabrication, nonlinear optical Materials.

Other Experience

- Assistant Staff Scientist, Chemistry, University of Arizona, 2001-03
- Research Associate, Chemistry, University of Arizona, 1999-01
- Post-Doctoral Researcher, California Institute of Technology, 1998-99

Professional Activities

- Interm Assistant Vice-President of Research and Commercialization (2012-2013)
- Editorial Board, J. of Micro/Nanolithography, MEMS, and MOEMS
- Editorial Board, Journal of Experimental Nanoscience
- Member, MRS, OSA, SPIE, ACS
- Chair, Orlando Section of the American Chemical Society
- Marshall Scholarship Selection Committee, Atlanta Region

Honors and Awards

- NSF CAREER Award, January 2008
- Teaching Incentive Program Award, UCF, May 2009
- Excellence in Undergraduate Teaching Award, College of Sciences, UCF, March 2008
- Marshall Scholar, Assoc. of Commonwealth Universities, UK, 1991
- NSF Graduate Fellowship, 1993
- Barry Goldwater Fellowship for physical sciences, 1989



Guifang Li

Professor of Optics and Photonics, Physics & EECS

Ph.D., Electrical Engineering, University of Wisconsin- Madison, 1991

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Research

Fiber-optic transmission systems, all-optical signal processing, free-space optical communication, optical networking, fiber optics, microwave photonics, coherent detection and imaging.

Other Experience

- ☐ Nonlinear surface polaritons
- ☐ Phase conjugation
- ☐ Nonlinear dynamics

Professional Activities

- ☐ Deputy Editor, Optics Express
- ☐ Associate Editor, IEEE Photonics Technology Letters

Honors and Awards

- ☐ ONR Young Investigator Award, 1995
- ☐ NSF CAREER Award, 1996
- ☐ IEEE EDS Distinguishes Lecturer
- ☐ Fellow, OSA, SPIE
- ☐ Florida Photonics Center of Excellence (FPCE) Professorship



Patrick L. LiKamWa

Associate Professor of Optics and Photonics & ECE

Ph.D., Electronic & Electrical Engineering, University of Sheffield, UK, 1987

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Research

Optoelectronics, integrated optics devices with gain using resonant nonlinearities, novel semiconductor nanostructures for advanced optoelectronics, implement monolithic all-Optical switching circuits, multi-platform integration using multilayer dielectric films for integrated, integrated optic bio-sensors, monolithically integrated wavelength tunable optical emitters

Other Experience

- ☐ Plasmonic waveguiding devices
- ☐ Fiber optic sensors

Professional Activities

- ☐ Senior Member, IEEE/LEOS

Honors and Awards

- ☐ IEEE/LEOS Orlando Chapter Engineer of the Year
- ☐ UCF Teacher Incentive Program
- ☐ College of Optics Excellence in Graduate Teaching Award



M. G. "Jim" Moharam

Professor of Optics and Photonics

Ph.D., EE, University of British Columbia, Canada, 1978

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Research

Diffraction holographic optics, Integrated photonics grating based devices, computational photonics, theory and analysis of periodic structures, subwavelength periodic structures and devices, guided-waves grating resonant devices, analysis and design artificial metamaterial devices, novel integrated antireflective surfaces, grating based plasmonic structures.

Other Experience

- ☐ Wave propagation in periodic and anisotropic media
- ☐ Analysis and design of optical filters
- ☐ Thin film optics

Professional Activities

- ☐ Topical Editor - JOSA - A
- ☐ Conference Chair, Topical meeting on diffractive optics
- ☐ Program Committee, SPIE Europe

Honors and Awards

- ☐ Fellow, OSA
- ☐ Senior Member, IEEE
- ☐ UCF Graduate Teaching Award



Kathleen A. Richardson

Professor of Optics and Photonics and Materials Science and Engineering

Ph.D., Ceramics, Alfred University, 1992

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(407) 823-6815

Research

Infrared optical glass and glass ceramics, photosensitive infrared materials, integrated MIR Planar sensors, optics manufacturing science, mid-infrared optical metrology, precision glass molding (PGM), graded index optical materials

Professional Activities

- ☐ President, American Ceramic Society
- ☐ Member of the Board of Directors Society of Photo-Optical Instrumentation Engineers (SPIE)
- ☐ Associate Editor, International Journal of Applied Glass Science
- ☐ Coordinating Technical Council, International Commission on Glass
- ☐ Member of the Board of Trustees, Alfred University

Honors and Awards

- ☐ Fellow, OSA, SPIE, ACerS
- ☐ Outstanding Education Award, American Ceramic Society
- ☐ Tau Beta Pi Honor Society
- ☐ Samuel R Scholes Lecture and Award, Alfred University
- ☐ Fellow; Society of Glass Technology, United Kingdom



Martin C. Richardson

FPCE Trustee Chair; Northrop Grumman Prof. of X-ray Photonics; Pegasus Prof. of Optics and Photonics, Physics, ECE; Director, Townes Laser Institute

Ph.D., Physics, London University, 1967

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Research

Laser system development, femtosecond laser-aided materials processing, laser-induced-breakdown spectroscopy (LIBS), biological x-ray microscopy, laser medicine, optical tweezers, physics of laser plasmas, plasma & radiation modeling - X-ray sources, ultra-fast X-ray production; interaction with matter diffraction studies, X-ray and EUV optics, laser plasma EUV sources for lithography, high energy lasers, solid state lasers, high power fiber lasers development & High power ultrafast lasers, laser spectroscopy and sensing

Professional Activities

- Member, SPIE, APS, Program Committee; LEOS
- Directed Energy Consortium (UCF rep.), 2003
- Member, Expert Review Panel - Canadian Institute for Photonic Innovations, Canadian Govt.

Honors and Awards

- UCF Pegasus Professor Award
- SPIE Harold E. Edgerton Award
- Fellow, OSA, IEEE, SPIE, APS
- Schardin Medal



Bahaa E. A. Saleh

Dean & Director, Professor of Optics and Photonics

Ph.D., Electrical Engineering, Johns Hopkins University, 1971

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Research

Nonlinear and quantum optics quantum information processing, coherence and statistical optics, optical imaging and sensing

Other Experience

- Chair of ECE, Boston University, 1994-07
- Chair of ECE, University of Wisconsin-Madison, 1990-94
- Assoc. Director, ERC Center for Subsurface Imaging, 2000-09

Professional Activities

- Member, Board of Directors, LIA, 2011-present
- Founding Editor, *Advances in Optics and Photonics*, 2008-present
- Editor, *Journal of Optical Society of America A*, 1991-97
- Author, *Introduction to Subsurface Imaging*, Cambridge 2011
- Co-author of *Fundamentals of Photonics*, Wiley, 2nd ed., 2007
- Author, *Photoelectron Statistics*, Springer, 1978

Honors and Awards

- OSA Distinguished Service Award, 2009
- OSA Esther Hoffman Beller Medal, 1999
- Kuwait Prize, 2006
- SPIE BACUS Prize, 2004
- Fellow, IEEE, OSA, SPIE
- Fellow; Guggenheim Foundation



Winston V. Schoenfeld

Associate Professor of Optics and Photonics

Ph.D., Materials Science, Univ. of California, Santa Barbara, 2000

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Research

MBE growth of oxide semiconductors (wurtzite and cubic), binary cubic oxide semiconductor solar-blind detectors, hybrid homoepitaxial zinc oxide-nitride laser diodes, cSi photovoltaics, passive/active photonic crystal nanocavity systems

Other Experience

- Director, cSi Photovoltaic Manufacturing Consortium (PVMC)
- President/CEO, Medical Lighting Solutions, 2003-04
- Device Manager, Uniroyal Optoelectronics, 2000-03

Professional Activities

- Principal Editor, *Journal of Materials Research*
- Chair, MOEMS/MEMS Conference - Photonic West
- Executive Committee, Florida Chapter of the AVS
- Energy sub-committee Member, National Photonics Initiative

Honors and Awards

- Fellow, SPIE
- UCF TIP Award, 2010
- College Excellence in Graduate Teaching, 2009
- UCF Presidential Initiative Award, 2006



Axel Schülzgen

Professor of Optics and Photonics

Ph.D., Physics, Humboldt University, 1992

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Research

Fiber laser devices, fiber optic sensors, linear and nonlinear light propagation in fiber, nanostructured and functionalized fibers, design and fabrication of specialty optical fiber, advanced optical materials, linear and nonlinear optical spectroscopy

Other Experience

- College of Optical Sciences, The University of Arizona, 1996-09
- Department of Physics, Trinity College, Dublin, Ireland, 1995
- Department of Physics, Humboldt University, Berlin, Germany, 1991-95

Professional Activities

- Associate Editor, *Applied Optics*, Ultrafast Lasers and Optics
- Member, OSA, SPIE, German Physical Society

Honors and Awards

- Habilitation Fellowship, German Research Foundation, 1993
- Carl Ramsauer-Magnus Award, AEG Corporation, 1992
- Heinrich Gustav - Magnus Award, Humboldt University, Berlin, 1988



Lawrence Shah

Research Assistant Professor of Optics and Photonics

Ph.D., Physics, University of Central Florida, 2001

lshah@creol.ucf.edu
(407) 823-2066

Research

Fiber Laser, ultrafast lasers, thin disk lasers, nonlinear optics for wavelength generation in the near-and mid-IR, laser materials processing.

Other Experience

- Post doc, Lawrence Livermore National Laboratory, 2001-02
- Application Development and Laser Development Research Scientists, IMRA America Inc, 2002-08
- Senior Research Scientists, Laser Plasma Laboratory, 2008-12
- Assistant Editor for IEEE Journal of Quantum Electronics

Professional Activities

- Member, SPIE, OSA



M.J. Soileau

Vice Pres., Research & Commercialization and Professor of Optics and Photonics, ECE & Physics

Ph.D., Quantum Electronics, University of Southern California, 1979

mj@ucf.edu
(407) 823-5538

Research

Nonlinear optical properties of materials, laser-induced damage; Laser-induced damage to optical materials, nonlinear refraction nonlinear absorption; Sensor protection

Other Experience

- Physicist, Naval Weapons Center Physics Div., China Lake, 1973-80
- Professor of Physics, North Texas State University, 1980-87
- Director, School of Optics/CREOL, 1987-99
- Chair of the Board, Orlando Science Center, 2002
- Technology-Based Economic Development; Technology Transfer
- Board of Directors, BEAM, Inc.; Board of Directors, Aquafiber

Professional Activities

- President, SPIE, 1997
- International Advisory Committee on Coherent and Nonlinear Optics, 2001
- Co-Chair, OSA/SPIE Joint Task Force, 1998-99

Honors and Awards

- Director's Award, SPIE, 1999
- Fellow, OSA, IEEE, SPIE, AAAS, NAI; Senior Member, LIA
- Outstanding Engineer Award, State of Florida, 1994
- SPIE Gold Medal
- OSA Esther Hoffman Beller Award
- Distinguished Service Medal, ICFO, Barcelona, Spain
- EDC Chairman's Award, 2014v



Eric W. Van Stryland

Pegasus Professor of Optics and Photonics, Past Dean

Ph.D., Physics; Optical Sciences, University of Arizona 1976

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(407) 823-6835
<http://nlo.creol.ucf.edu/>

Research

Develop NLO spectroscopic techniques, e.g. Z-scan, measure nonlinear absorption spectra, e.g. two-photon absorption, 2PA, measure nonlinear refraction dispersion, e.g. bound electronic n₂, model material nonlinearities, 2PA, n₂, excited-state absorption, etc., measure ultrafast NLO response and temporally resolve, develop nonlinear devices - e.g. widegap IR detectors using 2PA

Other Experience

- Dean, CREOL, The College of Optics and Photonics, 2004-09
- Director, School of Optics/CREOL, 1999-04
- Visiting Professor, Heriot-Watt University, 1985
- Chair, Center for Applied Quantum Electronics, U. of N. Texas, 1983-86
- Center for Laser Studies, University of South California, 1976-78

Professional Activities

- President, Optical Society of America (OSA), 2006, Board of Directors,
- Fellow, OSA, SPIE, IEEE-LEOS, APS
- Senior member, LIA (Board of Directors)
- Topical Editor, Optics Letters, 1994-98

Honors and Awards

- UCF Pegasus Professor Award, 2003
- UCF Researcher of the Year, 1990 and 2009; R&D 100 Award, 2001
- ISI Highly Cited Author
- OSA R. W. Wood Prize, 2012



Konstantin L. Vodopyanov

21 Century Scholar Chair and Professor of Optics and Photonics

Ph.D., Physics, Lebedev Physical Institute, Moscow, 1983

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<http://mir.creol.ucf.edu>

Research

Mid-IR and THz generation via frequency downconversion, laser spectroscopy, nano-IR spectroscopy, supercontinuum generation in fibers, biomedical applications of lasers, standoff sensing and detection

Other Experience

- Stanford University (2003-2013)
- Inrad Inc., Picarro Inc., USA (1999-2003)
- Imperial College, London, UK (1992-1998))
- University of Bayreuth, Germany (1990-1992)
- Moscow Inst. of Physics and Technology (1985-1990)
- Lebedev Physical Inst., Moscow (1983-1990)

Professional Activities

- General Chair, Inst. Symp. On Photodetection and Imaging (ISPD), Beijing, China, 2013
- Photonics West, LA106 Conference Chair (2010-present)
- CLEO General Chair, 2010, CLEO Program Chair, 2008
- Associate Editor, Optica
- Co-author, Solid-State Mid-Infrared Laser Sources, Springer, 2003

Honors and Awards

- Fellow, OSA, SPIE, APS
- Fellow, UK Institute of Physics (IOP)
- Alexander-von-Humboldt Fellow, Germany, 1990



Shin-Tson Wu

Pegasus Professor of Optics and Photonics

Ph.D., Physics, University of Southern California, 1981

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(407) 823-4763

Research

Blue-phase liquid crystal displays, adaptive lenses, adaptive optics, biosensors, laser beam control, new photonic materials.

Other Experience

- Senior Scientist, Hughes Research Labs

Professional Activities

- OSA Board of Directors
- Chair, OSA Publications Council
- SID Honors and Awards Committee
- SPIE G.G. Stokes Award Committee
- Vice Chair, OSA Publication Council
- Founding Editor-In-Chief, IEEE/OSA Journal Display Technology

Honors and Awards

- 2014 Florida Inventors Hall of Fame
- 2014 OSA Esther Hoffman Beller Medal
- 2012 NAI
- 2011 SID Slottow-Owaki Prize
- 2010 OSA Joseph Fraunhofer Award
- Fellow, OSA, SPIE, IEEE



Boris Y. Zeldovich

Professor of Optics and Photonics & Physics

Ph.D., Physics, Institute of Theoretical and Experimental Physics, Moscow, 1969

boris@creol.ucf.edu
(407) 823-6831

Research

Physical optics and propagation, Electrodynamics of Volume Bragg Gratings, beam clean-up and combining via nonlinear-optical processes, nonlinear optics, including liquid crystals.

Other Experience

- Vice President, Beam Engineering for Advanced Measurements Co., Winter Park, FL
- Head, Joint Nonlinear Optics Lab, Electrophysics Institute of the Russian Academy of Sciences and Chelyabinsk Technical University, Russia, 1987-94
- Principal Senior Scientific Researcher, Inst. for Problems in Mechanics, Moscow, 1981-87
- Lecturer on Nonlinear & Statistical Optics, Moscow Institute for Physics and Technology, 1969-1987

Professional Activities

Editorial Board Member, Optics Communications; Pure & Applied Optics; Optical and Quantum Electronics; International Journal of Nonlinear Optical; Physics & Materials Topical Editor, J.Optical Society of America B

Honors and Awards

- Max Born Award, OSA, 1997
- Fellow, OSA
- Member, USSR Academy of Sciences
- USSR State Prize for the discovery of optical phase conjugation, 1983

Emeritus Faculty



Larry C. Andrews

Emeritus Professor of Mathematics & Optics and Photonics

Ph.D., Engineering, Michigan State University, 1970

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407-823-2418

Research

Propagation of laser beams through random media
laser communication and laser radar

Other Experience

- Staff Mathematician, Antisubmarine Warfare Operation, Magnavox Co., Fort Wayne, IN
- Assistant Professor of Mathematics and Mechanics, Tri-State University, Angola, IN

Professional Activities

- Author of many textbooks and monographs on wave propagation through random media, applications to laser communications and radar, atmospheric optics, and advanced applied mathematics.

Honors and Awards

- Fellow, SPIE



Michael Bass

Emeritus Professor of Optics and Photonics, Physics & ECE

Ph.D., Physics, University of Michigan, 1964

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Research

Display technologies; all-optical 2- and 3-dimensional displays, up-conversion processes in dielectric materials, laser systems development, solid state laser design, models for high-average power solid state lasers, pump requirements, performance potentials and Limitations, spray cooling of diode laser bars, thermal management of diode laser arrays sources for solid state lasers

Other Experience

- Senior Research Scientist, Raytheon, 1966-73
- Director, Center for Laser Studies, USC, 1977-84
- Chair, EE Electrophysics, USC, 1984-87
- Vice President for Research, UCF, 1988-93
- Professional Activities
- Associate Editor, Optics Express
- Editor-in-chief "Handbook of Optics, 2nd and 3rd editions, OSA
- Associate Editor, 100th Anniversary of OSA commemorative books

Honors and Awards

- R. W. Wood Prize 2014
- Fellow, OSA, IEEE



Glenn D. Boreman

Emeritus Professor of Optics & Photonics
Professor and Chair
Univ. North Carolina
Ph.D., Optical Sciences, University of Arizona,
1984

gboreman@uncc.edu

Research

Infrared antennas and transmission lines, infrared frequency-selective surfaces, nano-scale E-field mapping, BRDF & surface-scatter measurement.

Other Experience

- Visiting Scholar, Imperial College (London), ETH (Zurich), Defense Research Agency (FOI) Sweden, Univer. Complutense (Madrid).
- Consultant, Licensed Professional Engineer

Professional Activities

- Editor-in-Chief, Applied Optics
- Co-author, *Infrared Detectors & Systems*
- Author, *Basic Electro-Optics for EEs & Modulation Transfer Function in Optical and Electro-Optical systems*
- 2015 SPIE Vice President
- Co-founder, Plasmonics, inc.

Honors and Award

- Fellow, OSA, SPIE
- SPIE Kingslake Medal
- Fellow, Military Sensing Symposium



Ronald L. Phillips

Emeritus Professor of EECS & Optics & Photonics
Ph.D., Electrical Engineering, Arizona State University, 1971

Ronald.phillips@ucf.edu

Research

Laser space communication systems, laser radar, detection theory and math modeling, optical wave propagation through random media, random field theory,

Other Experience

- Academic positions at Arizona State University and the University of California, San Diego.

Professional Activities

- Founding Director, UCF Florida Space Institute (FSI)
- Founding Director of CREOL
- Author of 3 books in the topic of wave propagation through random media and applications to laser communications and radar.
- Co-author of a text on advanced applied mathematics.

Honors and Awards

- Senior NATO Post-doctoral Fellow
- ASEE 1983 Medal Outstanding Contributions to Research
- Florida Space Business Roundtable Explorer Award for education
- Fellow, OSA, SPIE



William Silfvast

Emeritus Professor of Optics and Photonics
Ph.D., Physics, University of Utah, 1965

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(407) 823-6855

Research

X-Ray science and technology, EUV lithography and microscopy, X-Ray theory, X-Ray Lasers.

Other Experience

- Chair, UCF Department of Physics, 1994-97
- Distinguished Member Technical Staff, ATT-Bell Labs, 1994-97

Professional Activities

- Co-Chair, CLEO, 1983
- OSA Board of Directors, 1986-00
- Program Committee Member, LEOS, 1994-00
- Author, Textbook: "Laser Fundamentals," Cambridge University Press

Honors and Awards

- Fellow, OSA, APS, IEEE
- Guggenheim Fellow, Stanford University
- Distinguished Member Technical Staff, ATT-Bell Labs, 1983
- NATO Postdoctoral Fellow
- Researcher of the Year, University of Central Florida, 2000



George I. Stegeman

Emeritus Professor of Optics and Photonics,
Physics & EECS

Ph.D., Physics, University of Toronto, 1969

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(407) 629-2944

Research

Discrete optics, linear and nonlinear, solitons

Other Experience

- Distinguished Professor, University of Toronto

Professional Activities

- Editor-in-Chief, Journal of the OSA B
- Organizing Committee, NOA 2011, Torun Poland, June 2011
- Editorial Board, Physics Reports, Responsible for Optics, 2005-present
- Chair Professor, College of Engineering, King Fahd University, Saudi Arabia

Honors and Awards

- Cobb Family Chair, UCF
- Fellow, OSA, APS
- Hertzberg Medal for Achievement in Physics
- R. W. Wood Prize, OSA (2003)
- Bluto Award of the Polish Photonics Society, 2011
- Doctor Honoris Causa, Instituto Nacional de Astorfisica, Optica y Electronica (INAE), 2011

Joint Faculty



KEVIN D. BELFIELD

Department Chair & Prof. of Chemistry and Optics and Photonics

Ph.D., Syracuse University

Multiphoton Absorbing Materials

Belfield@ucf.edu



DEBASHIS CHANDA

Assistant Professor, AMPAC/NSTC

Ph.D., University of Toronto

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LOUIS CHOW

Professor and Univ. Chair in Mechanical Engineering

Ph.D., University of California, Berkeley

Heat Transfer Issues in Electro-Optics

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YAJIE DONG

Assistant Professor, NSTC

Ph.D., Harvard University

Nanoelectronics and nanophotonics

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Assoc. Prof., Nanoscience Technology Center, Chemistry, and Optics and Photonics

Ph.D., University of Leuven

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D.Sc., Universidad Central de Venezuela & Université Franche-comté

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DAVID KAUP

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Ph.D., University of Maryland

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Ph.D., University of Basel

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Defects in Semiconductors

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SEETHA RAGHAVAN

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Ph.D., Purdue University

Optical Characterization of Advanced Materials

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Near-IR Raman Spectroscopy

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Agere Chair Professor of Computer Science and Optics and Photonics

Ph.D., Wayne State University

Computer Vision

Mubarak.shah@ucf.edu



MICHAEL SIGMAN

Associate Professor of Chemistry and Optics and Photonics

Ph.D., Florida State University

Explosives, Chemistry & Forensics

Michael.sigman@ucf.edu



JAYAN THOMAS

Assistant Professor of Nanoscience & Technology

Ph.D., Cochin University of Science & Technology

Jayan.Thomas@ucf.edu

**THOMAS X. WU**

Associate Professor of EECS & Optics and Photonics
 Ph.D., University of Pennsylvania
 Numerical Techniques in Electromagnetics
Thomas.wu@ucf.edu

**CYNTHIA YOUNG**

Professor of Math and Optics and Photonics
 Ph.D., University of Washington
 Laser Propagation in Random Media
Cynthia.young@ucf.edu

Courtesy Faculty

**KURT BUSCH**

Prof. of Physics, Univ. Karlsruhe
 Ph.D., University of Karlsruhe
kurt@tfp.uni-karlsruhe.de

**BRUCE H. CHAI**

President, Crystal Photonics
 Ph.D., Yale University
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**JASON EICHENHOLZ**

Divisional Technology Director, Halma CEO, Open Photonics, Inc.
 Ph.D., CREOL, University of Central Florida
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**JAMES E. HARVEY**

Associate Professor of Optics and Photonics & ECE
 Ph.D., Optical Sciences, University of Arizona, 1976
harvey@creol.ucf.edu

**HANS P. JENSSEN**

AC Materials
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**ERIC G. JOHNSON**

Professor of Physics & Optical Science
 University of North Carolina Charlotte
 Ph.D., University of Alabama
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**VASSILIOS KOVANIS**

AFRL, Sensors Directorate
 Ph.D., University of New Mexico
 Semiconductor lasers, nonlinear optics
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**JANNICK ROLLAND**

Brian J. Thompson Prof. of Optical Engineering, Prof. of Biomedical Engineering, University of Rochester
 Ph.D., University of Arizona
 Optical Diagnostics & Applications
rolland@optics.rochester.edu

**KENNETH SCHEPLER**

AFRL, Sensors Directorate
 PhD, University of Michigan
schepler@creol.ucf.edu

**EMIL WOLF**

Wilson Professor of Optical Physics
 Ph.D., Bristol University, England
 Optical Coherence
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Visiting Faculty

**ANGELA GUZMAN**

Visiting Research Associate Professor
 Dr.SC., Ludwig Maximilian University
 Quantum Optics
angela.guzman@creol.ucf.edu

**MALVIN C. TEICH**

Visiting Research Professor
 Ph.D., Cornell University
 Quantum Optics
teich@creol.ucf.edu

Faculty Awards and Honors

	1997 Max Born Award 1999 Nicholas Holonyak Award 1999 Esther Hoffman Beller Award 2008 Esther Hoffman Beller Award 2008 Distinguished Service Award 2010 Joseph Fraunhofer/Robert M. Burley Prize 2003 R. W. Wood Prize 2011 R. W. Wood Prize 2012 R. W. Wood Prize 2013 C.E.K. Mees Medal 2014 R. W. Wood Prize	Boris Zeldovich Dennis Deppe Bahaa Saleh M.J. Soileau Bahaa Saleh Shin-Tson Wu George Stegeman Demetrios Christodoulides Eric Van Stryland Bahaa Saleh Michael Bass
	1995 Kingslake Medal and Prize 2004 Bacus Award 2008 Dennis Gabor Award 2008 G. G. Stokes Award 2008 Gold Medal Award 2013 Harold E. Edgerton Award	Glenn Boreman Bahaa Saleh Leonid Glebov Shin-Tson Wu M.J. Soileau Martin Richardson
	2003 Engineering Achievement	Dennis Deppe
	2008 Jan Rajchman Prize 2011 Slottow–Owaki Prize	Shin-Tson Wu Shin-Tson Wu
	2011 Edward A. Bouchet Award	Peter Delfyett
	NSF Presidential Early Career Award (PECASE)(1997) NSF Presidential Young Investigator Award (1991) NSF CAREER Award (2012) NSF CAREER Award (2007) NSF CAREER Award (2008) NSF CAREER Award (1996)	Peter Delfyett Dennis Deppe Sasan Fathpour Pieter Kik Stephen Kuebler Guifang Li
	ONR Young Investigator Award (1991) ONR Young Investigator Award (1995) ONR Young Investigator Award (2013)	Dennis Deppe Guifang Li Sasan Fathpour
	Ralph E. Powe Junior Faculty Award (2009)	Ayman Abouraddy
	Guggenheim Fellow (1984)	Bahaa Saleh
	ACerS Outstanding Educator Award (2009)	Kathleen Richardson

International Awards and Honors

Michael Bass	Fellow, Russian Academy of Engineering Science (1994)
Michael Bass	Fellow, International Academy of Engineering, Russia
Zenghu Chang	Hubert Schardin Gold Medal Medal (1996)
Kathleen Richardson	I.D. Varshnei Award, Indian Ceramic Society (2013)
Martin Richardson	Hubert Schardin Gold Medal Medal (1976)
Martin Richardson	Honorary doctorate, University of Bordeaux, France (2013)
Bahaa Saleh	Kuwait Prize (2006)
Axel Schülzgen	Habilitation Grant, German Research Foundation (1993)
Axel Schülzgen	Carl-Ramsauer-Award of the AEG AG (1992)
M.J. Soileau	ICFO's Distinguished Service Appreciation Medal (2012)
George Stegeman	Honorary doctorate, NRS University, Canada (2013)
Boris Zeldovich	USSR Academy of Sciences (1987)
Boris Zeldovich	USSR State Prize (1983)

Fellows of Professional Societies and Academies



Michael Bass	David Hagan	William Silfvast
Zenghu Chang	Guifang Li	M.J. Soileau
Demetrios Christodoulides	Jim Moharam	George Stegeman
Peter Delfyett	James Pearson	Eric Van Stryland
Dennis Deppe	Kathleen Richardson	Shin-Tson Wu
Aristide Dogariu	Martin Richardson	Boris Zeldovich
Leonid Glebov	Bahaa Saleh	



Glenn Boreman	Kathleen Richardson	Eric Van Stryland
Leonid Glebov	Martin Richardson	Shin-Tson Wu
James Harvey	Bahaa Saleh	
Guifang Li	Winston V. Schoenfeld	
James Pearson	M.J. Soileau	



Michael Bass	Guifang Li	William Silfvast
Peter Delfyett	James Pearson	M.J. Soileau
Dennis Deppe	Martin Richardson	Eric Van Stryland
Sasan Fathpour	Bahaa Saleh	Shin-Tson Wu



Zenghu Chang	Peter Delfyett
Aristide Dogariu	Martin Richardson
Demetrios Christodoulides	Eric Van Stryland



Aravinda Kar
Michael Bass



Shin-Tson Wu



Leonid Glebov
Kathleen Richardson



Michael Bass	M.J. Soileau
Peter Delfyett	Shin-Tson Wu
Leonid Glebov	



Michael Bass

Presidents, Directors and Officers of Professional Societies



Eric Van Stryland
Michael Bass
Peter Delfyett
Bahaa Saleh
Eric Van Stryland
Shin-Tson Wu

President (2006)
Board of Directors Member (1989–1992)
Board of Directors Member (2004–2006)
Board of Directors Member (1998–2005)
Board of Directors Member (1998–2001)
Board of Directors Member (2013–2014)



M.J. Soileau
Glenn Boreman
James Harvey
Kathleen Richardson

President (1997)
Board of Directors Member (1997–1999)
Board of Directors Member (2001–2003)
Board of Directors Member (2012–2015)



Shin-Tson Wu
Peter Delfyett
Jim Moharam
Kathleen Richardson

Board of Govenors (2003–present)
Board of Govenors (2000–2002)
Vice-President (1997–1999)
Board of Directors Member (2012–2015)



Michael Bass
Michael Bass
Aravinda Kar
Bahaa Saleh
Eric Van Stryland

President (1988)
Board of Directors Member (1985–1989)
Board of Directors Member (2005)
Board of Directors Member (2010–2012)
Board of Directors Member (1992–1994)



**National Society of
Black Physicists**

Peter Delfyett

President (2008–2011)



Kathleen Richardson
Kathleen Richardson

Board of Directors Member (2008–2015)
President (2014–2015)



Kathleen Richardson

President (2008–2009)

Journal Editors & Associate Editors

Editors

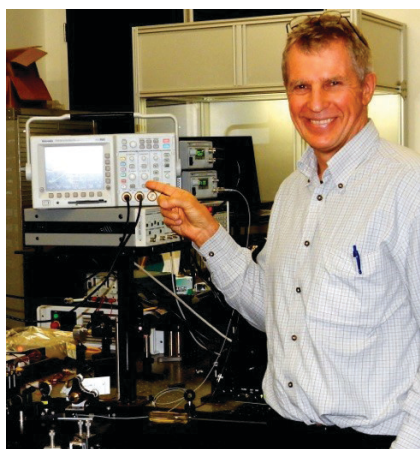
Journal of the Optical Society of America B (1984–1987)
Applied Optics (2000–2005)
Applied Optics/Optical Technology (1998–2003)
Applied Optics/Optical Technology (2004–2010)
IEEE Journal of Selected Topics in Quantum Electronics (2001–2006)
IEEE/LEOS Newsletter (1995–2000)
Optics Communications (2011–2012)
Optical Materials Express (2010–present)
Journal of the Optical Society of America A (1991–1997)
Advances in Optics & Photonics (2008–present)
IEEE/OSA Journal of Display Technology (2004–2008)

Michael Bass
Glenn Boreman
Glenn Boreman
Aristide Dogariu
Peter Delfyett
Peter Delfyett
Pieter Kik
David Hagan
Bahaa Saleh
Bahaa Saleh
Shin-Tson Wu

Associate/Topical Editors

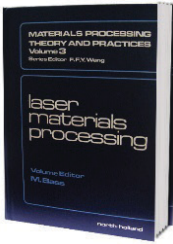
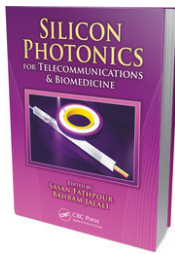
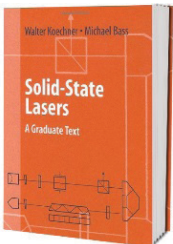
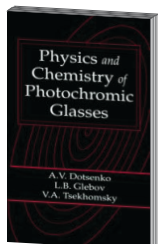
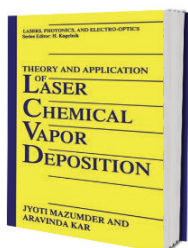
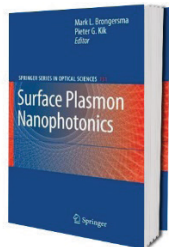
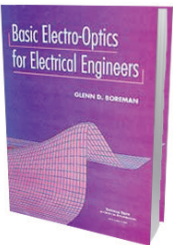
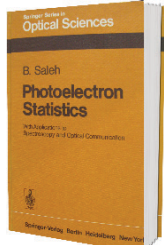
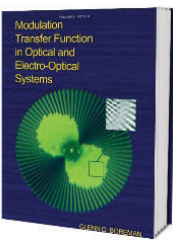
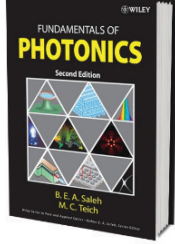
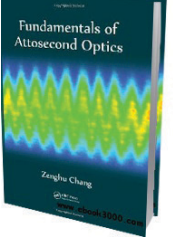
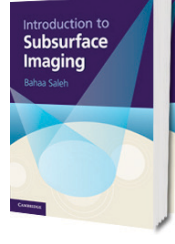
Optica (2014–present)
Optics Express (2001–2001)
Optical Engineering (Radiometry & Detectors) (1998–1999)
Applied Optics (Radiometry & Detectors) (1992–1997)
Optics Express (2009–present)
International Journal of Optics (2008–present)
IEEE Photonics Technology Letters (1995–2003)
IEEE J. of Quantum Electronics (1996–2001)
Journal of the Optical Society of America B (2001–2003)
Journal of the Optical Society of America B (2007–2013)
Journal of Materials Research (2000–2007)
Optics Express (2007–present)
Photonics Technology Letters (2007–present)
Journal of the Optical Society of America A (1998–2004)
International Journal of Applied Glass Science (2009–present)
Optical Materials Express (September 2013)
Journal of Quantum Electronics (1980–1986)
Journal of the Optical Society of America A (1984–1990)
Journal of the Optical Society of America (1980–1983)
Journal of Materials Research (2007–present)
Applied Optics (2008–present)
Optics Letters: Nonlinear Optics (1995–1998)
Reviews of Scientific Instruments (1978–1981)
IEEE/OSA Journal of Display Technology (2008–present)
Liquid Crystals (2009–present)

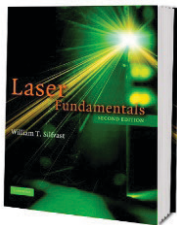
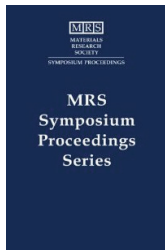
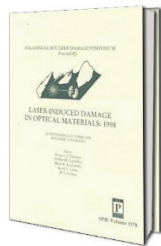
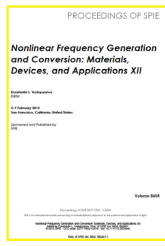
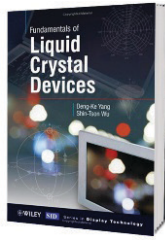
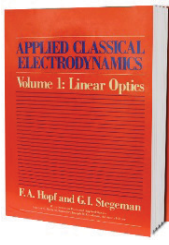
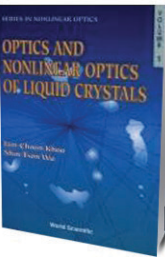
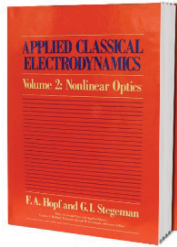
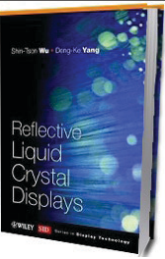
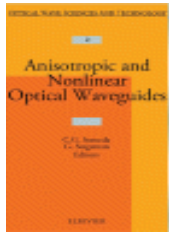
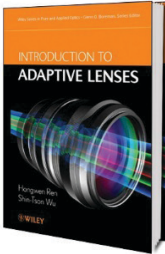
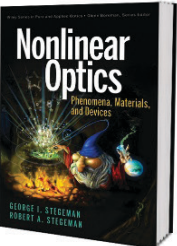
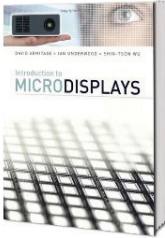
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Glenn Boreman
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Glenn Boreman
Peter Delfyett
Demetrios Christodoulides
Demetrios Christodoulides
David Hagan
David Hagan
Guifang Li
Guifang Li
Jim Moharam
Kathleen Richardson
Kathleen Richardson
Martin Richardson
Bahaa Saleh
Bahaa Saleh
Winston Schoenfeld
Axel Schülzgen
Eric Van Stryland
Eric Van Stryland
Shin-Tson Wu
Shin-Tson Wu



