CREOL,
The College of Optics and Photonics

UCF CREOL, The College of Optics and Photonics

Annual Report

2016

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Message from the Dean

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 graduate 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).

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, optoelectronics and integrated photonics, nonlinear and quantum optics, as well as imaging, sensing and display. These technologies have applications in manufacturing, communication, biology and medicine, energy and lighting, and defense. Advanced topics such as nanophotonics, attosecond optics, plasmonics, and biophotonics are embraced as areas of strength and future growth. World-renowned for their scholarly contributions to fundamental and applied optics and photonics, the faculty have published 26 books and more than 4,000 journal papers with close to 100,000 citations. Many are recipients of prestigious national and international awards.

CREOL was initially founded to promote growth in optics and related fields 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 support from the Florida High Tech Corridor Council and Enterprise Florida. The CREOL Industrial Affiliates Program has attracted 194 different industrial members since its founding. The faculty have produced close to 300 patents, and spun off 27 photonics-based companies involving a wide variety of technologies.

Highlights of 2016 include the addition of two new junior faculty members who joined the college in Spring 2016: Drs. Kye Young Han and Luca Argenti. An expert in fluorescence nanoscopy, label-free single-molecule and live-cell RNA imaging, Han received his Ph.D. from Seoul National University and the Max Planck Institute for Biophysical Chemistry, and was a postdoctoral fellow at the Howard Hughes Medical Institute. Argenti, who received his Ph.D. from Scuola Normale Superiore di Pisa, Italy, and was a faculty member with the Universidad Autónoma de Madrid, is active in theoretical attosecond science. He also has an appointment with the Physics Department. Recruitment effort to fill the position in laser-based advanced manufacturing was successful. Dr. Xiaoming Yu joins the college as Assistant Professor in Spring 2017. He received the Ph.D. from Kansas State University. Another key highlight is the George Stegeman Memorial Symposium, which was held in January 7–8, 2016 to honor Dr. Stegeman's legacy. The conference was attended by 80 participants and a new endowed graduate scholarship was created in his name.

The new BS in Photonic Science & Engineering, which began in Fall 2013, continues to grow. Current enrollment is 119. In AY 2015–16, 115 graduate students were enrolled, and 16 Ph.D. degrees and 24 M.S. degrees were awarded. Graduate students continue to receive national scholarships, fellowships, travel grants, and best papers/poster awards.

In 2016, MJ Soileau was inducted into the Florida Inventors Hall of Fame, and became Foreign Member of the Russian Academy of Sciences. Martin Richardson received a Fulbright-Tocqueville Distinguished Chair Award. Ayman Abouraddy became Fellow of OSA and Mike Bass became Fellow of AAAS. Mercedeh Khajavikhan received an ONR Young Investigator Award, and Sean Pang received the Ralph E. Powe Junior Faculty Enhancement Award. At the university level, Zenghu Chang received the Pegasus Professor Award as well as the UCF Trustee Chair Award. ST Wu received the University Award for Excellence in Research, and also the College Research Incentive Award. Jim Moharam received the TIP Award and Mercedeh Khajavikhan won the Excellence in Graduate Teaching award.

This year, the research conducted by the CREOL faculty, students, and scientists was disseminated nationally and internationally in 4 book chapters, 201 journal papers, including 12 papers in Nature journals, one in Science and 6 in Optica. Research and educational programs were funded by contracts and grants totaling approximately $17.1M in FY 2016. Our tradition of innovation has also continued. In 2016, the faculty were inventors or co-inventors of 13 issued patents.

Our partnership with industry continues to be strong. Approximately $3.1M were 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. The 2016 Industrial Affiliates Day events were attended by 225 guests and 18 exhibitors; the students presented 32 posters, and 4 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. The CREOL Association of Optics Students (CAOS) has maintained its strong involvement in outreach and professional development. Another highlight of 2016 is the Florida Science Olympiad, which was held at UCF in March 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 2016. Key data are also compared to previous years to show progress and identify trends. Academic data are reported for the academic year AY2015-2016 (Summer 2015, Fall 2015, Spring 2016). Fiscal data, grants, and patents are reported for the fiscal year FY2016 (July 2015–June 2016). Publications are reported for the 2016 calendar year. The report also highlights a number of selected research contributions. 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 on the website.

Bahaa Saleh

Faculty and Staff

Ayman F. Abouraddy

Associate Professor of Optics and Photonics

Ph.D., 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, non-linear fiber optics, supercontinuum generation, mid-infrared fibers, chalco-genide glass fibers, fibers for solar applications, quantum optics and quantum information processing, optical generation of entangled states for sensing and imaging, nanowire and naopartide 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

- Fellow, OSA 2016
- Research Initiative Award University-wide 2015
- Reach for the Stars Award 2014
- Teaching Incentive Program Award 2014

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

Luca Argenti

Assistant Professor of Physics, Optics and Photonics

Ph.D., Chemistry, Scuola Normale Superiore of Pisa, Italy 2008

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Research

Ab initio and analytical description of the electronic continuum of atoms and molecules, theoretical photoelectron spectroscopy, attosecond transient-absorption spectroscopy, attosecond interferometric techniques for the reconstruction of electronic wave packets, transiently bound states, Auger decay, vibrational excitation in photoemission, intramolecular photoelectron scattering, double ionization.

Other Experience

- Post-Doctoral fellow at Stockholm University (2009-2010)
- Post-Doctoral fellow at Autonomous University of Madrid (2010-2016)

Professional Activities:

- Member of the organizing committee of the Intl. Spring School on New Computational Methods for Attosecond Molecular Processes (Zaragoza, 2015)
- Member of the international organizing committee of ICPEAC (Intl. Conf. Phot. El. & At. collisions) since 2015
- Member of the local organizing committee for XXIX ICPEAC (Toledo 2015)

Zenghu Chang

University Trustee Chair; Pegasus and 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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Research

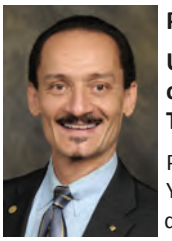
Nonlinear wave propagation, nonlinear optics, beam synthesis and dynamics, optical solitons, periodic and random optical structures, nonlinear optics in soft matter, quantum transport in arrays and photonic lattices.

Professional Activities

- QELS General Chair, 2014
- QELS Program Chair, CLEO/QELS, 2012
- Committee Chair, CLEO/QELS—QELS5, 2010-11

Honors and Awards

- Cobb Family Endowed Chair Professor
- OSA R.W. Wood Prize, 2011
- Fellow, OSA, APS
- ISI Highly Cited Researcher 2016
- UCF Pegasus Professor



Peter J. Delfyett

University Trustee Chair; Pegasus Professor of Optics and Photonics, EE, Physics; Director, Townes Laser Institute

Ph.D., Electrical Engineering, City University of New York, 1988

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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
- Chair, APS – Division of Laser Science

Honors and Awards

- NSF Presidential Early Career Award for Scientists & Engineers
- Fellow, APS, IEEE, NAI, NSBP, OSA, SPIE
- 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

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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, ECE

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
- Chair of Short Courses at Conference on Laser and Electro-Optics (CLEO)

Honors and Awards

- UCF Reach for the Stars Award, 2015
- 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 Professor of Optics and Photonics, NanoScience Technology

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

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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

Professional Activities

- Member, SPIE, ACerS, OSA

Honors and Awards

- Dissertation Thesis Award, 2002.

Ryan M. Gelfand

Assistant Professor of Optics and Photonics

Ph.D. Electrical Engineering, Northwestern University, 2013

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http://nbpl.creol.ucl.edu

Research

Near-field optics, Aperture based optical trapping, Plasmonic trapping, Single protein spectroscopy, Protein biophysics, dynamics, and behavior, Fiber optic biosensing device development, Protein assay development, Compact optical based biosensors, Pharmaceutical treatment testing for proteopathy diseases

Other Experience

- NSF post-doctoral fellowship in Biology, University of Victoria, 2013 – 2015

Professional Activities

- Member – OSA, SPIE
- Program Committee – SPIE Biosensing and Nanomedicine

Honors and Awards

- NSF Postdoctoral Fellowship in Biology
- Northwestern Terminal Year Fellowship
- SPIE Scholarship in Optics and Photonics

Leonid B. Glebov

Research Professor of Optics and Photonics

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

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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

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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

- Executive Editor-in-Chief, Chinese Optics Letters
- Editor-in-Chief, Optical Materials Express (2010-15)
- Topical Editor, J. Opt Soc. Am B., (2006-10)
- Principal Editor, Journal of Materials Research (2001-06)
- Chair, OSA Nonlinear Optics meeting (2017)
- Chair, Frontiers in Optics (2015)
- Senior Member, IEEE

Honors and Awards

- Fellow, OSA, SPIE
- Ranked by ISI as "Highly Cited Researcher"

Dr. Kyu Young Han

Assistant Professor of Optics and Photonics

Ph.D., Chemistry, Seoul National University, Korea 2010

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nanoscopy.creol.ucf.edu

Research

Development and applications of fluorescence nanoscopy (super-resolution fluorescence imaging), fluorescent tags, single-molecule fluorescence imaging, label-free imaging techniques to study essential problems in biology and neuroscience.

Other Experience

- Postdoctoral Fellow, Department of Physics and Howard Hughes Medical Institute
- University of Illinois, Urbana, IL (2011 – 2015)
- Visiting Student, Department of NanoBiophotonics
- Max Planck Institute for Biophysical Chemistry Göttingen, Germany (2007 – 2010)

Professional Activities

- Program session chair: SPIE Biosensing and Nanomedicine IX (08/2016)
- Journal reviewer: eLife, Nature Methods, Nanoscale, J Phys D

Honors and Awards

- Max Planck Institute Fellowship (2008-2010)
- International Research Collaboration Fellowship (KRF, 2007-2008)
- Korea Science and Engineering Foundation Scholarship (2005)

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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Research

Nanophotonics , applied electromagnetic, laser physics, quantum optics, non-Hermitian photonics, silicon photonics, and plasmonics.

Other Experience

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

Professional Activities

- Topical Editor: Optics Express
- Member: OSA, SPIE, IEEE
- Committee member: CLEO-QELS 2015-2017, SIAM 2015, Meta Conference 2017
- Reviewer: Nature, Science, Nature Communications, Optica, Optics Letters, Optics Express, Applied Physics Letters, IEEE Photonics Technology Letters

Honors and Awards

- Norton Fellowship for Academic Excellence, University of Minnesota, 2005
- NSF Early CAREER Award, 2015
- Excellence in Graduate Teaching Award- UCF CREOL, 2016
- ONR Young Investigator Award, 2016

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

- Member, OSA, MRS

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, ACS
- Senior Member, SPIE
- Chair, Orlando Section of the American Chemical Society, 2012
- Marshall Scholarship Selection Committee, Atlanta Region (2009-2013)

Honors and Awards

- NSF CAREER Award, January 2008
- Teaching Incentive Program Award, UCF, 2008 & 2014
- Excellence in Undergraduate Teaching Award, College of Sciences, UCF, 2008 & 2015
- 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

li@creol.ucf.edu | (407) 823-6811

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
- IEEEE 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

Diffractive holographic optics, Integrated photonics grating based devices, domputational 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

Shuo "Sean" Pang

Assistant Professor of Optics and Photonics

Ph.D. Electrical Engineering, Caltech 2013

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Research

Computational imaging, Optical imaging, X-ray imaging, Biophotonics:microscopy, Optical design, Microfluidics and Micro total analysis system

Professional Activities

- Chair, Microscopy and OCT Technical Group, OSA
- Member, SPIE

C. Kyle Renshaw

Assistant Professor of Optics and Photonics

Ph.D., Applied Physics, University of Michigan, 2014

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Research

Thin-film optoelectronics, Organic LEDs, Solar Cells and Sensors, Perovskite LEDs, Lasers and Photovoltaics, Hybrid organic/inorganic materials and devices, Thin-film transistors, Flexible electronics, Nanofabrication, Large area optoelectronics

Professional Activities

- Member, Materials Research Society

Other

- Physicist, Advanced Technology Center, Northrop Grumman Corp., 2013-2015

Kathleen A. Richardson

Professor of Optics and Photonics, Material Science and Engineering

Ph.D., Ceramics, Alfred University, 1992

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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

- Past President, American Ceramic Society
- Member, Board of Trustees, Ceramic and Glass Industry Foundation (CGIF)
- Curator, Ernst Abbe Fund Board of Trustees, Deutsches Stiftung
- Member, External Advisory Board, Savannah River National Laboratory
- Member, Board of Trustees, Alfred University

Honors and Awards

- Fellow, OSA, SPIE, ACerS and SGT
- Academician, World Academy of Ceramics
- I.D. Varshnei Award, Indian Ceramic Society
- Outstanding Educator Award, American Ceramic Society
- Samuel R. Scholes Lecture and Award, Alfred University

Martin C. Richardson

FPCE Trustee Chair; Northrop Grumman Prof. of X-ray Photonics; Pegasus Professor of Optics and Photonics, Physics, ECE

Ph.D., Physics, London University, 1967

mcr@creol.ucf.edu | (407) 823-6819

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 Mees Medal, 2013
- 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

winston@creol.ucf.edu | (407) 823-6898

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

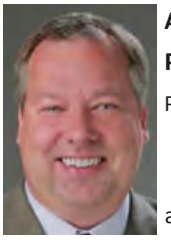
- Director, cSi Photovoltaic Manufacturing Consortium (PVMC)
- President/CEO, Medical Lighting Solutions, 2003-04
- Device Manager, Uniroyal Optoelectronics, 2000-03

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

axel@creol.ucf.edu | (407) 823-1746

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

- Member, OSA, SPIE, German Physical Society
- Topical Editor, Applied Optics, 2010-2016
- Guest Editor, JOSA B, 2016/2017
- Program Committee CLEO, OFC, SOF, FILA

Honors and Awards

- CREOL Excellence in Research Award, 2015
- 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

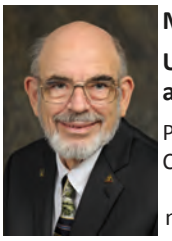
Fiber Laser, ultrafast lasers, thin disk lasers, nonlinear optics for wavelength generation in the near-and mid-IR, laser materials processing.