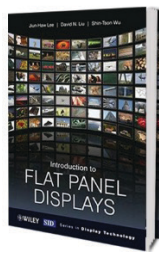
Konstantin Vodopyanov is an Associate Editor of OSA's new journal *Optica*

Authors & Editors of Books

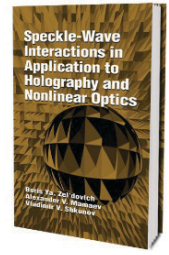
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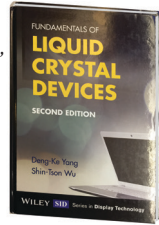
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Faculty Awards & Honors (2014)

National/International

Michael Bass
 Shin-Tson Wu
 Martin Richardson
 Shin-Tson Wu
 Peter Delfyett
 M.J. Soileau

OSA R.W. Wood Prize
 OSA Esther Hoffman Beller Medal
 Jefferson Science Fellow, APS Fellow
 Florida Inventors Hall of Fame
 2014 Florida Academy of Science Medal
 EDC Chairman's Award



Michael Bass (right) receiving the OSA Wood Prize



S.T. Wu (right) receiving the OSA 2014 Beller Medal

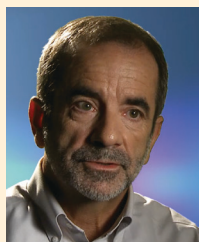


M.J. Soileau (left) and Peter Delfyett (right)

University

Pegasus Professor
 Excellence in Research Award (College & University level)
 Reach for the Stars Award
 Teaching Incentive Program Award (College Level)
 Research Incentive Award (College Level)
 Research Incentive Award (At-large/University level)
 Excellence in Graduate Teaching Award (college level)
 Sabbatical Award
 Promotion to Associate Professor

Aristide Dogariu
 Demetrios Christodoulides
 Ayman Abouraddy
 Ayman Abouraddy
 Martin Richardson
 Aristide Dogariu
 Pieter Kik
 Pieter Kik
 Ayman Abouraddy and Sasan Fathpour



Aristide Dogariu
 2014 Pegasus Professor



Ayman Abouraddy
 Reach for the Stars Award

1.2 Research Staff

Senior Research Scientists

Ivan Divliansky (Glebov's group)
Sabine Freisem (Deppe's group)
Ilya Mingareev (M. Richardson's group)

George Venus (Glebov's group)
Scott Webster (Groups of Bass, Hagan, Van Stryland)

Research Scientists

Jose Enrique Antonio Lopez (Amezcu/Schülzgen group)
Karima Chamma (K. Richardson group)
Ying Chen (Bass' group)
Michael Chini (M. Richardson's group)
Larissa Glebova (Glebov's group)
Qi Hong (Wu's group)
Joshua Kaufman (Abouraddy's group)
Huiyong Liu (Schoenfeld's group)
Devon McClane (K. Richardson group)
Sergiy Mokhov (Glebov's group)
David Musgraves (K. Richardson's group)
Homaira Parchamy Araghy (M. Richardson's group)

Payam Rabiei (Fathpour's group)
Jennifer Reed (Hagan/Van Stryland group)
Soroush Shabahang (Abouraddy's group)
Hong Shu (Bass' group)
Vadim Smirnov (Glebov's group)
Sergey Sukhov (Dogariu's group)
Guangming Tao (Abouraddy's group)
Giorgio Turri (Glebov's group)
Su Xu (Wu's group)
Guowei Zhao (Deppe's group)

Post-doctoral Research Associate

Nicholas Barbieri (M. Richardson's group)
Shi Chen (Gaume's group)
Magali Durand (M. Richardson's group)
Ashwani Kaul (Kar's group)
Jason Lonergan (K. Richardson's group)

Majid Masnavi (M. Richardson's group)
Samuel Paul David (Gaume's group)
Charmayne Smith (K. Richardson's group)
Viktor Smolski (Vodopyanov's group)
Akbar Ali Syed (Hagan/Van Stryland group)

Research Associate

Helene Mingareev (Prof. Glebov's group)

Visiting Research Scientists

Rodrigo Acuna Herrera (Hagan/Van Stryland group)
Ayman Mokhtar Ahmed (M. Richardson's group)
Ahmed Shebl Ahmed (Hagan/Van Stryland/Kuebler group)
Ju Cai (Li's group)
Matthias Heinrich (Christodoulides's group)
Miao Hu (Abouraddy's group)
Tamer Mohamed Kashef (M. Richardson's group)
Seung Kwan Kim (Schülzgen's group)
Chaoming Li (Chang's group)
Jinsong Li (Wu's group)
Yongliang Li (Bass's group)
Yan Liu (Li's group)
Hongbo Lu (Wu's group)

Xuechang Ren (Wu's group)
Hongjun Shen (Christodoulides's group)
Xiaoyan Shi (Wu's group)
Hongcheng Wang (Christodoulides's group)
Jiwei Wang (Wu's group)
He Wen (Li's group)
Xinghua Yang (Abouraddy's group)
Guiju Zhang (Abouraddy's group)
Hongjun Zheng (Li's group)
Ruilin Zheng (Abouraddy's group)

Lab Technicians

Arthur Freeman (Prof. M. Richardson's group)

Senior Electrical Engineer

Somsak (Tony) Teerawattanasook (M. Richardson's group)

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DR. JAMES PEARSON

Special Consultant

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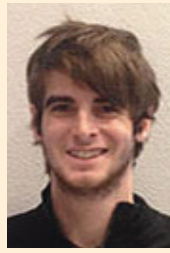
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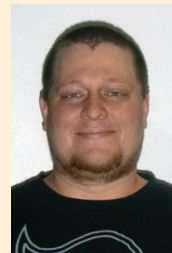
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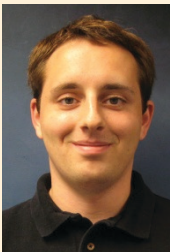
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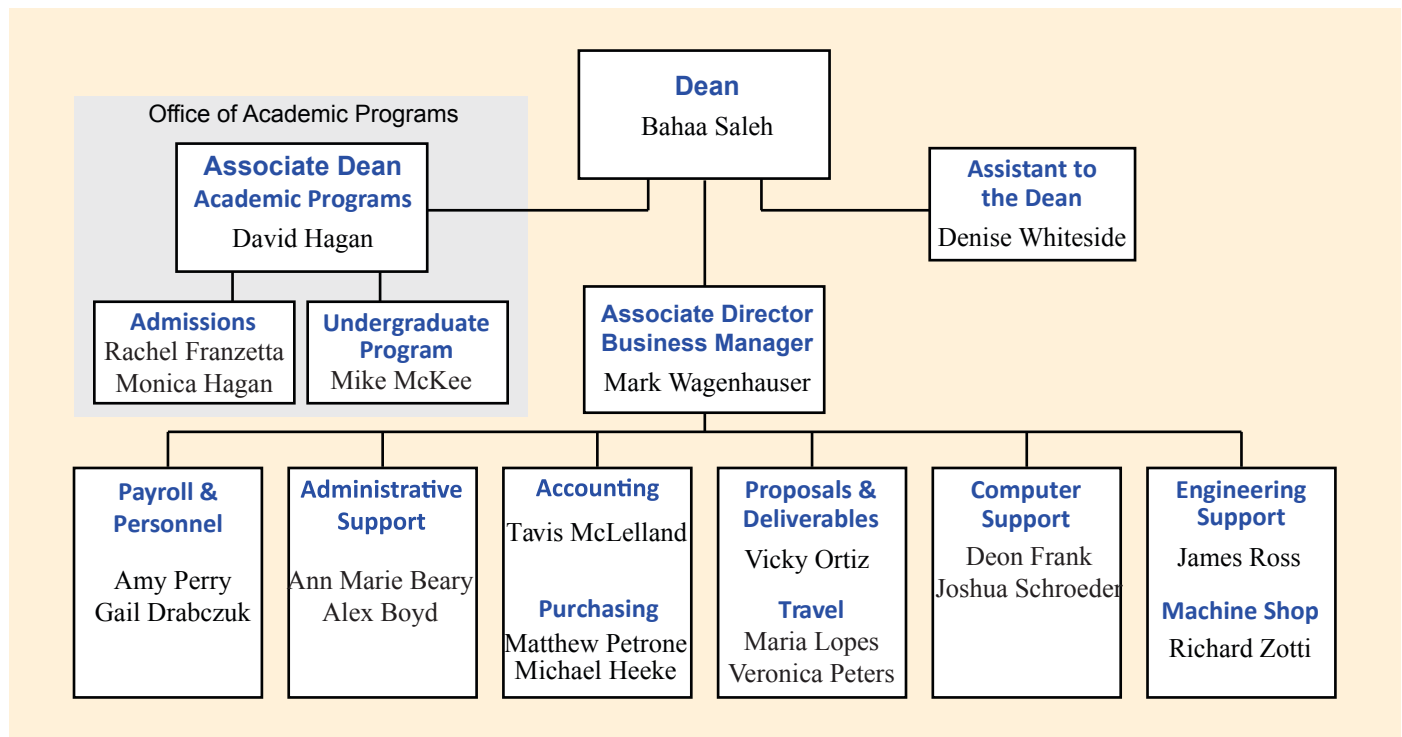


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RICHARD ZOTTI
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Organization Chart



The CREOL building: a 104,000 square ft building with approximately 100 labs.



The new Optical Materials Lab: a 4,500 sq. ft. facility completed in 2014.

2. Academic Programs

2.1 Undergraduate Program

Now in its second year, the Bachelor of Science in Photonic Science and Engineering (PSE) is continuing to attract great interest from students. 36 students have declared the major with an additional 31 students who are in “pending status,” still needing to complete calculus and physics courses prior to declaring the major. This is an increase from 13 students who declared at the end of 2013.

The PSE degree is offered as a joint program between the College of Engineering and Computer Science (CECS) and the College of Optics and Photonics (COP), making it the only B.S. program in the state of Florida in this area and only one of a few in the nation.

The program is designed to fill the growing need for photonics engineers. Florida is home to about 270 photonics-based companies with an annual need of 270 photonics engineers. Nationally, there is a need to fill 1600 open positions. Students who complete the program will be prepared for immediate employment or can pursue an advanced degree in optics and photonics.

Students who enroll in this program are required to complete 128 credit hours of instruction with 28 credit hours from coursework in electrical engineering and 40 credit hours in optics and photonics. Coursework includes classes such as Electrical Networks, Electronics, Laser Engineering, Fiber Optic Communication, Biophotonics, and Imaging and Displays. When the program is at capacity, the courses listed in the side chart will be offered annually by COP.

An undergraduate curriculum committee comprised of faculty and staff within the college meets on a bi-weekly basis to evaluate coursework and plan for eventual ABET accreditation, which is not awarded until after the first cohort of students graduate in 2015. A second joint committee with CECS meets twice a year to ensure successful collaboration and program progress. Also meeting two times per year is the Industrial Board who advises the program on various needs that will prepare students for the workforce.

In 2014, nearly a full slate of courses were offered, including Introduction to Photonics, Fiber Optic Communications, Laser Engineering, Electromagnetic Waves for Photonics, Imaging and Display and the capstone course Senior Design I. Labs accompanying Laser Engineering, Fiber Optics and Imaging Display also began. For the lab equipment, the college received donations and discounts from various companies and industrial affiliates.

Recruitment continues through various organizations. In 2014, numerous presentations were made to local state colleges and high schools. The program is also promoted at Wekiva High School, which has a photonics magnet program with nearly 100 students. Promotional materials and presentations have been made available for teachers to raise awareness of the program. Since UCF has a large percentage of students from South Florida, posters and materials were mailed to over 100 high schools in that area. Promotional materials were also distributed at the regional National Science Teachers Conference that was held in Orlando in early November.

COP sponsored the Florida Science Olympiad event in Optics as a way to increase awareness of the program and has impact to over 150 schools throughout Florida. On May 16-17, UCF hosted the Science Olympiad National Tournament, with over 7,000 in attendance. Each visiting team received information about the PSE program.

Advising, recruiting, and orientations are conducted by Mike McKee, Associate Director for the undergraduate program. He has worked with major recruitment and retention units across the university including Undergraduate Admissions, First Year Advising, and the Sophomore and Second Year Center.

Photonics Major and Capstone	31
OSE 3052 Fundamentals of Optics & Photonics	3
OSE 3052L Fundamentals of Optics & Photonics Lab	1
OSE 3053 EM Waves for Photonics	3
OSE 4520 Laser Engineering	3
OSE 4520L Laser Engineering Lab	1
OSE 4410 Optoelectronics	3
OSE 4410L Optoelectronics Lab	1
OSE 4830 Imaging & Display	3
OSE 4830L Imaging & Display Lab	1
OSE 4470 Fiber Optic Communications	3
OSE 4470L Fiber Optic Communications Lab	1
OSE 4930 Frontiers in Photonics	2
OSE 4951 Senior Design I	3
OSE 4952 Senior Design II	3

Restrictive Electives	9
OSE 4421 Biophotonics	3
OSE 4240 Optics & Photonics Design	3
OSE 4720 Visual Optics	3
OSE 5312 Light Matter Interaction	3
OSE/EEL/PHY Approved Course	3
or Math/Eng/Sci (max 6)	6



Students working in the Undergraduate Labs

Undergraduate Laboratories

OSE 3052L Introduction to Photonics Laboratory

The course is designed to reinforce the concepts discussed in class with a hands-on approach and to allow the students to learn laboratory techniques for observing optical phenomena and quantitative experimental characterization in geometrical optics, polarization, interference, and diffraction.

OSE 4520L Laser Engineering Laboratory

Students build small lasers and laser systems in order to gain experience in building lasers, understanding the various types of output they can deliver and manipulating and applying laser beams. Through these experimental projects, students are introduced to most of the major concepts covered in the course, including: photons; emission; laser cavities and modes; laser threshold; laser beams, focusing and collimation; and second harmonic generation.

OSE 4470L Fiber-Optic Communication Laboratory

The experiments are set up to cover three topics: 1) The optical fiber as a transmission channel; 2) Optoelectronic devices used in transmitters, receivers, and multiplexers; 3) Overall communication system performance. The challenges of coupling light into and between fibers and the associated losses are experimentally quantified. The dispersion of various types of optical fibers is measured. The issues of digital and analog systems and their performances are introduced and quantified. Introductions to wavelength-division multiplexing (WDM) components and systems are also provided.

OSE 4830L Imaging and Display Laboratory

The performance of various imaging and display systems will be simulated using MatLab image processing toolbox and measured for actual systems. The optical transfer function of an imaging system will be measured. Two interferometric axial imaging systems will be designed and tested: a surface profiling system and an optical coherence tomography system. A commercial multispectral imaging system will be used to identify various materials. The performance of a simple liquid crystal display will be assessed



Photonic Science and Engineering undergraduate students in the new undergraduate labs

Scholarship funds

The following scholarship funds have been established in support of students in the BS-PSE program:

- ❑ **UCF Research Foundation Photonics Scholarship:** a fully-funded \$50k endowment
- ❑ **Cheryl & MJ Soileau Scholarship:** Fully-funded \$20k endowment for “first in their family in college” students
- ❑ **CREOL Scholarship:** \$50k endowment with \$10k pledges already made.



Mike McKee is Associate Director of the Undergraduate Program in Photonic Science and Engineering. Since 1998, Mike has been the state director for the Florida Science Olympiad, and in 2012 was Co-Director for the 2012 Science Olympiad National Tournament at UCF

2.2 Graduate Programs

The College has a strong focus on education at the MS and PhD levels through both coursework and research. Our graduates are highly educated and well prepared for the modern-day work force and consequently they are highly sought after in both the private sector and in top research universities.

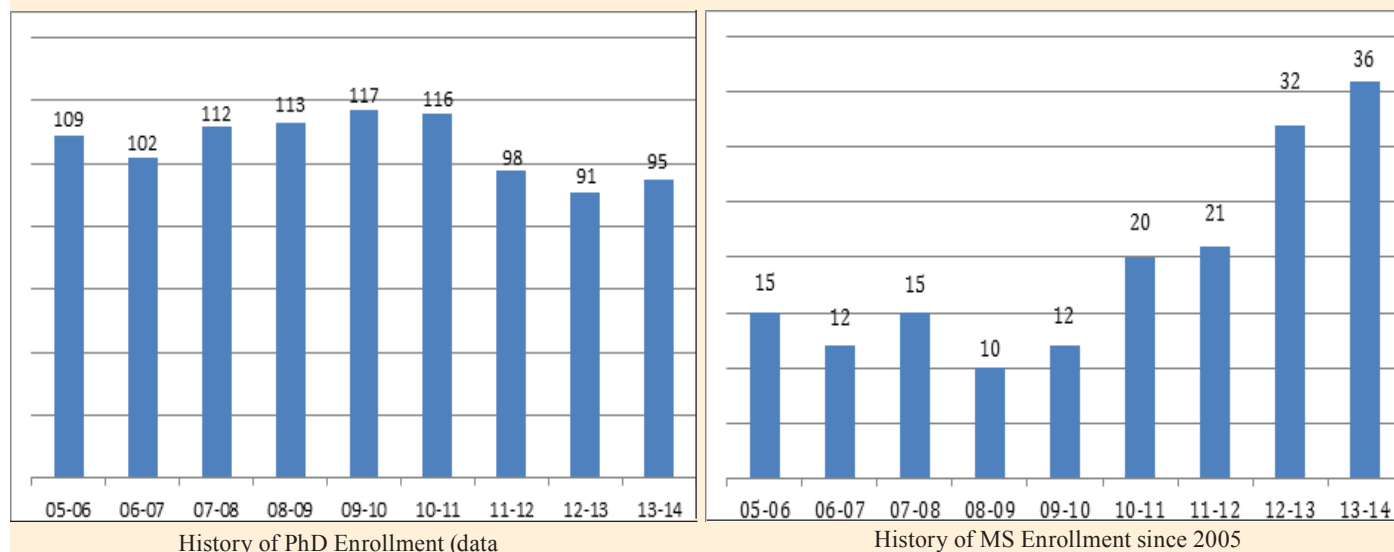
Course and Program Development

The college regularly updates the curriculum in its graduate programs in order to keep them up to date and relevant to the future careers of our students. In fall of 2014, we changed the title of our MS and PhD degrees in “Optics” to “Optics and Photonics”, reflecting the emphasis of photonics in our curriculum and research programs.

In terms of substantive curricular changes, over the past year, the College especially focused on updating and improving the MS program, introducing two new tracks in the MS program that allow students to specialize in either Optics or Photonics. Although this mostly involved the use of existing coursework, a new course in Optical Communications Systems, developed and taught by Prof. Fathpour, was developed as part of the core of the Photonics Track. Students selecting either track will also be required to perform research and write this up in the form of a Thesis or as a shorter Research Report. This is in response to the comments of MS alumni who after completing the non-thesis MS degree, expressed regret that they were not able to participate in CREOL’s strong research programs. In order to meet the needs of students on leave from industry, we have scheduled the courses in these tracks so that the degree can be completed on an accelerated schedule in addition to the more traditional 18 month schedule.

Graduate Recruitment and Enrollment

Enrollment in the PhD program has risen slightly in AY 2013-2014 at 95, while the MS enrollment continues to experience a growing trend, with 36 students, as shown in the charts below.



* In these charts the year 13-14 accounts for Summer 13, Fall 13 and Spring 14.

Recruitment of new students is a vigorous and continuing effort. In AY 2013-14, a total of 33 new students (31 Ph.D. and 2 MS) enrolled (see chart below). We received 335 pre-applications and 198 full applications for Fall 2013 admission. The pre-application is a preselecting tool run through our own web site that allows us to make contact with applicants early and to help advise international students as to whether to apply officially, which is an expensive undertaking for many international students.

New Matriculants						Fellowships & Scholarships					
		Male	Female			FT	PT	CREOL Fellow	UCF Award*	UCF Trustee	UCF Dean
PhD	US	5	1			6	0	5	2	0	0
	Intl	21	4			25	0	12	0	0	1
MS	US	2	0			0	2	0	0	0	0
	Intl	0	0			0	0	0	0	0	0
Total New Students		33									

New matriculants and scholarships for FY 2013-14 (Fall 13 - Summer 14). UCF Awards are from the following endowments: Northrop Grumman, Schwartz, Suchoski, Frances Townes

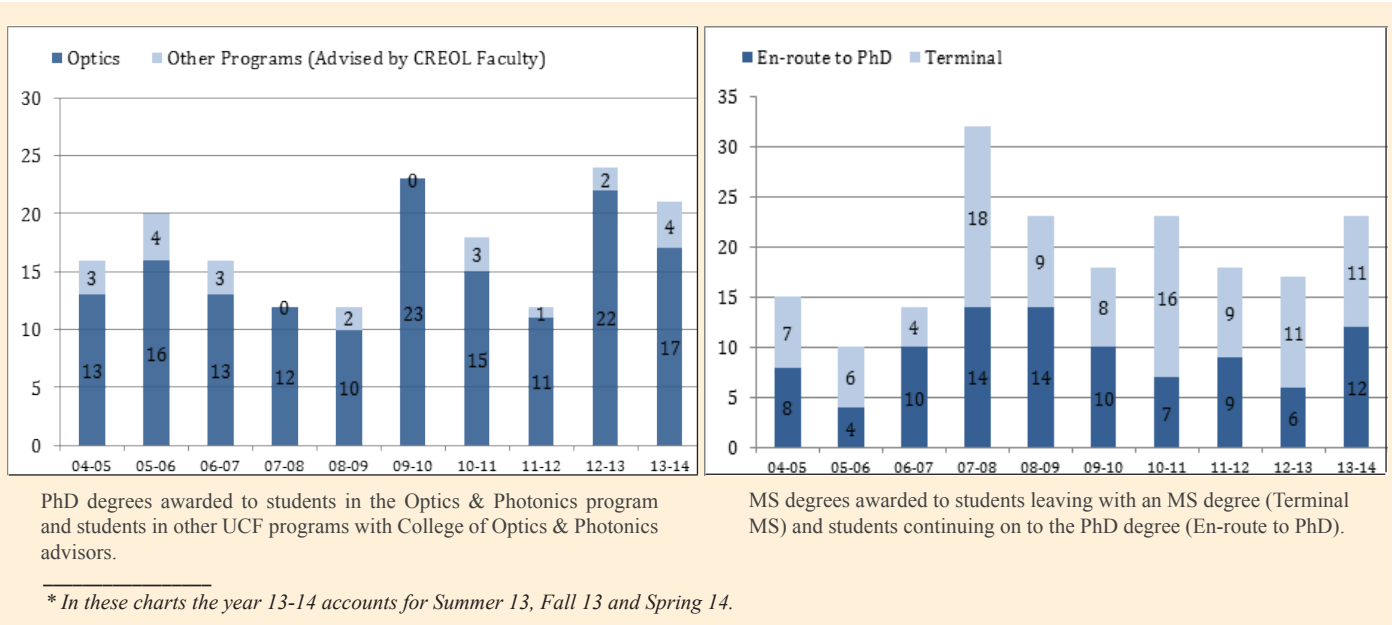
The GRE Exam was changed over the last two years, so it is difficult to compare the scores of entering students with previous years. The percentile scores were similar to 2012-2013, which were higher than in previous years. Overall, we received 335 pre-applications and 198 full applications to the graduate programs. The pre-application is a preselecting tool run through our own web site that allows us to make contact with applicants early and to help advise international students as to whether to apply officially, which is an expensive undertaking for many international students.

		Quantitative	%	Verbal	%	Analytic Writing	%
PhD	US	160	79%	151	50%	4	43%
	Intl	165	88%	150	47%	3	21%
MS	US	155	63%	151	51%	3.7	36%
	Intl	-		-		-	
Mean		160		150.7		3.6	

AY2013-14 Mean GRE Scores (Fall Admissions)

Degrees Granted

As shown in the chart below,[†] there was a small drop in the number of PhD degrees awarded in the past year. This does not appear to be related to any particular trend. The number of MS degrees awarded in academic year 2013-2014 (23) is roughly similar to previous years. This number tends to fluctuate on a year-to-year basis



Ph.D. Dissertations

Degrees granted in academic year 2014 (Fall 2013– Summer 2014)

Student	Program	Advisor	Dissertation Title
Abhijeet Ardey	Physics	Peter Delfyett	On-Chip Optical Stabilization of High-Speed Mode-Locked Quantum Dot Lasers for Next Generation Optical Networks
Yuan Chen	Optics	Shin-Tson Wu	Advanced Liquid Crystal Materials for Display and Photonic Applications
Kyle Douglass	Optics	Aristide Dogariu	Mesoscale Light-Matter Interactions
Shima Fardad	Optics	Demetrios Christodoulides	High Resolution Time-Resolved Imaging System in the Vacuum Ultraviolet Region
Manuel Ferdinandus	Optics	David Hagan	Techniques for Characterization of Third Order Optical Nonlinearities
Clemence Jolivet	Optics	Axel Schülzgen	Specialty Fiber Lasers and Novel Fiber Devices
Joshua Kaufman	Optics	Ayman Abouraddy	Multifunctional, Multimaterial Particle Fabrication Via an In-Fiber Fluid Instability
Ilhan Kaya	Electrical Engineering	Jannick Rolland	Mathematical and Computational Methods for Freeform Optical Shape Description
Saeed Khan	Electrical Engineering	Sasan Fathpour	Silicon Photonic Devices for Optical Delay Lines and Mid-Infrared Applications
Xiaochang Liu	Optics	Dennis Deppe	Semiconductor Laser Based on Thermoelectrophotonics
Yifan Liu	Optics	Shin-Tson Wu	High Efficiency Three-Dimensional Display Based on Polymer-Stabilized Blue Phase Liquid Crystal
Jichi Ma	Optics	Sasan Fathpour	Nonlinear Integrated Photonics on Silicon and Gallium Arsenide Substrates
Daniel Ott	Optics	Leonid Glebov	Holographic Recording and Applications of Multiplexed Volume Bragg Gratings in Photo-Thermo-Refractive Glass.
Marc Segall	Optics	Leonid Glebov	Volume Phase Masks in Photo-Thermo-Refractive Glass
Soroush Shabahang	Optics	Ayman Abouraddy	Multimaterial Fibers and Tapers; A Platform for Nonlinear Photonics and Nanotechnology
Jie Sun	Optics	Shin-Tson Wu	Fast-Response Liquid Crystals for Photonic and Display Applications
Guangming Tao	Optics	Ayman Abouraddy	Multimaterial Fibers in Photonics and Nanotechnology
Henry Williams	Chemistry	Steve Kuebler	Processing and Properties of Arsenic Trisulfide Chalcogenide Glasses for Direct Laser Writing of 3D Micro-structures
Yi Wu	Optics	Zenghu Chang	High Flux Isolated Attosecond Pulse Generation
Qi Zhang	Optics	Zenghu Chang	Generation and Characterization of Sub-70 Isolated Attosecond Pulse
Yu Zhang	Optics	Dennis Deppe	Self-Heating Control of Edge Emitting and Vertical Cavity Surface Emitting Laser

Student Scholarships and Awards

National Scholarships, Grants, and Awards (2014)

Scholarships

Lorelle Pye, NSF GRFP fellowship
Amy Van Newkirk, Ascentta's Photonics Scholarship & SPIE Optics and Photonics Education Scholarship
Brian Anderson, Directed Energy Professional Society (DEPS) scholarship
Guangming Tao, Chinese Government Award for Outstanding Self-financed Students Abroad
Yuan Chen, Chinese Government Award for Outstanding Self-financed Students Abroad
Antoine Lepicard, OSA Foundation's Harvey M. Pollicove Scholarship
Linghui Rao, International Liquid Crystal Society (ILCS) Glenn Brown Prize
Sihui He, IEEE (Orlando Section) graduate student scholarship
Benn Gleason, Clemson University Professional Enrichment Graduate Assistant Support (PEGAS)

Best Papers or Posters

Daming Xu, SID'14 Distinguished Paper award
Zhenyue Luo, SID'14 Distinguished Paper award
Esther Yuan Chen, SID'14 Distinguished Paper award
Jeff Chiles, Second-Best Poster Award of the IEEE Photonics Society 2014 Summer Topical Meeting
Cen Xia, Asia Communications and Photonics Conference, First Prize in Best Student Paper Award

Travel Grants (2014)

Guangming Tao, SPIE Newport Student Travel Grant for SPIE Photonics West 2014
Mohammad Ali Miri, Incubic/Milton Chang Student Travel Grant
Andy Buff, Benn Gleason, James Marro, NSF-International Materials Institute (IMI) for New Functionality in Glass's International Conference Travel Scholarship (to attend ACerS DGG-GOMD meeting in Aachen Germany)
Daming Xu, Zhenyue Luo, Yuan Chen, Fenglin Peng, Ruidong Zhu, Yifan Liu, SID Annual Meeting \$500

UCF Fellowships and Awards (AY 2013-2014)

Graduate Research Excellence Fellowship

Eric Cunningham
Trenton Ensley
Kumel Kagalwala
Anthony Klee
Chatdanai Lumdee
Zhenyue Luo
Matthew Reichert
Amy Van Newkirk
Benjamin Webb

Graduate Research Forum Poster Award

Amy Van NewKirk
Veerachart Kajorndejnukul

UCF College of Graduate Studies Presentation Fellowship

Andy Buff
Laura Sisken

College of Optics & Photonics Awards (2014)

Clémence Jollivet:, College of Optics & Photonics Student of The Year Award
Veerachart Kajorndejnukul, finalist, 2014 Student of the Year Award
Soroush Shabahang, finalist, 2014 Student of the Year Award
CheonHa Jeon, 2014 Best Poster Award



2014 Student-of-The-Year Award winner Clémence Jollivet:

Courses Taught

Course #	Course title	Instructor		
		Fall 2013	Spring 2014	Summer 2014
Core Graduate Courses				
OSE 5203	<i>Geometrical optics and imaging systems</i>	Moharam		
OSE 5312	<i>Light matter interaction</i>	Gaume	Kik	
OSE 6111	<i>Optical wave propagation</i>	Moharam		
OSE 6115	<i>Interference, diffraction and coherence</i>	Dogariu	Abouraddy	
OSE 6432	<i>Guided waves and optoelectronics</i>		LiKamWa	
OSE 6525	<i>Laser engineering</i>	Schülzgen		
Other Graduate Courses				
OSE 5041	Introduction to Wave Optics	Christodoulides		
OSE 5414	Fundamentals of Optoelectronics	LiKamWa		
OSE 6125	Computational Photonics		Moharam	
OSE 6143	Fiber Optics Communications		Li	
OSE 6265	Optical Systems Design			Curatu
OSE 6315	Liquid Crystal Materials and Devices			Wu
OSE 6319	Optical Waves and Materials			Zeldovich
OSE 6330	Stimulated and Holographic Scattering	Zeldovich		
OSE 6334	Nonlinear Optics		Van Stryland	
OSE 6347	Quantum Optics		Zeldovich	
OSE 6349	Applied Quantum Mechanics for Optics	Abouraddy		
OSE 6455C	Photonics Laboratory	Li		
OSE 6526C	Laser Engineering Laboratory			Richardson
OSE 6536	Semiconductor Lasers		Deppe	
OSE 6615L	Optoelectronic Device Fabrication Laboratory	Chanda		Chanda
OSE 6650	Optical Properties of Nanostructured Materials	Kik		
OSE 6938	Special Topic: Fiber Lasers		Schülzgen	
OSE 6938	Special Topic: Frontiers of Ultrafast Optics	Chang		
OSE 6938	Special Topic: Photonic Polymer Materials		Thomas	
OSE 6938	Special Topic: Research Seminar in Optics and Photonics		Christodoulides/ Abouraddy	
OSE 6938	Special Topic: Terahertz Technologies & Applications			Vodopyanov
Undergraduate Courses				
OSE 3052	<i>Introduction to Photonics</i>	Fathpour	Hagan	
OSE 3052L	<i>Introduction to Photonics Laboratory</i>	Khajavikhan	Fathpour	
OSE 3053	<i>EM Waves for Photonics</i>		Moharam	
OSE 4520	<i>Laser Engineering</i>		Delfyett	
OSE 4520L	<i>Laser Engineering Laboratory</i>		LiKamWa	
EEL 4440	<i>Optical Engineering</i>	Fathpour		
Other Courses				
IDS 6416	<i>S.T: History of physical science, cultural connections and other issues</i>		Bass	
EMA 5610	<i>Laser materials processing</i>	Kar		

Instructional Laboratories

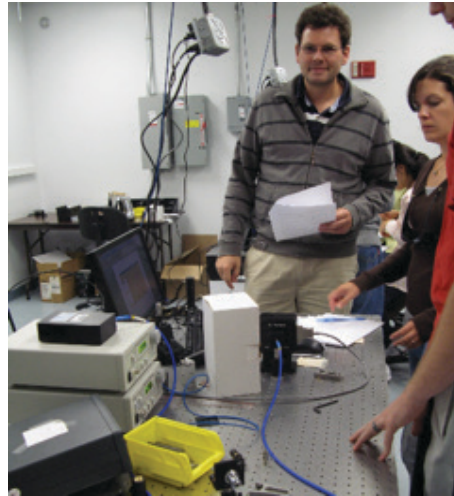
OSE 6234C Applied Optics Laboratory

Laboratory Techniques for observing optical phenomena and quantitative experimental study of geometrical optics, optical interferometry, diffraction, and image processing. Prerequisite Course: Graduate standing and OSE 5203 or consent of the instructor.



OSE 6526C Laser Engineering Laboratory

Designing and device implementation of diode pumped solidstate lasers, nonlinear frequency conversion, Q-switching, mode locking, and pulse second harmonic generation. Prerequisite Course: Graduate standing and OSE 6525 or consent of the instructor.



OSE 6455C Photonics Laboratory

Experimental study of photonic devices and systems including liquid crystal displays, fiber-optic sensors, laser diodes, electro optic modulation, acousto-optic modulation, lightwave detection, optical communications, and photonic signal processing. Prerequisite Course: Graduate standing and OSE 6432 or consent of the instructor.



OSE 6615L Optoelectronic Device Fabrication Laboratory

Design and micro-fabrication of semiconductor optoelectronics devices including passive waveguides, light emitting diodes (LEDs), laser diodes (LDs), photodetectors. Prerequisite Course: Graduate standing or consent of the instructor.



Colloquia and Seminars

Date	Speaker	Title
1/9/2014	Jason Eichenholz Open-Photonics Inc.	(OSA Student Chapter's CREOL Alumni Seminar Series)
1/10/2014	Andrea Wesser ORC-UCF	The High Value of the Entrepreneurial Skill. (IEEE Student Chapter Seminar Series)
1/14/2014	X.-C. Zhang University of Rochester	Past, present, and future of THz science and technology. (Distinguished Seminar Series)
1/16/2014	Matt Mills Kumel Kagalwala CREOL-UCF	Dressed Optical Filaments. Quantum Computation with Polarization and Spatial Profile of Photons. (OSA Graduate Research Symposium)
1/24/2014	David Brady Duke University	Petapixel photography and the limits of camera capacity. (Distinguished Seminar Series)
1/24/2014	Anna Raeva Florida International University	Volatiles sampling and detection using SPME-GC-MS and PSPME-IMS
1/24/2014	Igor Mokhun Chernivtsi University, Ukraine	Correlation between Parameters of Optical Field Angular Momentum in the Vicinity of Optical Singularity.
1/29/2014	Clémence Jollivet Veerachart Kajorndejnkul Soroush Shabahang CREOL-UCF	Specialty Fibers for Novel Fiber Lasers and Devices. Conservation Laws and Optical Interactions at Dielectric Interfaces. Multimaterial Fibers and Tapers: A Platform for Nonlinear Photonics and Nanotechnology. (CREOL Student of the Year Finals 2014)
1/31/2014	Xianghua Zhang Institute of chemistry Université de Rennes I-CNRS	Infrared transmitting glasses and glass ceramics for infrared transmission and energy applications. (OSA Student Chapter Seminar Series)
2/17/2014	Jürgen Jahns FernUniversität, Germany	Diffraction optics for short wavelengths and short pulses. (Distinguished Seminar Series)
2/21/2014	Taylor Shoulders Trenton Ensley CREOL-UCF	Scintillator Ceramics for Gamma Ray Detection. White-light continuum (WLC) for the purpose of broadband nonlinear optical spectroscopy. (OSA Graduate Research Symposium)
2/24/14	Zahid Yaqoob, MIT	Label-free cellular imaging and tissue turbidity suppression
2/28/2014	Bin Rao Washington University, St. Louis	Developing photoacoustic imaging technologies and optical coherence tomography for clinical applications and the "BRAIN" initiative
2/28/2014	Terence H. Risby Johns Hopkins University	Current status of clinical breath analysis including laser-based analysis
3/11/2014	Sergey Klimentov Russian Academy of Sciences	Characterization of ultra-short pulsed laser damage in optical crystals by interferometry and photoelectron spectroscopy experiments.
3/12/2014	Yu-hsin Chen Lawrence Livermore National Laboratory	Femtosecond laser filamentation in air: the roles of optical nonlinearity and plasma generation.

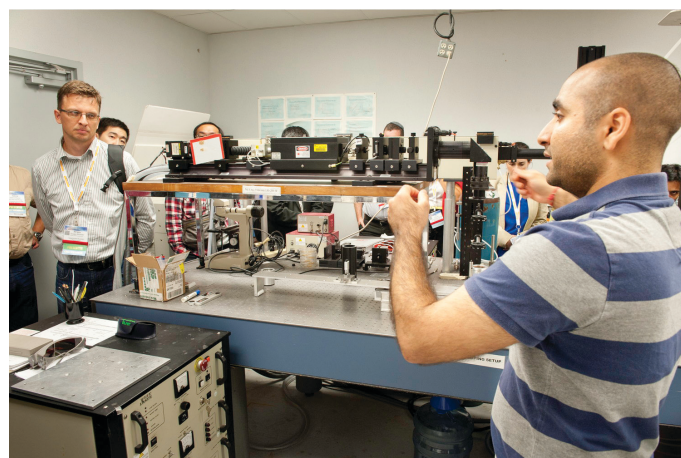
3/26/2014	Jeff Chiles Laura Sisken CREOL-UCF	Next-Generation Platforms for Mid-Infrared Integrated Photonics. Distribution of Laser Induced Heating in Multi-component Chalcogenide Glass. (OSA Graduate Research Symposium)
3/27/2014	Siddharth Ramachandran Boston University	Can fibers replace all (most) lasers? ---Nonlinear Optics with Bessel Beams in Fibers. (OSA Student Chapter Seminar Series)
3/28/2014	Matthieu Baudelet, CREOL National Center for Forensic Science-UCF	Get to Know Photonics at UCF: How Do Lasers Help Solve Crimes (Undergraduate Introduction to Photonics Seminar Series)
4/01/2014	Christopher Barty Lawrence Livermore National Laboratory	The National Ignition Facility and the Pursuit of Star Power on Earth. (IEEE Student Chapter Seminar Series)
4/04/2014	Atsushi Shishido Tokyo Institute of Technology	Photoresponsive Liquid-Crystalline Polymers.
4/10/2014	Shuo Pang Duke University	Computational Imaging for Chip-scale Microscopy and X-ray Scattering Imaging.
4/11/2014	Michal Lipson Cornell University	Silicon Photonics: The Optical Spice Rack. (Distinguished Seminar Series)
4/22/2014	Matthiew Reichert Alex Sincore CREOL-UCF	Transient Nonlinear Refraction of Liquids and Gases. Scaling Peak Powers in Fiber Lasers. (OSA Graduate Research Symposium)
5/02/2014	Rich Lepkowicz Rose-Hulman Institute of Technology	OSA Student Chapter's CREOL Alumni Series
5/05/2014	Aristide Dogariu, CREOL Lei Xi, UF, Martin Muschol, USF K. Vodopyanov, CREOL, Alexandre Fong, Gooch & Housego	SPIE Student Section Symposium on Medical Applications of Optics & Photonics.
5/14/2014	Sebastian Blais-Ouellette PhotonEtc Corp., Canada	Spectral Imaging using Volume Bragg Grating: from Astronomy to Cancer Research
5/30/2014	Michael Wittek Merck Performance Materials	Liquid Crystals for Smart Antennas and other Microwave Applications. (SID & IEEE Student Chapter Seminar)
6/02/2014	Antoine Camper Ohio State University	High-Harmonic Multi-Dimensional Phase Spectroscopy of the Attosecond Emission from Aligned Molecules
6/05/2014	José Capmany Universidad Politecnica de Valencia-Spain	Integrated Microwave Photonics. (IEEE & SPIE Student Chapter Seminar)
6/06/2014	Christophe Bonneville RESOLUTION Spectra Systems	SWIFTS: a groundbreaking integrated principle for high-performance spectroscopy and optical sensors
6/19/2014	Robert P. Breault Breault Research Organization	The Business of Optics Today and in the Next Ten Years. (OSA Traveling Lecturer Seminar)
6/25/2014	Hossein Hodaiei Kristina Bagnell	PT-Symmetric Micro-ring Laser. Low Noise Semiconductor-based Harmonically Modelocked Lasers. (OSA Graduate Research Symposium)

6/26/2014	Arash Mafi University of Wisconsin-Milwaukee	High quality image transport through optical fibers mediated by Anderson localization.
7/14/2014	Jian Wu East China Normal University, Shanghai	Probe and control electronic and nuclear dynamics of small molecules in strong laser fields.
7/30/2014	Rafael Guzman-Sepulveda Zenon Yu CREOL-UCF	Passive Optical Mapping of the Phase Transitions in Triblock Copolymer Systems. Electrical Cables that Store Energy. (OSA Graduate Research Symposium)
8/08/2014	Uriel Levy University of Jerusalem (HUJI)	Enhanced light matter interactions in silicon plasmonic platform.
8/12/2014	Seetha Raghavan Mechanical and Aerospace Engineering, UCF	High energy x-rays and Photo-luminescence spectroscopy to investigate the mechanics of ceramic coatings for extreme environments and sensing applications.
8/22/2014	Yan-qing Lu Nanjing University, China	Generation and modulation of optical vortices with liquid crystal technology. (IEEE/SID Student Chapter Seminar)
9/05/2014	Mostafa A. El-Sayed Georgia Institute of Technology	Nanotechnology Meets Biology in the Cancer Cell. (NSTC & CREOL Distinguished Seminar)
9/24/2014	Yan Cheng Tony Klee CREOL-UCF	Attosecond transient absorption experiments in atoms and molecules Towards Broadband, Multi-Gigahertz Spaced Frequency Combs (OSA Graduate Research Symposium)
9/26/2014	Vincent Motto-Ros Institut Lumière Matière	Recent advances in LIBS instrumentation: Application in quantification and elemental imaging
9/26/2014	Peter Delfyett CREOL-UCF	Perspectives on a Research Career – from Industrial Research at Bell Communications Research to Academia (SPIE Student Chapter Faculty Talk Series)
10/01/2014	Pierre J. Corriveau Tariq Manzur Naval Undersea Warfare Center (NUWC)	An overview of Naval Undersea Warfare Center and Research Opportunities
10/06/2014	Yajie Dong NSTC-UCF	Semiconductor Nanomaterials for Information and Energy Technologies
10/08/2014	Mohammad Umar Piracha FAZ Technology	(OSA Student Chapter's CREOL Alumni Series)
10/10/2014	Bernard Kress Google [X] Labs	Optical technologies paving the road from defense HMDs to consumer VR / AR headsets, Smart Glasses and Smart Eyewear (Distinguished Seminar Series)
10/15/2014	Xin Gai Australian National University	Infrared Nonlinear Materials: Properties and Applications (OSA Student Chapter's Outreach)
11/06/2014	David J. Masiello University of Washington	A Taxonomy of the Magneto-Optical Responses of Cyclic Plasmon-Supporting Metal Oligomers
11/07/2014	Konstantin Vodopyanov CREOL-UCF	Sensing molecules with frequency combs
11/17/2014	Lawrence Shah CREOL-UCF	How Did We Get Here? And what does the past tell us about the future?(surprisingly little, but it is all we have) (SPIE Student Chapter Faculty Talk Series)

11/21/2014	Zhiyi Wei Chinese Academy of Sciences	Novel femtosecond lasers for driving attosecond generation
11/21/2014	Nicolas Fontaine Bell Laboratories	Space-Division Multiplexed Transmission over Few-Mode-Fiber
12/02/2014	Roland Schiek Ostbayerische Technische Hochschule Regensburg	Self-phase modulation in lithium niobate waveguides
12/08/2014	Yunpei Deng Fritz-Haber-Institut der Max- Planck-Gesellschaft	Advancing Ultrashort Laser Pulse Technology: Controlling Ultrafast Electron Motion
12/09/2014	Spencer Novak, CREOL James Marro, CREOL	Deposition of luminescent quantum dot doped chalcogenide glass films from solution Temperature dependence of defect and microstructural evolution in thermally cycled Cu-TSVs. (OSA Graduate Research Symposium)
6/19/2014	Robert P. Breault Breault Research Organization	The Business of Optics Today and in the Next Ten Years. (OSA Traveling Lecturer Seminar)
6/25/2014	Hossein Hodaie Kristina Bagnell	PT-Symmetric Micro-ring Laser. Low Noise Semiconductor-based Harmonically Modelocked Lasers. (OSA Graduate Research Symposium)
6/26/2014	Arash Mafi University of Wisconsin- Milwaukee	High quality image transport through optical fibers mediated by Anderson localization.



Graduate student Yuan “Esther” Chen (front) giving a tour of the Liquid Crystal Display Laboratory.



Graduate student Ashwani Kaul, right, in the Laser Advanced Materials Processing (LAMP) Laboratory.

Students

MS Students (AY 2013-2014)

Anderson, Scott (Optics, part time)
Butrimas, Steve (Optics, part time)
Butler, Corey (Optics, MILMI), Advisor: Richardson
Clark, Joseph (Optics, part time)
Creekmore, Amy (Optics, part time)
Gebhardt, Martin (Optics, MILMI), Advisor: Richardson
Georgiev, Nikolay (Optics part time)
Grafer, Elliott (Optics, part time)
Hardin, James (Optics, part time)
Knebl, Andreas (Optics, MILMI), Advisor: Richardson
Levy, Melissa (Optics, part time)
Lin, Yu-wei (Optics, part time)
Matz, Gregor (Optics, MILMI), Advisor: Li

McKee, Eric (Optics, GRA), Advisor: Richardson
Modak, Sushrut (Optics), Advisor: Chanda
Mueller, Michael (Optics, MILMI), Advisor: Richardson
Patil, Aniket (Optics)
Popool, Atiloluwa (Optics)
Ryan, Robert (Optics), Advisor: Richardson
Schick, Ryan (Optics, part time)
Shappard, Todd (Optics, part time)
Tan, Felix (Optics), Advisor: Abouraddy
Temple, Sarah, (Optics part time)
Villinger, Massimo Maximilian (Optics, part time)
Vinueza, Emilio (Optics, part time)

Ph.D. Students (AY 2013-2014)

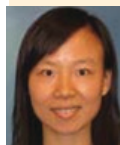
Akhlaghi Bouzan, Milad, (Optics GRA), Advisor: Dogariu
Aleahmad, Parinaz, (Optics GRA), Advisor: Christodoulides
Alhasan, Sarmad, (Optics), Advisor: Khajavikhan
Alvarez Perez, Oseas, (Optics GRA), Advisor: Dogariu
Anderson, James, (Optics GRA), Advisor: Vodopyanov
Anderson, Brian, (Optics GRA), Advisor: Glebov
Bagnell, Kristina, (Optics GRA), Advisor: Delfyett
Bagnell, Marcus, (Optics GRA), Advisor: Delfyett
Bakhshi, Sara, (Optics GRA), Advisor: LiKamWa
Bayat, Mina, (Optics GRA), Advisor: Abouraddy
Bhooplapur, Sharad, (Optics GRA), Advisor: Delfyett
Bradford, Joshua, (Optics GRA), Advisor: Richardson
Chantharasupawong, Panit, (Optics GRA), Advisor: Thomas
Chen, Haiwei, (Optics GRA), Advisor: Dogariu
Chen, Yuan, (Optics GRA), Advisor: Wu
Chiles, Jeffrey, (Optics GRA), Advisor: Fathpour
Constant, Colin, (Optics GRA), Advisor: Dogariu
Cunningham, Eric, (Optics GRA), Advisor: Chang
Darchangel, Jeffrey, (Optics GRA), Advisor: Schoenfeld
Davis, Kristopher, (Optics GRA), Advisor: Schoenfeld
Digaum, Jennafir, (Optics GRA), Advisor: Kuebler
Eftekhar, Mohammad Amin, (Optics GRA), Advisor: Christodoulides
Ensley, Trenton, (Optics GRA), Advisor: Hagan/Van Stryland
Fardad, Shima, (Optics GRA), Advisor: Christodoulides
Ferdinandus, Manuel, (Optics GRA), Advisor: Hagan/Van Stryland
Gao, Yating, (Optics GRA), Advisor: Wu
Grigorev, Roman, (Optics GRA), Advisor: Vodopyanov
Guzman Sepulveda, Jose Rafael, (Optics GRA), Advisor: Dogariu
Hassan, Absar, (Optics GRA), Advisor: Christodoulides
Hayenga, William, (Optics GRA), Advisor: Khajavikhan
He, Sihui, (Optics GRA), Advisor: Wu
Hodaei Esfahani, Seyed Hossein, (Optics GRA), Advisor: Khajavikhan
Howell-Dobbs, Nicholas, (Optics GRA), Advisor: Vodopyanov
Huang, Bin, (Optics GRA), Advisor: Li
Husam Eldeen, Hayder, (Optics GRA), Advisor:
Jang, Yuseong, (Optics GRA), Advisor: Richardson
Jeon, Cheonha, (Optics GRA), Advisor: Richardson
Jollivet, Clemence, (Optics GRA), Advisor: Schülzgen
Kagalwala, Kumel, (Optics GRA), Advisor: Saleh
Kajorndejnkul, Veerachart, (Optics GRA), Advisor: Dogariu
Kaufman, Joshua, (Optics GRA), Advisor: Abouraddy
Kazemi Jahromi, Ali, (Optics GRA), Advisor: Abouraddy
Klee, Anthony, (Optics GRA), Advisor: Delfyett
Kompan, Fedor, (Optics GRA), Advisor: Glebov
Kondakci, Hasan, (Optics GRA), Advisor: Saleh

Lantigua, Christopher, (Optics GRA), Advisor: Khajavikhan
Li, Jie, (Optics GRA), Advisor: Chang
Li, Mingxin, (Optics GRA), Advisor: Deppe
Lim, Khan, (Optics GRA), Advisor: Richardson
Lin, Yu-Wei, (Optics GRA), Advisor: Kik
Liu, Huiyuan, (Optics GRA), Advisor: Li
Liu, Xiaohang, (Optics GRA), Advisor: Deppe
Liu, Yifan, (Optics GRA), Advisor: Wu
Lumdee, Chatdanai, (Optics GRA), Advisor: Kik
Luo, Zhenyue, (Optics GRA), Advisor: Wu
Ma, Jichi, (Optics GRA), Advisor: Fathpour
Martin, Lane, (Optics GRA), Advisor: Saleh
Mayi Rivas, Jose, (Optics part time),
Mills, Matthew, (Optics GRA), Advisor: Richardson
Miri, Mohammad, (Optics GRA), Advisor: Christodoulides
Nye, Nicholas, (Optics GRA), Advisor: Christodoulides
Ogutman, Nizamettin Kortan, (Optics GRA), Advisor: Dogariu
Ott, Daniel, (Optics GRA), Advisor: Glebov
Pattanaik, Himansu, (Optics GRA), Advisor: Hagan/Van Stryland
Peng, Fenglin, (Optics GRA), Advisor: Wu
Pye, Lorelle, (Optics GRA), Advisor: Abouraddy
Rao, Ashutosh, (Optics GRA), Advisor: Fathpour
Reichert, Matthew, (Optics GRA), Advisor: Hagan/Van Stryland
Sarailou, Edris, (Optics GRA), Advisor: Delfyett
Shabahang, Soroush, (Optics GRA), Advisor: Abouraddy
Sincore, Alex, (Optics GRA), Advisor: Richardson
Sisken, Laura, (Optics GRA), Advisor: Richardson
Talukder, Javed Rouf, (Optics GRA), Advisor: Vodopyanov
Tan, Felix, (Optics GRA), Advisor: Abouraddy
Tao, Guangming, (Optics GRA), Advisor: Abouraddy
Toroghi, Seyfollah, (Optics GRA), Advisor: Kik
Van Newkirk, Amy, (Optics GRA), Advisor: Schülzgen
Vazquez-Guardado, Abraham, (Optics GRA), Advisor: Chanda
Wang, Tiansi, (Optics GRA), Advisor: Kar
Wang, Yang, (Optics GRA), Advisor: Chang
Webb, Benjamin, (Optics GRA), Advisor: Richardson
Xia, Cen, (Optics GRA), Advisor: LI
Xu, Daming, (Optics GRA), Advisor: Wu
Yang, Xu, (Optics GRA), Advisor: Deppe
Yuan, Jiamin, (Optics GRA), Advisor: Wu
Zhang, Qi, (Optics GRA), Advisor: Chang
Zhang, Yu, (Optics GRA), Advisor: Deppe
Zhao, Jian, (Optics GRA), Advisor: Vodopyanov
Zhao, Peng, (Optics GRA), Advisor: Hagan/Van Stryland
Zhu, Ruidong, (Optics GRA), Advisor: Wu

Post-Graduation Employment



Abhijeet Ardey
PhD Physics, 2014
Advisor: Peter Delfyett
Transceiver Design Engineer
Source Photonics, West Hills, CA



Yuan Chen
PhD Optics, 2014
Advisor: Shin-Tson Wu
Display Optics Engineer
Apple Computer



Kyle Douglass
PhD Optics, 2013
Advisor: Aristide Dogariu
Post Doctoral Researcher
EPEL, Univ Lausanne, Switzerland



Shima Fardad
PhD Optics, 2014
Advisor: Demetrios Christodoulides
Post Doctoral Researcher
University of Kansas



Manuel Ferdinandus
PhD Optics, 2014
Advisor: David Hagan & Eric Van Stryland
Assistant Professor of Optics
US Airforce AETC/AFIT/ENP



Clemence Jollivet
PhD Optics, 2014
Advisor: Axel Schülzgen
Principal Engineer
Nufern, East Brandy, Hartford, CT



Joshua Kaufman
PhD Optics, 2014
Advisor: Ayman Abouraddy
Post Doctoral Researcher
College of Optics and Photonics, UCF



Ilhan Kaya
PhD Computer Science, 2013
Advisor: Jannick Rolland
Program Engineer
Undisclosed Company, Italy



Saeed Khan
PhD Electrical Engineering, 2013
Advisor: Sasan Fathpour
Principal Engineer
Atomic Energy Commission, Pakistan



Yifan Liu
PhD Optics, 2014
Advisor: Shin-Tson Wu
Optical Engineer
ThorLabs, Shanghai, China



Xiaohang Liu
PhD Optics, 2014
Advisor: Dennis Deppe
Laser Engineer
Trump Photonics, NJ



Jichi Ma
PhD Optics, 2014
Advisor: Sasan Fathpour
Process Engineer
BinOptics, Ithaca, NY



Daniel Ott
PhD Optics, 2014
Advisor: Leonid Glebov
Post Doctoral Researcher
NIST, NRC



Marc Segall
PhD Optics, 2013
Advisor: Leonid Glebov
Research Scientist
Physical Optics Corp., Torrence, CA



Soroush Shabahang
PhD Optics, 2014
Advisor: Ayman Abouraddy
Post Doctoral Researcher
Harvard University



Jie Sun
PhD Optics, 2013
Advisor: Shin-Tson Wu
Sr. Optical Engineer
Magic Leap, Boca Raton FL



Guangming Tao
PhD Optics, 2014
Advisor: Ayman Abouraddy
Post Doctoral Researcher
College of Optic and Photonics, UCF



Henry Williams
PhD Chemistry, 2013
Advisor: Steve Kuebler
Technical Associate
NanoSpective



Yi Wu
PhD Optics, 2013
Advisor: Zenghu Chang
Post Doctoral Researcher
Physics Department, UCF,



Qi Zhang
PhD Optics, 2014
Advisor: Zenghu Chang
Sales Technical Support
Coherent, China



Yu Zhang
PhD Optics, 2014
Advisor: Dennis Deppe
Design and Process Engineer
BinOptics, Ithaca, NY

3. Research

The faculty, scientists, and students of CREOL, The College of Optics and Photonics, engage in research in areas utilizing radiation at wavelengths extending from millimeter waves to X-rays and cover the basic science and physics of optics and photonics, as well as prototyping development and demonstration of feasibility of applications. They vigorously pursue joint research projects with industry, academia, and government laboratories. In addition to CREOL (*Center for Research and Education in Optics and Lasers*), which is the primary research arm of the College, three centers are also active:

3.1 Research Centers

Florida Photonics Center of Excellence (FPCE)

The FPCE was established with a \$10 million grant from the State of Florida to create a new center of excellence within The College of Optics and Photonics at the University of Central Florida. The program began in 2003 with three primary goals: Advance excellence in research and graduate education to serve existing and emerging industry clusters in the state (photonics, optics, lasers), leverage state resources via partnerships with industry and government, and work in partnership with local, state and regional economic development organizations to attract, retain and grow knowledge-based, wealth producing industries to Florida. The focus of the FPCE research and education work has been on the technologies of nanophotonics, biophotonics, advanced imaging and 3D displays, and ultra-high bandwidth communications, all of which are forecast to experience rapid market growth. The grant has been used for developing the research infrastructure (new faculty, new facilities, new equipment), funding competitive R&D Partnership Projects at Florida universities in partnership with Florida industry, and pursuing commercialization and outreach with the help of the FPCE Industrial Advisory Board, the UCF Technology Incubator, and the Florida Photonics Cluster.

Townes Laser Institute

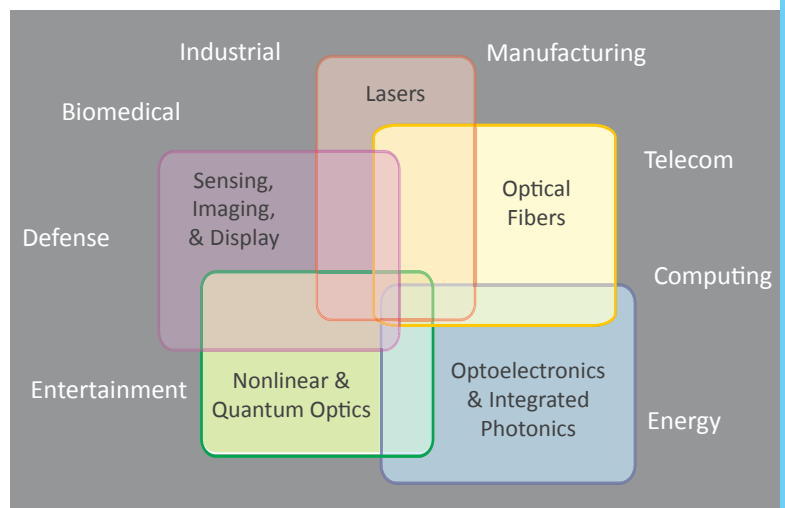
The Townes Laser Institute was established in 2007 in the presence of and in honor of Charles Townes, inventor of the concept of the laser, and a 1964 Nobel Laureate for Physics. Established for the development of next-generation lasers and their uses in medicine, advanced manufacturing and defense applications, the Institute was funded by a \$4.5M grant from the State of Florida, together with matching funds from UCF for 5 faculty positions and \$3M for start-ups and infrastructure. Since its founding, the Townes Laser Institute has grown to a faculty of 14 and has developed major capabilities in optical fibers, attoscience and new laser materials. It has made significant investments in optical fiber pulling facilities, pre-form fabrication, glass science and processing. It is currently building up a comprehensive capability in transparent ceramic laser materials. Future areas of investment include mid-infrared sources and materials, medical laser technology, laser-bioengineering, advance laser-based manufacturing and new defense-related laser technologies including long-distance laser light propagation through the atmosphere. The Townes Laser Institute is directed by Prof. Martin Richardson.

The Institute for the Frontier of Attosecond Science and Technology (iFAST)

The Institute for the Frontier of Attosecond Science and Technology (iFAST), directed by Prof. Zenghu Chang, is established in 2013. At the present time, iFAST has 6 research groups dedicated to research, education and outreach of attosecond physics and optics. The mission is to provide unique opportunities for faculty, scientists and students from College of Science and CREOL to closely collaborate in attosecond science research, create and disseminate new knowledge in attosecond physics by conducting, presenting, and publishing cutting-edge fundamental and applied research and develop next generation attosecond lasers for technology transfer and creating jobs in the State of Florida and the nation. An \$8 million DARPA PULSE and a \$7.5 million MURI are awarded to Chang and his collaborators to develop high energy and ultrashort attosecond light sources.

3.2 Areas of Research

Five major photonic technologies are pursued in the College: 1) lasers, 2) optical fibers, 3) semiconductor and integrated photonic devices, 4) nonlinear and quantum optics, and 5) imaging, sensing and display. Each of these technologies have applications in industry, communication and information technology, biology and medicine, energy and lighting, aerospace, and homeland security and defense. Design of optical systems, which has been the core of optical engineering, remains a principal component of the optics discipline, but advanced topics such as nano-photonics, atto-second optics, meta-materials, plasmonics, and biophotonics, are being embraced as areas of strength and future growth. The College is well positioned to take advantage of the revolution taking place in several areas enabled by optics and photonics. The following list describes some of the details of each research area and the applications pursued. A list of the faculty active in each of these areas and their specializations is available at <http://www.creol.ucf.edu/Research/ResearchArea.aspx>

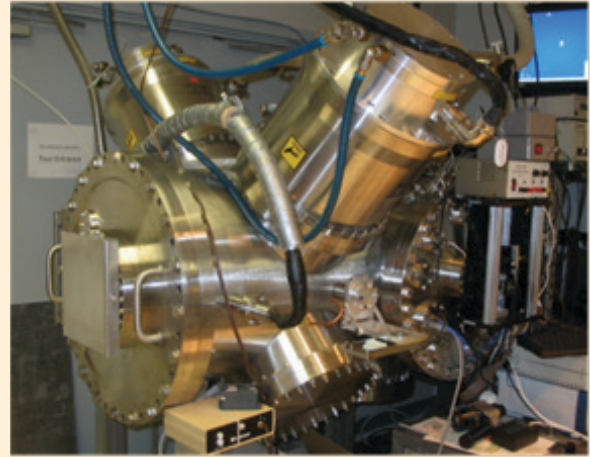


Science & Technology

- ☐ Solid State Lasers
- ☐ Ceramic Lasers
- ☐ Semiconductor Lasers
- ☐ EUV & X-ray Lasers
- ☐ High Power Lasers
- ☐ Ultrafast Lasers
- ☐ Optical Frequency Combs
- ☐ Attosecond science

Applications

- ☐ Laser Fabrication & Lithography
- ☐ Laser Material Processing
- ☐ Lasers in Medicine



Laser and Plasma Laboratory

Optical Fibers

Science & Technology

- ☐ Fiber Fabrication Technology
- ☐ Multimaterial Fibers
- ☐ Nano-structured Fibers
- ☐ Mid Infrared Fibers
- ☐ Fiber Lasers

Applications

- ☐ Fiber Optic Communication
- ☐ Fiber Optic Networks
- ☐ Fiber Optic Sensing



Fiber Drawing Towers

Optoelectronics & Integrated Photonics

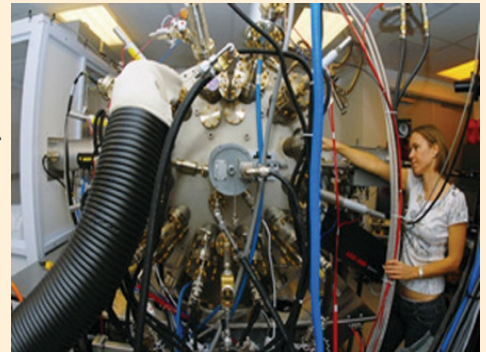
Science & Technology

- ☐ Epitaxial Growth
- ☐ LEDs & Laser Diodes
- ☐ Quantum Dots & Nanostructures
- ☐ Optoelectronics
- ☐ Oxide Semiconductors
- ☐ Photovoltaics
- ☐ Integrated Optics
- ☐ Periodic Structures & Photonic Crystals
- ☐ Nanophotonics & Plasmonics
- ☐ Silicon Photonics
- ☐ Gratings & Holographic Optical Elements

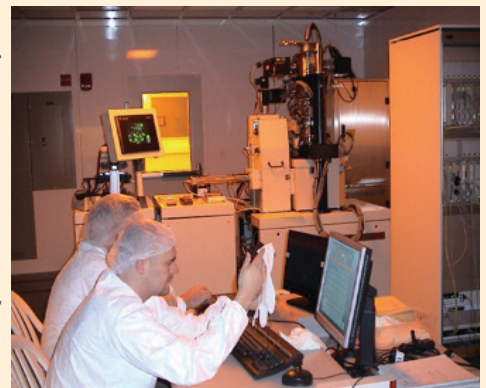
Applications

- ☐ Optical Communication
- ☐ Optical Processing & Switching
- ☐ Solar Energy Applications
- ☐ Integrated-Optic Sensing
- ☐ Integrated-Optic Signal Processing

MBE Facility



Nanophotonics Fabrication Facility

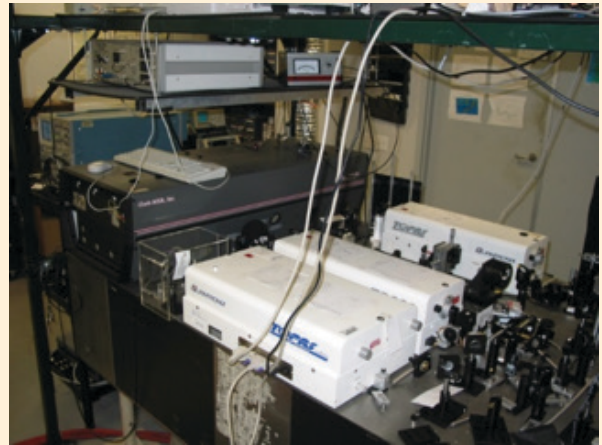


Science & Technology

- Nonlinear Guided Waves & Fibers
- Nonlinear Optical Materials
- Nonlinear Optics & Spectroscopy
- Nonlinear Optics in Periodic Structures
- Photosensitive Glasses
- Quantum Optics
- Solitons

Applications

- Laser Protectors
- Quantum Communication & Information
- Lasers in Medicine



Femto-second Nonlinear Optics Laboratory

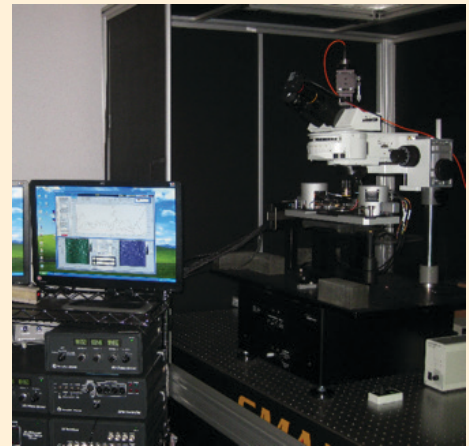
Sensing, Imaging, and Display

Science & Technology

- Optical Design & Image Analysis
- Near Field Imaging
- Propagation in Random Media
- X-ray & EUV Technology
- Infrared Sensors & Systems
- Millimeter & THz Technology
- Optics of Liquid Crystals

Applications

- Laser Protectors
- Quantum Communication & Information



Near field microscope

3.3 Laboratories & Facilities

The main facilities of the College are housed in a state-of-the art 104,000 sq. ft. building dedicated to optics and photonics research and education.

Facilities

Nanophotonics Systems Fabrication Facilities. A 3,000 ft² multi-user facility containing Class 100 and Class 1000 cleanrooms and a Leica 5000+ e-beam lithography instrument capable of 10-nm resolution. These facilities are used for fabrication and study of nanostructured materials and nanophotonic integrated circuits. The facility equipment includes a Suss MJB-3 and MJB-4 aligners, 2 Plasma-Therm 790 RIE systems with silicon and III-V etching capabilities, a Temascal and V&N E-beam evaporators, along with an atomic force microscope, a profilometer, a rapid thermal annealer, a bonder, a scribe and microscope. The Laboratory is designed and operated as a multi-user facility, with availability to companies and other outside users. Rm 180.

Optoelectronic Fabrication Cleanroom. 800 sq. ft. multiuser facility consisting of class 100 and class 10,000 cleanrooms. Used in the development of optoelectronic semiconductor devices. The facility equipment includes a Suss MJB-3 aligner, a Plasma-Therm 790 RIE/PECVD, an Edwards thermal evaporator, along with a bonder, a scribe and microscope. Rm 211

Scanning Electron Microscope (SEM) Facility. Vega SBH system built by Tescan is a tungsten-filament scanning electron microscope.

The system is designed with a fully electronic column and is capable of imaging from 1–30 keV with nanometer scale resolution. Additionally, the system is equipped with the state of the art sample positioning stage with 5 nm resolution and a full scale travel of 42 mm. The shared SEM is ideal for checking the fidelity of travel of 42 mm. The shared SEM is ideal for checking the fidelity of the microfabrication routinely performed in the CREOL cleanroom. Rm 176

Cary Spectra-Photometer and Microscope. Cary 500 is Spectrophotometer that is capable of measuring light absorption in both transmitted and reflected light in the UV, visible and near IR spectrum. Rm 159

Zygo Facility. Rm 211B. Shared facility administered by [Martin Richardson](#).

Machine Shop. Has two modern Sharp LMV milling machines and a 16–50G lathe capable of achieving the tolerances required for the instruments used in CREOL. Classes are offered to qualify research scientists and students to safely modify and construct instruments critical to their research. Rm A106. [Richard Zotti](#).

Townes Innovative Science & Technology Facility (TISTEF)

The TISTEF site is a secure facility located at the Kennedy Space Center, Florida. It was a Navy SSC PAC operated facility, but is now an Air Force facility on NASA property, managed and operated by UCF. TISTEF supports research and development of electro-optics sensing technologies for DOD, commercial and academic applications. The facilities include a laser and optics laboratory, a 1 km laser test range, a precision tracker (gimbal) with a 0.5 meter telescope and coude mirror path (for laser transmission), and several transportable trackers capable of supporting active (laser) or passive testing

at remote sites. Additionally, TISTEF maintains an assortment of telescopes, optics, and sensors to support various data collection requirements. It also has standardized range operations and procedures for laser testing against boosting rockets, satellites, and other terrestrial targets.



Optical Materials Laboratory (OML)

The Optical Materials Laboratory (OML) is a new 4,000 square-foot facility with state-of-the-art laboratory fabrication and characterization capabilities for research in optical ceramics, IR glasses and glass-ceramics as well as optical fibers. It features dedicated ceramic laboratories with extensive powder processing and sintering equipment, IR glass and glass-ceramic advanced manufacturing, and cutting-edge

MOCVD fiber-preform fabrication laboratory. These laboratories also include dedicated analytical tools and post-processing capabilities offering student training opportunities in these areas. The OML is located on the UCF main campus (Building 154 on 12765 Ara Drive) in close proximity to the Material Characterization Facility (MCF).