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

Professional Activities

- Member, SPIE, OSA
- Assistant Editor for IEEE Journal of Quantum Electronics
- Topical Editor for Optics Letters



M.J. Soileau

University Distinguished 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, Aquafibe

Professional Activities

- President, SPIE, 1997
- International Advisory Committee on Coherent and Nonlinear Optics, 2001
- Co-Chair, OSA/SPIE Joint Task Force, 1998-9

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, 2014

Eric W. Van Stryland

Pegasus Professor of Optics and Photonics, Founding Dean

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

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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, 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

21st Century Scholar Chair and Professor of Optics and Photonics

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

vodopyanov@creol.ucf.edu | (407) 823-6818
mir.creol.ucf.edu

Research

Mid-Infrared Combs Group (MIR). Broadband mid-infrared ($\lambda > 2.5$ μm) frequency combs generation based on subharmonic optical parametric oscillators. Trace molecular sensing and coherent dual-comb spectroscopy using octave-wide MIR combs. Biomedical applications of frequency combs. Photonic THz wave generation and THz imaging. Nano-IR spectroscopy.

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 (ISPDI), Beijing, China, 2013
- Photonics West, LA106 Conference Chair (2010-present)
- CLEO General Chair, 2010, CLEO Program Chair, 2008
- Associate Editor, Optica
- Co-author, Solid-Steate 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

swu@creol.ucf.edu | (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

- SID Honors and Awards Committee
- SPIE G.G. Stokes Award Committee
- 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 Fellow
- 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

Larry.andrews@ucf.edu | 407-823-2418

Research

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

Other Experience

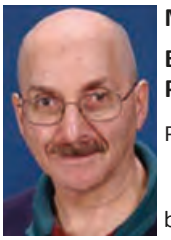
- Staff Mathematician, Antisubmarine Warfare Operation, Magnavox Co., Fort Wayne, IN
- Assistant Professor of Mathematics and Mechanics, Tri-State University, Angola, IN

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

bass@creol.ucf.edu | (407) 823-6977

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
- Fellow of LIA
- Fellow of AAAS
- Fellow of Russian Academy of Engineering Science
- Fellow of National Academy of Inventors

Glenn D. Boreman

Emeritus Professor of Optics and 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 Electo-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 and 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

silfvast@creol.ucf.edu

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

Optical Materials Laboratory

Joint Faculty

Matthieu Baudelet

Assistant Professor of Chemistry, Optics and Photonics; National Center for Forensic Science

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

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Debashis Chanda

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Heat Transfer Issues in Electro-Optics

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Ph.D., Harvard University

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Andre Gesquiere

Associate Professor, Nanoscience Technology Center, Chemistry, Optics and Photonics

Ph.D., University of Leuven

Optoelectronic Materials, Nanobiology

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Florencio E. Hernandez

Associate Professor of Chemistry, Optics and Photonics

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

Optical Materials

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David Kaup

Provost Distinguished Research Professor of Math, Optics and Photonics

Ph.D., University of Maryland

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Associate Professor of Physics, Optics and Photonics

Ph.D., University of Basel

Quantum Information

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Arkadiy Lyakh

Assistant Professor, NanoScience Technology Center

Ph.D., University of Florida

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Robert E. Peale

Professor of Physics, Optics and Photonics

Ph.D., Cornell University

Defects in Semiconductors

robert.peale@ucf.edu

Seetha Raghavan

Associate Professor of MAE

Ph.D., Purdue University

Optical Characterization of Advanced Materials

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Alfons Schulte

Professor of Physics and Optics and Photonics

Dr. rer. Nat, Technical University of Munich

Near-IR Raman Spectroscopy

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Mubarak A. Shah

Agere Chair Professor of Computer Science, Optics and Photonics

Ph.D., Wayne State University

Computer Vision

mubarak.shah@ucf.edu

Michael Sigman

Professor of Chemistry, 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

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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, Optics and Photonics

Ph.D., University of Washington

Laser Propagation in Random Media

cynthia.young@ucf.edu

Courtesy Faculty

Clara Rivero Baleine

Mechanical Engineer Staff, Lockheed Martin Missiles and Fire Control

Ph.D., CREOL/Optics and Photonics, University of Central Florida

clara.rivero-baleine@lmco.com

Bruce H. Chai

President, Crystal Photonics

Ph.D., Yale University

chai@crystalphotonics.com

Jason Eichenholz

Divisional Technology Director, Halma CEO, Open Photonics, Inc.

Ph.D., CREOL, University of Central Florida

jason@open-photonics.com

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

Ph.D., MIT

h.jenssen@ac-materials.com

Eric G. Johnson

Professor of Physics & Optical Science

University of North Carolina Charlotte

Ph.D., University of Alabama

egjohnso@uncc.edu

Vassilios Kovanis

AFRL, Sensors Directorate

Ph.D., University of New Mexico

Semiconductor lasers, nonlinear optics

vassilios.kovanis@ucf.edu

Jannick Rolland

Brian J. Thompson Professor of Optical Engineering, Professor of Biomedical Engineering, University of Rochester

Ph.D., University of Arizona

Optical Diagnostics & Applications

rolland@optics.rochester.edu

Kenneth Schepler

AFRL, Sensors Directorate

Ph.D., University of Michigan

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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

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Malvin C. Teich

Visiting Research Professor

Ph.D., Cornell University

Quantum Optics

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2016 Faculty Awards and Honors

National and International Awards

Fellow of The Optical Society	Ayman Abouraddy
Fellow of America Association for the Advancement of Science	Michael Bass
Ralph E. Powe Junior Faculty Enhancement Awards	Shou "Sean" Pang
Fellow of SPIE	David Hagan
Florida Inventors Hall of Fame Inductee	M.J. Soileau

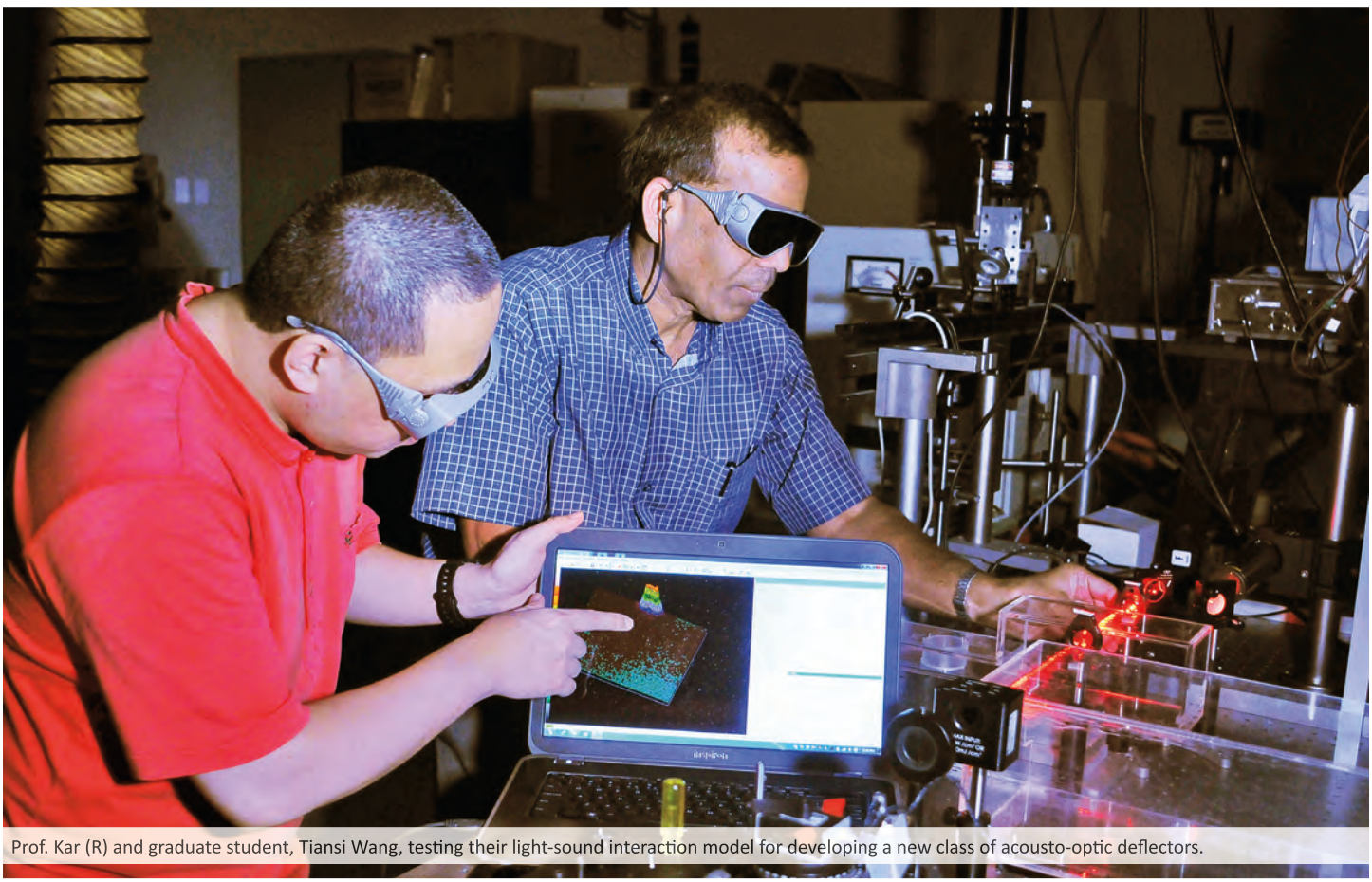
University Awards

Pegasus Professor Award	Zenghu Chang
Trustee Chair	Zenghu Chang
Teaching Incentive Program Award (College Level)	Jim Moharam
Research Incentive Award (College Level)	Shin-Tson Wu
Excellence in Graduate Teaching Award (College level)	Mercedeh Khajavikhan
Excellence in Research Award (College level and At Large)	Shin-Tson Wu

Faculty Awards and Honors

OSA The Optical Society	1997 Max Born Award	Boris Zeldovich
	1999 Nicholas Holonyak Award	Dennis Deppe
	1999 Esther Hoffman Beller Award	Bahaa Saleh
	2008 Esther Hoffman Beller Award	M.J. Soileau
	2008 Distinguished Service Award	Bahaa Saleh
	2010 Joseph Fraunhofer/Robert M. Burley Prize	Shin-Tson Wu
	2003 R. W. Wood Prize	George Stegeman
	2011 R. W. Wood Prize	Demetrios Christodoulides
	2012 R. W. Wood Prize	Eric Van Stryland
	2013 C.E.K. Mees Medal	Bahaa Saleh
	2014 R. W. Wood Prize	Michael Bass
SPIE.	1995 Kingslake Medal and Prize	Glenn Boreman
	2004 Bacus Award	Bahaa Saleh
	2008 Dennis Gabor Award	Leonid Glebov
	2008 G. G. Stokes Award	Shin-Tson Wu
	2008 Gold Medal Award	M.J. Soileau
	2013 Harold E. Edgerton Award	Martin Richardson
	2015 G.G. Stokes Award	Aristide Dogariu
IEEE photonics SOCIETY	2003 Engineering Achievement	Dennis Deppe
SID SOCIETY FOR INFORMATION DISPLAY	2008 Jan Rajchman Prize	Shin-Tson Wu
	2011 Slottow–Owaki Prize	Shin-Tson Wu

APS AMERICAN PHYSICAL SOCIETY	2011 Edward A. Bouchet Award	Peter Delfyett
The American Ceramic Society	ACerS Outstanding Educator Award (2009)	Kathleen Richardson
NSF	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) NSF CAREER Award (2015)	Peter Delfyett Dennis Deppe Sasan Fathpour Pieter Kik Stephen Kuebler Guifang Li Sasan Fathpour
ONR Science & Technology	ONR Young Investigator Award (1991) ONR Young Investigator Award (1995) ONR Young Investigator Award (2013)	Dennis Deppe Guifang Li Sasan Fathpour
ORAU OAK RIDGE ASSOCIATED UNIVERSITIES	Ralph E. Powe Junior Faculty Award (2009)	Ayman Abouraddy
John Simon Guggenheim Memorial Foundation	Guggenheim Fellow (1984)	Bahaa Saleh



Prof. Kar (R) and graduate student, Tiansi Wang, testing their light-sound interaction model for developing a new class of acousto-optic deflectors.