Faculty Labs

Diffraction and Holographic Optics Lab. Conducting rigorous analysis, design, and demonstration of diffractive and holographic optical elements, subwavelength grating structures and their applications, E-M theory of grating diffraction, holographic optical information processing and storage, volume holography. **Leonid Glebov.**

Fiber Optics Lab. Research in optical fiber applications and devices, fiber lasers, fiber optic sensors, nonlinear fiber optics, **Axel Schülzgen, Rodrigo Amezcua**

Florida Attosecond Science and Technology Lab. Generation of attosecond (10^{-18} s) and zeptosecond (10^{-21} s) X-ray pulses. The Double Optical Gating method is refined to generate shorter and stronger single isolated attosecond pulses with both few-cycle and multicycle lasers. **Zenghu Chang.**

Glass Processing and Characterization Lab. Research on the design, processing, manufacturing (including conventional and advanced hot forming fabrication methods) and characterization of novel optical glass, glass ceramic and ceramic materials for use in bulk, planar, and fiber applications. Compositional-tailoring for customized integration with multi-material components, platforms and applications. **Kathleen Richardson.**

Integrated Photonics & Energy Solutions Lab. Specializing in fundamental and technological aspects of silicon-based optoelectronic devices and chips, including their energy efficiency issues. The lab encompasses near- and mid-infrared setups for characterizing the devices fabricated in CREOL's Nano Fabrication Facility. **Sasan Fathpour**

Laser Advanced Material Processing (LAMP). Engaged in novel manufacturing technology; new materials synthesis including optical, electronic and magnetic materials for a variety of applications such as sensors, detectors and medical devices; and process physics modeling. **Aravinda Kar.**

Laser Aided Materials Processing Lab. Investigating the interaction of lasers with absorbing and non-absorbing materials, growth, solidification, and plasma effects; laser CVD; laser ablation, laser drilling, cutting, welding; developing process-monitoring and diagnostic techniques. **Stephen Kuebler (NPM) and Martin Richardson (LPL).**

Laser System Development Lab. Developing new solid-state lasers, external cavity semiconductor lasers and amplifiers, seeding lasers,

laser-induced damage, far infrared semiconductor lasers, high-average-power solid state lasers, semiconductor and solid state volume Bragg lasers, high power laser beam combining, ultra-high-intensity femtosecond lasers, new solid state lasers and materials development (crystals, glasses in bulk or fibers and ceramics). **Michael Bass, Martin Richardson, Peter Delfyett, Leonid Glebov, Axel Schülzgen, Rodrigo Amezcua-Correa, Kathleen Richardson and Romain Gaume.**

Liquid Crystal Display Lab. Investigating 1) advanced liquid crystal display materials, devices, and device modeling, 2) electronic laser beam steering and adaptive optics using fast-response spatial light modulators, 3) adaptive liquid crystal and liquid lenses for optometry and zoom lens, and 4) bio-sensors for life sciences. **Shin-Tson Wu**

Mid-infrared Frequency Combs Lab. Generation of ultra-broadband frequency combs in the mid-IR spectral range for laser spectroscopy, supercontinuum generation in optical fibers, standoff sensing and detection, nano-IR spectroscopy, photonic THz wave generation, and biomedical applications of lasers. **Konstantin Vodopyanov**

Multi-Material Optical Fiber Devices Lab. Research on novel optical fiber structures, nanophotonics, fiber-based optoelectronic devices, optical imaging using large-scale three-dimensional arrays constructed from photosensitive fibers, and mid-infrared fiber nonlinear optics. **Ayman Abouraddy.**

Multiple Quantum Wells Lab. Research on the design, fabrication and testing of novel all-optical switching devices using III-V multi-quantum well semiconductors, and the integration of high-speed optical and optoelectronic devices to form monolithic integrated optical circuits for high data throughput optical networks. **Patrick LikamWa**

Nanophotonics Characterization Lab. Optical analysis tools for investigation of nanostructured devices including near-field scanning optical microscope, fiber-coupled microscope for single particle spectroscopy, leakage radiation setup for surface plasmon imaging, near-infrared waveguide analysis setup, and variable temperature photoluminescence setup. **Pieter Kik.**

Nanophotonic Devices Lab. Research in epitaxial growth and properties of oxide semiconductors, oxide and nitride-semiconductor light emitting diodes, self-assembled quantum dots, and e-beam nanolithography. **Winston Schoenfeld.**

Nonlinear Waves Lab. Research in nonlinear optics, spatial and spatio-temporal solitons, discrete solitons in photonic lattices, and

curved beams. [Demetrios Christodoulides](#).

Nonlinear Optics Lab. Development and application of new, powerful spectroscopic tools for the characterization of nonlinear optical properties of materials on the femtosecond, picosecond and nanosecond time scales. Materials systems of interest include organic molecules and polymers, bulk and quantum-confined semiconductors and plasmonic complexes. Applications include all-optical switching, optical limiting, infrared detection and imaging. [Eric Van Stryland](#) and [David Hagan](#)

Northrup Grumman EUV Photonics Lab. Also referred to as the **Laser Plasma Lab.** Conducting research on X-ray and EUV optics and sources, X-ray microscopy, laser-aided material processing, and laser generated plasmas. [Martin Richardson](#).

Optical Glass Sciences & Photo-Induced Processing Lab. Conducting studies of new materials for high-efficiency, robust holographic optical elements; high power laser beam combining, glass spectroscopy, refractometry and interferometry; photo-induced processes in glasses; technology of optical quality and high-purity glasses. [Leonid Glebov](#).

Optical Ceramics Lab. Conducting research on the design, synthesis and characterization of transparent ceramics for laser, nuclear detector and energy harvesting applications. Powder processing, ceramic casting techniques, sintering, dopant engineering, diffusion bonding, optical spectroscopy, scintillation measurements, thermoelectric measurements. [Romain Gaume](#).

Optical Communication Lab. High-capacity optical communication through linear and nonlinear channels including free space and optical fiber using synergy of advanced optical and electronic techniques. [Guifang Li](#).

Optical Fiber Fabrication Lab. Research in fiber fabrication and processing technology, nano-structured fibers, novel optical fiber

materials, fused fiber device processing. [Axel Schülzgen](#), [Rodrigo Amezcua](#).

Optical Fiber and Fiber Devices Developing optical fiber and fiber components for high power lasers, communications, sensing and medical applications. [Rodrigo Amezcua](#)

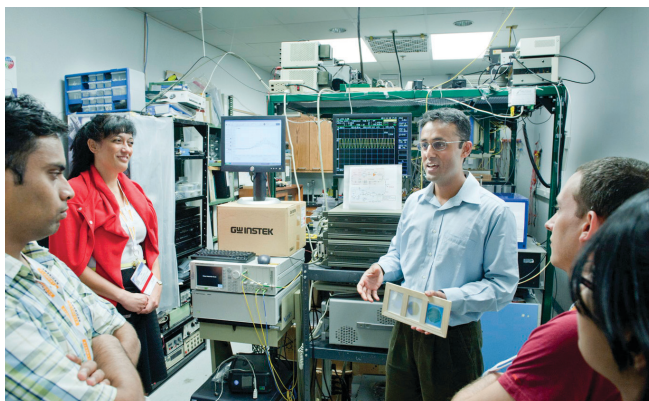
Plasmonics and Applied Quantum Optics Lab. Developing nanoscale emitters using metallic structures, study the dynamic response of nanoscale lasers. Generation and characterization of non-classical light. [Mercedeh Khajavikhan](#)

Photonics Diagnostic of Random Media. Exploring different principles for optical sensing, manipulation of electromagnetic fields, and phenomena specific to optical wave interactions with complex media. [Aristide Dogariu](#).

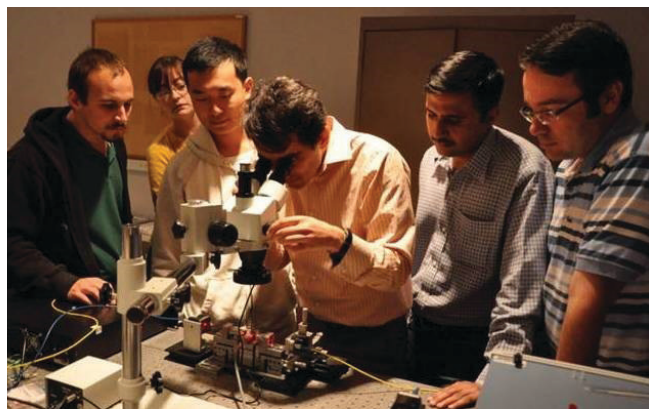
Quantum Optics Lab. Conducting research on the generation and detection of nonclassical light, such as entangled photons, and its quantum information applications, including quantum imaging and quantum communication. [Bahaa Saleh](#), [Ayman Abouraddy](#).

Semiconductor Lasers Lab. A III-V epitaxial growth facility used to research new types of semiconductor heterostructures and devices that include quantum dots, quantum dot laser diodes, vertical-cavity surface-emitting laser diodes, spontaneous light sources, and single quantum dots. A characterization laboratory is used to study the optical properties of the samples, including their light emission, microcavity effects, and laser diode characteristics. [Dennis Deppe](#).

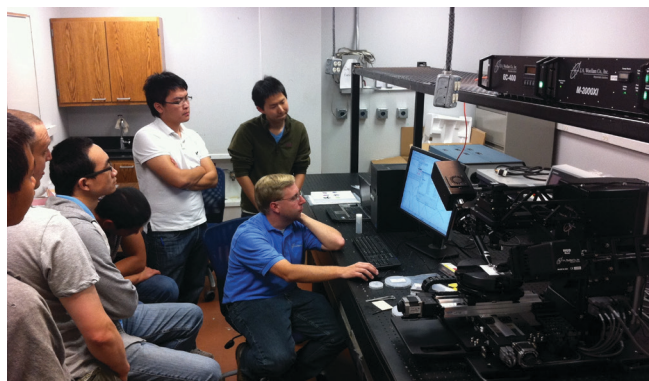
Ultrafast Photonics Lab. Conducts research on the development, integration and application of semiconductor-based ultrafast laser sources and frequency combs, for uses in optical signal processing, laser radar, ultrabroad-band photonic networks, laser induced materials modification and metrology. [Peter Delfyett](#).



Graduate student Sharad Bhoopapur, center, in the Ultrafast Optical Signal Processing Laboratory.



Professor Sasan Fathpour, looking into the microscope, with graduate students in the Integrated Photonics & Energy Solutions Laboratory.



Training session during installation of the variable angle mapping spectroscopic ellipsometer, Woollam M2000, in the Nanophotonics Characterization Lab.



Graduate student Amy Van Newkirk, left, in the Fiber Optics Laboratory.

3.4 Research Highlights

Breaking Single-Mode Fiber Transmission Capacity Using Space-Division Multiplexing



Optical fiber communication is the backbone for the telecommunications infrastructure. Fueled by emerging bandwidth-hungry applications, the Internet traffic has sustained an exponential growth in the past and this trend is expected to continue for the foreseeable future. It is well known that the capacity of a communication channel cannot exceed the Shannon limit. In the past two decades, the Internet traffic demand was mainly met by the wavelength-division multiplexing (WDM) technology using single-mode fibers (SMF), which can increase the number of channels by two orders of magnitude. Even though the number of communication channels in a SMF can be further increased by exploiting the low-loss transmission window of the optical fiber beyond the C and L bands, the resulting capacity increase is limited to below one order of magnitude. Furthermore, lack of an integrated amplification platform makes such a system unattractive from a technical and economic perspective.

As today's WDM technology has already taken advantage of all degrees of freedom of a light-wave in a single-mode fiber, namely frequency, polarization, amplitude and phase, further multiplicative growth for fiber-optic communication capacity has to explore new degrees of freedom that do not exist in single-mode fibers. Similar to the multiple-input-multiple-output (MIMO) architecture in wireless communication, space is the degree of freedom that is being considered for optical fiber communication beyond WDM. Space-division multiplexing (SDM), including mode-division

multiplexing (MDM) using multimode fibers or few-mode fibers (FMF) and/or core multiplexing using multi-core fibers (MCF), has attracted much attention in the last three to four years for the next multiplicative capacity growth for optical communication. The goal of SDM is to increase the capacity of a single fiber by at least two orders of magnitude over WDM.

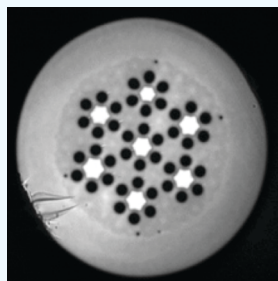
The concept of MDM, in which independent information is carried by orthogonal fiber modes, has been around since the 1970s but has not been pursued until recently. The reason is that the orthogonality of modes can only be maintained in practical applications for a very short distance because of crosstalk among modes due to fiber imperfections, bending and twisting. Mode coupling is a fundamental obstacle for MDM that must be addressed first. In optical fiber, mode couple is distributed and statistical. As such, it is highly unlikely that mode coupling matrix untangled using optical techniques.

Mathematically, since the coupling process is linear, the input and output modes are related by a linear matrix. Techniques invented for MIMO wireless communication for channel matrix estimation can be straightforwardly adopted for MDM signals and the input signal can be recovered by inverting the channel matrix. The challenge is that the computational complexity for this MIMO equalization is proportional to the number of the elements of the channel matrix. Therefore, the complexity of MDM MIMO equalization scales unfavorably as the square of the number of MDM channels.

CREOL faculty members Rodrigo Amezcua-Correa, Guifang Li and Axel Schülzgen have designed and fabricated a special fiber to reduce the MDM MIMO equalization complexity using a divide-and-conquer approach. The few-mode multicore fiber (FM-MCF) divides the SDM channels into multiple uncoupled cores. By

doing so, not all SDM channels are coupled to each other, thus reducing the number of MIMO matrix element by a factor equal to the number of cores. In order to ensure core-to-core isolation, air holes are used to confine the modes of each of the cores.

This fiber has been used in a record-setting SDM transmission experiment, in collaboration with COBRA Research Institute, Eindhoven University of Technology, and the results was published in the October 2014 issue of Nature Photonics. They demonstrated transmission over a 1 km FM-MCF, employing 7 few-mode cores, each supporting the LP01 and two degenerate LP11 modes, which results in 7 cores $\times$ 3 modes $\times$ 2 polarizations = 42 simultaneously



Cross-section of the 7-cores (13.1 μm diameter at a core pitch of 40 μm) FM-MCF. Air-holes of diameter 8.2 μm were placed 13.3 μm apart, creating an air-hole to pitch ratio of 0.62, yielding an inter-core crosstalk of under -80 dB/km.

transmitted spatial channels. This corresponds to 21 conventional SMF transmission channels. The air-holes minimize inter-core crosstalk and reduce the required MIMO equalizer complexity from 42×42 to $7 \times 6 \times 6$, and hence reduce power consumption. A single-carrier spectral efficiency of 102 b/s/Hz is achieved by encoding 24.3 GBaud 32 quadrature amplitude modulation (QAM), allowing for 5.103 Tb/s per carrier gross (4 Tb/s per carrier net) data rate spatial super-channels. Combining the spatial dimension with 50 wavelength channels on a 50 GHz International Telecommunication Union (ITU) grid, a gross total capacity of 255 Tb/s (200 Tb/s net) is demonstrated, further indicating the viability of combining few-mode and multi-core transmission techniques in a single fiber for achieving ultra-high capacity.



Rodrigo Amezcua-Correa



Guifang Li



Axel Schülzgen

Making Arbitrary Waveform Generation a Reality

The generation of arbitrary optical waveforms in real time is of keen interest owing to their use in a broad range of applications, spanning secure communications, advanced radar and lidar systems, and control of complex optically induced phenomena. The ability to modify such signals at ultrafast rates would make radar systems more accurate, secure, and with better resolution, and could also usher in new modalities in laser-based material interactions for manufacturing.

In the past, arbitrary optical waveforms could be generated by using a single laser beam, a modulator and an electronic arbitrary waveform generator (AWG). The difficulty is that the performance of the waveform generation is limited by the electronic AWG. To achieve waveforms with much faster variations, an alternative approach, called “pulse shaping” is used. In this technique, a laser that produces very short pulses, much shorter than a picosecond is used as the light source. The optical spectrum of the laser is dispersed using a diffraction grating, analogous to a prism that separates the components of the spectrum and direct them to a liquid crystal spatial light modulator (LC-SLM) array, where each pixel of the LC-SLM modulates a component. The outcome is then reassembled to create the arbitrary waveform. This process is identical to the mathematical process of describing a signal by its ‘Fourier transform’ spectrum. While this approach has proven very useful for some applications, the ability to modify the generated waveform is limited by the speed of the LCD, which operates in the millisecond regime.

Peter Delfyett and his students use instead an array of vertical cavity surface emitting lasers (VCSELs), with the individual lasers playing the role of elements of the LCD array (see Fig. 1). An ultrashort pulse laser is dispersed into its spectral components and each component ‘injection locks’ each laser in the VCSEL array. By modulating the electric current driving each VCSEL element, they can modulate the spectral components, thereby creating the arbitrary waveform. The key advantage of

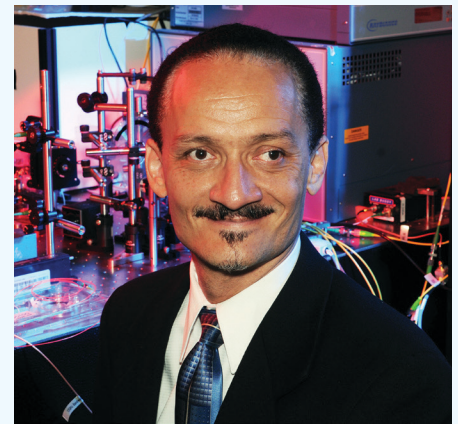
this approach is that the VCSEL array can be updated much faster (several billion times a second) than the LC-SLM, an improvement of several million folds.

In Delfyett’s system the ultrashort pulse is an optical frequency comb with 12 comb spectral components, spaced on a 12.5 GHz grid. The pulse spectral dispersion is obtained by use of a diffraction grating and a lens designed such that each comb component is spatially dispersed on a 250 micron spacing that matches the spacing between individual VCSELs. The light from each comb component injection

Injection-locked VCSEL arrays as spatial light modulators

locks each VCSEL, such that the output lasing emission of each VCSEL is forced, or locked, to emit at exactly the same wavelength of the injected light. By slightly changing the current to each VCSEL, the output emission maintains its wavelength but acquires a phase shift as compared to the input injection seed light. It is this phase shift that provides modulation on a comb-by-comb basis, and allows the synthesis of arbitrary waveforms. For the VCSELs used in the experiment, a maximum phase range of $\sim 0.7\pi$ rad is measured, which limits the complexity of the pulse shapes that can be generated. Also, phase-only modulation is achieved for slowly varying VCSEL currents.

To show the ability to adapt this approach to dynamic changes of the optical waveform, four of the comb components were dynamically modulated and the resulting waveforms were measured using multi-heterodyne detection. This was used to demonstrate the ‘real-time’ capability of the approach. Future work

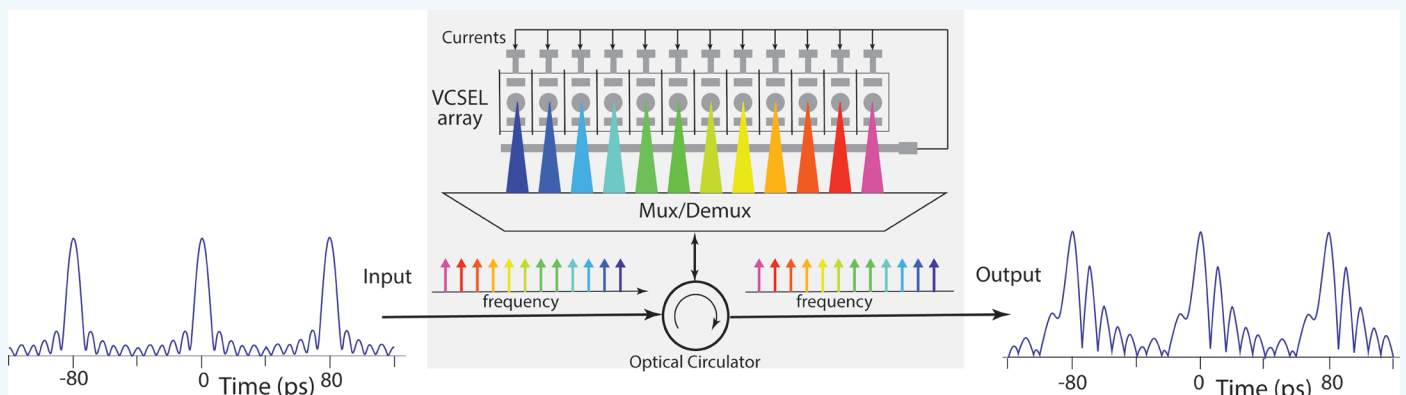


Peter Delfyett

will be performed by utilizing larger arrays, with faster VCSEL speeds and developing a modified architecture for integrating specific functionalities for a compact system design.

In summary, the injection locked VCSELs can act as an ultrafast spatial light modulator in the process of arbitrary waveform generation using Fourier synthesis techniques. The technique has improved on past works by over a million fold. Future work will be performed by utilizing larger arrays, with faster VCSEL speeds and developing a modified architecture for integrating specific functionalities for a compact system design.

Prof. Delfyett was named Florida Academy of Science’s 2014 Medalist. He is a member of the National Academy of Inventors and a recipient of the APS Edward Bouchet Award.



An ultrashort pulse with frequency-comb spectrum is converted into an arbitrary waveform by independent modulation of the spectral components using injection-locked VCSEL array.

Single-Mode Microring Lasers

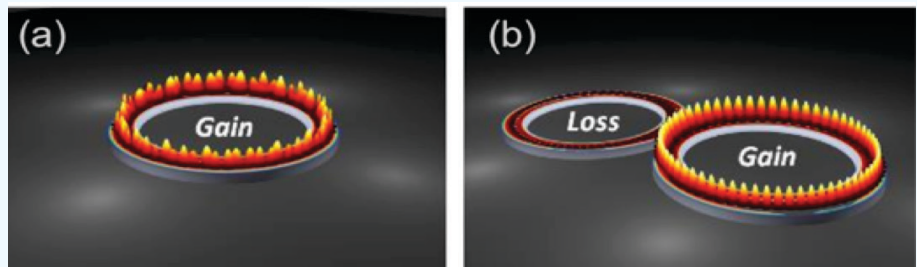
Since the invention of the laser, there has been a continuous effort to increase its coherence. High temporal and spatial coherence is what makes lasers indispensable tools in many areas of research and technology ranging from spectroscopy to optical communications. Most lasers, especially those employing semiconductors as the active gain material, tend to support multiple spectral lines or longitudinal modes. Over the years, several schemes have been adopted to effectively suppress undesired excess longitudinal modes. In this regard, distributed feedback (DFB) structures and vertical cavity surface emitting lasers (VCSEL) have been routinely used to select a predetermined frequency line by employing intracavity dispersive elements. However, these techniques are not universally applicable to all types of lasers. Hence the quest for other more-robust methods is still ongoing.



Mercedeh Khajavikhan

Passive microring resonators are one of the archetypical components of photonic integrated circuits. They support whispering gallery (WG) modes that exhibit high optical quality factors and small footprints, which are also useful attributes of on-chip laser cavities. However, like other micro-scale semiconductor lasers, microrings also support multiple longitudinal modes throughout the gain bandwidth (that can extend up to a few hundred nanometers). Unfortunately, the sparsity of the modes and the sensitivity of such cavities to perturbations prohibit the effective use of intracavity dispersive structures for mode filtering in these configurations.

Prof. Khajavikhan's group in collaboration with Prof. Christodoulides' team at CREOL have recently proposed a novel technique based on the notion of parity-time (PT) symmetry in order to suppress unwanted longitudinal modes in heavily multi-modal microring cavities. A new concept borrowed from quantum field theory, PT symmetry is steadily finding new applications in optics. In its unbroken phase, PT symmetry dictates that gain and loss can perfectly compensate one another in an identical pair of amplifying and lossy cavities. As a result, modes of the system propagating in such an arrangement would be completely oblivious to local gain or attenuation. However, this dramatically changes once the contrast between gain and loss exceeds a certain critical level, at which point spontaneous PT symmetry breaking will occur. In the PT symmetry broken regime, the



(a) A single micro ring laser supports multiple longitudinal modes. (b) Parity-time symmetric microring laser comprised of a pair of pumped and unpumped coupled rings supports only a single longitudinal mode.

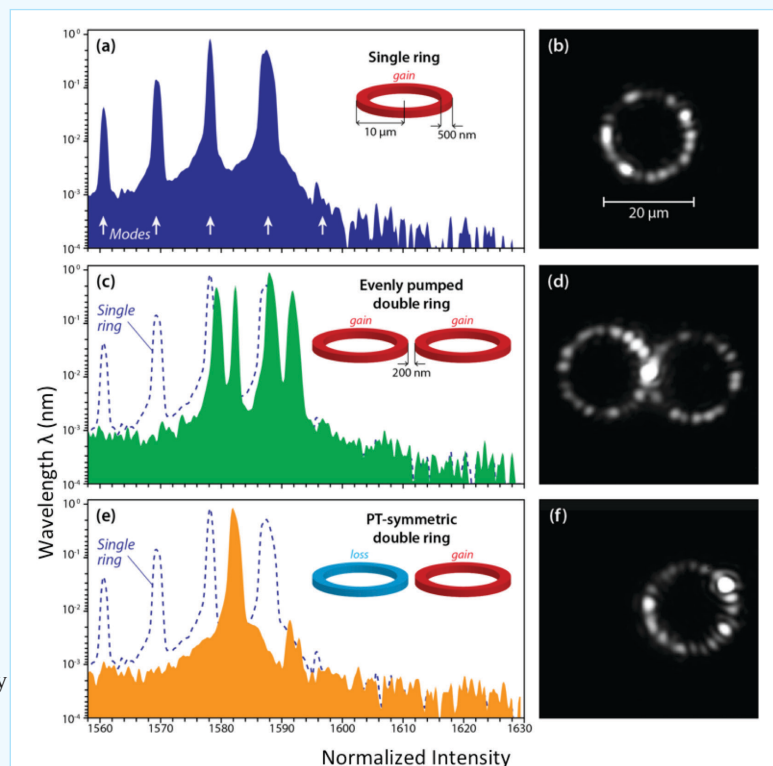
respective modes experience gain or loss in conjugate pairs.

In a 2014 paper entitled "Parity time symmetric microring lasers" published in the November issue of *Science* magazine, the CREOL researchers use the abrupt nature of the transition at PT breaking threshold to enforce single-mode operation in microring lasers. This effect is harnessed by fabricating closely spaced pairs of microring resonators infused with indium-gallium-arsenide-phosphide quantum wells. PT symmetry is established by withholding the pump from one of the rings and adjusting the inter-ring separation allowed for a precise and seamless tuning of the PT breaking threshold. The schematics in Fig. 1 show how PT symmetric structures filter out the unwanted longitudinal modes in coupled microring resonators. The laser continues to exhibit stable single-mode

operation at pump powers that would drive a classical microring cavity deep into the chaotic multimode regime. As an additional benefit, the overall efficiency is substantially increased because – and not in spite of – the presence of losses, the PT laser can extract much more power from the active medium than its conventional counterpart.

The CREOL team suggests that PT-symmetric lasers may serve as building blocks for a new class of integrated photonic devices that could enable optical communications and information processing. Since mode suppression is carried out on the most fundamental level, the design concept can be adapted to manipulate the modal content of a wide range of laser resonators at will. In addition, this class of PT-symmetric microring lasers could be an important step forward in the quest for miniaturization. The ability to dispose of the external filters and stabilization devices may lead to an unprecedented reduction in the footprint of single-mode on-chip laser sources, and finally allow for large-scale integration of active photonic circuits.

Experimental observations confirm mode suppression by PT-symmetry breaking.





Flexible Glass Integrated Photonics

Engineering optical function and mechanical flexibility

in the composite structure. This design allows the photonic layer to be placed close to the surface, enabling access to the optical field for applications such as sensing.

Critical to the optical and mechanical design was use of a solution derived processing route that allows conformal glass films of single or varying composition, to be integrated with desired low optical loss in a manner compatible with multi-material property and processing windows. The UCF/UD team's monolithic integration route offers excellent device performance with high yield: their best optical resonator device exhibited an intrinsic Q-factor as high as 460,000, which is believed to be the highest value reported in photonic devices on plastic substrates. Even after the membrane was bent many thousands of times at 0.8 mm bending radius, the devices maintain structural integrity and only a small increase (0.5 dB cm^{-1}) in optical losses. These results open up emerging application avenues of flexible photonic devices where they can benefit from superior optical and mechanical performance extending from traditional substrates to alternatives for use in land- and space-based application arenas.

Similar strategies are currently in use in other multi-material, planar integration efforts taking place at CREOL between the GPCL team in partnership with Profs. Fathpour and Kuebler. Additionally, as part of a Delaware/UCF US Dept. of Energy SunShot Transformational Photovoltaic Science and Technology Program, ChG films are being examined in enhanced light capture strategies employing asymmetric gratings imprinted on solar cells.

Prof. Richardson is currently serving as President of the American Ceramics Society (ACerS) and she is past-President of the National Institute of Ceramic Engineers..

This summary was adapted from highlights reported in *OSA's Optics and Photonics*, 1 December 2014

In recent years, the increasing penetration of flexible devices into the consumer products market has led to a surge of interest in flexible photonics, i.e., integrated optical systems fabricated on flexible polymer substrates that can be mechanically deformed without compromising their optical performance. In addition to being an essential component in consumer electronics, flexible photonics also have enormous application potential for board-to-board optical interconnects, epidermal sensors, wearable photonics and flexible displays as well as other arenas where light-weight, compact optical function is required.

To date, most flexible photonic devices are made entirely from polymers. Unfortunately, polymer-based systems generally have small refractive index differences between their cores and claddings, resulting in weak light confinement, a large device footprint, excessive loss during bending and limited thermal stability. These attributes can affect and limit device design, processing, and integration strategies. High-index-contrast semiconductor photonic devices can be alternatively fabricated using pattern transfer to overcome these limitations. However, the transfer process is complicated and has limited integration capacity. Further, the resulting devices only exhibit moderate flexibility with a bending radius typically no less than 5 mm.

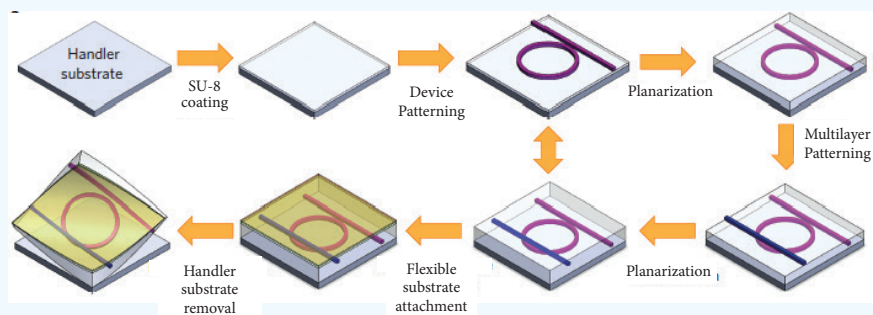
Chalcogenide glass, specifically, oxygen-free glasses that transmit throughout the infrared, have seen increasing use in a diverse range of infrared optical system. CREOL's *Glass Processing and Characterization Laboratory*, led by Prof. Kathleen Richardson, designs and manufactures glasses with tailored optical and physical properties that are compatible with a range of platforms that span bulk molded optics, planar integrated photonics and optical fibers. In work published in the June 2014 issue of *Nature Photonics* the Richardson team partnered with Prof. Juejun

Hu's group at the University of Delaware and CREOL/UCF spin-off *IRradiance Glass* to develop glasses compatible with polymer substrates for use as flexible, infrared photonic structures. The flexible photonic chip boasts excellent optical performance and extreme mechanical robustness and flexibility enabling repeated bending down to sub-millimeter radius without measurable performance degradation. Both of these advances represent major improvements over other state-of-the-art devices.



Kathleen Richardson

Designing requisite optical function with the mechanical and chemical compatibility needed to engineer device robustness, the team blended optical material science expertise to realize an integrated flexible chalcogenide glass photonic device. The device's performance enhancement capitalizes on two innovations. First is the adoption of high-index chalcogenide glasses (ChGs), namely the amorphous compounds of S, Se or Te as the backbone optical materials. Unlike oxide glasses, chalcogenides can be deposited at room temperature without compromising their low loss properties, thus facilitating monolithic photonic integration on plastic substrates. Second, a novel multi-neutral-axis micro-mechanical design is implemented to render the structure highly flexible. In the design, a soft silicone adhesive layer is sandwiched inside the flexible substrate, which serves to significantly relieve the strain



Schematic overview of the monolithic 3D flexible photonic device fabrication process.



Shin-Tson Wu

The liquid crystal display (LCD) has become ubiquitous and indispensable in our daily life. It is widely used in applications such as smart phones, pads, computer screens, TVs, and data projectors. Recently, the LCD is facing competition from the organic light emitting diode (OLED) display, especially in smart phones. LCDs advantage lie in their low cost, low power consumption, and high resolution density, but lags behind the OLED in the response time, color saturation, and flexibility. To achieve fast response time, Prof. Shin-Tson Wu's group has developed a new polymer-stabilized blue phase LCD. In the voltage-off state, the blue phase liquid crystal is optically isotropic so that it does not require surface alignment. This greatly simplifies the manufacturing process. In the voltage-on state, the isotropic-to-anisotropic transition induced by the Kerr effect takes place. Its response time is in the sub-millisecond range, which is approximately 20 times faster than that of nematic liquid crystals. The major problem of polymer-stabilized blue phase LCD is its relatively high operation voltage (~50V). Wu's group has invented a novel protrusion electrode approach that significantly lowers the operation voltage to below 10V. This

Prime Time for Quantum-Dot-Enhanced LCD is Around the Corner

approach has now been widely adopted by display industry.

Conventional LCDs utilize a white light-emitting-diode (WLED) as backlight because of its excellent efficacy. This white light is produced by using a high-brightness blue LED to pump yellow phosphor. However, the emission spectrum is quite broad (see figure below). The yellow light leaks through the green and red color filters and degrades the color purity. As a result, the displayed color is not saturated and its color gamut is only about 75% of Adobe RGB (see figure below). By contrast, OLED can achieve 100% color gamut.

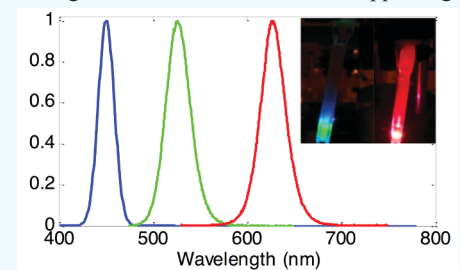
LCD is facing competition from OLED

To obtain vivid colors for LCDs while keeping the optical efficiency high, Wu's group is designing quantum dot (QD) enhanced backlight with matched spectra to color filters. They have developed the first model to systematically optimize the system. Quantum dots are semiconductor nanocrystals with diameter around 2–10 nm. Quantum dots exhibit several attractive features, resulting from quantum confinement, for display applications: high quantum efficiency, broad absorption band, narrow emission linewidth, and controllable emission peak. The FWHM of QD emission is approximately 30 nm, which is much narrower than that of phosphors. Moreover, the emission wavelength can be tuned by varying the QD size or composition during material synthesis. This offers a new degree of freedom for achieving saturated colors. To achieve white light, a blue LED is used to excite the green and red quantum-dot mixture. Such a white light is mixed by the transmitted blue LED and the down-conversion red and green QD emission bands. By tuning the QD emission wavelengths to match the transmission spectra of color filters, QD-enhanced LCD exhibits 118% color gamut and 15%

higher optical efficiency than conventional WLED.

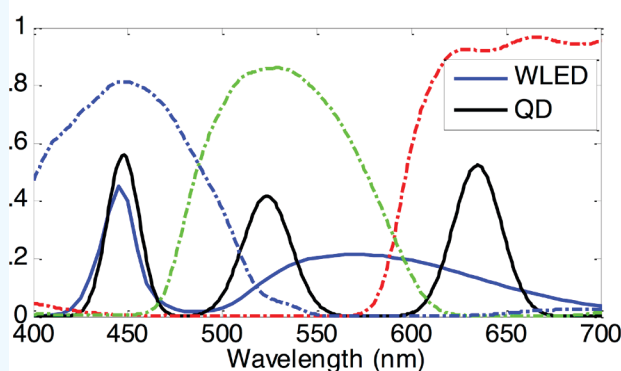
The implementation of QD backlight can be cost effective, reliable, and process-ready. In addition, Wu's group found another remarkable advantage of using QD-backlit: the sunlight readability is greatly enhanced and color washout is dramatically reduced when viewing an LCD from an off-axis direction. This feature is particularly desirable for mobile display devices.

Wu's group continues to develop novel QD device structures, and extend its applications to emissive quantum-dot LED, color-tunable LED lighting based on quantum dot suspension, tunable color temperature LEDs, and low power liquid display based on quantum-dot backlight. The integration of quantum dots with blue phase liquid crystals makes next generation LCDs even more appealing.

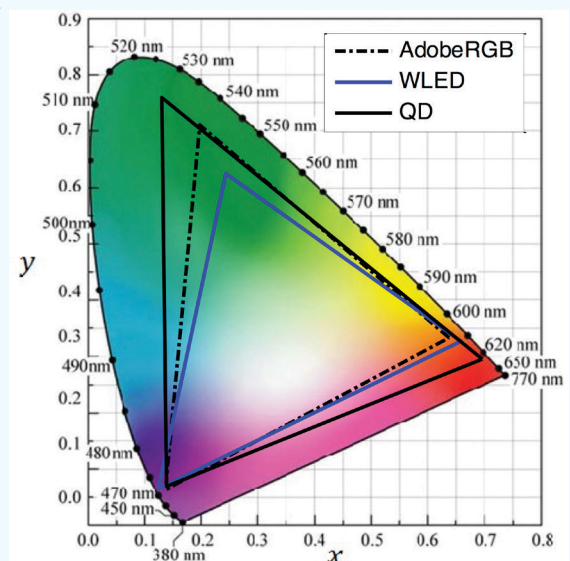


White light is mixed by transmitted blue LED and down-conversion red and green QD emission bands

Shin-Tson Wu was inducted to the Florida Inventors Hall of Fame this year, and also received the 2014 OSA Esther Hoffman Beller medal. The 2nd edition of his book *Fundamentals of Liquid Crystal Devices* was published this year. This is one of 7 books that he has co-authored.



Transmission spectra of color filters and emission spectra of WLED and QD backlight



Color gamut in CIE 1931

3.5 Publications and Presentations

Names of full-time CREOL faculty authors are highlighted in black; those of joint and courtesy appointments who listed CREOL as one of their affiliations are highlighted in blue; names of CREOL scientists and also students with no faculty co-authors are highlighted in green.

Books

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S. Mokhov, D. Ott, I. Divliansky, B. **Zeldovich**, and L. B. **Glebov**, “Moire volume Bragg grating filter with tunable bandwidth,” *Optics Express* 22(17), pp.20375–20386 (2014).

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G. Tao and A. F. **Abouraddy**, “Drawing robust infrared optical fibers from preforms produced by efficient multimaterial stacked coextrusion,” *Proc. SPIE* 8982, 89820F (2014).

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G. Tao, S. Shabahang, H. Ren, F. Khalilzadeh-Rezaie, R. E. **Peale**, Z. Yang, X. Wang, and A. F. **Abouraddy**, “Robust multimaterial tellurium-based chalcogenide glass infrared fibers,” *CLEO*, San Jose, Ca., June (2014).

T. M. Yarnall, A. F. **Abouraddy**, and G. Di Giuseppe, “A phase unlocked Hong-Ou-Mandel interferometer,” *Proc. SPIE* 8749, 87490G-8 (2014).

K. H. Kagalwala, G. Di Giuseppe, A. F. **Abouraddy**, and B. E. A. **Saleh**, “Demonstration of single-photon three-qubit quantum logic gate with spatial light modulators,” *OSA-FIO*, Tucson, AZ, Oct 18-22 (2014).

H. E. Kondakci, A. F. **Abouraddy**, B. E. A. **Saleh**, “Discrete speckle: localization and coherence in anderson-disordered lattices,” *OSA-FIO*, Tucson, AZ, Oct 18–22 (2014).

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H. E. Kondakci, A. F. **Abouraddy**, and B. E. A. **Saleh**, “Appearance of a photonic thermalization gap in symmetry-constrained anderson-disordered photonic lattices,” *CLEO*, San Jose, CA, June 8–13 (2014).

K. H. Kagalwala, G. Di Giuseppe, A. F. **Abouraddy**, and B. E. A. **Saleh**, “Three-qubit photonic quantum logic with spatial light modulators,” *CLEO*, San Jose, CA, June 8–13 (2014).

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K. H. Kagalwala, G. Di Giuseppe, A. F. **Abouraddy**, and B. E. A. **Saleh**, “Three-qubit CNOT gates using spatial light modulators,” *OSA North*, Quebec, Canada, 2014.

A. Van Newkirk, E. Antonio-Lopez, G. Salceda-Delgado, R. **Amezcuac-Correa**, and A. **Schülzgen**, “Supermode interference in multicore fiber optimized for use in sensing applications,” *OSA Specialty Optical Fibers & Applications (SOF)*, paper: SoW2B.4 (2014).

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P. Hofmann, K. Al Yahyaei, C. Jollivet, A. Van Newkirk, R. **Amezcuac-Correa**, E. Antonio-Lopez, D. Ott, M. SeGall, I. Divliansky, L. Glebova, L. **Glebov**, and A. **Schülzgen**, “Highly photosensitive fiber fabricated from photo-thermo-refractive glass,” 38th International Conference and Exposition on Advanced Ceramics and Composites ICACC, paper: ICACC-FS2-025-2014, Daytona Beach FL (2014). **Invited.**

R. G. H. van Uden, R. **Amezcuac-Correa**, E. Antonio-Lopez, F. M. Huijskens, G. Li, A. **Schülzgen**, H. de Waardt, T. Koonen, and C. Okonkwo, “16 QAM SDM-WDM transmission over a novel hole-assisted few-mode multi-core fiber,” *IEEE Photonics Society Summer Topicals*, paper: ME3.2 (2014).

M. **Baudelet**, B. Seesahai, Y. Liu, C. Jeon, M. C. **Richardson**, M. Sigman, and J. Chappell, “Quantitative line assignment in optical emission spectroscopy,” *SciX* 2014, Reno, NV; September 29 (2014). **Invited.**

M. **Baudelet**, R. **Gaumé**, M. C. **Richardson**, M. Chun, B. Seesahai, Y. Liu, and C. Jeon, “Education in plasma spectrochemistry via LIBS for high school and undergraduate students at the Townes Laser Institute,” *SciX*, Reno, NV, October 02 (2014). **Invited.**

B. Webb, J. Bradford, K. Lim, N. Bodnar, A. Vaupel, E. Mckee, M. **Baudelet**, M. Durand, L. **Shah**, and M. C. **Richardson**, “Compact 10 TW laser to generate multt-filament arrays,” CLEO Science and Innovation, paper SM1F.6 (2014).

C. Jeon, M. M. Durand, M. **Baudelet**, and M. C. **Richardson**, “Filament interaction with micro-water droplets”, CLEO: Science and Innovations, STh4B.6 (2014).

S. Rostami, M. Chini, K. Lim, M. Durand, M. **Baudelet**, J. M. Diels, M. C. **Richardson** and L. Arissian, “Measurements of the impact of polarization on filaments and the associated supercontinuum,” OSA-FIO, paper FTh2A.5 (2014).

Y. Liu, M. **Baudelet**, and M. C. **Richardson**, “Microwave-assisted LIBS: beyond signal enhancement,” Winter Conference on Plasma Spectrochemistry, Amelia Island, FL, January 07, (2014).

Y. Cheng, M. Chini, X. Wang, Y. Wu, and Z. **Chang**, “Attosecond transient absorption in molecular hydrogen,” in CLEO paper FM2B.3. (2014).

Y. Wu, E. Cunningham, J. Li, M. Chini, and Z. **Chang**, “Carrier-envelope phase stabilization of a 10 Hz, 20 TW laser for high-flux attosecond pulse generation,” in CLEO: OSA Technical Digest (online, paper FTu3B. 8 (2014).

M. Chini, X. Wang, Y. Cheng, H. Wang, Y. Wu, E. Cunningham, P. Li, J. Heslar, D. Telnov, S. Chu, and Z. **Chang**, “Coherent VUV emission from field-controlled bound states,” in CLEO OSA Technical Digest (online), paper FM2B.5. (2014).

X. Yu, Q. Bian, Zenghu **Chang**, P. B. Corkum, and S. Lei , “Control of multiphoton and avalanche ionization using an ultraviolet-infrared pulse train in femtosecond laser micro/nano-machining of fused silica,” Proc. SPIE 8968, Laser-based Micro- and Nanoprocessing VIII, 89680G, March 6 (2014).

Z. **Chang**, “Approaching the atomic unit of time with isolated attosecond pulses,” CLEO, San Jose, CA, June 9-13 (2014).

Z. **Chang**, “Broadband high flux isolated attosecond pulses,” Photonics North, Montreal, Canada May 28-30 (2014).

Z. **Chang**, “Broadband isolated attosecond pulses for transient absorption spectroscopy,” Multiphoton Processes Gordon Research Conference, Bentley University, USA, June 15-20 (2014).

Z. **Chang**, “Attosecond transient absorption spectroscopy,” Chinese Physical Society Fall Meeting, Harbin, China. Sept. 12-14 (2014). **Plenary**.

A. P. Leija, A. Szameit, and D. N. **Christodoulides**, “Entanglement of single-photon W -eigenstates,” paper JW2A.63. High Intensity Lasers and High Field Phenomena, Messe Berlin, Berlin Germany, March 18-20 (2014).

A. P. Leija, A. Szameit, and D. N. **Christodoulides**, “Entanglement of single-photon W -eigenstates,” in Research in Optical Sciences , paper JW2A.63, Quantum Information and Measurement, Messe Berlin, Berlin Germany, March 18-20 (2014).

T. Eichelkraut, C. Vetter, A. Perez-Leija, D. N. **Christodoulides**, and A. Szameit, “Coherent random walks in free space,” paper QTh1A.6, Quantum Information and Measurement, Messe Berlin, Berlin Germany, March 18-20 (2014).

M. Graefe, R. Heilmann, A. Perez-Leija, R. Keil, F. Dreisow, M. Heinrich, S. Nolte, D. N. **Christodoulides**, and A. Szameit, “Single-photon W -states of high-order for random number generation,” paper QTh1A.4, Quantum Information and Measurement, Messe Berlin,

Berlin Germany, March 18-20 (2014).

D. N. **Christodoulides**, “Optical Airy beams and bullets,” New Frontiers in Photonics: Looking Toward the International Year of Light 2015, Doha, Qatar, May 25 (2014). **Invited**.

D. N. **Christodoulides**, “Physics and applications of airy beams and other optical accelerating waves”, 16th Photonics North Conference 2014, Montreal, Canada, May 28- 30 (2014). **Plenary**.

T. Eichelkraut, R. Heilmann, S. Weimann, S. Stutzer, D. N. **Christodoulides**, and A. Szameit, “Mobility transition between ballistic and diffusive transport in PT -symmetric lattices”, paper H3.00007, 45th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics, Madison, Wisconsin, June 2–6 (2014).

A. Perez-Leija, M. Grafe, R. Heilmann, R. Keil, S. Stutzer, S. Weimann, D. N. **Christodoulides**, and A. Szameit, “Eigenstate-assisted longitudinal quantum state transfer and qubit storage in photonic and spin lattices”, paper J4.00010, 45th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics, Madison, Wisconsin, June 2–6 (2014).

S. Stutzer, M. Heinrich, M. A. Miri, R. El-Ganainy, S. Nolte, D. N. **Christodoulides**, and A. Szameit, “A new class of optical structures: Supersymmetric mode converters”, paper N6.00004, 45th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics, , Madison, Wisconsin, June 2–6 (2014).

M. Graefe, R. Heilmann, A. Perez-Leija, R. Keil, F. Dreisow, M. Heinrich, S. Nolte, D. N. **Christodoulides**, and A. Szameit, “High-order photonic W -states for random number generation”, paper N6.00007, 45th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics, Madison, Wisconsin, June 2–6 (2014).

T. Eichelkraut, C. Vetter, A. Perez-Leija, D. N. **Christodoulides**, and A. Szameit, “Continuous time quantum random walks in free space”, paper Q1.00107, 45th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics, Madison, Wisconsin, June 2–6 (2014).

M. Graefe, R. Heilmann, A. Perez-Leija, R. Keil, F. Dreisow, M. Heinrich, S. Nolte, D. N. **Christodoulides**, and A. Szameit, “High-order single-photon W -states for random number generation,” paper JT4A.36, CLEO, June 8-13 (2014).

A. P. Leija, M. Graefe, R. Heilmann, R. Keil, S. Weimann, D. N. **Christodoulides**, and A. Szameit, “Highly efficient eigenstate-assisted long-distance quantum state transfer in photonic lattices,” paper FF2D.4, CLEO, June 8-13 (2014).

M. Heinrich, S. Stützer, M. Miri, R. El-Ganainy, S. Nolte, D. N. **Christodoulides**, and A. Szameit, “Supersymmetric mode converters,” paper SF2O.2, CLEO, June 8-13 (2014).

M. Miri, M. Heinrich, and D. N. **Christodoulides**, “Beyond PT -symmetry: SUSY-mediated real spectra in complex refractive index landscapes,” paper FM1D.1, CLEO, June 8-13 (2014).

T. Eichelkraut, C. Vetter, A. Perez-Leija, D. N. **Christodoulides**, and A. Szameit, “Quantum random walks in free space,” paper FF1D.1, CLEO, June 8-13 (2014).

H. Hodaei, M. Miri, M. Heinrich, D. N. **Christodoulides**, and M. **Khajavikhan**, “ PT symmetric large area single mode DFB lasers,” paper FM1D.3, CLEO, June 8-13 (2014).

M. Miri, M. A. Eftekhar, M. Facao, and D. N. **Christodoulides**, “Scattering off PT -symmetric particles,” paper FM1D.5, CLEO, June 8-13 (2014).

R. El-Ganainy, M. Teimourpour, A. Eisfeld, and D. N.

- Christodoulides**, “*Light transport in PT photonic structures with hidden symmetries*,” paper FM1D.4, CLEO, June 8-13 (2014).
- I. D. Chremmos, J. Zhao, D. N. **Christodoulides**, Z. Chen, and N. K. Efremidis, “*Diffraction-resisting Vortex Bessel beams with arbitrary trajectories*,” paper FM3D.1, CLEO, June 8-13 (2014).
- D. N. **Christodoulides**, “*Parity-time symmetry in optics*”, invited, *International School of Physics “Enrico Fermi”* Frontiers in Modern Optics, Varenna, Italy, June 30 – July 5 (2014).
- I. Chremmos, J. Zhao, D. N. **Christodoulides**, Z. Chen, and N. K. Efremidis, “*Diffraction-resisting vortex Bessel beams with arbitrary trajectories*,” paper NM4A.4., Nonlinear Photonics, Barcelona Spain, July 27-31, (2014).
- D. N. **Christodoulides**, “*PT symmetric optics*,” 9th International Workshop on disordered systems, San Antonio, Texas, August 18-22 (2014). **Invited**.
- D. N. **Christodoulides** and M. A. Miri, “*PT symmetry in optics and photonics*”, SPIE, San Diego, California August 17-21 (2014). **Invited**.
- D. N. **Christodoulides**, “*Externally refueled dressed optical filaments*”, The 5th International symposium on filamentation, Shanghai, China, September 18-24 (2014). **Invited**.
- H. Hodaie, M. Miri, M. Heinrich, D. N. **Christodoulides**, and M. **Khajavikhan**, “*PT symmetry breaking and transverse mode filtering in microring lasers*,” paper LTh4I.2, OSA-FIO, Tucson, Arizona, October 19-23 (2014).
- D. N. **Christodoulides**, M. Miri, H. Hodaie, M. Heinrich, and M. **Khajavikhan**, “*PT symmetry in optics*,” paper FTu2E.1, OSA-FIO, Tucson, Arizona, October 19-23 (2014). **Invited**.
- M. Miri, S. Stuetzer, M. Heinrich, R. El-Ganainy, S. Nolte, D. N. **Christodoulides**, and A. Szameit, “*Observation of supersymmetric dynamics in photonic lattices*,” paper FTu2E.3, OSA-FIO, Tucson, Arizona, October 19-23 (2014).
- M. Clerici, Y. Hu, P. Lassonde, C. Milian, A. Couairon, D. N. **Christodoulides**, Z. Chen, L. Razzari, F. Légaré, D. Faccio, and R. Morandotti, “*Curved and self-healing discharges guided by optical beams*,” paper LTu2D.3, Latin America Optics and Photonics Conference, Cancun Mexico, November 16-21 (2014).
- E. Sarailou, A. Ardey, and P. J. **Delfyett**, “*A novel intensity modulator for photonic ADCS using an injection-locked mode-locked laser*,” Conference on Lasers and Electro-Optics / Optical Signal Processing, SM1G.3, (OSA CLEO (2014).
- E. Sarailou, A. Ardey, and P. J. **Delfyett**, “*A true linear intensity modulator for pulsed light*,” Conference Photonics Society Annual Meeting, (IEEE IPC) (2014).
- P. J. **Delfyett**, “*Frequency combs and related technologies for microwave synthesis*”, P. J. **Delfyett**, “Physics of Quantum Electronics Meeting; Snowbird: “New Directions in Photonic Microwave Synthesis.” Jan 5-9 (2014). **Invited**
- A. Ardey, E. Sarailou, and P. J. **Delfyett**, “*On-chip nonlinear injection locking for stable frequency comb generation*,” OSA-FIO (2014).
- A. Klee, K. Bagnell, and P. J. **Delfyett**, “*Stabilized semiconductor optical frequency comb with programmable intracavity dispersion compensation*,” OSA-FIO, FTu1G (2014).
- A. Klee, K. Bagnell, and P. J. **Delfyett**, “*Dispersion optimization in a semiconductor optical frequency comb*,” IPC, TuE3.5 (2014).
- A. Ardey, E. Sarailou, and P. J. **Delfyett**, “*Towards all monolithic stabilization of high-speed modelocked semiconductor lasers*,” IPC, TuE3.5 (2014).
- P. J. **Delfyett**, “*Ultrawideband coherent optical signal processing using semiconductor laser based optical frequency combs*,” OSA IONSA KOALA, Adelaide AU (2014). **Keynote Invited**
- M. Akhlaghi Bouzan, W. Hayenga, P.J. **Delfyett** and M. **Khajavikhan**, “*Monolithic mode-locked lasers based on high finesse silicon ring resonator*,” SPIE Optics and Photonics (2014).
- E. Sarailou, A. Ardey, and P. J. **Delfyett**, “*Semiconductor-based linear intensity modulator with spur free dynamic range of 105 dB.Hz^{2/3}*,” OSA-FIO (2014).
- A. **Dogariu**, “*Optical action at mesoscales*,” SPIE Photonics West, San Francisco, CA (2014). **Invited**
- S. Khan and S. **Fathpour**, “*Apodized grating silicon waveguides for tunable optical delay lines*,” SPIE Photonics West, San Francisco, CA, February (2014).
- J. Chiles, S. Khan, J. Ma and S. **Fathpour**, “*High-contrast, all-silicon waveguiding platform for multi-octave integrated photonics*,” OFC, San Francisco, CA, March (2014).
- J. Chiles, and S. **Fathpour**, “*Silicon on lithium niobate: a hybrid electro-optical platform for near- and mid-infrared photonics*,” CLEO, San Jose, CA, June (2014).
- J. Ma, J. Chiles, Y. D. Sharma, S. Krishna and S. **Fathpour**, “*Two-photon photovoltaic effect in gallium arsenide*,” Conference on Lasers and Electro-Optics (IEEE/OSA CLEO 2013), San Jose, CA, June (2014).
- P. Rabiei, J. Ma, J. Chiles, S. Khan and S. **Fathpour**, “*Lithium niobate photonics on silicon substrates*,” IEEE Photonics Conference, Paper TuC3.1, San Diego, CA, October (2014). **Invited**.
- S. **Fathpour**, “*Hybrid silicon photonic platforms for Near- and mid-Infrared wavelengths*,” OSA LAOP Conference, Paper LTu3A.1, Cancun, Mexico, November (2014). **Tutorial**.
- R. **Gaume**, “*Engineered optical ceramics for laser applications*,” 38th American Ceramic Society Conference ICACC’14, Daytona Beach, January 27 (2014).
- R. **Gaume**, R. Locke, M. Chun, and M. **Baudelet**, “*Towards highly-sensitive stoichiometric analysis by laser-induced breakdown spectroscopy (LIBS)*,” 10th Laser Ceramics Symposium; Wroclaw, Poland; December 04 (2014). **Invited**.
- B. Anderson, G. Venus, D. Ott, I. Divliansky, J. W. Dawson, D. R. Drachenberg, M. J. Messerly, P. H. Pax, J. B. Tassano, and L. B. **Glebov**, “*Transverse mode selection in laser resonators using volume Bragg gratings*,” Proc. SPIE 9081, Laser Technology for Defense and Security X, 90810Y, June 9 (2014).
- D. J. **Hagan**, H. Hu, M. R. Ferdinandus, T. R. Ensley, M. Reichert and E. W. **Van Stryland**, “*New methods for measuring nonlinear refraction: beam deflection and dual-arm Z-Scan*,” MRS Spring meeting, paper JJ7.02, San Francisco, April (2014). **Invited**.
- R. Gvishi, P. Zhao, H. Hu, G. Strum, A. Tal, S. Grinvald, G. Bar, L. Bekere, V. Lokshin, V. Khodorkovsky, M. Sigalov, D. J. **Hagan** and E. W. **Van Stryland**, “*Advanced non-linear solid filter based on photochromism induced by 2-photon absorption of a dye-doped sol-gel disc*,” SPIE Optics and Photonics (OP210), San Diego CA (2014).
- M. Reichert, D. J. **Hagan** and E. W. **Van Stryland**, “*Extremely*

nondegenerate doubly-stimulated two-photon emission: towards a semiconductor two-photon laser,” IEEE 24th International Semiconductor Laser conference, Palma de Mallorca, Spain, Sept. 7-10 (2014).

M. Reichert, P. Zhao, J. M. Reed, T. R. Ensley, D. J. **Hagan** and E. W. **Van Stryland**, “*Beam deflection measurements of transient nonlinear refraction from coherent rotational revivals in air,*” OSA-FIO (2014).

M. Reichert, H. Hu, M. Ferdinandus, M. Seidel, P. Zhao, J. Reed, D. Fishman, S. Webster, D. J. **Hagan** and E. W. **Van Stryland**, “*Measurement of nonlinear refraction dynamics of CS₂,*” CLEO-OSA (2014).

P. Zhao, H. Hu, R. Gvishi, G. Strum, A. Tal, S. Grinvald, G. Bar, L. Bekere, V. Lokshin, V. Khodorkovsky, M. Sigalov, D. J. **Hagan** and E. W. **Van Stryland**, “*Förster resonance energy transfer within a donor-acceptor composite photochromic molecule through one- and two-photon absorption,*” CLEO-OSA (2014).

A. Elhalawany, W. E. Hayenga, S. He, C. Lantigua, N. J. N. J. Johnson, A. Almutairi, and M. **Khajavikhan**, “*Increased upconversion quantum yield in plasmonic structures,*” Proc. SPIE 9163, Plasmonics: Metallic Nanostructures and Their Optical Properties XII, 916331; doi:10.1117/12.2061910 September 10 (2014).

A. Elhalawany, M. **Khajavikhan**, W. Hayenga, S. Alhasan, and C. Lantigua, “*Enhanced ultraviolet upconversion emission using nanocavities,*” OSA-FIO (2014).

S. Novak, D. E. Johnston, N. Patel, W. Deng, N. McClenaghan, A. Agarwal, W. Liyanage, M. Nath, H. Hodaie, M. **Khajavikhan**, and K. **Richardson**, “*Characterization of luminescent quantum dot doped chalcogenide glass films from solution,*” Joint DGG (German Glass Society) - Glass and Optical Materials Division meeting of the American Ceramic Society, Aachen Germany (2014).

M. Miri, H. Hodaie, M. Heinrich, M. **Khajavikhan**, and D. N. **Christodoulides**, “*PT-symmetric microring lasers,*” paper FTu5D.2, OSA-FIO, Tucson, Arizona, October 19-23 (2014).

P. G. **Kik**, “*Extreme energy concentration in multi-scale and multi-material plasmon resonant systems,*” Spring MRS Conference, San Francisco, CA (2014).

C. Lumdee and P. G. **Kik**, “*Numerical prediction of the effect of nanoscale surface roughness on film-coupled nanoparticle plasmon resonances,*” Proc. SPIE 9163, 91631I (2014).

S. Toroghi and P. G. **Kik**, “*Plasmon-enhanced photothermal response in heterogeneous metallic trimers,*” Proc. SPIE 9163, 91631B (2014).

S. M. **Kuebler**, J. L. Digaum, J. Pazos, J. Chiles, G. Padilla, A. Tatulian, R. C. Rumpf and S. **Fathpour**, “*Tight control of light beams in photonic crystals with spatially-variant lattice orientation,*” OSA-FIO 1.1: Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning, Optical Society of America, Tucson, AZ, Oct. 19-23 (2014). **Invited**

C. M. Schwarz, H. E. Williams, C. N. Grabill, A. M. Lewis, S. M. **Kuebler**, B. Gleason, K. **Richardson**, A. Pogrebnaykov, T. S. Mayer, C. Drake, and C. Rivero-Baleine “*Processing and properties of arsenic trisulfide chalcogenide glasses for direct laser writing of 3D micro-structures,*” SPIE Photonics West, paper # 8974-25, San Francisco CA (2014).

D. A. May-Arrijoja, J. E. Antonio-Lopez, P. **LiKamWa**, and J. J. Sanchez-Mondragon, “*Multimode Interference Photonic Devices,*” Latin America Optics and Photonics Conference LAOP (2014).

K. **Richardson**, “*Advanced photonics based on infrared glass and glass ceramic solutions,*” International Conference on Advanced Ceramics and Composites, Daytona Beach, FL (2014). **Invited**.

K. **Richardson** and T. Mayer, “*Engineering chalcogenide materials – from optics to microelectronics,*” 225th meeting of the Electrochemical Society, paper #1410, Orlando FL (2014). **Invited**.

H. Lin, L. Li, Y. Zou, F. Deng, C. Ni, J. Hu, S. Danto, K. **Richardson**, S. Kozacik, M. Murakowski, D. Prather, and J. D. Musgraves, “*Planar chalcogenide glass mid-infrared photonics,*” SPIE Photonics West, paper # 8974-12, San Francisco CA (2014). **Invited**.

H. Lin, L. Li, Y. Zou, Qi.Du, O. Ogbuu, C. Smith, E. Koontz, J. D. Musgraves, K. **Richardson**, and J. Hu “*Substrate-blind photonic integration based on high-index glasses,*” Proc. SPIE Photonics Asia, paper #92770 Beijing CHINA (2014). **Invited**.

K. **Richardson**, “*Optimization of manufacturability of chalcogenide glasses for mid-infrared optical components,*” OSA Topical Meeting on Optical Fabrication and Testing (OF&T), paper #OM2C.5, Kona HA (2014). **Invited**.

E. Koontz, P. Wachtel and K. **Richardson**, “*Compositional dependence of structural relaxation behavior in the Ge-As-Se system characterized by length dilatometry,*” OSA Topical Meeting on Optical Fabrication and Testing (OF&T), paper #OM2C.4, Kona HA (2014).

L. Li, Y. Zou, H. Lin, J. Hu, X. Sun, N.-N. Feng, S. Danto, K. **Richardson**, T. Gu, and M. Haney “*Chip-to-chip optical interconnects based on flexible integrated photonics,*” Proc. SPIE Vol. 8991 paper# 8991-27, San Francisco CA (2014).

K. **Richardson**, “*GPCL Infrared optics manufacturing at UCF,*” Korean Optics and Photonics Technology Institute (KOPTI), Gwanju KOREA, August 29 (2014)

K. **Richardson**, “*Progress on mid-infrared multi-material on-chip planar photonics,*” Summer meeting of the Optical Society of Korea, Jeju KOREA, August 25 (2014). **Plenary**

L. Li, H. Lin, Y. Zou, J. Hu, S. Qiao, N. Lu, S. Danto, J. D. Musgraves, and K. **Richardson**, “*Chalcogenide glass based flexible photonics,*” paper #C2-1 04-1039, 19th International Symposium on Non-Oxide and New Optical Glasses, Jeju KOREA, August 24-28 (2014). **Invited**.

K. **Richardson**, J. D. Musgraves, P. Wachtel, T. Mayer, D. Werner, and C. Baleine “*Advanced photonics based on infrared glass and glass ceramic solutions,*” paper #B2-1 04-1033, 19th International Symposium on Non-Oxide and New Optical Glasses, Jeju KOREA, August 24-28 (2014)

A. Buff, K. **Richardson**, and C. Baleine “*Engineering nanocrystalline microstructures in Sb₂S₃-GeS₂-PbS glasses,*” paper #B3-4 04-1017, 19th International Symposium on Non-Oxide and New Optical Glasses, Jeju KOREA, August 24-28 (2014).

J. Hu, H. Lin, Y. Xiang, L. Li, Y. Zou, E. Koontz, and K. **Richardson** “*Mid-infrared photonic sensing using high-Q chalcogenide glass on-chip resonators,*” paper #P2-6 05-1041, 19th International Symposium on Non-Oxide and New Optical Glasses, Jeju KOREA, August 24-28 (2014)

H. Lin, Y. Xiang, L. Li, K. McLaughlin, Y. Liu, Y. Chillakuru, E. Koontz, J. D. Musgraves, K. **Richardson**, C. Ni and J. Hu “*High-Q mid-infrared chalcogenide glass resonators for chemical sensing,*” presented at the IEEE Summer Topical meeting, Montreal Canada (2014).

K. **Richardson**, J. D. Musgraves, P. Wachtel, T. Mayer, D. Werner,

and C. Baleine, “Advanced photonics based on infrared glass and glass ceramic solutions,” 19th International Symposium on Non-Oxide and New Optical Glasses (ISNOG), Jeju Korea (2014).

K. Richardson “Optimization of manufacturability of chalcogenide glasses for mid-infrared optical components,” OSA Topical Meeting on Optical Fabrication and Testing (OF&T), Kona, Hawaii (2014). *Invited.*

H. Lin, K. McLaughlin, Y. Chillakuru, L. Li, Y. Liu, S. Danto, J. D. Musgraves, K. **Richardson**, and J. Hu “On-chip mid-IR cavity enhanced chemical sensing using chalcogenide glass resonators,” Joint DGG (German Glass Society) - Glass and Optical Materials Division meeting of the American Ceramic Society, Aachen Germany (2014).

E. Koontz, P. Wachtel, R. Loucks and K. **Richardson**, “Compositional dependence of structural relaxation behavior in the As_xSe_{1-x} and $Ge_xAs_{1-x}Se_{1-y}$ systems characterized by length dilatometry,” Joint DGG (German Glass Society) - Glass and Optical Materials Division meeting of the American Ceramic Society, Aachen Germany (2014).

K. Richardson, J. D. Musgraves, P. Wachtel, A. Buff, L. Siskin, K. Chamma and T. Mayer, “Advances in mid-infrared chalcogenide glass ceramics for photonic applications,” Joint DGG (German Glass Society) - Glass and Optical Materials Division meeting of the American Ceramic Society, Aachen Germany (2014). *Invited.*

S. Novak, V. Singh, N. Patel, A. Agarwal, J. Marro, J. Giammarco, I. Luzinov, Q. Quaranta, W. Raniero, M. Chiesa and K. **Richardson**, “Radiation effects in chalcogenide glass materials for planar mid-IR photonic devices,” Joint DGG (German Glass Society) - Glass and Optical Materials Division meeting of the American Ceramic Society, Aachen Germany (2014)

V. Singh, P. T. Lin, J. Giammarco, A. P. Soliani, J. Hu, J. D. Musgraves, K. **Richardson**, I. Luzinov, J. Hensley, L. C. Kimerling and A. Agarwal, “Chalcogenide glass-on-silicon platform for integrated infrared chemical sensing,” Joint DGG (German Glass Society) - Glass and Optical Materials Division meeting of the American Ceramic Society, Aachen Germany (2014)

O. Ogbuu, Q. Du, H. Lin, L. Li, Y. Zou, S. Danto, K. **Richardson**, and J. Hu, “Effect of oxygen deficiency on structural and optical properties of sputter deposited multi-component tellurite glass films,” Joint DGG (German Glass Society) - Glass and Optical Materials Division meeting of the American Ceramic Society, Aachen Germany (2014)

Y. Zou, J. Zhou, L. Moreel, L. Savelli, H. Lin, L. Li, E. Koontz, S. Danto, J. D. Musgraves, K. **Richardson** and J. Hu, “Thin film As-Se chalcogenide glasses: Physiochemical properties and optical applications,” Joint DGG (German Glass Society) - Glass and Optical Materials Division meeting of the American Ceramic Society, Aachen Germany (2014).

J. Marro. C. Okoro, Y. Obeng, K. **Richardson**, “Impact of thermal history on grain size and grain size distribution of thermally cycled Cu-TSVs,” Joint DGG (German Glass Society) - Glass and Optical Materials Division meeting of the American Ceramic Society, Aachen Germany (2014)

J. Marro. C. Okoro, Y. Obeng, and K. **Richardson** “Temperature dependence of defect evolution and distribution in thermally cycled Cu-TSVs,” Joint DGG (German Glass Society) - Glass and Optical Materials Division meeting of the American Ceramic Society, Aachen Germany (2014).

L. Li, Y. Zou, H. Lin, J. Hu, X. Sun, N.-N. Feng, S. Danto, K. **Richardson**, T. Gu, and M. Haney, “Chip-to-chip optical interconnects based on flexible integrated photonics,” SPIE Photonics

West, paper # 8991-27, San Francisco CA (2014).

Y. Zou, H. Lin, L. Li, L. Moreel, J. Zhou, D. Zhang, Q. Du, J. Hu, S. Danto, K. **Richardson**, J. D. Musgraves, K. D. Dobson, and R. Birkmire, “Demonstration of high-performance chalcogenide glass photonic devices by thermal nanoimprint,” SPIE Photonics West, paper #8988-5, San Francisco CA (2014).

C. J. Frederickson, C. J. Frederickson, W. I. Manton, S. Rehse, C. Jeon, M. C. **Richardson**, and M. **Baudelet**, Matthieu, “LIBS methods for determination of elemental nutritional status from fingernails in situ”, SciX 2014, Reno, NV, September 30 (2014). *Invited.*

Y. Liu, B. Bousquet, M. C. **Richardson**, and M. **Baudelet**, “Thomson scattering of laser-induced plasma in air”, Winter Conference on Plasma Spectrochemistry, Amelia Island, FL, January 07, (2014).

H. Parchamy, M. M. Mueller, J. Szilagyi, Y. Jang, M. Masnavi, M. C. **Richardson**, “Conversion efficiencies from laser-produced Kr, Mo, Gd, and Tb plasmas at 6.xnm,” SPIE Advanced Lithography: Extreme Ultraviolet (EUV) Lithography V, paper 9048-82 (2014).

M. Masnavi, J. Szilagyi, H. Parchamy, Y. Jang, M. M. Mueller, and M. C. **Richardson**, “Conversion efficiency of laser-produced Sn plasma EUV light source,” SPIE Advanced Lithography 2014: Extreme Ultraviolet (EUV) Lithography V, paper 9048-79 (2014).