International Awards and Honors

Michael Bass	Fellow, Russian Academy of Engineering Science (1994)
Michael Bass	Fellow, International Academy of Engineering, Russia
Michael Bass	Fellow, American Association for the Advancement of Science (2016)
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)
M.J. Soileau	Foreign Member of the Russian Academy of Sciences (2016)
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

OSA The Optical Society	Ayman Abouraddy Michael Bass Zenghu Chang Demetrios Christodoulides Peter Delfyett Dennis Deppe Aristide Dogariu	Leonid Glebov David Hagan Guifang Li Jim Moharam James Pearson Kathleen Richardson Martin Richardson	Bahaa Saleh William Silfvast M.J. Soileau George Stegeman Eric Van Stryland Shin-Tson Wu Boris Zeldovich
SPIE.	Glenn Boreman Peter Delfyett Leonid Glebov David Hagan James Harvey	Guifang Li James Pearson Kathleen Richardson Martin Richardson Bahaa Saleh	Winston V. Schoenfeld M.J. Soileau Eric Van Stryland Shin-Tson Wu
APS American Physical Society	Zenghu Chang Aristide Dogariu Demetrios Christodoulides	Peter Delfyett Martin Richardson Eric Van Stryland	
Laser Institute of America	Aravinda Kar Michael Bass		
The American Ceramic Society	Leonid Glebov Kathleen Richardson		
SID Society for Information Display	Shin-Tson Wu		
AAAS Advancing Science, Serving Society	Michael Bass Martin Richardson		
NAI National Academy of Inventors	Michael Bass Peter Delfyett Leonid Glebov	Guifang Li M.J. Soileau Shin-Tson Wu	
Florida Inventors Hall of Fame	M.J. Soileau ST Wu		

Presidents, Directors, & Officers of Professional Societies

OSA The Optical Society	Eric Van Stryland	President (2006)
	Michael Bass	Board of Directors Member (1989–1992)
	Peter Delfyett	Board of Directors Member (2004–2006)
	Bahaa Saleh	Board of Directors Member (1998–2005)
	Eric Van Stryland	Board of Directors Member (1998–2001)
	Shin-Tson Wu	Board of Directors Member (2013–2014)
SPIE.	M.J. Soileau	President (1997)
	Glenn Boreman	Board of Directors Member (1997–1999)
	James Harvey	Board of Directors Member (2001–2003)
	Kathleen Richardson	Board of Directors Member (2012–2015)
IEEE photonics SOCIETY	Shin-Tson Wu	Board of Govenors (2003–present)
	Peter Delfyett	Board of Govenors (2000–2002)
	Jim Moharam	Vice-President (1997–1999)
	Kathleen Richardson	Board of Directors Member (2012–2015)
Laser Institute of America	Michael Bass	President (1988)
	Michael Bass	Board of Directors Member (1985–1989)
	Aravinda Kar	Board of Directors Member (2005)
	Bahaa Saleh	Board of Directors Member (2010–2012)
	Eric Van Stryland	Board of Directors Member (1992–1994)
National Society of Black Physicists	Peter Delfyett	President (2008–2011)
The American Ceramic Society	Kathleen Richardson	Board of Directors Member (2008-2015)
	Kathleen Richardson	President (2014-2015)
APS American Physical Society	Peter Delfyett	Vice-Chair (2015-)
National Institute of Ceramic Engineers (NICE)	Kathleen Richardson	President (2008–2009)

Journal Editors

Journal of the Optical Society of America B (1984–1987)	Michael Bass
Applied Optics (2000–2005)	Glenn Boreman
Applied Optics/Optical Technology (1998–2003)	Glenn Boreman
Applied Optics/Optical Technology (2004–2010)	Aristide Dogariu
IEEE Journal of Selected Topics in Quantum Electronics (2001-2006)	Peter Delfyett
IEEE/LEOS Newsletter (1995–2000)	Peter Delfyett
Optics Communications (2011–2012)	Pieter Kik
Optical Materials Express (2010–present)	David Hagan
Chinese Optics Letters (2016)	David Hagan
Journal of the Optical Society of America A (1991–1997)	Bahaa Saleh
Advances in Optics & Photonics (2008–2014)	Bahaa Saleh
IEEE/OSA Journal of Display Technology (2004–2008)	Shin-Tson Wu

Associate and Topical Editors

Optica (2014– present)	Konstantin Vodopyanov
Optics Express (2001–2001)	Michael Bass
Optical Engineering (Radiometry & Detectors) (1998–1999)	Glenn Boreman
Applied Optics (Radiometry & Detectors) (1992–1997)	Glenn Boreman
Optics Express (2009–present)	Glenn Boreman
International Journal of Optics (2008–present)	Glenn Boreman
IEEE Photonics Technology Letters (1995–2003)	Peter Delfyett
IEEE J. of Quantum Electronics (1996–2001)	Demetrios Christodoulides
Journal of the Optical Society of America B (2001–2003)	Demetrios Christodoulides
Journal of the Optical Society of America B (2007–2013)	David Hagan
Journal of Materials Research (2000 –2007)	David Hagan
Optics Express (2007–present)	Guifang Li
Photonics Technology Letters (2007–present)	Guifang Li
Journal of the Optical Society of America A (1998–2004)	Jim Moharam
International Journal of Applied Glass Science (2009–present)	Kathleen Richardson
Optical Materials Express (September 2013)	Kathleen Richardson
Journal of Quantum Electronics (1980–1986)	Martin Richardson
Journal of the Optical Society of America A (1984–1990)	Bahaa Saleh
Journal of the Optical Society of America (1980–1983)	Bahaa Saleh
Journal of Materials Research (2007–present)	Winston Schoenfeld
Applied Optics (2008–present)	Axel Schülzgen
IEEE Journal of Quantum Electronics Lawrence Shah	Lawrence Shah
Optics Letters: Nonlinear Optics (1995–1998)	Eric Van Stryland
Reviews of Scientific Instruments (1978–1981)	Eric Van Stryland
IEEE/OSA Journal of Display Technology (2008–present)	Shin-Tson Wu
Liquid Crystals (2009–present)	Shin-Tson Wu

Books

Michael Bass,

Laser Materials Processing **(***Materials Processing, Theory and Practices***),** Vol. 3, Elsevier (1983).

Walter Koechner and **Michael Bass**,

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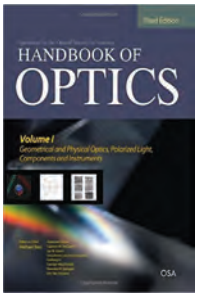

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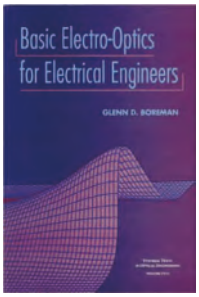

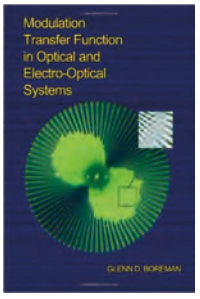

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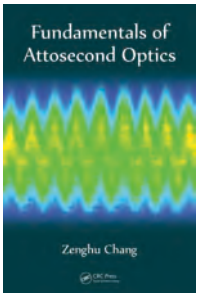

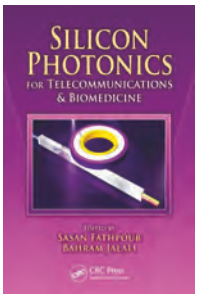

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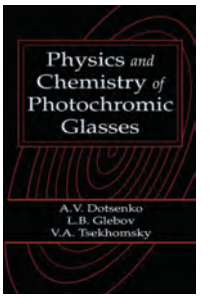

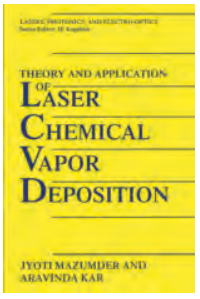

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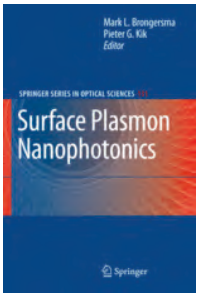

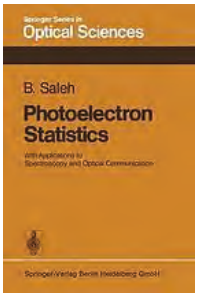

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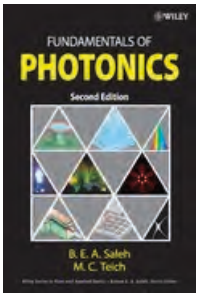

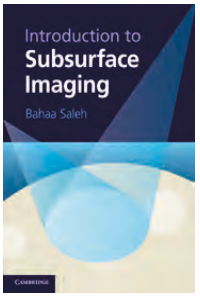

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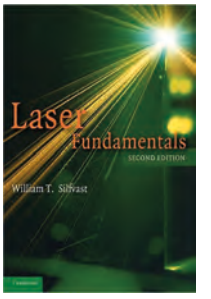

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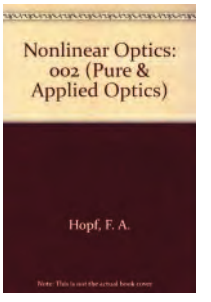

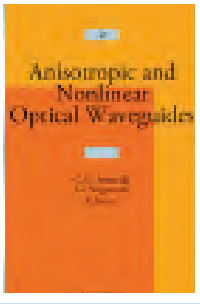

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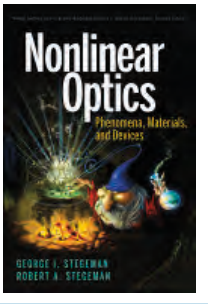

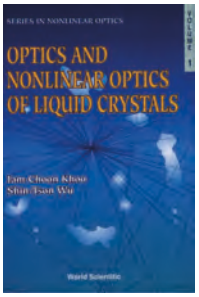

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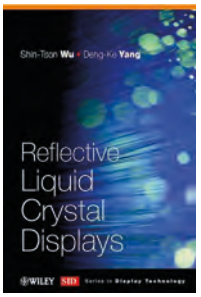

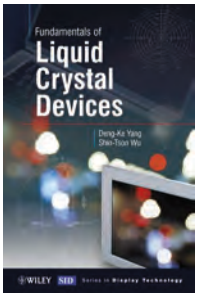

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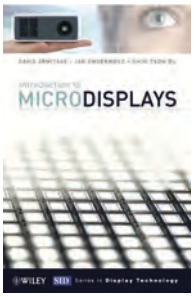

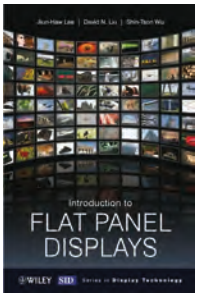

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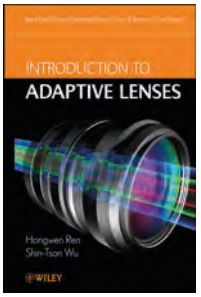

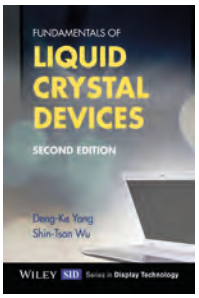

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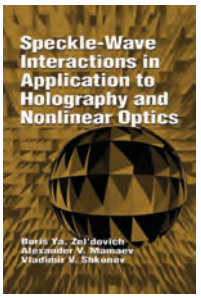

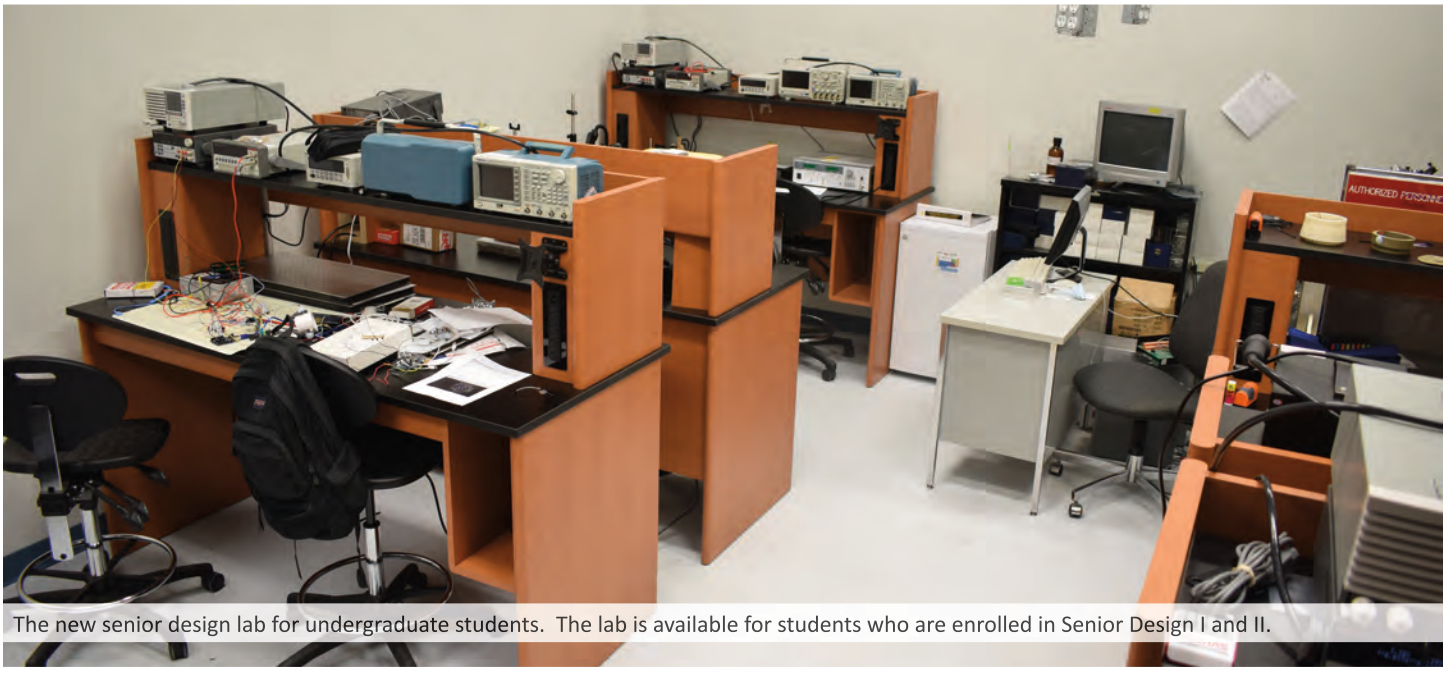

The new senior design lab for undergraduate students. The lab is available for students who are enrolled in Senior Design I and II.

Research Staff

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Ivan Divliansky (Prof. Glebov's group)
Ilya Mingareev (Prof. M. Richardson's group)
George Venus (Prof. Glebov's group)
Scott Webster (Groups of Profs. Abouraddy, Hagan, Van Stryland)

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Hong Shu (Prof. Bass' group)
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Anupama Yadav (Prof. K. Richardson's group)

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Nejmettin Avci (Prof. Wu's group)
Mykhailo Bondar (Profs. Hagan/Van Stryland group)
Luiz Gustavo Cancado (Prof. Dogariu's group)
Sang Hun Choi (Prof. Wu's group)
Jose Hipolito Garcia-Gracia (Prof. Khajavikhan's group)
Juhao Li (Prof. Li's group)
Gisela Lopez Galmiche (Prof. Christodoulides's group)
Christos Markos (Prof. Abouraddy's group)
Partha Mukhopadjyay (Prof. Schoenfeld's group)
Felix Jose Salazar Bloise (Prof. Dogariu's group)
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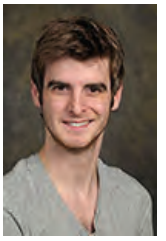

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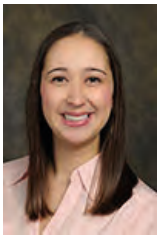

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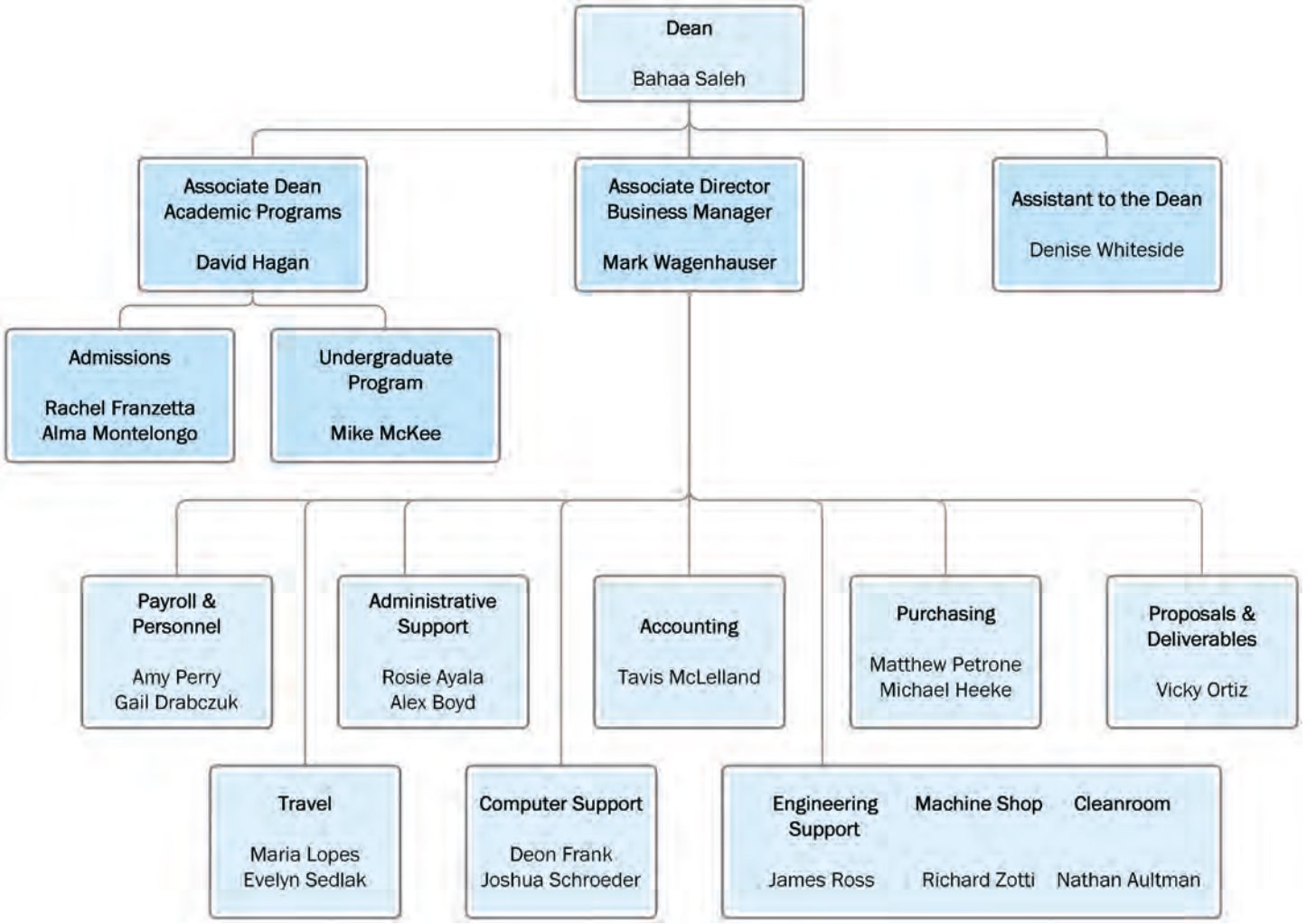
Organizational Chart



Academic Programs

With the ramping up of the undergraduate program and the offering of three masters tracks in addition to the Ph.D. program, the teaching load of the college has grown over the past few years, a trend which is projected to continue for some time. The faculty have responded well to these changes and remain committed to delivering world-class programs in optics and photonics at both the undergraduate and graduate levels.

Undergraduate Program

Fall 2016 marked the start of the fourth year of the Bachelor of Science in Photonic Science and Engineering program with over 110 students and eight graduates.

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. 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 3000 open positions. On a recent sampling of job postings, annual salaries begin at $50,000 to $70,000. Students who complete the program will be prepared for immediate employment or can pursue an advanced degree in optics and photonics. The U.S. Department of Labor is forecasting a need for approximately 30,000 new photonics engineers by 2024.

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 43 credit hours in optics and photonics. Coursework includes classes such as Electrical Networks, Electronics, Laser Engineering, Fiber Optic Communication, Biophotonics, and Imaging and Displays.

In 2016, we saw the edition of a course in Geometric Optics. This content was partially taught within Introduction to Photonics, but there was a need to add a course to provide additional depth in both geometric and physical optics.

An undergraduate curriculum committee comprised of faculty and administrative staff within the college meets on a monthly basis to evaluate coursework.

In September, the ABET accreditation team visited COP to evaluate the PSE program. Over the course of three days they visited with faculty, toured facilities and evaluated student coursework. Their initial report was presented but the final vote on our accreditation status will not occur until July 2017.

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 various colleges. In 2016, many more out of state students are showing interest in the PSE program.

Recruitment continues through various organizations. In 2016, presentations were made to local state college and high schools. Promotional materials and presentations have been made available for teachers to raise awareness of the program with targeted campaigns to schools where there has historically been a significant number of students majoring in engineering. Promotional materials were also distributed at the Florida Association of Science Teachers conference held in Tallahassee in late October.

In Fall 2016, a new undergraduate senior design lab was brought online. The lab space is designed for students who are in Senior Design II who need space to design and build their projects. The space is outfitted with six laboratory benches, with three stations outfitted with basic instrumentation students need to complete projects. Corporate donations from Tektronix helped to accelerate the process of outfitting the lab. However, not all workstations have been completely outfitted, so in coming years additional equipment will be purchased.

Again this year, the college was active in outreach and many of

our undergraduate students helped with various activities.

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. The PSE students were judges in several events, including the Optics events.

The OSA Foundation / The Optical Society awarded a grant of $8000 to create a curriculum manual containing 40 lesson plans and demonstrations for science teachers in grades K-12. The book was finalized and printed in early 2016. The book has activities ranging from using light as a fingerprint to lenses and mirror basics. It is available online and in print form for a limited distribution to teachers.

COP gives scholarships annually to students based on their grades and other factors. Latifah Maasarani and Antonett Nunez-Delprado each received $1000 scholarships.

The Society of Optics Students (SOS) had its first full year and conducted various outreach activities that included a field trip to Harris Corporation, seminars on resume writing, and outreach for K-12 students. They participated in the bi-annual UCF STEM Day.

Undergraduate Labs

There are two undergraduate lab facilities available for students. The Undergraduate Lab is a shared space where all course-based labs (for example, Optoelectronics and Laser Engineering) are conducted. A second lab facility opened in Fall 2016 which hosts students who are working on Senior Design. This space has 6 lab benches and are outfitted with basic electronic and photonic meters and instruments.

Photonics Major and Capstone	34
OSE 3200 Geometric Optics	3
OSE 3052 Introduction to Photonics	3
OSE 3052L Introduction to 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

PSE Restricted Electives	11
OSE 4421 Biophotonics	3
OSE 4240 Optics & Photonics Design	3
OSE 4720 Visual Optics	3
ISC 6416 History of Physical Science & Cultural Connections	1
OSE/EEL/PHY Approved Course	3
or other approved Math/Eng/Sci courses (max 6 CR)	6

Graduate Program

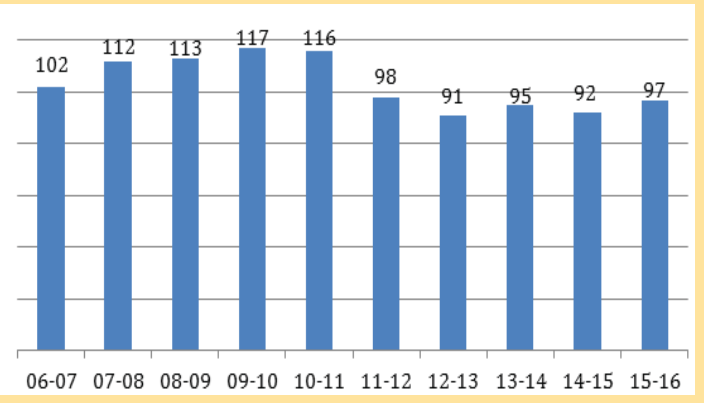
The College maintains a strong focus on education at both undergraduate and graduate levels. Our M.S. and Ph.D. programs emphasize rigorous coursework and strong opportunities to conduct leading-edge research. Our goal is that when our M.S. and Ph.D. students graduate, they are well prepared to become leaders in the field of optics and photonics, whether they choose a career in industry or academia.