J. Szilagyi, H. Parchamy, M. Masnavi, and M. C. **Richardson**, “Laser-based vacuum-ultraviolet light source,” SPIE Advanced Lithography: Metrology, Inspection, and Process Control for Microlithography XXVIII, paper 9050-80 (2014).

M. C. **Richardson**, M. Masnavi, L. **Shah**, J. Szilagyi, J. D. Bradford, H. Parchamy, N. Bodnar, and Y. Jang, “Potential of solid state laser-driven EUV sources for HVM lithography,” SPIE Advanced Lithography: Extreme Ultraviolet (EUV) Lithography V, paper 9048-77 (2014).

M. C. **Richardson**, M. Durand, M. **Baudelet**, N. Barbieri, M. Chini, K. Lim, C. Jeon, N. Litchinister, Z. Kudyshev, S. Will, Z. Roth and E. Johnson, “Nonlinear radiation effects with filaments - inside and outside,” OSA-FIO, paper FTh1F.1 (2014).

Y. Liu, C. Jeon, M. C. **Richardson**, and M. **Baudelet**, “Quantitative line assignment in optical emission spectroscopy,” Winter Conference on Plasma Spectrochemistry, Amelia Island, FL, January 07 (2014).

B. E. A. **Saleh**, “Cross-correlation imaging, osa topical meeting on signal recovery & synthesis (SRS)”, Seattle, WA, July 13–17 (2014). *Invited.*

A. C. Rudack, K. O. Davis, H. P. Seigneur, J. Walters, L. Wilson, and W. V. **Schoenfeld**, “Surface preparation challenges in crystalline silicon photovoltaic manufacturing,” SEMATECH Surface Preparation and Cleaning Conference, Austin, TX, April 22–24 (2014).

A. C. Rudack, K. O. Davis, H. P. Seigneur, and W. V. **Schoenfeld**, “Electrostatic charge/discharge challenges in c-Si PV manufacturing,” ESTECH, San Antonio, TX, May 13-16 (2014).

K. O. Davis, J. Sun, K. Jiang, R. P. Brooker, and W. V. **Schoenfeld**, “Optical properties of screen-printed aluminum contacts,” 40th IEEE Photovoltaic Specialist Conference, Denver, CO (2014).

K. O. Davis, J. Walters, E. Schneller, H. P. Seigneur, R. P. Brooker, G. Scardera, M. P. Rodgers, N. Mohajeri, N. Shiradkar, N. G. Dhere, J. Wohlgemuth, A. C. Rudack, and W. V. **Schoenfeld**, “A review of manufacturing metrology for improved reliability of silicon photovoltaic modules,” SPIE Optics + Photonics, San Diego, CA, August 9 – 13 (2014).

- K. O. Davis, E. Schneller, and W. V. **Schoenfeld**, “*Evaluating the potential of increasing module energy yield by spectrally binning c-Si solar cells*,” 24th Workshop on Crystalline Silicon Solar Cells & Modules: Materials and Processes, Breckenridge, CO (2014).
- H. P. Seigneur, B. Wang, A. Leadbetter, K. O. Davis, A. C. Rudack, and W. V. **Schoenfeld**, “*Stress associated with the shaping of CZ grown silicon ingots*,” 29th European Photovoltaic Solar Energy Conference and Exhibition, Amsterdam, Netherlands September 22 – 26 (2014).
- K. O. Davis, J. Walters, E. Schneller, H. Seigneur, R. P. Brooker, G. Scardera, M. P. Rodgers, N. Mohajeri, N. Shiradkar, N. G. Dhere, J. Wohlgemuth, A. C. Rudack, and W. V. **Schoenfeld**, “*Manufacturing metrology for c-Si module reliability and durability*,” SPIE Optics + Photonics, San Diego, California, August 9 - 13 (2014).
- C. Jollivet, A. Van Newkirk, J. Anderson, K. Schuster, S. Grimm, and A. **Schülzgen**, “*Advances in multi-core fiber lasers*,” OSA Latin America Optics & Photonics Conference LAOP (2014).
- N. Peyghambarian, K. Khanh, X. Zhu, A. Chavez, V. Temyanko, J. Nagel, A. **Schülzgen**, J. Albert, E. Dianov, M. M. Bubnov, M. E. Lkihachev, and J. Dobler, “*Functional glass and applications in fiber lasers and fiber optics*,” 40th European Conference and Exhibition on Optical Communication ECOC, paper: Tu1.4.6 (2014).
- A. Van Newkirk, Z. Sanjabi Eznaveh, E. Antonio-Lopez, G. Salceda-Delgado, A. **Schülzgen**, and R. **Amezcu-Correa**, “*High temperature sensor based on supermode interference in multicore fiber*,” CLEO, paper: SM2N.7 (2014).
- C. Jollivet, A. Mafi, D. Flamm, M. Duparré, K. Schuster, S. Grimm, and A. **Schülzgen**, “*Mode-resolved gain analysis of a 7-core fiber laser based on multi-supermode interference*,” OSA Specialty Optical Fibers & Applications (SOF), paper: SoW2B.2 (2014).
- C. Jollivet, J. Guer, P. Hofmann, and A. **Schülzgen**, “*Monolithic integration of active LMA PCF and standard fiber Bragg gratings into all-fiber lasers*,” OSA Specialty Optical Fibers & Applications (SOF), paper: JM5A.11 (2014).
- A. Van Newkirk, G. Salceda-Delgado, J. E. Antonio-Lopez, A. **Schülzgen**, and R. **Amezcu-Correa**, “*Multicore optical fiber point sensors*,” OSA-FIO, paper: FTu4B.3 (2014).
- J. E. Antonio-Lopez, G. Salceda-Delgado, A. Van Newkirk, A. **Schülzgen**, R. **Amezcu-Correa**, “*Multiplexed high temperature sensor based on multicore fiber*,” OSA Optical Sensors (SENSORS), paper: SeW4C.2 (2014).
- G. Salceda-Delgado, A. Van Newkirk, J. E. Antonio-Lopez, A. **Schülzgen**, and R. **Amezcu-Correa**, “*Optical Fiber curvature sensors based on single mode - 7 core - single mode fiber structures*,” OSA Optical Sensors (SENSORS), paper: SeW3C.2 (2014).
- G. Freihofer, A. Bullock, F. Vaughn, A. **Schülzgen**, S. **Raghavan**, H. Tat, and J. Dustin, “*Stress and damage sensing of composite coupons with piezospectroscopic coatings*,” Proceeding of the Society for the Advancement of Material and Process Engineering SAMPE conference, Nanomaterials IV (2014).
- C. Jollivet, D. Flamm, M. Duparré, and A. **Schülzgen**, “*Supermode Decomposition during operation of a 7-core fiber laser*,” OSA Specialty Optical Fibers & Applications (SOF) (2014).
- L. Sisken, J. Bradford, P. Wachtel, B. Gleason, J. D. Musgraves, L. **Shah**, M. C. **Richardson**, and K. **Richardson**, “*The effects of laser induced heating on multi-component chalcogenide glass*,” SPIE Defense and Sensing Symposium, Baltimore MD (2014).
- L. Sisken, J. Bradford, P. Wachtel, B. Gleason, L. **Shah**, M. C. **Richardson**, and K. **Richardson**, “*Examination of laser-induced heating on multi-component chalcogenide glass*,” Proc. SPIE vol. 9070, paper# 9070-40, SPIE Defense and Security Conference, Baltimore MD (2014).
- A.M. Sincore, J. Tafoya, D. Sipes, L. Leick, L. **Shah**, and M.C. **Richardson**, “*Photonic crystal fiber pump combiner for high-peak power all-fiber thulium lasers*,” SPIE Photonics West, paper 8961-112, San Francisco, January (2014).
- A. Vaupeul, N. Bodnar, B. Webb, L. **Shah**, and M.C. **Richardson**, “*Pico-second DPSS laser technology for OPCPA pumping*,” Proceedings of the SPIE, Solid State Lasers XX: Technology and Devices, SPIE Photonics West – LASE, 8959-45, San Francisco, CA February (2014).
- N. Gerlich, T. Bonhoff, L. Sisken, M. Ramme, C. Gaida, M. Gebhardt, I. Mingareev, L. **Shah**, and M.C. **Richardson**, “*Utilizing the transparency of semiconductors via backside machining with a nanosecond 2 μ m Tm: fiber laser*,” SPIE Photonics West, paper 8968-32 (2014).
- N. Barbieri, Z. Hosseinimakarem, K. Lim, M. Durand, B. Webb, J. Bradford, E. McKee, N. Bodnar, L. **Shah**, M. **Baudelet**, E. Johnson and M. C. **Richardson**, “*Helical filaments*,” CLEO-QELS, paper FTu3D.6 (2014).
- E. W. **Van Stryland**, H. Hu, T. R. Ensley, M. C. Reichert, M. R. Ferdinandus, D. J. **Hagan**, “*Nonlinear absorption and refraction spectroscopic tools*,” SPIE Optics & Photonics, 9181, San Diego, CA, Aug. 20-21, 2014.
- E. W. **Van Stryland**, T. Ensley, M. Reichert, D. **Hagan**, “*Experimental tool for nonlinear spectroscopy: absorption and refraction*,” SPIE Laser Damage 2014, NIST, Boulder, CO, Sept. 14-17, 2014. Keynote presentation
- E. W. **Van Stryland**, M. Reichert, M. R. Ferdinandus, H. Hu, P. Zhao, J. M. Reed, T. R. Ensley and D. J. **Hagan**, “*Spectroscopic tools for nonlinear absorption and refraction*,” International Commission on Optics, ICO, Santiago de Compostella, Spain, August (2014). **Invited**.
- J. Bradford, K. L. **Vodopyanov**, P. Schunemann, L. **Shah** and M. C. **Richardson**, “*Measurement of thermal lensing in GaAs induced by 100 W Tm: fiber laser*,” SPIE, LASER, 896419-89419-6, February (2014).
- S. Shabahang, G. Tao, K.F. Lee, V. Smolksi, K. L. **Vodopyanov** and M. Fermann, “*Mid-infrared supercontinuum generation in robust step-index chalcogenide nanotapers pumped with a thulium fiber laser*,” CLEO: Science and Innovations, SW31.2, June (2014).
- P. Tekavec, D. Fast, I. McNee, V. Kozlov, Y.S. Lee, and K. L. **Vodopyanov**, “*Video rate THz imaging based on frequency upconversion using near-IR CMOS camera*,” CLEO: Science and Innovations, STh4F, June (2014).
- J. Kiessling, K. Buse, K. L. **Vodopyanov**, and I. Breunig, “*Continuous-wave optical parametric source for terahertz waves tunable from 1 to 4.5 THz frequency*,” Proc. SPIE 8964, Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications XIII, 896408, February 20 (2014).
- J. Kiessling, K. Buse, K. L. **Vodopyanov**, and I. Breunig, “*Continuous-wave optical parametric source for terahertz waves tunable from 1 to 4.5 THz frequency*,” SPIE LASE 896408-896408-8, November (2014). **Invited**.
- K. L. **Vodopyanov**, “*Massively-parallel intracavity trace molecular detection in the mid-infrared using broadband frequency combs*,”

Photonics West, OPTO. San Francisco, CA (2014). **Plenary**

K. L. **Vodopyanov**, “Frequency divide-and-conquer approach to producing octave-wide frequency combs and few-cycle pulses in the mid-IR,” American Physical Society’s 45th Annual Division of Atomic, Molecular and Optical Physics (DAMOP) Meeting, Madison, Wisconsin, June 2-6 (2014).

K. L. **Vodopyanov**, “Mid-IR combs pumped by fiber lasers,” Photonics West, LASE. San Francisco, CA (2014).

D. Xu, F. Peng and S. T. **Wu**, “Is polymer-stabilized blue phase liquid crystal ready for prime time?,” 10th SPSJ International Polymer Conference, Tsukuba, Japan (2014). **Invited.**

Z. Luo, Y. Chen, D. Xu, and S. T. **Wu**, “Is quantum-dot LCD ready for prime time?,” IEEE Photonics Conference, San Diego, CA (2014). **Invited.**

D. Xu, Y. Chen, Y. Liu and S. T. **Wu**, “Low-voltage and high-transmittance blue-phase LCDs,” SID Symp. Digest 45, 168-171, San Diego, CA (2014).

Y. F. Lan, Y. Liu, P. J. Huang, D. Xu, C. Y. Tsai, C. H. Lin, N. Sugiura

and S. T. **Wu**, “Non-ideal optical isotropic blue phase liquid crystal and their self-assembly on electrode surface,” 25th International Liquid Crystal Conference, Dublin, Ireland (2014).

S. T. **Wu**, “Is quantum-dot LCD ready for prime time?,” (Keynote) Third Symposium on Liquid Crystal Photonics (Shanghai Jiao Tung University, April 18-23, (2014). **Plenary.**

S. Kaim, S. Mokhov, I. Divliansky, V. Smirnov, J. Lumeau, B. **Zeldovich**, and L. B. **Glebov**, “Saturation of multiplexed volume Bragg grating recording,” OSA-FIO, Tucson, AZ, Oct 18-22 (2014).

Edited Proceedings

K. L. **Vodopyanov** (ed.), “Nonlinear frequency generation and conversion: materials, devices, and applications XIII,” Proceedings of SPIE, Volume 8964 (2014).

Invited Lectures and Tutorials

Z. **Chang**, “Attosecond optics,” XIV Swieca Summer School on Quantum and Nonlinear Optics, Recife, Brazil, Jan 27 to Feb 7 (2014). **Invited.**

Z. **Chang**, “Attosecond transient absorption spectroscopy,” Jilin University, Changchun, China, Sept. 10, (2014). **Invited.**

Z. **Chang**, “Broadband isolated attosecond pulses for transient absorption spectroscopy,” KITP Frontiers of Intense Laser Physics workshop, University of Santa Barbara, July 29 (2014). **Invited.**

Z. **Chang**, “Generation, characterization and applications of broadband isolated attosecond pulses,” State Key Laboratory of Transient Optics and Photonics, Xi’an Institute of Optics & Precision Mechanics, Xi’an, China, June 30 (2014). **Invited.**

Z. **Chang**, “High flux attosecond pulses,” Institute of Physics, Chinese Academy of Sciences, Beijing, China, Sept. 15 (2014). **Invited.**

Z. **Chang**, “Latest development of attosecond transient absorption spectroscopy,” State Key Laboratory of Transient Optics and Photonics, Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou, China, July 15 (2014). **Invited.**

Z. **Chang**, P. Corkum, S. Leone, and D. Neumark, “Microjoule-level isolated attosecond pulses for atto pump-atto probe,” DARPA winter meeting, Austin, Texas, Feb 24-25 (2014). **Invited.**

Y. **Cheng**, “Attosecond transient absorption experiments in atoms and molecules,” OSA Graduate Research Symposium, CREOL, University of Central Florida, , Sept 24 (2014). **Invited.**

M. **Chini**, “Absorption spectroscopy with ultrabroadband attosecond pulses,” Department of Physics, Kansas State University, Manhattan, Kansas, January 29, (2014). **Invited.**

P. J. **Delfyett**, T. Klee, K. Bagnell and S. Bhoojapur “Ultra-wideband coherent optical signal processing using semiconductor laser based optical frequency combs,” OSA LAOP, Cancun Mexico (2014). **Invited.**

P. J. **Delfyett**, “Frequency combs and related technologies for microwave synthesis,” Physics of Quantum Electronics Meeting; “New Directions in Photonic Microwave Synthesis” Snowbird (2014). **Invited**

P. J. **Delfyett**, “Ultrafast photonics – applications in high speed signal processing, computing and communications,” Carnegie Mellon, Dept. of EE, May 1 (2014). **Invited**

P. J. **Delfyett**, “Ultrafast photonics – applications in high speed signal processing, computing and communications,” University of Minnesota, April 24th (2014). **Invited**

P. J. **Delfyett**, “Ultrafast photonics – applications in high speed signal processing, computing and communications,” Lockheed Martin Fellows Talk, September 10 (2014). **Invited.**

P. J. **Delfyett**, “Perspectives on a research center – from industrial research at bell communications research to academia” CREOL SPIE (2014). **Invited.**

P. J. **Delfyett**, “Ultrafast laser technology & applications from the lab to market” UCF Science Café, November 13 (2014). **Invited.**

P. J. **Delfyett**, “Ultrafast photonics – applications in high speed signal processing, computing and communications,” University of Minnesota, Dept. of EE, April 24th (2014). **Invited.**

S. **Fathpour**, “Novel heterogeneous integrated photonic platforms on silicon,” Workshop for NSF Engineering Research Center Proposal, Orlando, FL, March (2014).

S. **Fathpour**, “Novel heterogeneous integrated photonic platforms on silicon,” DODOS DARPA Proposer’s Day, Capital Conference Center, Arlington VA, April (2014).

S. **Fathpour**, “Novel heterogeneous integrated photonic platforms on silicon,” Optoelectronic Research Center, University of Southampton, UK, February (2014).

S. **Fathpour**, “Novel heterogeneous integrated photonic platforms on silicon,” CREOL Affiliates’ Day Symposium, Orlando, FL, March (2014).

S. **Fathpour**, “Novel heterogeneous integrated photonic platforms on silicon,” Lockheed Martin Senior Fellows Conference, Orlando, FL, September (2014).

S. **Fathpour**, “Silicon photonics,” CREOL Affiliates’ Day Short Courses (2014).

S. **Fathpour**, “Silicon photonics,” OSA LAOP Conference, Short

Courses, Cancun, Mexico, (2014).

L.B. **Glebov**, “Spectral and coherent beam combining by volume Bragg gratings recorded in photo-thermo-refractive glass,” Presentation at Trumpf (2014).

L.B. **Glebov**, “Volume Bragg gratings – precise control of laser radiation,” University of Potsdam, Potsdam, Germany. April 10 (2014).

L.B. **Glebov**, “Volume Bragg gratings for laser beams control,” Aston University, Birmingham, UK. April 23 (2014).

B. E. A. **Saleh**, “Cross-correlation imaging: classical & quantum,” University of Wisconsin-Madison, April 7, (2014). **Invited**.

B. E. A. **Saleh**, “Coherence and entanglement: classical and quantum,” Tutorial, Siegmán International School on Lasers, Stanford University, Stanford, CA, August 3–8 (2014). **Invited**.

E. W. **Van Stryland**, “Nonlinear Spectroscopy: Absorption and Refraction” Nano2Fun workshop, EU funded program on nonlinear organics, Antwerp, Belgium, Sept. 2014.

E. W. **Van Stryland**, “Nonlinear Spectroscopy: absorption and refraction,” University of Angers, France, July 11, 2014

E. W. **Van Stryland**, “Nonlinear Spectroscopy: absorption and refraction,” University of Antwerp, Belgium, Sept. 17, 2014

K. L. **Vodopyanov**, “Real-time chemicals sensing and imaging with mid-IR frequency combs,” Lockheed Martin Fellows Conference,

Orlando, September 10 (2014).

S. T. **Wu**, “Quantum-dots-enhanced liquid crystal displays,” (Seminar) Department of Materials Science and Engineering, University of Florida, March 19 (2014).

S. T. **Wu**, “Quantum-dots-enhanced LCDs,” (Invited) Tianma Microelectronics, Shanghai, China, April 18 (2014). **Invited**.

S. T. **Wu**, “Quantum dot and blue phase: A new era of LCDs,” Display Masters Seminar Series National Chiao Tung Univ. Hsinchu, Taiwan, April 28 (2014). **Plenary**

Q. **Zhang**, “Ultrabroadband coherent light for generating shortest attosecond pulse,” University of California Berkeley, March 18 (2014). **Invited**.

Q. **Zhang**, “Generating and characterizing the shortest attosecond pulse,” Stanford University, March 21

K. **Zhao**, “Broadband isolated attosecond pulse generation and characterization,” CFEL, Hamburg, Germany, September 4 (2014).

K. **Zhao**, “Broadband isolated attosecond pulse generation and characterization,” Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai, China, April 25 (2014). **Invited**.

K. **Zhao**, “Broadband isolated attosecond pulse generation and characterization,” Institute of Physics, Chinese Academy of Sciences, Beijing, China., April 28 (2014). **Invited**.

3.6 Patents and Disclosures

Patents

M. **Bass**, and D. G. **Deppe**, “Up Converters and GaAs Based Semiconductor Light Sources System for Large Color Gamut Display and Projection Displays,” US 8,585,207, November 19 (2013).

M. **Bass**, and D. G. **Deppe**, “Low voltage display or indicator systems employing combinations of up converters and semiconductor light sources,” US 8,592,838, November 26 (2013).

K. R. Coffey, V. H. Lam, E. Dein, A. P. Warren, and G. **Boreman**, G. V. Zummo, W. Caba, “Nanocomposite semiconducting material with reduced resistivity DIV,” US 8,502,639 B1, August 6 (2013).

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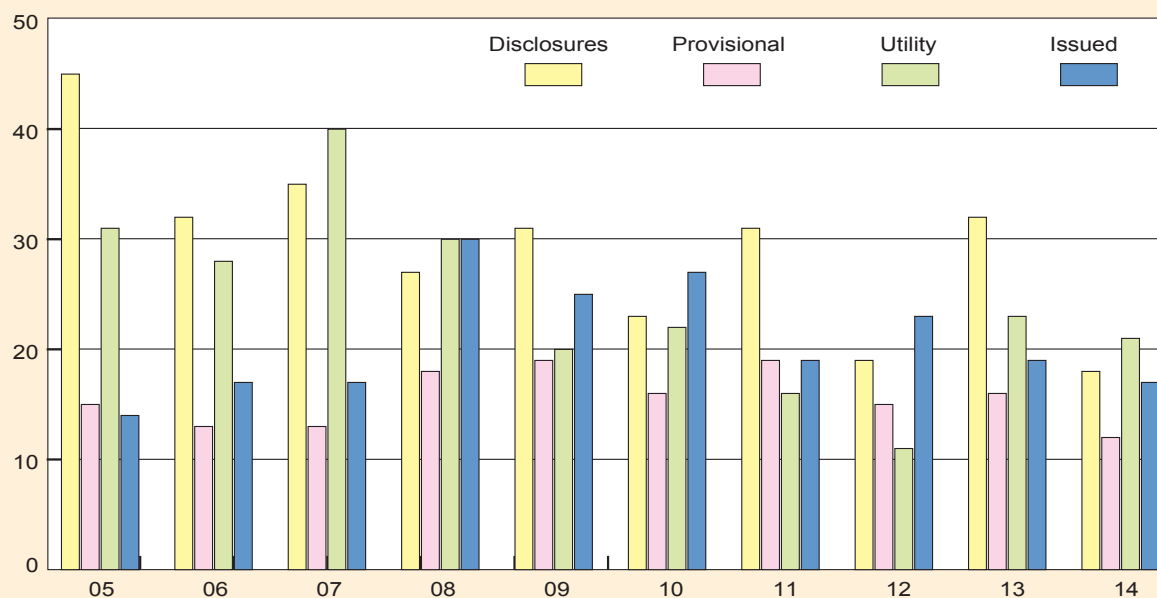
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Disclosures

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- A. **Dogariu**, "Optical force to regulate nanotube."
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- S. T. **Wu**, "Display Appartus."



Professor S.T. Wu (second from right) was inducted into the 2014 Florida Inventors Hall of Fame in 2014

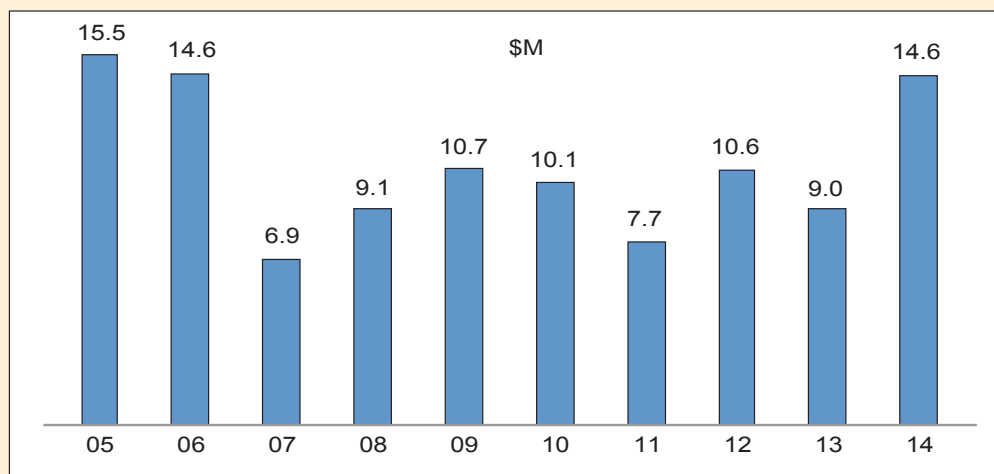


History of disclosures, applications, and issued patents

3.7 Research Funding

Research has been funded by a combination of federal, industrial, and state grants. The amounts shown below are actual funds received for each year, with each grant covering a different period. Some of the industrial grants include federal funding that has come via industry. Not included in the chart of funding history are the state grants. A \$10M

fund was received in FY 2004 for the Florida Photonics Center of Excellence (FPCE) and a \$4.5M grant received in FY2007 to establish the Townes Laser Institute (TLI). These funds continue to support the research and educational activities of these centers.



History of funding (\$M) in FY 2005–2014

Grants received in FY 2014

Federal	\$12,201,637
Federal through industry	\$273,275
Industry R&D	\$1,127,484
International	\$1,027,667
Foundation	\$1,200
Total	\$14,631,263

Research Funding (FY 2014)

Recipient	Source	Title of Award	Begin	End	Awarded 2013	Cumulative Funding
Abouraddy, A.	Massachusetts Institute of Technology	CMSE IRG 3 - Multimaterial, Multifunction Nano-structured Fibers	2/1/2012	8/31/2014	\$18,150	\$128,150
Abouraddy, A.	National Science Foundation	Scalable manufacturing of size-controllable structured nanoparticles via capillary instabilities in multimaterial fibers	8/1/2013	7/31/2016	\$299,909	\$299,909
Abouraddy, A.	National Science Foundation	Mid-infrared, wide-bandwidth, stable coherent optical sources generated by multi-material, nonlinear chalcogenide-glass	4/15/2010	3/31/2014	\$0	\$320,752
Abouraddy, A., Christodoulides, D	US Air Force Office of Scientific Research (AFOSR)	Large-scale Fabrication of Macroscopic All-Polymer PT-Materials	4/15/2012	4/14/2015	\$147,011	\$309,495
Amezcuia Correa, R.	US Air Force Research Laboratory (AFRL)	Low Loss mid-IR Hollow Core Photonic Crystal Fibers for Advanced mid-IR Laser Technologies	5/19/2014	5/19/2015	\$79,788	\$79,788
Amezcuia Correa, R. Schülzgen, A.	Asymmetric Medical Ltd	Side Fire Optical Fiber	7/15/2013	9/30/2013	\$4,000	\$4,000
Amezcuia Correa, R. Schülzgen, A.	FAZ Technology, Inc.	Specialty Multi-Core Optical Fibre Development for Sensing	8/1/2013	8/31/2014	\$150,000	\$150,000
Amezcuia Correa, R., Glebov, L., Richardson, M., Schülzgen, A., Shah, L.	US Army Research Office	Fiber Laser Light Engines - A New Platform to Collectively Address Power-limiting Constraints	8/20/2012	2/19/2018	\$749,655	\$1,122,155
Amezcuia Correa, R., Richardson, M., Schülzgen, A., Shah, L.	DOD/Army/Army Research Office	DURIP: Advanced Splicing and High-Resolution Imaging Facility for High Power PCF Laser Fabrication	8/1/2013	7/31/2014	\$120,000	\$120,000
Amezcuia Correa, R., Schülzgen, A., Shah, L.	No Needles Venipuncture	Design of a Gain Switched Short Pulse Fiber Amplifier	4/21/2014	9/24/2014	\$15,000	\$15,000
Amezcuia Correa, R., Schülzgen, A., Shah, L.	Inertial Labs, Inc	Stimulated Raman Scattering in Hollow Core Photonic Crystal Fiber	12/1/2013	4/30/2014	\$29,000	\$29,000
Bass, M.	Powerlase Photonics, Ltd	Design of a KW class, Pulsed, ~1mm, 10kHz, Diode Pumped Slab Solid State Laser System	3/19/2012	5/5/2013	-\$21,036	-\$21,036
Bass, M.	Raytheon Company	Laser Calorimetry Measurements	3/26/2014	6/30/2014	\$12,000	\$12,000
Bass, M.	Element Six LTD	Polycrystalline Analysis Laser Calorimetry	5/1/2013	12/31/2013	\$2,000	\$11,368
Bass, M.	Powerlase Photonics, Ltd	Preliminary design and performance modeling of a Seed laser, PCF and rod-amplifier	4/21/2014	8/31/2014	\$28,319	\$43,560
Bass, M.	Element Six LTD	Single Crystal Analysis Laser Calorimetry	5/1/2013	12/31/2013	\$22,816	\$28,448
Bass, M.	Element Six LTD	Single Crystal Analysis Laser Calorimetry	1/30/2014	3/1/2014	\$1,500	\$1,500

Bass, M., Glebov, L.	Honeywell	Volume Bragg Grating (VBG) Beam Combiner	4/30/2013	9/30/2013	\$0	\$150,000
Baudelet, M., Durand, M., Richardson, M.	DOD/Army/Army Research Office	Chamber for Laser Propagation Through Aerosol Medium (CLaPTAM)	8/1/2013	7/31/2015	\$181,478	\$181,478
Baudelet, M., Richardson, M.	National Institute of Justice (NIJ)	LIBS For Soil Screening Study Of Matrix Effects On Elemental Profiling	1/1/2014	12/31/2015	\$292,182	\$292,182
Baudelet, M	National Institute of Justice (NIJ)	Level of Confidence in Elemental Analysis by LIBS	1/1/2013	12/31/2015	\$0	\$399,532
Chang, Z.	US Army Research Office	High flux isolated attosecond XUV source	9/10/2012	1/9/2015	\$65,170	\$65,170
Chang, Z.	Defense Advanced Research Projects Agency (DARPA)	Microjoule-level isolated attosecond pulses for atto pump-atto probe	7/25/2013	7/25/2015	\$1,584,334	\$1,584,334
Christodoulides, D.	Government of Israel: Ministry of Defense	Airy Wavepackets and wavefront Engineering for Beam Filamentation Studies	7/13/2011	2/1/2015	\$100,000	\$400,000
Christodoulides, D.	University of Arizona	Mathematical Modeling and Experimental Validation of Ultrafast Nonlinear Light- Matter Coupling Associated with Filamentation in Transparent Media	9/30/2010	11/29/2014	\$103,543	\$373,543
Christodoulides, D.	Georgia State University	Novel Nonlinear Optical Processes in Active, Random, And Nanostructured Systems	7/1/2013	5/31/2015	\$44,268	\$108,290
Christodoulides, D.	United States- Israel Binational Science Foundation	Sub-wavelength Linear and Non-Linear Optics	10/1/2011	9/30/2015	\$8,000	\$59,897
Christodoulides, D.	National Science Foundation	IDR: Collaborative Research: Novel Photonic Materials and Devices based on Non- Hermitian Optics	9/1/2011	8/31/2015	\$0	\$179,731
Christodoulides, D. , Richardson, K.	Lockheed Martin Missiles and Fire Control	Advanced Optical Filters and Coatings	3/1/2014	12/31/2014	\$25,000	\$25,000
Christodoulides, D., Abouraddy, A.	US Air Force Office of Scientific Research (AFOSR)	MURI: PT-Symmetric Optical Materials and Structures	10/15/2013	1/14/2017	\$1,939,856	\$1,939,856
Crabbs, R.	Radiance Technologies	Testing Support at Eglin Air Force Base	3/27/2014	9/24/2016	\$10,000	\$39,579
Delfyett, P.	Northrop Grumman Corporation	RF - Novel Low Noise Mode- locked Lasers for Advanced Components for Electronic Warfare	1/1/2013	4/15/2016	\$0	\$37,156
Delfyett, P.	SPAWAR	Self-Stabilized, Self- Referenced Mode-Locked Diode Laser Using Optical Frequency Division for Generating Low Noise Optical Pulse Trains	12/12/2013	12/11/2015	\$520,563	\$520,563
Deppe, D.	sdPhotonics, LLC	New VCSEL Technology	7/1/2014	12/31/2015	\$37,345	\$37,345
Deppe, D.	DOD/Army/Army Research Office	WDM Nanoscale Laser Diodes for Si Photonic Interconnects	2/1/2012	9/30/2015	\$120,000	\$406,203
Deppe, D.	National Science Foundation	Research Into the P-N Junction Thermophotonic Effect	9/15/2010	8/31/2014	\$0	\$420,000

Dogariu, A.	KaMin LLC	General Study of the Interaction Radiation with Coatings	9/1/2013	8/31/2014	\$60,000	\$60,000
Dogariu, A.	US Air Force Office of Scientific Research (AFOSR)	Sensing Random Electromagnetic Fields and Applications	5/1/2010	4/30/2015	\$311,612	\$772,315
Dogariu, A.	National Science Foundation	Optical Control of Cellular Biomechanics	7/1/2012	6/30/2015	\$0	\$97,085
Dogariu, A.	Malvern Instruments Ltd	LCDLS Technology Development and Tests	7/1/2013	7/1/2015	\$0	\$150,343
Dogariu, A., Abouraddy, A	Sherwin Williams Company	Composite Optical Scatter	2/18/2013	2/17/2014	\$0	\$120,535
Fathpour, S.	Office of Naval Research	Hybrid Second-Order Nonlinear Photonic Devices on Silicon	5/20/2013	5/19/2016	\$170,500	\$328,500
Fathpour, S.	National Science Foundation	Silicon Photonic Devices for Optical Delay Line Integrated Circuits	9/1/2011	8/31/2015	\$0	\$328,289
Fathpour, S.	National Science Foundation	CAREER: Mid-Infrared Photonic Devices and Integrated Circuits on Silicon	2/1/2012	1/31/2017	\$0	\$400,000
Fathpour, S., Delfyett, P., Deppe, D., Schoenfeld, W.	National Science Foundation (NSF)	MRI: Acquisition of a Hybrid Mask-Aligner/Nanoimprinter Lithography Tool	8/15/2013	7/31/2015	\$402,290	\$502,863
Gaume, R.	University of California/ Lawrence Berkeley National Laboratory (LBNL)	BaBrI:Eu2+ and other Ba-based bright scintillators as transparent ceramics: a multi-institutional approach	4/16/2013	9/30/2015	\$66,555	\$173,000
Gaume, R.	Duke University	High-throughput computational and experimental search of novel phono mediated covalent metal superconductors and thermoelectric materials	10/1/2011	3/31/2015	\$0	\$285,586
Gaume, R.	Government of Israel: Ministry of	Transparent Ceramics for Nonlinear Optics	4/30/2013	4/30/2016	\$0	\$98,986
Glebov, L.	OptiGrate Corporation	Volume Bragg Gratings for Spectral and Coherent Beam Combining in MWIR Spectral Region - Phase 2	2/1/2013	1/31/2015	\$113,275	\$225,000
Glebov, L.	OptiGrate Corporation	Compact Stretcher/compressor for high power ultrafast laser based on volume chirped Bragg grating in PTR glass	5/1/2012	3/31/2014	\$0	\$100,000
Glebov, L., Schülzgen, A., Zeldovich, B.	US Air Force Office of Scientific Research (AFOSR)	Volume Bragg Gratings - Research, Testing and High Power Applications	9/27/2010	12/26/2014	\$500,000	\$2,000,000
Hagan, D., Van Stryland, E.	Government of Israel: Ministry of Defense	Development of new materials for strong, broadband nonlinear transmission (Year 3)	7/28/2009	2/1/2015	\$100,000	\$200,000
Kar, A.	Semiconductor Research Corporation	AO Deflector for Laser Beam Scanning in Material Processing	10/1/2011	6/30/2015	\$100,000	\$300,000
Kar, A.	Naval Undersea Warfare Center	Uncooled MWIR SIC Detector	4/12/2012	7/31/2013	\$0	\$20,000
Kar, A., Vaidyanathan, R.	Lumen Medical LLC	Laser Treatment of MP35N Wires for MRI Compatibility	9/1/2012	8/31/2015	\$0	\$151,200
Kuebler, S.	Academy of Applied Science	High School Traineeship via AEOP/REAP	4/15/2014	9/30/2014	\$1,200	\$1,200
Li, G.	Luster LightTech Company, Ltd	Dispersion-Managed Fiber for Folded Nonlinearity Compensation	11/1/2013	5/31/2015	\$24,900	\$24,900