Graduate Recruitment and Enrollment

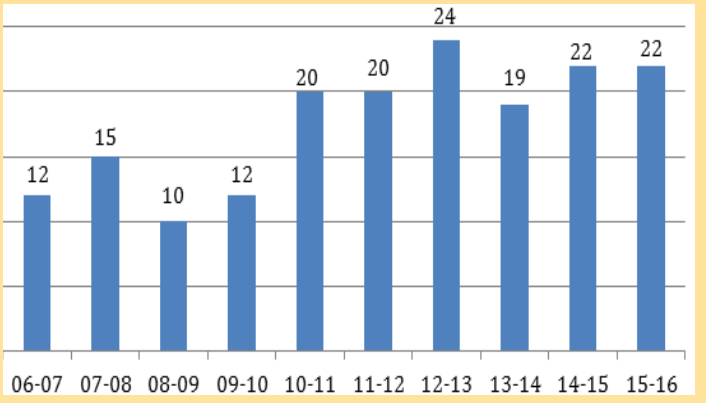
Enrollment in the Ph.D. program in AY 2015-2016 at 97 has remained roughly constant over the last five years. The average for the 5 year period 2006 – 2011 is 112 students, while the average over the last five years is 94.6 students. This was associated with low intakes in 2011 and 2012 due to low federal funding amounts. We expect this number to grow over the next 5 years.

The M.S. average enrollment from 2006 to 2011 was 14 students, which has grown to 21 students between 2011 to 2015.

History of Ph.D. Enrollment since 2005



History of M.S. Enrollment since 2005



A combined total of 30 new students (23 Ph.D. and 7 M.S.) enrolled in AY 2015-16. The following charts reflect the enrollment near the beginning of the fall semester in each academic year and this number fluctuates slightly throughout the year due to students entering and graduating in different terms. Note that we have corrected the way in which we report the number of M.S. students compared to previous annual reports, so as to count students who are active in both M.S. and Ph.D. programs only once.

Overall, we received 342 pre-applications and 199 full applications to the graduate programs for the AY 2015-2016. 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.

The mean GRE percentile scores for admitted students of 86% for AY 2015-2016 is higher than the five year average of 85% for the Quantitative Scores. The highest Mean Percentile Ranking achieved over the last five years was 91% in 2014-15.

Attracting a balance of gender is a target that CREOL is attempting to achieve. In fall 2015, 21% of Ph.D. and 14% of M.S. student were female. Our goal is to grow the number of female students admitted by 10% each year.

Fall 2015 Mean GRE Scores

		GRE Quantitative	Quant %	GRE Verbal	Verbal %	WA %
Ph.D.	US	163.8	86.2%	158.4	78.4%	63.7%
	Intl	164.0	84.9%	150.8	48.7%	19.4%
M.S.	US	161.0	79.7%	161.7	88.0%	56.0%
	Intl	167.0	93.3%	150.3	46.5%	15%
Mean		163.9		154.6		

New Matriculants for Fall 2015 - Summer 2016

		Male	Female	FT	PT	CREOL Fellow	UCF Award*	UCF Trustee	UCF Dean
Ph.D.	US	6	3	9	0	4	0	1	0
	Intl	11	3	14	0	13	0	0	0
M.S.	US	3	0	3	0	0	0	0	0
	Intl	4	0	4	0	0	0	0	0
Total New Students		30							

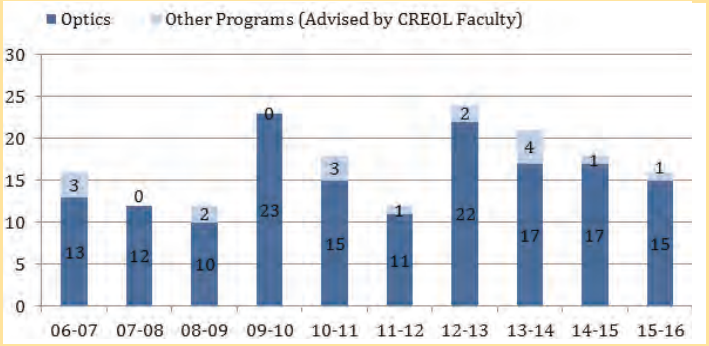
* Northrop Grumman, Schwartz, Suchoski, Frances Townes

Degrees Awarded

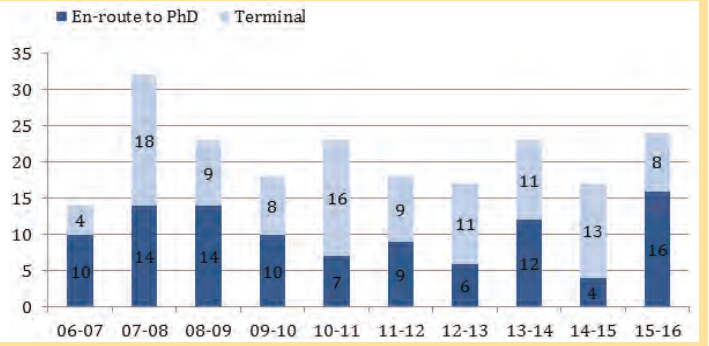
The charts below show the number of graduate degrees awarded in each academic year over the last decade. As shown in the chart below, there was a small drop in the number of Ph.D. degrees awarded in the past year. A total of 172 degrees were awarded between summer 2006 and spring 2016, and the average awarded is just over 17 per year. The average for the last five years is 18.8 per year, and the total of 18 degrees awarded in 2015-16 is continuation of the current trend.

The number of M.S. degrees awarded in academic year 2015-2016 (24) is roughly similar to previous years. The total number of degrees awarded during the 10 year period from 2006 to 2015 is 219 and the average is 20.9 per year. The current year awards at 24 higher than the average. With the increase in incoming M.S. students, this number should continue to increase.

Note that we have changed the definition of "academic year" as compared to previous years in order to match the way UCF records data. The UCF academic year begins in the summer term.



Ph.D. degrees awarded to students in the College of Optics and Photonics and students in other UCF colleges with College of Optics and Photonics advisors.



MS degrees awarded. Recipients of these degrees are classified into two groups: those who leave with an MS degree ("Terminal MS") and those who are continuing on to the Ph.D. degree ("En-route to Ph.D.).

Graduate Labs

Graduate Laboratory courses are held in CREOL A265. Classes are: OSE 6525 Laser Engineering (Spring and Summer Terms), OSE 6455 Photonics Lab (Fall Term), and OSE 6615 Optoelectronics Device Fabrication Laboratory (Fall and Spring terms).

Courses Taught

Course Number and Name		Spring 2016	Summer 2016	Fall 2016
	Core Graduate Courses			
OSE 5203	Geometrical Optics and imaging Systems			Moharam
OSE 5312	Light Matter Interaction	Van Stryland		Kik
OSE 6111	Optical Wave Propagation			Moharam
OSE 5115	Interference, Diffraction and Coherence	Abouraddy		Kar
OSE 6432	Guided Waves and Optoelectronics	Christodoulides		
OSE 6525	Laser Engineering		Richardson	Khajavikhan
	Additional Photonics Graduate Courses			
OSE 5414	Fundamentals of Optoelectronics			Gelfand
OSE 6120	Theoretical Foundations of Optics			Zeldovich
OSE 6125	Computational Photonics	Moharam		
OSE 6211	Imagaing and Optical			Dogariu
OSE 6265	Optical Systems Design		Curatu	
OSE 6335	Nonlinear Guided Wave Optics			Christodoulides
OSE 6347	Quantum Optics	Zeldovich		
OSE 6349	Applied Quantum Mechanics for Optics			Abouraddy
OSE 6416	Organic Photonics	Thomas		
OSE 6421	Integrated Photonics	Fathpour		
OSE 6445	Fundamentals of Ultrafast Optics			Delfyett
OSE 6447	Attosecond Optics			Chang
OSE 6455C	Photonics Laboratory			Li
OSE 6526C	Laser Engineering Laboratory	Vodopyanov		
OSE 6615L	Optoelectronic Device Fabrication Laboratory	Chanda		Chanda
OSE 6650	Optical Properties of Nanostructured Materials	Kik		
OSE 6820	Flat Panel Displays		Wu	
	Other Courses			
EGN 3365	Structures and Properties of Materials			
EMA 4506	Emerging Materials	Richardson		
EEL 4440	Optical Engineering			LiKamWa
ISC 6416	History of Physical Science, Cultural Connections & Other Issues	Bass		
	Undergraduate Photonics Courses			
OSE 3052	Introduction to Photonics	Hagan		LiKamWa
OSE 3052L	Introduction to Photonics Laboratory	Schülzgen		Schülzgen
OSE 3053	Electromagnetic Waves for Photonics	Moharam		
OSE 4240	Optics and Photonics Design	Pang		
OSE 4410	Optoelectronics	Khajavikhan		
OSE 4410L	Optoelectronics Laboratory	Kar		
OSE 4470	Fiber-Optic Communications			Fathpour
OSE 4470L	Fiber-Optic Communications Laboratory			Li
OSE 4520	Laser Engineering	Delfyett		
OSE 4520L	Laser Engineering Laboratory	LiKamWa		
OSE 4720	Visual Optics	Saleh		
OSE 4721	Biophotonics			Han
OSE 4830	Imaging and Display			Pang
OSE 4830L	Imaging and Display Laboratory			Vodopyanov
OSE 4930	Frontiers of Optics and Photonics			Kuebler
OSE 4951	Senior Design I	LiKamWa	Hagan	Hagan
OSE 4952	Senior Design II	LiKamWa	LiKamWa	Hagan

Doctoral Dissertations

Degrees granted in academic year 2016 (Fall 2015-Summer 2016) All students below graduated from the Optics and Photonics Program.

Student	Advisor	Dissertation Title
Parinaz Aleahmad	Demetrios Christodoulides	Monolithically Integrated InP-based Unidirectional Circulators Utilizing non-Hermiticity and Nonlinearity
Eric F. Cunningham	Zenghu Chang	Towards High-Flux Isolated Attosecond Pulses with a 200~TW CPA
Jennefir Digaum	Steven Kuebler	Fabrication and Characterization of Spatially-Variant Self-Collimating Photonic Crystals
Cheonha Jeon	Martin Richardson	Laser Filamentation in Adverse Conditions
Kumel Kagalwala	Bahaa Saleh	Entanglement and Coherence in Classical and Quantum Optics
Veerachart Kajorndejnukul	Aristide Dogariu	Conservation Laws and Electromagnetic Interactions
Anthony Klee	Peter Delfyett	Broad Bandwidth Optical Frequency Combs from Low Noise, High Repetition Rate Semiconductor Mode-Locked Lasers
Hassan Esat Kondakci	Bahaa Saleh	Photon Statistics in Disordered Lattices
Mingxin Li	Dennis Deppe	Intrinsic Modulation Response Modeling and Analysis for Lithographic Vertical-Cavity Surface-Emitting Lasers
Chatdanai Lumdee	Pieter Kik	Nanoscale Control of Gap-Plasmon Enhanced Optical Processes
Matthew Mills	Demetrios Christodoulides	Nonlinear Optical Wave Propagation: Dressed Optical Filament and Supercontinuum Generation in Parabolic Multimode Fibers
Amy Van NewKirk	Axel Schülzgen	Sensing Using Specialty Optical Fibers
Benjamin Webb	Martin Richardson	Design and Engineering of Ultrafast Amplifier Systems
Daming Xu	Shin-Tson Wu	Advanced Blue Phase Liquid Crystal Displays
Xu Yang	Dennis Deppe	Electrical Parasitic Bandwidth Limitations of Oxide-Free Lithographic VCSELs

Student Scholarships and Awards

National Scholarships, Fellowships, and Awards

Scholarships

Daming Xu, Chinese government scholarship
Fenglin (Maple) Peng, SPIE Optics and Photonics Education Scholarship & IEEE Outstanding graduate student award and scholarship
Ruidong Zhu, IEEE Outstanding graduate student scholarship

Fellowships

Jennifer Kassel, NSF GRFP Fellowship

Best Papers or Posters

Zeinab "Zahoora" Sanjabi Eznaveh-Corning Outstanding Student Paper Competition
Fenglin Maple Peng SID'16 Distinguished Paper award
Juan Rachel He, SID'16 Distinguished Paper award
Ruidong Zhu, SID'16 Distinguished Paper award
Haiwei Chen, SID'16 Distinguished Paper award
Jennefir Digaum, Second place poster, OIDA Workshop on Integrated Photonics for High Volume Packaging, OSA

Travel Grants (2016)

Roxana Rezvani Naraghi, Incubic/Milton Chang Travel Grant
Fenglin (Maple) Peng, Rachel He, Haiwei Chen, Guanjun Tan, John Yun-Han Lee, Daming Xu, Ruidong Zhu, SID Travel Grants

UCF Scholarships, Fellowships, and Awards

Undergraduate Awards

Josie Lorenzo, UCF Founders' Award for Exceptional Ability and Performance
Anthony Riggins – REU at Colorado State University in their Extreme UV Center
Jasmine Thompson, third place winner at the UCF SURE (Showcase of Undergraduate Research Excellence)
Nick Kosan, UCF Distinguished Undergraduate Researcher Award

Undergraduate Scholarships

Latifah Maasarani, Northrop Grumman Scholarship
Antonett Nunez-Delprado, Northrop Grumman Scholarship

Graduate Deans Fellowship

Andrew Chew
Juan He
Midya Parto
Danielle Reyes
Guanjun Tan

Graduate Trustees Doctoral Fellowship

Andrew Runnion

Graduate Research Forum Poster Award

Jennefir Digaum, Second Place Doctoral
Zeinab "Zahoora" Sanjabi Eznaveh, First place, (in category of mathematics, Optics, Physical Science)

UCF Scholarships

Roxana Rezvani Naraghi, UCF Women in Science and Mathematics Scholarship
Naman Anilkumar Metha, Extreme Leadership Scholarship
Naman Anilkumar Metha, Campus Involvement Scholarship

Student Government Spring Award

Naman Anilkumar Metha

College of Optics & Photonics Awards

CheonHa Jeon, Student of The Year Award
Anthony Klee, finalist, Student of the Year Award
Amy Van Newkirk, finalist, Student of the Year Award
Zahoora Sanjabi, finalist, Student of the Year Award
Roxana Rezvani Naraghi, Best Poster Award

Dr. Khajavikhan in Plasmonics and Applied Quantum Optics lab performing experiments.

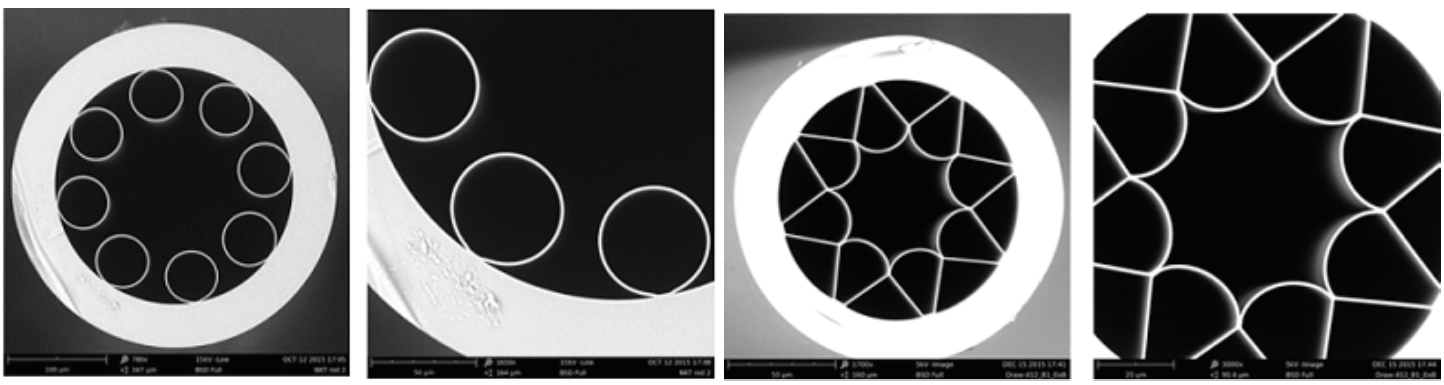
Colloquia and Seminars

Date	Speaker	Title
1/13/2016	Sung Tae Shin Kyung Hee University	The Second Korean War in the Display Industry (SID Student Chapter Seminar)
1/15/2016	K. Käläntär Japan Global Optical Solutions	BLU Optics -Optics for LCD Backlighting Unit (SID Student Chapter Seminar)
1/20/2016	C Martin Stickley Former CREOL Associate Director (ret)	Global Warming: the Source of the Heat
1/21/2016	Maria Jesus Pascual Ceramics and Glass Institute (CSIC)	Transparent glass-ceramics for photonics applications produced by melting and sol-gel
1/29/2016	Robert F. Crabbs and Ronald L. Phillips TISTEF	TISTEF Overview
2/03/2016	Roxana Rezvani Naraghi Fenglin Peng CREOL-UCF	Mesoscopic interactions incomplex photonicmedia Recent advances in IR liquid crystal spatial light modulators (OSA Graduate Research Symposium)
2/19/2016	Michael Wittek Merck Performance Materials	Liquid Crystals for Non-display Applications (SID Student Chapter Seminar)
2/19/2016	Fang-Cheng Lin National Chiao Tung University	Why Field-Sequential-Color LCD?" (SID Student Chapter Seminar Series)
2/23/2016	Eric Larkins University of Nottingham	Photonics by Design: Opportunities for physics-based simulation tools in the development of advanced photonic devices
2/24/2016	Hui Cao Yale University	Harnessing Disorder for Photonics Applications (Distinguished Seminar Series)
2/25/2016	Robert W. Boyd University of Rochester	Quantum Nonlinear Optics: Nonlinear Optics Meets the Quantum World (IEEE Student Chapter Seminar)
3/04/2016	Mercedeh Khajavikhan CREOL/UCF	Evolving Lasers to Solve Problems (SPIE Faculty Talk)
3/08/2016	Bo Zhen MIT	Nanophotonics in Systems of Large Sizes
3/14/2016	Jason Eichenholz Open Photonics	A Career in the Optics and Photonics Industry (SOS/SPIE Student Chapter Seminar)
3/16/2016	Hooman Banaei Everix	Dangers of Comfort Zone: An entrepreneurial roller coaster ride… in progress (SPIE CREOL Alumni Talk)
3/18/2016	Liang-Chy Chien Kent State University	High-performance and fast-switching liquid crystal devices based on polymer-stabilized cholesteric blue phase III and uniform lying helix (SID Student Chapter Seminar)
3/31/2016	Chang Hee Nam Gwangju Institute of Science and Technology (GIST)	Laser-Driven Particle Acceleration Performed with Femtosecond PW Lasers
4/01/2016	Jie Qiao Rochester Institute of Technology	Coherent Phasing and Deformable Gratings, Optical Differentiation Wavefront Sensing, and Ultrafast Lasers for Photonics Fabrication and Additive Manufacturing
4/05/2016	Veerabhemanye Gewgial National Instruments	National Instruments Free Seminar: An Introduction to Software Defined Radio With NI LabVIEW and NI USRP
4/05/2016	Gregory Quarles OSA Chief Scientist Eric Van CREOL/UCF	OSA Centennial Celebration SymposiumThermal modal instabilities in high power fiber amplifiers (OSA Student Chapter)
4/06/2016	Thomas Gallinelli Université Paris 13, France	New concept for organic solid state laser
4/08/2016	Peter Delfyett CREOL-UCF	Lasers - the Light Fantastic (Optics Day Seminar)
4/11/2016	Magesh T. Rajan Texas A&M University Corpus Christi	Advanced laser-based manufacturing of high-purity nanoparticles at phase boundaries with highly enhanced physical, chemical, thermal and transport properties (Manufacturing Faculty Candidate Seminar)

4/21/2016	Rodrigo Amezcua Correa CREOL-UCF	Multimode Fiber Photonics
4/22/2016	Arkadiy Lyakh NSTC-UCF	Research Trends in the Quantum Cascade Laser Field (Faculty Highlights)
4/25/2016	Xiaoming Yu Kansas State University	Developing novel laser processing strategies based on spatial, temporal and spectral control of light-matter interaction
5/11/2016	Kristopher Davis PVMC	Perspective of post-graduate life from a researcher working in solar energy (SPIE Post-Graduate Talk Series)
5/20/2016	Kristian Neyts Ghent University, Gent, Belgium	Light emission from liquid crystal and quantum rods (SID & IEEE Joint Student Chapter Seminar)
5/27/2016	Stelios Tzortzakis University of Crete & Texas A&M	Sculptured high power laser beams and applications
5/27/2016	L. Jay Guo University of Michigan	Structural Colors and Ultrasonics by Light Interaction with Nanostructures (NSTC/CREOL Distinguished Seminar)
6/02/2016	Henry Everitt Redstone Arsenal, AL	High recognition specificity remote sensing of trace gases using IR/THz double resonance spectroscopy
6/08/2016	Jiun-Haw Lee National Taiwan University	Light Extraction of OLED Display by Microstructured Film Attachment (SID & IEEE Joint Student Chapter Seminar)
7/05/2016	Kambiz Jamshidi Technische Universität Dresden	Energy Efficiency Transceiver for On Board Optical Communications
7/12/2016	Evelyn Strunk Lockheed Martin	The light at the end of the tunnel…and you've got the light part down! (OSA Student Chapter Alumni Talk)
8/10/2016	Absar Hassan Fedor Compan CREOL-UCF	PT-Symmetry and phase tranitions Photo-Thermo-Refractive glass with photosensitivity to the visible IR light (OSA Graduate Research Symposium)
8/18/2016	Yundong Zhang Harbin Institute of Technology	Engineering Dispersion: A way to enhance sensing sensitivity of our instruments (IEEE & SID Joint Student Chapter Seminar)
8/30/2016	Jayan Thomas (NSTC-UCF) David Hagan (CREOL-UCF)	Introduction to Research at CREOL: Jayan Thomas and David Hagan
9/02/2016	Shin-Tson Wu (CREOL-UCF) Kyu Young Han (CREOL-UCF)	Introduction to Research at CREOL: Shin-Tson Wu and Kyu Young Han
9/06/2016	Peter Delfyett (CREOL-UCF) Romain Gaume (CREOL-UCF)	Introduction to Research at CREOL: Peter Delfyett and Romain Gaume
9/08/2016	Raymond C. Rumpf UTEP	Spatially-Variant periodic structures in electromagnetics (IEEE MTT/AP Orlando Chapter, CREOL, & Raj Mittra Distinguished Lecture Program)
9/09/2016	Kyle Renshaw (CREOL-UCF) Ryan Gelfand (CREOL-UCF)	Introduction to Research at CREOL: Kyle Renshaw and Ryan Gelfand
9/20/2016	Eric Van Stryland (CREOL-UCF) Debashis Chanda (NSTC/CREOL)	Introduction to Research at CREOL: Eric Van Stryland and Debashis Chanda
10/13/2016	C. Kumar N. Patel Pranalytica, Inc.	All about useful infrared lasers (Distinguished Seminar Series)
10/21/2016	Vasudha Aggarwal Johns Hopkins School of Medicine	Single-molecule studies of signaling events in crude cell extracts
10/24/2016	Peter G. Schunemann BAE Systems, Inc.	Highly nonlinear crystals for efficient mid-IR frequency conversion
10/25/2016	Samindranath Mitra Editor, Physical Review Letters	You and PRL
10/26/2016	J.J. Sáenz Donostia International Physics Center (DIPC)	Casimir-like forces between particles under fluctuating optical fields (OSA Student Chapter Seminar)
11/02/2016	Peng Zhao Yangyang Sun CREOL/UCF	Ultrafast Spectroscopy of Nonlinear Refraction and Two-Photon Photochromism Recovery of 3D video from single frame (OSA Graduate Research Symposium)
11/04/2016	Tania Roy NSTC, MSE, & ICAMR	Van der Waals Heterojunctions for Nanophotonics and Energy-efficient Electronics

11/10/2016	Brian H. Kolner University of Wisconsin	Space-Time Dualities and Temporal Imaging of Optical Waveforms (IEEE Distinguished Seminar)
11/16/2016	Leonid B. Glebov CREOL/UCF	Long and Sinuous Way in Optics Research - Part II (SPIE Student Chapter Faculty Talk Series)
11/29/2016	Jonathan Arenberg Northrop Grumman Aerospace Systems	Designing the James Webb Space Telescope (SPIE Student Chapter Seminar)
12/15/2016	Myungkoo Kang Pennsylvania State University	Irradiation-Enabled, Energy-Efficient Fabrication of Next Generation Nanocomposites for (Plasmonics and Transmissive Optics)
12/19/2016	Rick Trebino Georgia Institute of Technology	Measuring Everything You've Always Wanted to Know About a Light Pulse (OSA Traveling Lecturer Talk)

Experimental setup for the development of high power, mid infrared Thulium:fiber lasers and beam combining.



SEM images of anti resonant, single mode hollow core fibers fabricated at CREOL.