Li, G.	Open Photonics, Inc.	Integrated Mode-Division (De)Multiplexer	6/15/2014	6/14/2016	\$100,000	\$100,000
Li, G.	Luster LightTech Company, Ltd	Optical Amplifiers for High-Speed Optical Communication	9/15/2013	9/14/2014	\$40,000	\$40,000
Li, G.	Open Photonics, Inc.	Reconfigurable Mode-Division Multiplexer	2/10/2014	2/9/2016	\$39,997	\$39,997
Li, G.	NSG America, Inc	10 Gb/s APD Packaging	6/1/2009	5/31/2014	\$0	\$30,000
LiKamWa, P.	Nufern	Monolithically Integrated Transceiver Chip	8/1/2013	12/31/2014	\$73,888	\$73,888
Phillips, R.	Office of Naval Research	DURIP: Precision Tracking Mount for Laser Beam Control Testing	9/1/2013	8/31/2015	\$619,950	\$619,950
Richardson, K.	University of Delaware	Beyond the Lambertian Limit -- Novel Low-Symmetry Grating for Ultimate Light	5/1/2013	11/30/2015	\$206,952	\$206,952
Richardson, K.	Lockheed Martin Missiles and Fire Control	Broadband Gradient Index (GRIN) Optics	3/3/2014	12/31/2014	\$280,000	\$280,000
Richardson, K.	National Science Foundation (NSF)	Collaborative Research: GOALI-FRG: Engineered Crystalization behavior of Phase Change Materials to enable advanced optical functionalities	8/1/2013	7/31/2015	\$87,500	\$87,500
Richardson, K.	US Department of Commerce/ National Institute of Standards and Technology (NIST)	Evaluation of IC Interconnect Failure of through Silicon Vias (TVSs)	4/1/2013	3/31/2015	\$192,869	\$192,869
Richardson, K.	FISBA OPTIK	Expedited ChG Molding Study	3/1/2014	12/31/2015	\$67,303	\$67,303
Richardson, K.	Pennsylvania State University	Innovative Design and Manufacturing of Gradient-Index-Based Transformation Optics Components	12/24/2013	6/24/2015	\$340,000	\$340,000
Richardson, K.	Lockheed Martin Missiles and Fire Control	Precision Glass Molding	4/1/2014	12/31/2014	\$35,000	\$35,000
Richardson, K.	Lockheed Martin Missiles and Fire Control	Silver Doped Glass	3/21/2014	11/30/2014	\$50,000	\$50,000
Richardson, K., Kuebler, S	Lockheed Martin Missiles and Fire Control	Chalcogenide Materials and Functional Optics	1/2/2013	11/30/2014	\$0	\$50,000
Richardson, K.	Lockheed Martin Missiles and Fire Control	IRAD - Improved thermal mechanical oxy-Chalcogenide (oxy-ChG) materials	4/12/2013	12/31/2013	\$0	\$70,020
Richardson, K.	Lockheed Martin Missiles and Fire Control	Low dn/dt materials with enhanced thermal mechanical properties	4/1/2014	12/1/2014	\$0	\$90,000
Richardson, M.	KLA-Tencor Corporation	DUV Laser Plasma Studies	10/10/2011	6/30/2014	\$260,254	\$512,306
Richardson, M.	TRUMPF, Inc.	High Power EUV test with Trumpf Thin Disk Lasers	1/1/2014	12/31/2014	\$218,211	\$218,211
Richardson, M.	University of Maryland/College Park	Optical Turbulence Instrumentation	8/15/2012	8/14/2015	\$275,007	\$1,261,389
Li, G.	Luster LightTech Company, Ltd	Dispersion-Managed Fiber for Folded Nonlinearity Compensation	11/1/2013	5/31/2015	\$24,900	\$24,900

Richardson, M.	US Army Research Office	Engineered Laser Filaments in air for defense stand-off sensing and interaction applications	9/5/2009	9/4/2013	\$0	\$787,461
Richardson, M.	US Naval Supply Systems Command	Localized High Power RF Generation at Large Distances Using Self-Channeled Laser Beams	9/14/2011	6/30/2014	\$0	\$188,000
Richardson, M.	Inertial Labs, Inc	Next Generation Laser Training Systems	11/1/2012	11/30/2014	\$0	\$450,920
Richardson, M., Baudalet, M.	US Air Force Office of Scientific Research (AFOSR)	Fundamentals of Filament Interaction	10/15/2010	10/14/2015	\$484,214	\$1,949,068
Richardson, M., Baudalet, M.	DOD/Army/Army Research Office	Phase-Stabilized Terawatt High Energy Ultra-Short (PhaSTHEUS) Laser Facility	8/25/2012	8/24/2014	\$0	\$302,800
Richardson, M., Baudlet, M., Chang, Z.	DOD/Army/Army Research Office	Light Filamentation Science	8/1/2011	3/31/2016	\$703,646	\$4,649,768
Richardson, M., Masnavi, M.	TRUMPF, Inc.	Modeling and simulation of EUV Laser-Plasma Sources	1/1/2014	12/31/2014	\$81,654	\$81,654
Richardson, M., Shah, L.	University of North Carolina	Novel GMRF devices for integration with Tm: fiber lasers	12/1/2010	11/30/2014	\$49,882	\$229,882
Richardson, M., Bradford, J., Willis-Ott, C., Liu, Y.	US Army Research Office	ARO High School Apprenticeships in Laser Development and Spectroscopy at the Townes Laser Institute	9/5/2009	9/4/2013	\$0	\$6,000
Schoenfeld, W.	US Army Research Office	Deep-UV Emitters and Detectors Based on Lattice-Matched Cubic Oxide Semiconductors	7/1/2010	8/31/2014	\$40,000	\$340,000
Schoenfeld, W.	Agnitron Technology, Inc.	Molecular Beam Epitaxy Grown Wurtzite MgZnO Solar Blind Detectors	9/23/2013	5/7/2014	\$25,000	\$25,000
Schoenfeld, W.	Agnitron Technology, Inc.	Novel Heterostructure Doping for Optoelectronic Devices	7/1/2013	1/17/2014	\$50,000	\$50,000
Schoenfeld, W.	DOD/Army/Army Research Office	Research Initiative (RI) Proposal to Enhance Oxide MBE Growth through Facilitation of an Ozone Source and Oxygen Resistant Zn Effusion Cell	9/1/2012	8/31/2013	\$0	\$22,000
Schülzgen, A. Amezcua Correa, R.	Q-Peak Inc.	Novel Extended-Zone High Power WDM Couplers	1/15/2014	11/4/2014	\$55,000	\$55,000
Schülzgen, A., Amezcua Correa, R., Richardson, M.	US Air Force Office of Scientific Research (AFOSR)	DURIP: MCVD Lathe System for Fiber Preform Fabrication	9/30/2013	9/29/2015	\$870,400	\$870,400
Schülzgen, A.	National Science Foundation	GOALI: Developing Piezospectroscopic Sensing Systems in Adhesives and Coatings	10/1/2011	9/30/2015	\$0	\$227,094
Van Stryland, E., Hagan, D.	Georgia Tech Research Corporation	MURI: Nonlinear Optical Characterization	9/30/2010	9/29/2015	\$283,283	\$1,249,999
Van Stryland, E., Hagan, D.	Lawrence Livermore National Laboratory	Non-Linear Measurements	3/26/2014	7/31/2014	\$11,861	\$11,861
Van Stryland, E., Hagan, D.	National Science Foundation	Extremely Nondegenerate (END) Photonic Devices	11/1/2012	10/31/2015	\$0	\$361,683
Van Stryland, E., Hagan, D., Kik, P.	US Army Research Office	Engineered Multifunctional Nanophotonic Materials for Ultrafast Optical Switching	8/15/2006	8/14/2012	\$0	\$5,250,000

Van Stryland, E., Abouraddy, A., Fathpour, S., Thomas, J., Hagan, D	National Science Foundation	MRI: Development of a Nonlinear Optical Spectrometer	9/1/2012	8/31/2015	\$0	\$494,477
Vodopyanov, K.	Stanford University	Laser Sensor for In-Situ Detection of Chemical and Organic Biomarkers and Isotopes	1/1/2013	9/8/2014	\$0	\$199,872
Vodopyanov, K.	Stanford University	Novel Concept of Frequency-Combs Interferometric Spectroscopy in the Mid-IR for Significantly Enhanced Detection of Explosives	1/13/2013	9/30/2013	\$0	\$90,000
Vodopyanov, K.	PolarOnyx	Supercontinuum fiber laser for multi-spectral energy propagation	5/1/2013	12/14/2013	\$0	\$81,794
Wu, S.	AU Optronics Corporation	Advanced Liquid Crystal Displays	7/1/2010	6/30/2015	\$200,000	\$650,000
Wu, S.	US Air Force Office of Scientific Research (AFOSR)	Fast response and low voltage dual frequency liquid crystals	3/1/2009	2/28/2014	\$20,000	\$750,000
Wu, S.	Office of Naval Research	Low-Absorption Liquid Crystals for Infrared Beam Steering	10/23/2012	9/30/2015	\$299,208	\$524,163
Wu, S.	Kent Optronics, Inc.	Short Wave Infrared Liquid Crystals	7/1/2013	3/31/2014	\$30,000	\$30,000
Wu, S.	China Star Optoelectronics Tech.	Active Liquid Crystal Lens	1/1/2013	12/30/2013	\$0	\$155,000
Wu, S.	ITRI Display Technology Center	Novel Display and Biosensor Devices	12/1/2011	12/31/2016	\$0	\$729,117
Wu, S.	Kent Optronics, Inc.	Electronically switchable IR beam splitter technology	1/7/2012	5/31/2014	\$0	\$292,000

TOTAL

\$14,631,263 \$41,684,148

Most funded faculty

Twenty six researchers in areas ranging from optics, medicine, psychology and education were recognized by UCF in 2014 in what has become a much-anticipated campus tradition – induction into the UCF Millionaires Club. Five CREOL faculty were inducted.



Ayman
Abouraddy



Zenghu
Chang



Demetrios
Christodoulides



Kathleen
Richardson



Martin
Richardson

3.8 Affiliated Research Centers

The University of Central Florida has several nationally and internationally recognized research institutes in addition to the three at CREOL, The College of Optics and Photonics that are devoted to research and development.

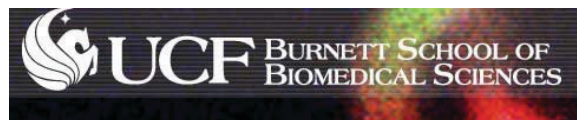
Advanced Materials Processing and Analysis Center

The Advanced Materials Processing and Analysis Center (AMPAC) is an interdisciplinary research and education center for materials science and engineering, one of two major UCF research centers that comprise the Center of Advanced Materials and Nanotechnology. Our two university-wide multi-user facilities — the Materials Characterization Facility (MCF) and the Advanced Microfabrication Facility (AMF) - are available to all researchers at UCF and from outside companies, government labs, and universities, enabling them to perform cutting-edge research, and to train and educate students and other personnel in the use of state-of-the-art equipment. AMPAC's vision is to make UCF an international leader in materials science and engineering research and education by excelling in the development, processing and characterization of advanced materials to achieve prominence in targeted research areas; providing leadership to the UCF Materials Science and Engineering research and education program; and enhancing economic growth and promoting industrial development through effective partnerships with industry

NanoScience Technology Center

In 2004 the Nanoscience Technology Center (NSTC) was formed with formed with a \$4M grant from the state of Florida when leaders recognized the potential of nanotechnology as its applications in medicine, materials, computing and electronics began entering the mainstream. Since that time, NSTC has consolidated UCF researchers across multiple disciplines and hired many more to better respond to nanoscience funding opportunities and to develop the technologies demanded by the industries of the future. In 2007 the NSTC officially opened a 20,000- square-foot renovated research facility in the Central Florida Research Park. A total of 19 faculty, 7 staff and more than hundred graduate students, postdocs, researchers at the center are creating tools to treat neurological diseases; materials that can advance solar and fuel cell technology; and longer batteries that can make ever-smaller electrical devices a reality. Current research areas include Green Energy, In Vitro Test Systems, Functional Nanomaterials, Computer/Mathematical Simulations, Quantum Dynamics, Nano-Bio-Imaging, NanoElectronics & NanoPhysics, and Integrated Device Development.

Burnett School of Biomedical Sciences



The Burnett School of Biomedical Sciences is an integral part of the UCF College of Medicine, making the college a research-intensive medical school where cutting edge medical research spans the entire spectrum from laboratory bench to bedside of the patients, providing a great environment of training physicians and biomedical researchers. The School's mission is to provide quality undergraduate and graduate programs in the biomedical sciences and build excellent research programs focused on cancer, cardiovascular, neurodegenerative diseases, and infectious diseases. Our faculty are working to take science from the bench to the bedside. In addition to conducting cutting edge research in biomedicine with potential application to curing major diseases, the School is committed to helping to develop

a technology-based industry in Florida. Active partnerships formed with other units at UCF such as the College of Optics and Photonics, the School of Electrical Engineering and Computer Science and the NanoScience Technology Center will facilitate interdisciplinary research and education programs in the innovative applications of photonics, bioinformatics and nanoscience to biomedical problems. The School offers three BS degree programs: Biomedical Sciences; Biotechnology; and Medical Laboratory Sciences. Graduate programs include the MS Biomedical Sciences (non-thesis), an MS Program in Biotechnology, and a new MS Professional Science in Biotechnology. The interdisciplinary PhD and MD-PhD programs in Biomedical Sciences prepare tomorrow's biomedical research scientists.

Florida Solar Energy Center

The Florida Solar Energy Center® (FSEC®) is the largest and most active state-supported energy research institute in the United States. Located on the Cocoa campus of UCF at Eastern Florida State College, FSEC has gained national and international respect for its programs on photovoltaics, solar thermal systems, energy-efficient buildings, advanced cooling technologies, hydrogen and fuel cells, and the testing and certification of solar equipment. The Center conducts continuing education workshops for professionals, government and industry leaders around the world. Additionally, FSEC offers Science, Technology, Engineering and Mathematics (STEM)-focused opportunities to K-12 and college level-students, professional development for teachers, and renewable energy curriculum and activities to schools throughout Florida.



Florida Space Institute



Florida Space Institute is located at the space center, in Brevard County in East Central Florida, so as to provide a focus on space for the research and education programs of its institutional members. Classrooms, faculty offices and

laboratories are located at the Kennedy Space Center Visitors Center, in the Astronaut Memorial Foundation's Center for Space Education facility. While the academic program is at the core of FSI, providing Masters and Ph.D. level programs of study, the Institute also has a strong engineering support staff, and performs research on contracts and grants, providing real-life opportunities for student research and thesis projects. The organizational structure also encourages research on the individual campuses of the member schools, allowing the development of space hardware, and then "flowing" that hardware through the FSI facilities at the space center for processing and then on to space flight. Since its founding in 1990 as a consortium of state universities, community colleges, and private schools, the consortium has expanded, and now counts as its members UCF, Florida Institute of Technology, Brevard Community College, Embry-Riddle Aeronautical University, Florida Agricultural & Mechanical University, University of Miami, Florida Atlantic University, University of South Florida, University of Florida, and Broward Community College. Additionally, through NASA's Florida Space Grant Consortium program resident with FSI, some 16 additional universities and colleges throughout Florida enjoy an indirect relationship with the Institute.



IST is an internationally recognized research institute that focuses on advancing modeling and simulation technology and increasing our understanding of simulation's role in training and education. Founded in 1982 as a research unit of the University of Central Florida, the institute provides a wide range of research and information services for the modeling, simulation and training community. Faculty and staff are distributed among IST's three Central Florida Research Park buildings, Partnership II, Partnership III and the Army Research Laboratory Simulation and Training Technology Center (ARL-STTC).



Center for Research in Computer Vision

The common goal and purpose of the center is to strongly promote basic research in computer vision and its applications in all related areas including National Defense & Intelligence, Homeland Security, Environment Monitoring, Life Sciences and Biotechnology and Robotics. Computer vision is the science of electronically acquiring, analyzing and understanding images in ways superior to the human brain. The CRCV is directed by Dr. Mubarak Shah of the Department of Electrical Engineering and Computer Science. Shah is also an affiliate faculty member at CREOL.



The International Consortium for Advanced Manufacturing Research (ICAMR) is the only manufacturing development center focused on the integration of next generation semiconductor based processes and materials into advanced smart sensors and photonics devices. ICAMR serves as an open-innovation platform for the development of these devices through collaborative programs and shared access to the deposition of III-V and other advanced materials on silicon wafers via state-of-the-art process equipment, metrology tools and testing platforms. ICAMR is in the process of building one of the most advanced labs/fabs in the world to support manufacturing development of these emerging technologies just south of the Orlando Airport in Osceola County. This 100,000 square-foot facility will have state-of-the-art cleanrooms and facilities and services to accommodate manufacturing development of emerging technologies. The first equipment set is in the development phase and will support manufacturing scale processing for some of the most novel and leading edge materials ever integrated into manufacturing processes



Other Facilities & Centers

Other organized programs at UCF offer researchers and students additional support in pursuit of their research goals. These include:

- National Center for Simulation (NCS)
- Center for Advanced Transportation Systems Simulation (CATSS)
- National Center for Forensic Science (NCFS)
- Small Business Development Center (SBDC)
- University of Central Florida Business Incubation Program (UCFBIP)



The CREOL building. Shelled out lab space in the 3rd floor is expected to be finished in 2015.

4. Partnership and Outreach

One of the major objectives of UCF is to be the leading Partnership University in the nation in the 21st century. To fulfill this mission, the College has formed strong bonds with industry, has become a major force in Florida's laser and photonics community, and is a prime source of highly educated talent in the optics and photonics field. The faculty members participate in the formulation and execution of a wide variety of outreach programs and public service activities.

4.1 Industrial Partnership

Since its early years, CREOL has benefited from a strong partnership with industry and it endeavors to transfer the technology developed by the faculty, scientists, and students to industry, particularly Florida industry, and to assist in forming, recruiting, and retaining optics and optics-related industries in Florida. CREOL is an active partner with the Florida Photonics Cluster (FPC), which supports the growth and profitability of the photonics industry in Florida.



The Industrial Affiliates Program

The College has established a large industrial affiliates program (with current membership of **66** companies, sustained over many years).

Membership in the Industrial Affiliates (IA) program provides to industrial corporations, organizations, and individuals many benefits, most of which are also of mutual benefit to The College of Optics and Photonics. One of these mutual benefits is the regular communication and contact the program provides between the research faculty and students at the College and the IA member company's engineers and scientists who are developing new technologies and products for their business. Other benefits include:

- Establishing a close association with this leading institute in optics, lasers, and photonics
- Exposure to the latest research and developments in cutting edge technologies
- Membership certificate or plaque for display in your facility
- Availability of sophisticated measurement, test, and calibration facilities
- Early notice of students approaching graduation (the next generation of experts in the field). See our Student Resumes.
- Ability to post your job openings on our website (exclusive benefit for IA members)
- Close interactions with our faculty, each of whom are leaders in their fields
- Opportunity to make presentations about your company and products to the faculty and students of the College
- Opportunity to participate in our Industrial Advisory Board, a committee of our senior stakeholders that provides advice on the long-term direction of CREOL, The College of Optics & Photonics
- Copies of the College's periodic newsletter, Highlights, and monthly e-Highlights
- Notification of seminars at the College
- Opportunity for free presentation space at our annual Industrial Affiliates Day meeting
- Several Web-based benefits, including linkage to your company's web site from the College website
- For companies who donate equipment, getting their hardware/software in the hands of some of the leading researchers – faculty and students– in the field provides visibility to future customer prospects and information on its impact in leading-edge research
- Demonstration by the company of their support of CREOL, The College of Optics & Photonics, its research programs, and its effective corporate cooperation and partnership activities

In addition, we use many mechanisms to give visibility to our Industrial Affiliates that can be valuable to them in marketing their products. Wherever possible, the level of the membership is indicated. Examples of current practices include:

- Listing in CREOL, The College of Optics & Photonics High-lights quarterly newsletter
- Special recognition at the annual Industrial Affiliates Day
- Listing in other CREOL, The College of Optics & Photonics publications, where appropriate, including on CREOL, The College of Optics & Photonics website (with a link to the company's website)
- Company name plaque prominently displayed in the entrance lobby of the CREOL building of CREOL, The College of Optics & Photonics

There are also many intangible benefits that accrue from association with this dynamic research and education institution. Among these are facilitated access to and collaboration with other specialized facilities within the University of Central Florida and the central Florida area. In addition to resources in the Center for Research & Education in Optics & Lasers (CREOL) and the Florida Photonics Center of Excellence (FPCE), UCF facilities include the following major research centers:

- Nano-Sciences & Technology Center (NSTC)
- Advanced Materials Characterization Facility (AMPAC)
- Materials Characterization Facility (MCF)
- Biomolecular Science Center
- Institute for Simulation and Training (IST)
- Center for Distributed Learning
- National Center for Forensic Science (NCFS)
- Florida Solar Energy Center (FSEC)
- Florida Space Institute (FSI)

The College's faculty and students play leading roles in both local and international professional associations and can provide effective introductions to the extensive network of industry and expertise to which CREOL, The College of Optics & Photonics connects. Through the IA program, your company can also readily connect with other optics, photonics, and industrial organizations through local Florida organizations in which the College maintains an active participation, including the Florida Photonics Cluster (FPC), the Laser Institute of America (LIA), Florida High Technology Corridor Council (FHTCC), the UCF Technology Incubator — ranked #1 in the US in 2004 — and a large family of laser and optics companies in the Central Florida region.

2014 Industrial Affiliates Members

Life Members

Cobb Family Foundation
Northrop Grumman Corporation
Nufern

Memoriam Members

Dr. Arthur H. Guenther
Dr. William C. Schwartz

Medallion Members

Breault Research
Northrop Grumman Laser

Lasersec Systems Corp.

Optical Research Associates
Paul G. Suchoski, Jr

Senior Members

AFL
Coherent, Inc.
CST of America
DataRay, Inc
Edmund Optics
ER Precision Optical
LAS-CAD GmbH

LightPath Technologies
Lockheed Martin
Newport
Open Photonics
Ophir-Spiricon

Optimax Systems, Inc
Radiant Zemax, LLC
Tektronix
Thorlabs
TRUMPF, Inc.
V & N
Zygo Corporation

Affiliate Members

Aerotech Inc.
ALIO Industries*
Analog Modules
Applied Image Inc
eVision, LLC
Fike Corporation
Finisar*
Gentec-EO, Inc
Gooch & Housego, LLC
Harris Corporation
HORIBA Jobin Yvon
Iridance Glass, Inc*

JENOPTIK Optical Systems Inc
Laser Institute of America
Lee Laser, Inc
Ocean Optics
Optigrate Corp.
OIDA
Photonics Media
Photonics Online
Plasma-Therm*
Plasmonics
Princeton Instruments
Q-Peak, Inc*
QPC Lasers/Laser Operations LLC

R-Soft Design Group
SCD USA
Sciperio, Inc.
SPIE
StellarNet, Inc
OSA
Tower Optical Corporation
TwinStar Optics, Coatings & Crystals
ULVAC Technologies, Inc*
Vytran LLC
Yokogawa Corporation of America
Zomega Terahertz Corporation

* New members

Industrial Affiliates Day

The CREOL Industrial Affiliates Day brings in optics companies from around the country to learn about the ongoing research, recruit students, and identify new partnering opportunities. The 2014 event, held on March 6 & 7, 2014, drew over 212 attendees including industrial affiliates, guests from industry and academia, representatives from photonics professional societies, faculty and students, and 22 exhibitors. Four technical sessions covered advances in fiber lasers, nanophotonics for medical applications, optical ceramic lasers, and silicon photonics. Four distinguished speakers from the US and Canada and four UCF faculty speakers participated (see program details on the next page).

In addition to these technical talks, a panel discussion on “*Photonics Education-current and future education expectations in optics & photonics*” was moderated by James Pearson (CREOL & FPC). The

panelists were: David Hagan (CREOL), Dan Hull (OP-TEC), Alex Fong (Gooch & Housego & FPC), Barry Shoop (USMA West Point) and Tim Fritzley (FAZTech). The symposium was followed by tours of the CREOL facilities and viewing of student posters featuring research of 38 graduate students (see poster titles on page 78). The Best Poster Award went to graduate student Cheonha Jeon for his poster entitled “Filament Interaction with Micro-water Droplets,” and the Student-of-the-Year Award went to Clemence Jollivet. This year, four short courses were offered (see list on the next page) on March 6. The following Saturday attendees were invited to the traditional annual event: The Spring Thing, hosted by M. J. Soileau, Founding Director of CREOL and now the Vice-President for Research and Commercialization at UCF. The festivities included fellowship and great Cajun cuisine.

2014 Industrial Affiliates Day Program

Friday 7 March, Morning Session –UCF Student Union

8:00	Continental Breakfast, Registration & Exhibits		Cape Florida Room
8:30	Welcoming Remarks	MJ Soileau	UCF Vice President for Research
8:50	Welcome and overview of CREOL	Bahaa Saleh	Dean & Director, CREOL, UCF
Morning Sessions			
Session I. Manufacturing			
9:15	A Brief History of Fiber Lasers	Bryce Samson	Nufern
9:45	The Role of Universities in Fiber Lasers	Lawrence Shah	CREOL, UCF
10:05	Break & Exhibits		UCF Student Union
Session II. Nanophotonics for Medical Applications			
10:25	Upconverting Nanoparticles: A Platform for PDT, Photoswitching and Bioimaging	John A. Capobianco	Concordia University, Canada
10:55	Extreme photothermal response enhancement in plasmonic oligomers	Pieter Kik	CREOL, UCF
Session III. Optical Ceramic Lasers			
11:15	Transparent Polycrystalline Materials: Historical Developments and Next Generation	Greg Quarles	Optoelectronics Management Network
11:45	Novel characterization techniques for optical ceramics	Luke Lester	CREOL, UCF
12:05	Lunch Served		UCF Student Union
Tabletop Exhibits-Student Union			
Session IV. Silicon Photonics			
1:00	Silicon Photonics for Data Center and High Performance Computing Application	Mehdi Asghari	Mellanox
1:30	Hybrid Integrated Platforms on Silicon	Sasan Fathpour	CREOL, UCF
Session V. Panel Discussion			
1:50	Panel discussion on “Photonics Education-current and future education expectations in optics & photonics”	Jim Pearson – moderator David Hagan Dan Hull Barry Shoop Tim Fritzley	CREOL, FPC CREOL, FPC OP-TEC USMA-West Point FAZ Technology
2:50	Break & Walk to CREOL Building		
Session VI. Poster Session, Tours, Exhibits, et al			
3:15	Poster Sessions; lab Tours; exhibits; (contiguous).	CREOL Graduate Students	CREOL rooms 102 & 103; Tours start from lobby; exhibits in lobby
4:45	Poster awards presentation; reception	Bahaa Saleh	CREOL, The College of Optics and Photonics
Short Courses			
<i>Thursday, 6, March UCF</i>			
1:00-2:30p	Terahertz Photonics	Konstantin Vodopyanov	CREOL, Rm 102
1:00-2:30p	Nanophotonics and Plasmonics	Pieter Kik	HEC, Rm 125
2:45-4:15p	Silicon Photonics	Sasan Fathpour	CREOL, Rm 102
2:45-4:15p	Fiber Lasers	Axel Schülzgen	HEC, Rm 125

Student Posters

Sihue He, Liquid crystal-based biosensors for the detection of bile acids.

Chatdanai Lumdee, All-inorganic substrate-tuned nanoparticle plasmon resonances for robust biochemical sensors.

Kristopher Davis, Functional APCVD oxide films for c-Si solar cells.

Jennefir L. Digaum, Ninety-degree beam bending using a spatially variant self-collimating photonic crystal.

Guangming Tao, Robust multimaterial tellurium-based chalcogenide glass fibers for mid-wave and long-wave infrared transmission.

Jichi Ma, Two-photon photovoltaic effect in gallium arsenide.

Jeff Chiles, All-silicon waveguiding platform for ultra-broadband mid-infrared photonics.

Matthew Reichert, Nonlinear refraction dynamics of CS₂

Zahoor Sanjabi, Investigation of dynamic modal instabilities in high power fiber amplifiers.

Danielle Harper, Effect of aerosols on laser filamentation.

L. Martin, Entangled photon pairs in periodic and disordered lattices.

Cheonha Jeon, Filament interaction with micro-water droplets.

Brian Anderson, Improving brightness of multimode lasers by use of volume Bragg gratings.

Laura Sissen, Characterization of induced changes in chalcogenide glass from 2 μ m, ns

laser irradiation.

Spencer Novak, Deposition of chalcogenide glass films from solution by electrospray.

Alex Sincore, PCF pump combiner for high peak power, all-fiber thulium lasers.

Eric Cunningham, Institute for the Frontier of Attosecond Science and Technology: CEP stabilization of a 20 TW CPA system at 10 Hz.

Yi Wu, Institute for the Frontier of Attosecond Science and Technology: Towards high-flux isolated attosecond pulses with a 100 TW CPA.

Amy Van Newkirk, Multicore optical fiber for high temperature sensing.

Daniel Ott, Spectral filtering with sharp roll-off produced by multipass reflections from volume Bragg gratings.

Benn Gleason, Property extrema in the GeAsSe chalcogenide ternary glass system.

Khan Lim, Blueshifted continuum peaks from filamentation in the anomalous dispersion regime.

H. Hodaei, Single mode PT symmetric large area lasers.

Gisela Lopez-Galmiche, Designs of advanced large mode area fibers for high power lasers.

M. Akhlaghi Bouzan, Monolithic mode-locked lasers based on high finesse silicon ring resonators.

Aniket Patil, Fiber mode converter using holograms of phase masks in photo-thermo-refractive glass.

Benjamin Webb, Compact 10 TW laser to

generate multi-filament arrays.

Abraham Vázquez-Guardado, Plasmonic system interaction with cavity and high order diffraction modes for enhanced sensing applications.

Himansu S. Pattanaik, Scanning 3-D IR imaging in an uncooled wide band gap photodiode using nondegenerate two-photon absorption.

G. Salceda-Delgado, Curvature sensor based on seven core fiber.

Sushrut Modak, Narrowband and broadband perfect metamaterial absorbers in infrared.

Khawlah Al Yahyaie, Fabrication of highly photosensitive fiber from photo-thermo-refractive glass.

Daniel Franklin, Bio-inspired hybrid liquid crystal-plasmonic reflective display.

J. R. Guzman-Sepulveda, Optical measurements of local viscoelastic properties of complex fluids.

Alireza Safaei, Exciting localized surface plasmon to enhance light harvesting by Graphene.

Michael Chini, Transient absorption with ultrabroadband attosecond pulses.

H. Esat Kondakci, Photonic thermalization gap in Anderson-disordered photonic lattices.

Sudeep J. Pandey, Fabrication of titanium oxide Magneli phase nanoceramics for thermoelectric applications.

Photonics Incubator

The Photonics Incubator is part of the UCF Business Incubation Program and is located within the facilities of the College. It is one of the ways that the College fulfills one element of its mission, namely to "Aid the development of Florida's and the nation's high technology industries." Companies in the Photonics Incubator have ready access to the CREOL faculty, graduate students, laboratory facilities and other excellent UCF resources including the staff of the Office of Research and Commercialization and the Venture Lab. The following is a list of 2014 clients:

- **FAZ Technology, Inc.** (Tim Fritzley, www.faztechnology.com) is launching the next generation of optical interrogation and sensing platform. Their platform provides high precision, real-time data available to any authorized user.
- **LC Matter Corp.** (Sebastian Gauza, www.lcmatter.com,) offers custom design and manufacturing of liquid crystal materials and its polymeric composites. Applications include military electronically driven laser devices, optical telecommunication and entertainment systems.
- **Orlando Photonics Laboratory Corp.** (Chang Ching Tsai) de-

signs and develops custom diffractive optical elements (DOEs), including diffractive lenses, gratings, fibers, optical thin films and diffusors.

- **Plasmonics, Inc.** (David Shelton, www.plasmonics-inc.com) is developing tunable infrared metamaterials which are engineered composites with unique refractive-index characteristics. Metamaterials with tunable resonances have wide ranging potential for optical devices, modulators, and sensors.
- **sdPhotonics LLC** (Dennis Deppe, Sabine Freisem) is an emerging leader in the development of high power laser diode technologies that provide improved power, efficiency, brightness and reliability.
- **Partow Technologies, LLC**, (Payam Rabiei) is developing compact high-speed lithium niobate modulators for data-center and telecommunication applications. The company technology is based on nano-waveguides made in thin film lithium niobate on silicon substrates. The devices can fit into small form factor transceivers used in data-centers and in telecommunication coherent systems. and reliability.