Graduate Students

Master's Students

Student	Advisor	Student	Advisor	Student	Advisor
Anand, Sambhav	Kar	Lane, Jesse Ethan	M. Richardson	Schick, Ryan	
Bakhshi, Sarah	LiKamWa	Leshin, Jason	Deppe	Strunk, Evelyn	Hagan
Beadsworth, James	Deppe	Leshin, Jeremy	Deppe	Sun, Yangyang	Pang
Carboni, Christian	Guifang Li	Levy Wade, Melissa		Tatulian, Adrian	Chang
Clark, Joseh		Liu, Sili		Vinueza, Emilio	
Cox, Nicholas	Deppe	Ma, Zhao	Renshaw	Yuan, Jiamin	Wu
Dhasmana, Nitesh	Thomas	Mehta, Naman	Schülzgen	Zhang, Da	Amezcua
Fisher, Chris	Fathpour	Qin, Yangyang		Zhang, Yansong	Deppe
Gao, Munan	Hagan	Pye, Lorelle	Abouraddy	Zhu, Jianxiong	Wu
Hu, Xiaowen	Schülzgen	Rakes, Colin		Zhu, Weibin	Amezcua
Kepler, Daniel	M. Richardson	Ryan, Robert	M. Richardson		

Doctoral Students

Student	Advisor	Student	Advisor	Student	Advisor
Ahmadzadeh Benis, Sepehr	Hagan	Huang, Yuge	Wu	Runnion, Andrew	Schülzgen
Akhlaghi Bouzan, Milad	Dogariu	Jeon, Cheonha	M. Richardson	Sanchez Cristobal, Enrique	Khajavikhan
Aleahmad, Parinaz	Christodoulides	Kagalwala, Kumel	Saleh	Sincore, Alex	M. Richardson
Alvarado Zacarias, Juan Carlos	Amezcua	Kajorndejnukul, Veera-chart	Dogariu	Sisken, Laura	K. Richardson
Anderson, James	Schülzgen	Kassel, Jennifer	Renshaw	Sjaardema, Tracy	Fathpour
Bagnell, Kristina	Delfyett	Kazemi Jahromi, Ali	Abouraddy	Smith-Dryden, Seth	Saleh
Bayat, Mina	Delfyett	Kerrigan, Haley	M. Richardson	Sun, Yangyang	Pang
Bradford,Joshua	M. Richardson	Klee, Anthony	Delfyett	Suttinger, Matthew	Lyakh
Bustos Ramirez, Ricardo	Delfyett	Kompan, Fedor	Glebov	Talukder, Javed	Vodopyanov
Butrimas, Steven		Kondakci, H. Esat	Saleh	Tan, Felix	Abouraddy
Camacho Gonzalez, Guillermo	Fathpour	Larson, Walker	Saleh	Tan, Guanjun	Wu
Chen, Haiwei	Wu	Lee, Yun Han	Wu	Tang, Jialei	Han
Chen, Hao	Dong	Li, Mingxin	Deppe	Thul, Daniel	M. Richardson
Chew, Andrew	Zhang	Li, Jie	Chang	Tofighi, Salimeh	Van Stryland
Chiles, Jeffrey	Fathpour	Li, Jinxin	Gelfand	Van Newkirk, Amy	Schülzgen
Constant, Colin	Dogariu	Liu, Huiyuan	Li	Vazquez-Guardado, Abraham	Chanda
Cook, Justin	M. Richardson	Lopez Aviles, Helena	Christodoulides	Wang, Tiansi	Kar
Cunningham, Eric	Chang	Lumdee, Chatdanai	Kik	Wang, Yang	Chang
Digaum, Jennefir	Kuebler	Malinowski, Marcin	Fathpour	Wang, Ning	Li
Eftekhar, M. Amin	Christodoulides	Mayi Rivas, Jose		Webb, Benjamin	M. Richardson
Fan, Shengli	Li	Mills, Matthew	Christodoulides	Wittek, Steffen	M. Richardson
Gao, Yating	Wu	Nye, Nicholas	Christodoulides	Wu, Fan	Christodoulides
Go , Rowel	Lyakh	Parto, Midya	Christodoulides	Xu, Daming	Wu
Gou, Fangwang	Wu	Peng, Fenglin	Wu	Xu, Chi	LiKamWa
Guzman Sepulveda, J. Rafael	Dogariu	Plascak, Michael	Delfyett	Yang, Xu	Deppe
Hale, Evan	Glebov	Pye, Lorelle	Abouraddy	Zhang, Wenxu	Chang
Hassan, Absar	Christodoulides	Rao, Ashutosh	Fathpour	Zhao, Peng	Van Stryland
Hayenga, William	Khajavikhan	Ren, Jinhan	Khajavikhan	Zhao, Jian	Schülzgen
He, Juan	Wu	Roumayah, Patrick	M. Richardson	Zhu, Ruidong	Wu
Hodaeiesfahani, S. Hossein	Khajavikhan	Ru, Qitian	Vodopyanov	Zhu, Zheyuan	Pang
Huang, Bin	Li				

Post-Graduation Employment, AY 2015-2016

Parinaz Aleahmad

Ph.D. Optics & Photonics, Spring 2016

Advisor: Demetrios Christodoulides
Title: Research Scientist
Employer: Micron Systems, Ithica, NY

Eric F. Cunningham

Ph.D. Optics & Photonics, Fall 2016

Advisor: Zenghu Chang
Title: Post Doctoral Fellow
Employer: SLAC National Accelerator Lab, Menlo Park, CA

Jennefir Digaum

Ph.D. Optics & Photonics, Spring 2016

Advisor: Steven Kuelber
Title: Level-III Engineer
Employer: Micron, Inc.

Cheonha Jeon

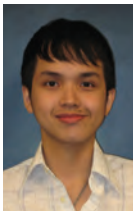
Ph.D. Optics & Photonics, Spring 2016

Advisor: Martin Richardson
Title: Ph.D. Research Fellow
Employer: Center for Relativistic Laser Science, S. Korea

Kumel Kagalwala

Ph.D. Optics & Photonics, Fall 2015

Advisor: Bahaa Saleh
Title: Post Doctoral Fellow
Employer: Joint Quantum Institute, Gaithersburg, MD



Veerachart Kajorndejnukul

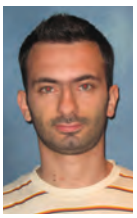
Ph.D. Optics & Photonics, Fall 2015

Advisor: Aristide Dogariu
Title: Post Doctoral Fellow
Employer: ICFO Institute of Photonic Sciences

Anthony KLee

Ph.D. Optics & Photonics, Spring 2016

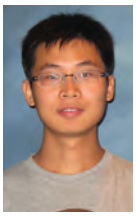
Advisor: Peter Delfyett
Title: Electrical Engineer III
Employer: Harris Corp., Melbourne, FL



Hassan Esat Kondakci

Ph.D. Optics & Photonics, Fall 2015

Advisor: Bahaa Saleh
Title: Post Doctoral/Research Scientist
Employer: UCF, College of Optics and Photonics



Mingxin Li

Ph.D. Optics & Photonics, Summer 2016

Advisor: Dennis Deppe
Title: Sr. Engineer Mfg Process Development
Employer: Lumentum, San Jose CA

Chatdanai Lumdee

Ph.D. Optics & Photonic, Fall 2015

Advisor: Pieter Kik
Title: Post Doctoral Researcher
Employer: University of Gothenburg, Sweden

Matthew Mills

Ph.D. Optics & Photonics, Fall 2015

Advisor: Demetrios Christodoulides
Title: Analyst
Employer: Citicorp Inc, Tampa, FL

Amy Van Newkirk

Ph.D. Optics & Photonics, Summer 2016

Advisor: Axel Schülzgen
Title: Post Doctoral Scholar
Employer: Pennsylvania State Univ Electro-Optics Center

Benjamin Webb

Ph.D. Optics & Photonics, Spring 2016

Advisor: Martin Richardson
Title: Research Associate
Employer: Laboratory of Laser Energetics, Rochester NY

Daming Xu

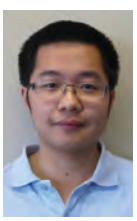
Ph.D. Optics & Photonics, Spring 2016

Advisor: Shin-Tson Wu
Title: Optical Display Engineer
Employer: Apple Inc., Cupertino CA

Xu Yang

Ph.D. Optics & Photonics, Summer 2016

Advisor: Dennis Deppe
Title: Post Doctoral Researcher
Employer: Nanjing University



Yan Cheng

Ph.D. Physics, Fall 2015

Advisor: Zenghu Chang
Title: Post Doctoral Researcher
Employer: Microsoft

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:

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 Peter Delfyett.

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.

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/*.

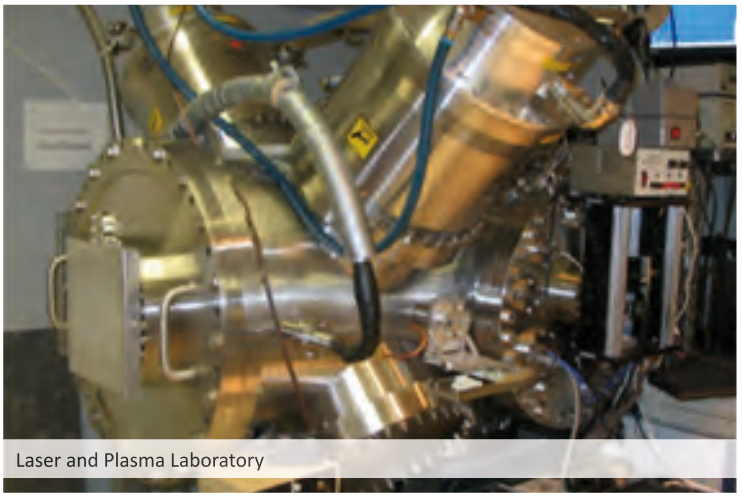
LASERS

Science and 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 and Technology

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

Applications

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

One of two fiber draw towers in the college.

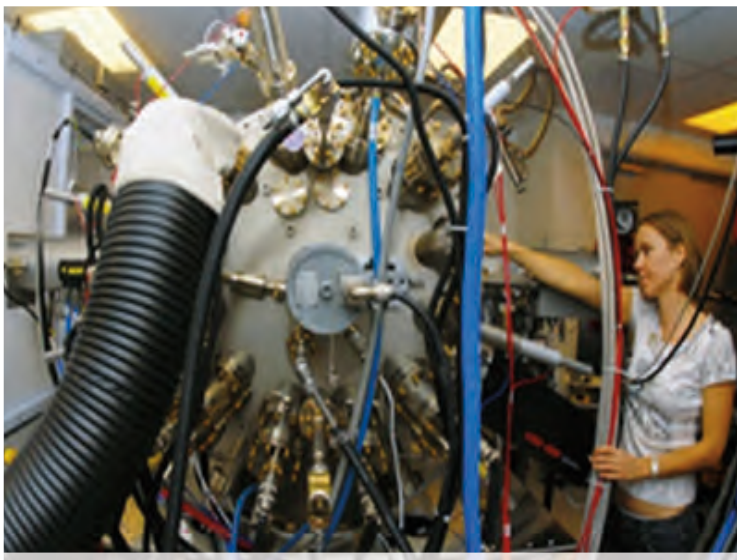
OPTOELECTRONICS & INTEGRATED PHOTONICS

Science and Technology

- Eptiaxial 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



Molecular Beam Epitaxy Laboratory

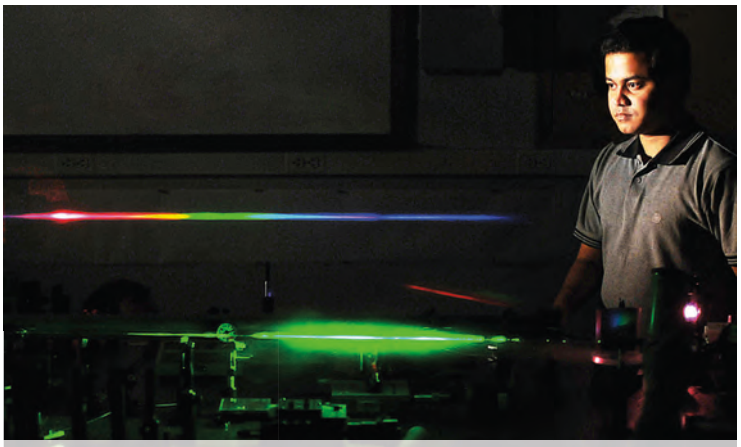
NONLINEAR & QUANTUM OPTICS

Science and 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



Demonstration of white light continuum generated by high power laser.