Industrial Projects

Recipient	Source	Title of Award	Begin	End	Awarded 2013	Cumulative Funding
Amezcuia Correa, R., Schülzgen, A., Shah, L.	No Needles Venipuncture	Design of a Gain Switched Short Pulse Fiber Amplifier	4/21/2014	9/24/2014	\$15,000	\$15,000
Amezcuia Correa, R., Schülzgen, A., Shah, L.	Inertial Labs, Inc	Stimulated Raman Scattering in Hollow Core Photonic Crystal Fiber	12/1/2013	4/30/2014	\$ 29,000	\$29,000
Bass, M.	Raytheon Company	Laser Calorimetry Measurements	3/26/2014	6/30/2014	\$12,000	\$12,000
Christodoulides, D., Richardson, K.	Lockheed Martin Missiles and Fire Control	Advanced Optical Filters and Coatings	3/1/2014	12/31/2014	\$25,000	\$25,000
Crabbs, R.	Radiance Technologies	Testing Support at Eglin Air Force Base	3/27/2014	9/24/2016	\$10,000	\$39,579
Deppe, D.	sdPhotonics, LLC	New VCSEL Technology	7/1/2014	12/31/2015	\$37,345	\$37,345
Dogariu, A.	KaMin LLC	General Study of the Interaction Radiation with Coatings	9/1/2013	8/31/2014	\$60,000	\$60,000
Glebov, L.	OptiGrade Corporation	Volume Bragg Gratings for Spectral and Coherent Beam Combining in MWIR Spectral Region - Phase 2	2/1/2013	1/31/2015	\$113,275	\$225,000
Kar, A.	Semiconductor Research Corporation	AO Deflector for Laser Beam Scanning in Material Processing	10/1/2011	6/30/2015	\$100,000	\$300,000
Li, G.	Open Photonics, Inc.	Integrated Mode-Division (De) Multiplexer	6/15/2014	6/14/2016	\$100,000	\$100,000
Li, G.	Open Photonics, Inc.	Reconfigurable Mode-Division Multiplexer	2/10/2014	2/9/2016	\$39,997	\$39,997
LiKamWa, P.	Nufern	Monolithically Integrated Transceiver Chip	8/1/2013	12/31/2014	\$73,888	\$73,888
Richardson, K.	Lockheed Martin Missiles and Fire Control	Broadband Gradient Index (GRIN) Optics	3/3/2014	12/31/2014	\$280,000	\$280,000
Richardson, K.	Lockheed Martin Missiles and Fire Control	Precision Glass Molding	4/1/2014	12/31/2014	\$35,000	\$35,000
Richardson, K.	Lockheed Martin Missiles and Fire Control	Silver Doped Glass	3/21/2014	11/30/2014	\$50,000	\$ 50,000
Richardson, M.	KLA-Tencor Corporation	DUV Laser Plasma Studies	10/10/2011	6/30/2014	\$260,254	\$ 512,306

Kuebler, S. Richardson, K.	Lockheed Martin Corporation	Chalcogenide materials and functional optics	1/2/2013	11/27/2013	\$32,500	\$50,000
Richardson, K.	Lockheed Martin Corporation	IRAD - Improved thermal mechanical oxy-Chalcogenide (oxy-ChG) materials	4/12/2013	12/31/2013	\$70,020	\$70,020
Schoenfeld, W.	Agnitron Technology, Inc.	Molecular Beam Epitaxy Grown Wurtzite MgZnO Solar Blind Detectors	9/23/2013	5/7/2014	\$25,000	\$25,000
Schoenfeld, W.	Agnitron Technology, Inc.	Novel Heterostructure Doping for Optoelectronic Devices	7/1/2013	1/17/2014	\$50,000	\$50,000
Schülzgen, A., Amezcuá Correa, R.	Q-Peak Inc.	Novel Extended-Zone High Power WDM Couplers	1/15/2014	11/4/2014	\$55,000	\$55,000
Van Stryland, E., Hagan, D.	Georgia Tech Research Corporation	MURI: Nonlinear Optical Characterization	9/30/2010	9/29/2015	\$283,283	\$1,249,999
Wu, ST.	Kent Optronics, Inc.	Short Wave Infrared Liquid Crystals	7/1/2013	3/31/2014	\$30,000	\$30,000



Industrial Affiliates members providing financial support for research projects

Visitors from Industry

Habib Amirzadeh, DigitalOptics Corporation, January 15, 2014
Steven R. Frey, Tim Fritzley, FAZtech, January 23, 2014
Barry McSweeney, FAZtech, February 10, 2014
Ron Driggers, St Johns Optical Systems, May 21, 2014
Robert Breault, Breault Research Organization, June 19, 2014
Beverly Seay, BJ Seay LLC, July 10, 2014
Chris Lupfer, Advanced Photonic Crystals, July 31, 2014

Richard Albright, Phil Harrington, K Laser, August 21, 2014
David Nicol, Aptas Technologies, August 28, 2014
Lancen Fuller, August 29, 2014
Hughes Metras, CEA LETI, September 17, 2014
Bernard Kress, Google [X] Labs, October 10, 2014
William Hennessey, ALIO Industries, October 14, 2014
Hughes Metras, CEA LETI, October 24, 2014

4.2 Alumni Relations

CREOL maintains an ongoing relation with its alumni. The online CREOL Highlights Newsletter, which is produced several times a year, is distributed to all alumni, and alumni profiles and alumni news are posted on the CREOL website. Alumni are invited to the Industrial Affiliates Day and alumni reunions are held at various locations during key meetings of professional societies. In 2014, a reunion was hosted on February 3 during the SPIE Photonics West meeting in San Francisco (at Jillian's Metreon) with about 90 guests attending. At the CLEO meeting in San Jose, the alumni reunion was held on June 9 at the Gordon Biersch Brewery Restaurant.

Winston Schoenfeld (far right) with Industrial Affiliates at the Photonics West 2014 reunion



Michael Mielke Receives The 2014 Professional Achievement Award

Michael Mielke, Ph.D., '00, '03 received the UCF Professional Achievement Award at the Black & Gold Gala 2014 on October 23, 2014. Since earning his PhD from CREOL in 2003 Michael has had a distinguished career. He helped found Raydiance, the leading provider of industrial grade ultrafast laser solutions. As the principal architect of the Raydiance laser platform, he has brought ultrafast light to the industrial laser materials processing sector where previous attempts to do so had failed, since conventional ultrafast lasers are extremely sensitive to ambient conditions and require hourly tuning by a highly trained laser engineer. Michael's bold approach to technology advancement and relentless work ethic have been clear from the start, which is why he won the Grand Prize in the OSA New Focus Student Award in 2003.

Michael Mielke at the Black & Gold Gala

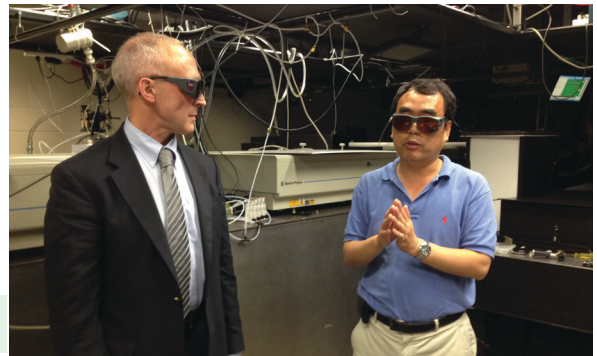


4.3 Outreach

Government Visitors

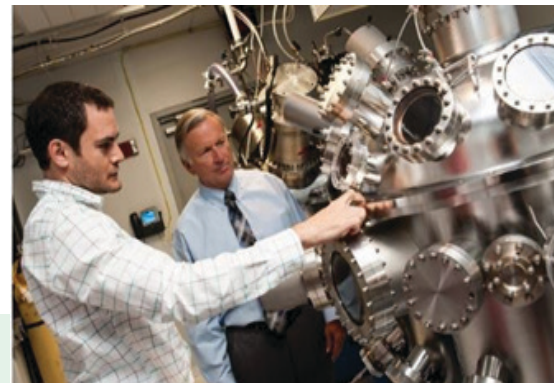
□ Peter Highnam, Director of the Intelligence Advanced Research Activity (IARPA) program, Office of the Director of National Intelligence, visited UCF and was introduced to several projects in modeling, simulation, photonics, electro-optics and engineering, and computer science. Mr. Highnam visited the lab of Zenghu Chang, who explained how attosecond laser pulses may be used to understand how electrons transition and move in materials.

Peter Highnam talks with Zenghu Chang (right) in the Florida Atto Science and Technology lab in the Physics building



□ Osceola County Commissioner Frank Attkisson visited CREOL in preparation for the construction and development of the new Florida Advanced Manufacturing Research Center (ICAMR). He visited Martin Richardson's Laser Plasma Lab (LPL) where he was introduced to new laser techniques for advanced manufacturing, and Kathleen Richardson's facilities, where he became acquainted with infrared glass processing and characterization techniques for sensors..

Larry Shah with Osceola County Commissioner Frank Attkisson (right).



- Bill Sutey, Bruce Hock (SASC PSM), & Cathy Haverstock (SEN Nelson's MLA), August 8, 2014
- Harold K. Brown, K CIV USARMY CERDEC (US), February 27, 2014
- Pierre Corriveau , Tariq Manzur, Naval Undersea Warfare Center (NUWC), October 1, 2014

International Visitors

- Igor Mokhun, Chernivtsi University, Ukraine, January 24, 2014
- Jürgen Jahns, FernUniversität in Hagen, Germany, February 17, 2014
- Javier Mondragon, Inst Nat Astrofisica Optica Electronica, Mexico, March 10, 2014
- Zhiyi Wei, Institute of Physics, Beijing, November 21, 2014
- Team from Sichuan Engineering Technical College (SCETC) exploring partnership, joint programs and opportunities for international exchange with UCF.

Bahaa Saleh and visitors from Sichuan Engineering Technical College (SCETC)



Fraunhofer-Townes Partnership

Research and academic collaboration between the Townes Laser Institute and the Fraunhofer Institute for Laser Technology (ILT), RWTH Aachen University (Germany) has been established in August 2009. Under this collaboration agreement a joint research program in the fields of laser development, material processing, novel system technology, and life sciences has been created, including the exchange of scientist and students.

Fraunhofer ILT is the leading industrial laser and laser applications facility in Europe. For more than 20 years, ILT has stood for concentrated expertise in the field of laser technology. The innovative solution to manufacturing and production problems, the development of new technical components, competent consultancy and training, highly specialized personnel, the latest technology as well as an international reputation: all these factors make for long-term partnerships.

Fraunhofer ILT's interdisciplinary research activities cover a wide range of areas such as the development of new laser beam sources and components, the use of modern laser measurement and testing

technology and laser-supported manufacturing. This includes for example laser cutting, caving, drilling, welding and soldering as well as surface treatment, micro-processing and rapid-prototyping. Furthermore, ILT's research involves laser plant technology and versatile system technology including process control. Besides solving questions of laser technology, the institute develops high-energy sources for soft X-rays for use in semiconductor production and in X-ray microscopy.

The close contact to the Department of Laser Technology at the RWTH Aachen University ensures that a continuous access to a wide knowledge base in the field of laser technology is ensured. RWTH Aachen University has achieved international recognition in several fields of engineering and science, currently ranked the first place in Germany in the fields of mechanical engineering, electrical engineering, and computer science. Several scientists affiliated with RWTH Aachen have won world-wide acclamations, including Nobel Prizes in physics and chemistry.

K-12 Outreach

Jan-Dec 2014: Eight presentations to Seminole State College about the Photonic Science and Engineering Program for nearly 200 students.

March 15, 2014: Hosted the Florida Science Olympiad State Tournament for nearly 2000 students.

May 16-17, 2014: Hosted the Science Olympiad National Tournament for over 7000 attendees.

July 2, 2014: Conducted an optics presentation for students visiting from Upward Bound.

Nov 6-9, 2014: Hosted a booth display at the National Science Teachers Conference in Orlando

June 2014: Presented to over 100 high school students on engineering at Seminole State College's High School Engineering Week.

Oct. 8, 2014: Attended the Knights Degree Expo at Valencia State College

Oct. 29, 2014: Presented to students in Laser Magnet program at Wekiva High School

Nov. 19, 2014: Attended Orange County Public Schools "Teach In" to talk about Photonics Science and Engineering.

The Khet laser game



5. CREOL Association of Optics Students

CAOS, the *CREOL Association of Optics Students*, is a student organization founded in 1999 to bring together the diverse population of graduate students of CREOL, The College of Optics and Photonics. CAOS facilitates communication and integration of the student chapters of four optics and photonics professional societies: OSA-The Optical Society, IEEE-Photonics Society, SPIE-The International Society for Optics and Photonics, and SID-The Society for Information Display. The OSA Student Chapter was a finalist for OSA's 2014 Chapter Excellence Award for recognition of excellence in the areas of advocacy, youth education, and professional development programming. Inaugurated on August 21, 2014, WiLO (Women in Lasers and Optics) is a UCF registered student organization that will be a member of the now 6 student organizations at CREOL. WiLO is a group of students

at UCF working to establish connections between women in optics and related fields, enabling the development of valuable networks of professionals as well as preparedness for post-graduate life. This is done through events such as discussion panels with recent CREOL alumni and local professionals, soft skills seminars, and outreach activities. WiLO's mission is: (1) to promote personal and professional growth for women of CREOL in the field of Optics, Photonics and Lasers through community building, networking opportunities, and encouraging young women to choose optics as a career. (2) To work towards preparing all CREOL students, enrolled in undergraduate and graduate degrees, for the transition from student to professional life.

5.1 Officers

Elected officers of CAOS and the professional societies' student sections in 2013-2014 are listed below:



President: Alex Sincore
Vice President: Ashutosh Rao
Treasurer: Laura Sisken
Secretary: Jaie Greene



President: Zhenyue Luo
Vice President: Ruidong Zhu
Treasurer: Yating Gao
Secretary: Atiloluwa Popoola



President: Anthony Klee
Vice President: Guangming Tao
Treasurer: Colin Constant
Secretary: Himansu Pattanaik



President: Sihui He
Vice President: Md Javed Rouf Talukder
Treasurer: Aniket Patil
Secretary: Joshua Beharry



President: Daming Xu
Vice President: Fenglin Peng
Treasurer: Jiamin Yuan
Secretary: Eric Prado
Webmaster: Haiwei Chen

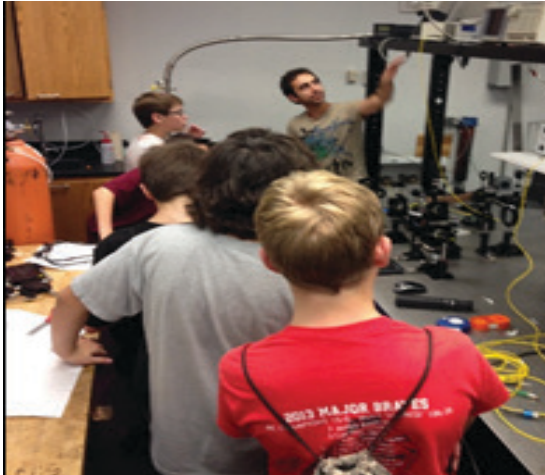


President: Clémence Jollivet
Vice President: Kristina Bagnell
Treasurer: Amy Van Newkirk
Secretary: Laura Sisken

5.2 Educational Outreach

Jackson Middle School Visit – January 10, 2014

CREOL hosted close to 35 middle school students, part of the 7th grade Cambridge program, for lab tours during their visit to the University of Central Florida. The students were guided through three labs where they learned exciting optical phenomena and met CREOL graduate researchers. The students learned about new developments in frequency combs, fiber optics, and applied quantum optics. After touring CREOL, the students got to interact with the wonderful optic demonstrations before visiting the rest of UCF.



Graduate student Hossein Hodaei shows a laser system to Jackson Middle School students

Pine Hills Elementary Science Night – January 30, 2014

Pine Hills Elementary school held their Science Night and invited CREOL as the special guest! The elementary students presented their science projects while engaging in teacher-planned activities. OSA and SPIE student chapter volunteers Himansu Pattanaik and Sihui He demonstrated total internal reflection by shining a laser into a water stream, spreading of white light into the rainbow through a prism, and fluorescent beads



OSA and SPIE student chapter volunteers Himansu Pattanaik and Sihui He with the elementary students and their science projects

Cypress Creek High School Visit – February 3, 2014

The CREOL Association of Optics Students was invited to Wheatley Elementary School's math night in Apopka. The CREOL students performed demos at one of the stations that the elementary students rotated through. The elementary students were introduced to total internal reflection, the different bandwidths of fluorescent and incandescent light bulbs, and solar powered cars.

Florida Science Olympiad – March 15, 2014

UCF hosted the Florida Science Olympiad (FSO) State Tournament, a competition for Florida high school and junior high students covering a broad range of science disciplines. The OSA student chapter designed and coordinated the optics event for FSO. The event consisted of a written exam covering basic geometrical and physical optics and a hands-on segment requiring the students to use mirrors to guide a laser beam around obstacles toward a target. Over 100 students from more than 50 schools participated in the optics event.

ACE: Achieving a College Education Day – March 17, 2014

For the 5th Annual ACE: Achieve a College Education Day, 650 fifth grade students from 7 title one schools in Orange County were brought to UCF for an interactive, hands-on day on the UCF Campus. Over 120 attendees visited CREOL in two separate sessions. The groups were given exciting lab tours of fiber optics, diffractive optical elements, random optical media, laser communication, and liquid crystal displays. After the lab tours, the students interacted with our optic demos such as a light-guiding water fountain and a real-life hologram.

Optics Day – April 4, 2014

CREOL opened its doors for the annual Optics Day, a fun-filled event of lab tours, optic demos, exciting talks, and prizes. Over 200 visitors attended, including five different middle and high schools in the Orlando area. The CREOL lobby was filled from back to front with demos, including three brand new ones that were chosen via a CAOS-held Optics Demo Contest. Profs. Saleh, Delfyett, Wu, Schülzgen, and Baudelet presented exciting talks on their research for the public and school students. In between the talks and checking out the demos, attendees had a chance to take a lab tour through CREOL visiting three different research groups



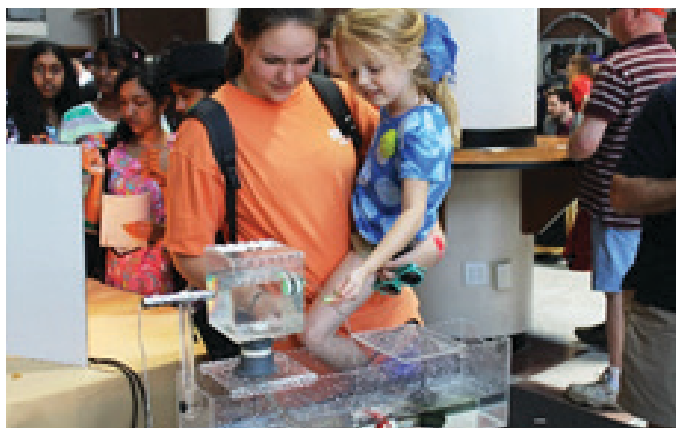
Left: CREOL graduate Roman Grigorev shows an Orlando local a home-made scintillator. Right: Dr. Delfyett presents his exhilarating talk on lasers, as well as demonstrating fluorescence (bottom right).

National Science Olympiad – May 16-17, 2014

UCF hosted the National Science Olympiad, which is the premiere science competition in the nation, providing rigorous, standards-based challenges to nearly 7,000 teams in 50 states. Science Olympiad's ever-changing line-up of events in all STEM disciplines exposes students to practicing scientists and career choices, and energizes classroom teachers with a dynamic content experience. As a part of this experience, CREOL hosted nine lab tours for the Science Olympiad attendees on May 16th. This covered the Nonlinear Optics group, Fiber Optics group, and Multi-material Optical Fiber Devices group. WiLO had a booth at the STEM Expo, in which they displayed science demos and informed students of the opportunities at CREOL and within WiLO.



WiLO President Clémence Jollivet speaks with Science Olympiad guests about opportunities at UCF-CREOL



Attendees got to see some of the CREOL home-built optics demos, such as the TIR Fountain

High School High Tech Program Visit – June 20, 2014

High School High Tech is an enrichment program for foster youth who would like to pursue careers in STEM. As a part of their schedule, the students visited CREOL to learn how their phone display works with the LCD group, and how fiber optics work with the Fiber Optic group.

ZORA! STEM Summer Camp – July 1, 2014

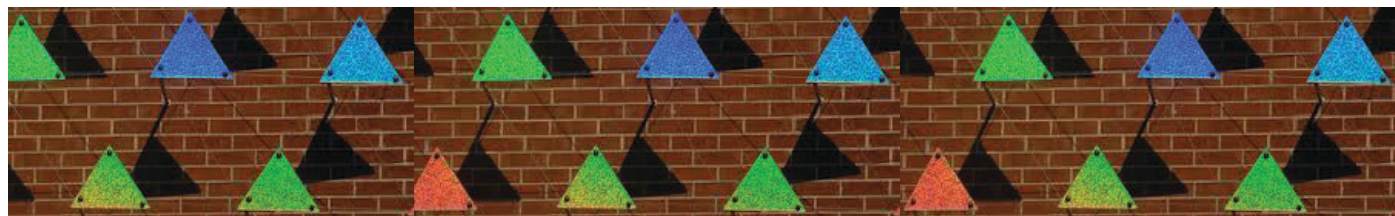
The CREOL Association of Optics Students (CAOS), hosted twenty-seven students from the ZORA! STEM Summer Camp as part of a nearly a month long experience for middle school students in which they learn about science, engineering, and mathematics in a fun and exciting way. Dr. Peter Delfyett presented a talk about lasers, optics and photonics; while CAOS presented hands on activities on the nature of light, lasers and basic optics. Students used diffraction gratings to view light that was spread out to reveal a spectrum of colors

ACU Upward Bound Program visit – July 11, 2014

Twenty students and seven chaperones from Abilene Christian University Upward Bound Program (from Abilene, Texas) visited CREOL to view laboratories and learn about optics and photonics. This was part of a field trip in which students visited Kennedy Space Center and other local attractions. CAOS hosted the students for their visit and demonstrated several of the exhibits on display in the lobby.

Arbor Ridge K-8 Teach-In – November 19, 2014

Arbor Ridge invited CREOL to come demonstrate optics and general science to 86 first grade students during Orange County's annual Teach-In day. CAOS president Ali Abdulfattah and SPIE vice-president Alex Sincore showed phenomena such as total internal reflection and fiber optics, which were well received by the students. Each first grader got a pair of their very own diffraction glasses to remember the event



5.3 Professional Development

IEEE-PS Guest Speaker Seminar – January 10, 2014

The High Value of the Entrepreneurial Skill Set with Andrea Wesser

In this talk, Andrea Wesser discusses what skill sets make an entrepreneur, and how the entrepreneurial mindset will help you with your career, no matter what sector you are in. Also, learn more about how to become active in UCF's growing entrepreneur ecosystem and what resources are available to help you succeed with your first start-up. This entrepreneur workshop also promoted the valuable resources UCF has, such as the Office of Research & Commercialization, and the Venture Accelerator, of which Andrea is a member.

Apple – February 20, 2014

Optics Networking Event with Lea Fink and Zhibing Ge

"Every day, people do amazing things at Apple. What will you do?" During this Optics networking event, Lea Fink (University Relations Recruiter) described the experience of working at Apple and what Apple is looking for in a potential employee. Apple collected students' résumés for summer and future interns. CREOL alumni Zhibing Ge attended the event, and held an informal chat to answer questions about work and social life with his new career.

OSA Traveling Lecturer Seminar – June 19, 2014

The Business of Optics Today and in the Next Ten Years with Robert Breault

Optics is a rapidly evolving industry and maintaining a competitive edge is a constant challenge. In this presentation, Dr. Robert Breault gave his perspective on the current state of the optics market and its outlook in the coming future. He spoke on the challenges of starting and growing a company and how to foster a culture of innovation that enables continued success.

SPIE Faculty Talk Series – September 26, 2014

Perspectives on a Research Career: Research at Bell Labs to Academia with Peter Delfyett

This presentation was a personal perspective on how one can manage their research career, whether it is in a world class industrial research lab or in a research intensive university. Dr. Delfyett highlighted the inherent challenges and rewards one might encounter on either path. He also discussed the transition from graduate school to the professional career, as well as suggested possible strategies to help in navigating the difficult times.



Dr. Delfyett filled the lecture room with record attendance for his enthusiastic and informed talk on life after graduate school.

WiLO Entrepreneurship and Starting a Business – November 6, 2014

Discussion with Jennifer McKinley and Professor K. C. Richardson

Have you thought about starting a business? Are you interested in creating or working in a start-up company? UCF graduate Jennifer McKinley along with UCF Professor and WiLO Faculty Advisor Kathleen Richardson discussed their experiences in entrepreneurship and starting a company. They discussed what it was like to work at a major corporation and to start businesses of their own. They described what it was like to go from a new idea and new technology to a company, with intellectual property, product development, customers, employees, and payroll. They also held a lunch afterwards with a group of students.

SPIE Faculty Talk Series – November 17, 2014

How Did We Get Here? with Lawrence Shah

The fact that we are here within CREOL is the result of many choices, some conscious, some unconscious, and many beyond our control. Although clearly limited, understanding the past is the only way to inform preparation for the future. This presentation reviewed the changing challenges of trying to figure out "what I want to do when I grow up" based upon Dr. Shah's experience as a former CREOL graduate student, industrial researcher, and now research professor.

SPIE Industry Tour and Lunch – December 11, 2014

FAZ Technology, Inc.

SPIE Student Chapter organized an industry tour at FAZ Technology with 20 students attending. Four CREOL Alumni now work at FAZ Tech, two of which gave us a technical tour. Charles Williams and Umar Piracha demonstrated some of FAZ Tech's novel optical sensing devices in various environments. After the technical tour, three of FAZ Tech's employees ate lunch with the group and answered many questions about industry, career paths, and work life.



Students toured the facilities of FAZ Technology in Research Park.

5.4 Seminars and Symposia

OSA Graduate Research Symposium

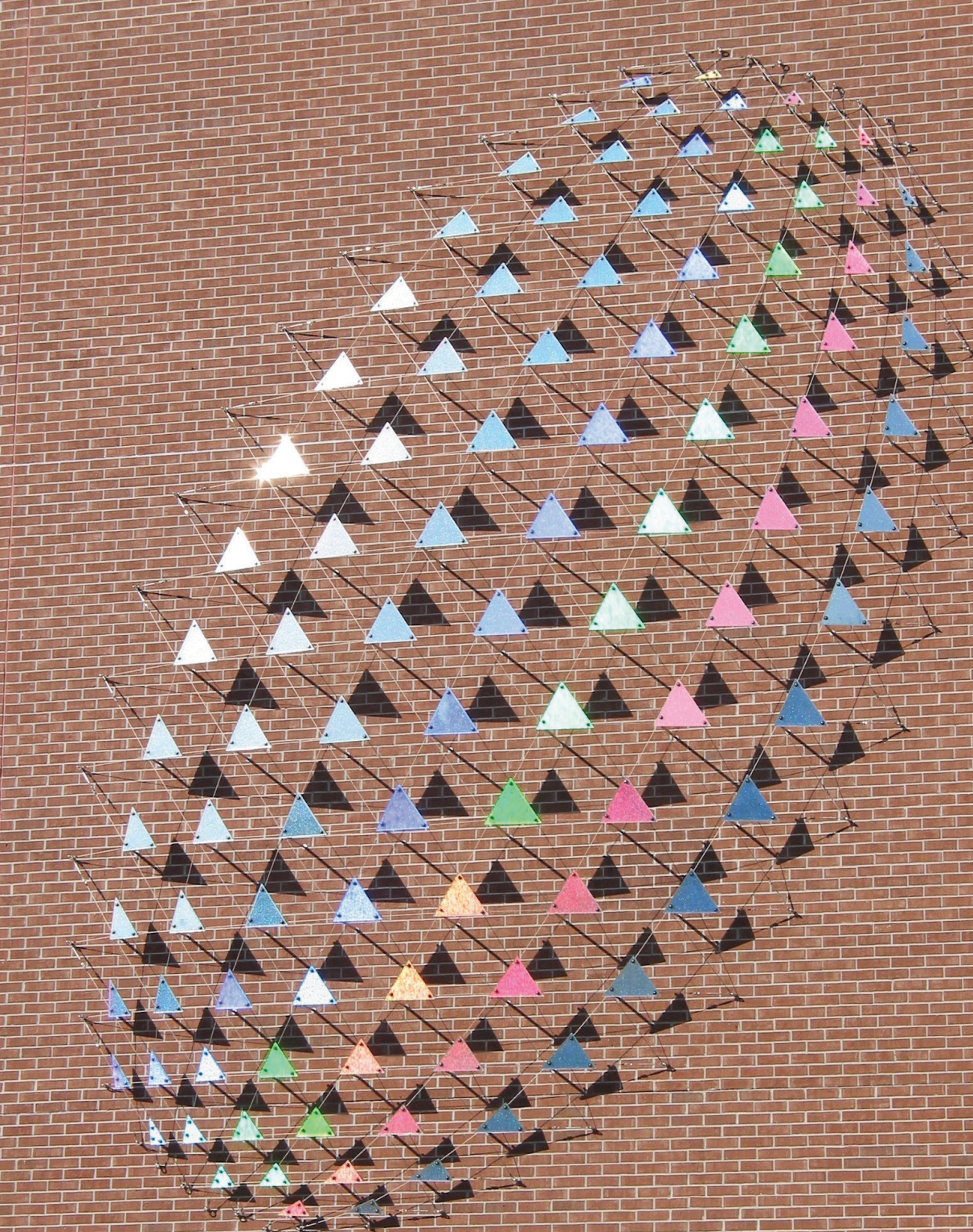
In this series of talks sponsored by the student chapter of OSA at CREOL, graduate students gave presentations on their research. The purpose of this new symposium is to internally educate our researchers, promote collaboration, and give students practice at presenting. With 20 graduate student speakers, these talks have spanned over 15 research groups covering the vast breadth of activities at CREOL.

DATE	TITLE & SPEAKER
1/16/2014	“Dressed Optical Filaments” Matt Mills “Quantum Computation with Polarization and Spatial Profile of Photons” by Kumel Kagalwala
2/21/2014	“Transparent Ceramics: Multiple Processing Routes” by Taylor Shoulders “White Light Continuum for Broadband Nonlinear Spectroscopy” by Trenton Ensley
3/26/2014	“Distribution of Laser Induced Heating in Multi-component Chalcogenide Glass” by Laura Sisken “Next-Generation Platforms for Mid-Infrared Integrated Photonics” by Jeff Chiles
4/22/2014	“Transient Nonlinear Refraction in Liquids and Gases” by Matt Reichert “Scaling Peak Powers in Fiber Lasers” by Alex Sincore
6/25/2014	“PT-Symmetric Micro-ring Laser” by Hossein Hodaei “Low-noise Semiconductor-based Harmonically Modelocked Lasers” by Kristina Bagnell
7/30/2014	“Passive Optical Mapping of the Phase Transitions in Triblock Copolymer Systems” by Rafael Guzman-Sepulveda “Electrical Cables that Store Energy” by Zenan Yu
8/25/2014	“Outlook for Next-Generation Liquid Crystal Displays” by Daming Xu “Transverse Mode Control in Laser Resonators using Holographic Elements” by Brian Anderson
9/24/2014	“Attosecond Transient Absorption Experiments in Atoms and Molecules” by Yan Cheng “Towards Broadband, Multi-Gigahertz Spaced Frequency Combs” by Anthony Klee
11/12/2014	“Liquid Crystal-Plasmonic structural Metasurfaces for Dynamic Color Pixels” by Daniel Franklin “Compositional dependence of relaxation behavior in the Ge-As-Se system characterized by length dilatometry” by Erick Koontz
12/9/2014	“Deposition of luminescent quantum dot doped chalcogenide glass films from solution” by Spencer Novak “Temperature dependence of defect and microstructural evolution in thermally cycled Cu-TSVs” by James Marro

CAOS Organized Seminars

1/9/2014	Jason Eichenholz, Open Photonics, Inc.	CREOL Alumni Series: <i>Jason Eichenholz</i> , OSA
1/10/2014	Andrea Wesser UCF Office of Research and Commercialization	<i>The High Value of the Entrepreneurial Skill Set</i> , IEEE-PS
1/31/2014	Xianghua Zhang, Université de Rennes I – CNRS	<i>Infrared Transmitting Glasses and Glass Ceramics for Infrared Transmission and Energy Applications</i> , OSA
2/20/2014	Lea Fink, Zhibing Ge, Apple	<i>Optics Networking Event</i> , CAOS

DATE	SPEAKER	TITLE & ORGANIZER
3/27/2014	Siddharth Ramachandran, Boston University	<i>Can fibers replace all (most) lasers? – Nonlinear Optics with Bessel Beams in Fibers,</i> IEEE-PS
4/1/2014	Christopher Barty, Lawrence Livermore National Laboratory	<i>The National Ignition Facility and the Pursuit of Star Power on Earth,</i> IEEE-PS
5/2/2014	Richard Lepkowitz, Booz Allen Hamilton	CREOL Alumni Series: <i>Richard Lepkowitz,</i> OSA
5/5/2014	Lei Xi, University of Florida	<i>Photoacoustic Imaging of Breast Cancer: Detection and Image-guided Surgery,</i> SPIE
5/5/2014	Martin Muschol, University of South Florida	<i>Optical Approaches for Studying Amyloid Fibril Assembly Near Physiological Conditions,</i> SPIE
5/5/2014	Alexandre Fong, Gooch & Housego, LLC	<i>New Photonic Developments for Life Sciences Application,</i> SPIE
5/30/2014	Michael Wittek, Merck Performance Materials Liquid Crystals	<i>Liquid Crystals for Smart Antennas and other Microwave Applications,</i> IEEE-PS, SID
6/5/2014	José Capmany, ITEAM Research Institute	<i>Integrated Microwave Photonics,</i> IEEE-PS, SPIE
6/19/2014	Robert Breault, Breault Research Organization	OSA Traveling Lecturer Seminar: <i>The Business of Optics Today and in the Next Ten Years,</i> OSA
8/22/2014	Yan-qing Lu, Nanjing University	“Generation and Modulation of Optical Vortices with Liquid Crystal Technology” IEEE-PS, SID
9/26/2014	Peter Delfyett, University of Central Florida	Faculty Talk Series: <i>Perspectives on a Research Career – From Industrial Research at Bell Labs to Academia,</i> SPIE
10/08/2014	Mohammad Umar Piracha, FAZ Technology	CREOL Alumni Series: <i>Mohammad Umar Piracha,</i> OSA
10/15/2014	Xin Gai, Australian National University	<i>Infrared Nonlinear Materials,</i> OSA
11/06/2014	Jennifer McKinley, IRradiance Kathleen Richardson, University of Central Florida	<i>Entrepreneurship and Starting a Business,</i> WiLO
11/17/2014	Lawrence Shah, University of Central Florida	Faculty Talk Series: <i>How Did We Get Here?</i> SPIE



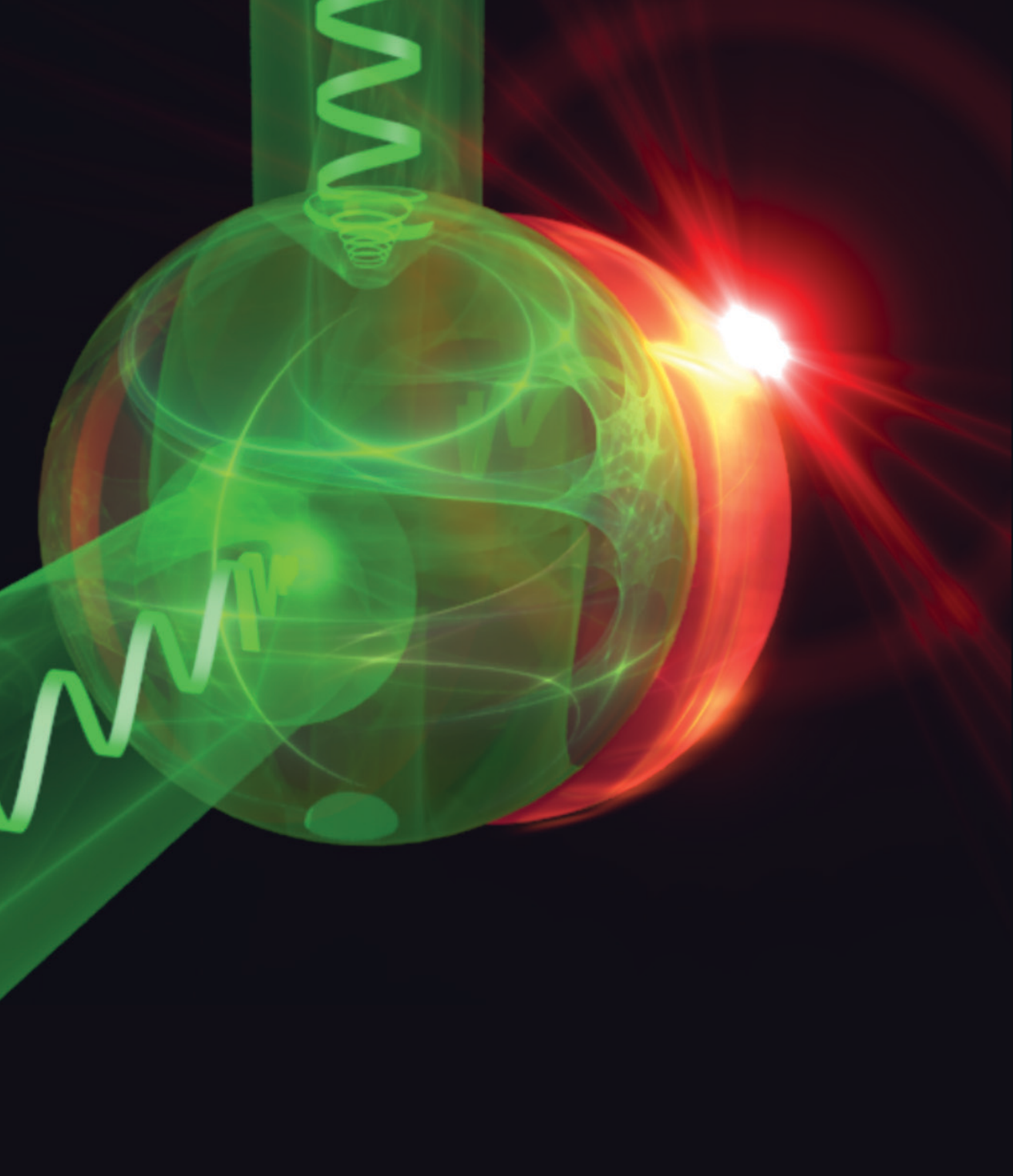
University of Central Florida

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Annual Report



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2014



CREOL