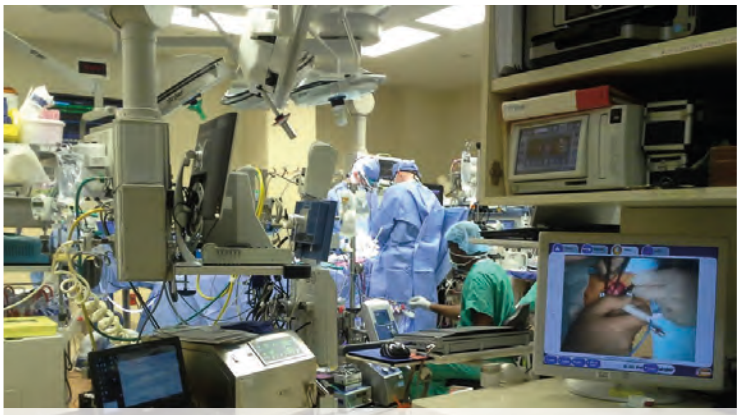
SENSING, IMAGING, & DISPLAY

Science and 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



Intraoperative real-time blood monitoring: Fiber-optic technology allows for the real-time monitoring of blood coagulability in the operating room.

Laboratories and 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. Other facilities, like the Optical Materials Laboratory (pictured below) are located on the main UCF campus.

College 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 scriber 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 containing class 100 and class 10,000 cleanrooms. Used in the development of optoelectronic semiconductor devices. The facility includes a Suss MJB-3 aligner, a Plasma-Therm 790 RIE/PECVD, an Edwards thermal evaporator, and a bonder, scriber, 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

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.

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).

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.

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 was originally built in 1989 to support the Strategic Defense Initiative Organization's Innovative Sciences and Technology Office (SDIO/ISTEF). Today TISTEF has a much broader mission; it supports research and development of electro-optics sensing technologies for DOD, commercial and academic applications. DOD customers include: the Army, Navy Air Force, DARPA, and DIA. The facilities include a laser and optics laboratory, a 1 km

Cesar Blanco in the Optical Materials Lab located separate from CREOL.

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. Since TISTEF is a tenant of the 45th Space Wing and NASA, operating agreements are in place that permit tasking AF Eastern Range and NASA assets as needed. It also has standardized range operations and procedures for laser testing against boosting rockets, satellites, and other terrestrial targets. TISTEF has a close partnership with the CREOL which provides access to cutting edge R&D and expertise in atmospheric propagation of lasers, laser communications, laser radar (LADAR), fiber-optic lasers, passive imaging, and optical design.

Faculty Facilities

Diffractive 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 fiber fabrication technology, nano-structured fibers, nonlinear fiber materials, fiber lasers, and fiber sensing applications. Axel Schülzgen, Rodrigo Amezcua.

Florida Attosecond Science and Technology Lab:
Generation of attosecond (10-18 s) and zeptosecond (10-21 s) X-ray pulses. Zenghu Chang.

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 Labs:
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).

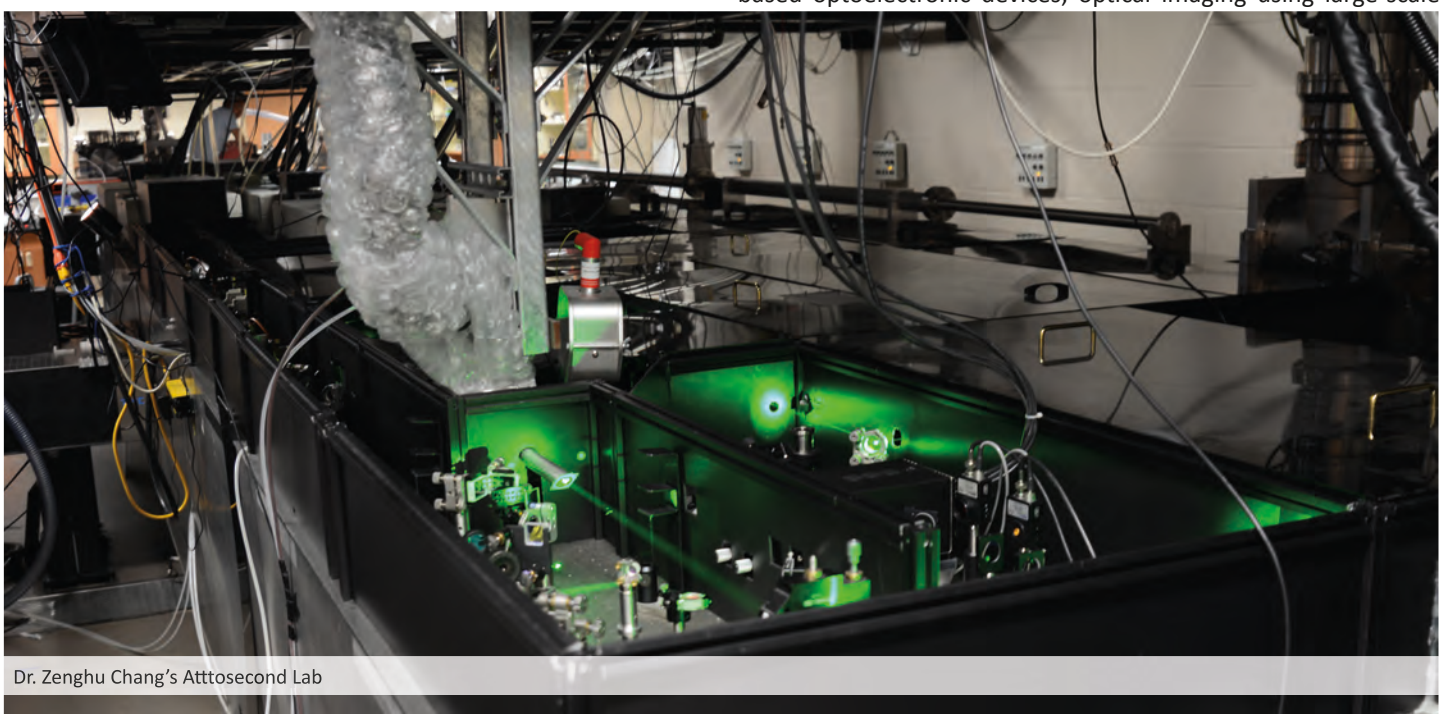
Laser Plasma Lab:
Conducting research on X-ray and EUV optics and sources, X-ray microscopy, laser-aided material processing, and laser generated plasmas. Martin Richardson.

Laser System Development Labs:
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). Michael Bass, Martin Richardson, Peter Delfyett, Leonid Glebov.

Liquid Crystal Display Lab:
Investigating 1) advanced liquid crystal display materials, display 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 forveated imaging and zoom lens, and 4) bio-inspired tunable optical filters using cholesteric liquid crystals. Shin-Tson Wu.

Mid-Infrared Combs Group (MIR)
Broadband mid-infrared ($\lambda > 2.5$ μm) frequency combs generation based on subharmonic optical parametric oscillators. Trace molecular sensing and coherent dual-comb spectroscopy using octave-wide MIR combs. Biomedical applications of frequency combs. Photonic THz wave generation and THz imaging. Nano-IR spectroscopy. Konstantin Vodopyanov.

Multi-Material Optical Fiber Devices Lab:
Research on novel optical fiber structures, nanophotonics, fiber-based optoelectronic devices, optical imaging using large-scale



Dr. Zenghu Chang's Atttosecond Lab

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

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 nano-lithography. Winston Schoenfeld.

NanoBioPhotonics Lab (NBPL):
Developing nanoaperture optical trapping based single molecule biophysics methods for studying protein dynamics, structure, and behavior; protein-protein and protein-small molecule interactions; drug discovery; and fundamental life sciences. Ryan Gelfand

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. Projects include manipulation of surface plasmon dispersion in nanoscale thin films, enhancement of erbium excitation in semiconductor nanocrystal doped oxides, and enhancement of optical nonlinearities using plasmon resonances. Pieter Kik.

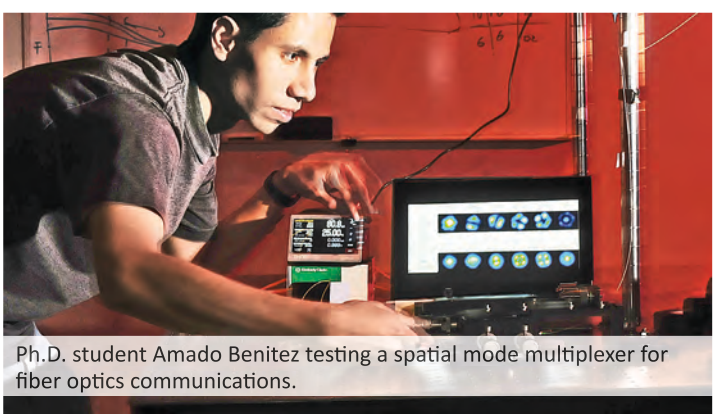
Nonlinear Optics Labs:
Conducting research on a variety of nonlinear optical effects, materials, and devices including nonlinear interactions in waveguides, nonlinear signal processing, optical power limiting, and characterizing materials response at picosecond and nanosecond scales. Eric Van Stryland and David Hagan

Nonlinear Waves Lab:

Research in nonlinear optics, spatial and spatio-temporal solitons, discrete solitons in photonic lattices, and curved beams. Demetrios Christodoulides.

Optical Ceramics Lab:
Conducting research on the synthesis of transparent ceramics, powder processing, ceramic casting, vacuum and pressure sintering, diffusion bonding, dopant diffusion, and crystal growth for laser and nuclear detector applications. 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.


Ph.D. student Amado Benitez testing a spatial mode multiplexer for fiber optics communications.

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 Imaging System Laboratory:
Creating novel imaging systems by integrating physical coding and computational methods for biological research, medical diagnosis, and industrial imaging applications in both visible and X-ray regimes. Shuo “Sean” Pang.

Optical Nanoscopy Lab:
Developing and applying novel optical tools such as fluorescence nanoscopy (super-resolution imaging) and single-molecule imaging to study essential problems in biology and neuroscience. Kyu Young Han

Optical Imaging System Lab (OISL):
The research of the Optical Imaging System Lab is focused on developing computational imaging platforms for biomedical research, medical diagnosis, and industrial imaging applications in both visible and X-ray regimes. Research topics include Computational Imaging, Coded Aperture, X-ray Tomography, X-ray Scatter Imaging, Fluorescence Microscopy, Lens-less Optical Imaging, Bio-sensor and Portable Imaging Devices. Shuo “Sean” Pang

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) (PAQO).

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.

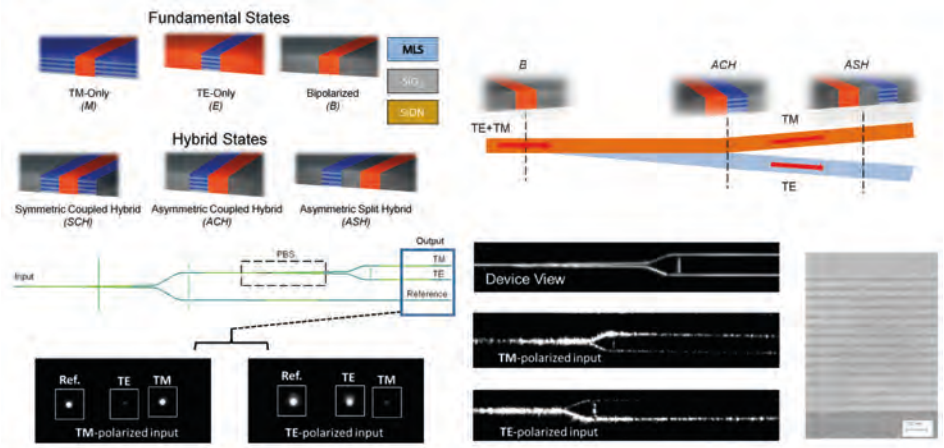
Semiconductor Lasers Lab:
A III-V epitaxial growth facility used to research new types of semiconductor heterostructures and devices that include quantum dots, quantum dot laser diodes, vertical-cavity surface-emitting laser diodes, spontaneous light sources, and single quantum dots. A characterization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

Thin-Film Optoelectronics Lab:
Developing novel optoelectronic materials and devices for sensors, solar cells, lighting and displays that are large area, flexible, cost-effective and efficient. Kyle Renshaw

Ultrafast Photonics Laboratory:
Conducting research on ultrafast high power optical pulses from semiconductor diode lasers, for applications in applied photonic networks and laserinduced materials modification. Peter Delfyett.

Taming Polarization: T-Guides and Topographically Anisotropic Photonics

Studying the polarization of light has been pursued for over two centuries, since Étienne Malus did the first related observations using a birefringent calcite crystal in 1808. Nowadays, most people have at least heard of "polarized sunglasses" -- an 80-year-old invention. Engineering the polarization properties of guided waves in integrated photonic devices, however, has not been as easy. For starters, optical waveguides are, in general, not that sensitive to polarization. In symmetric slab waveguides, for example, the transverse-electric (TE) and transverse-magnetic (TM) modes always coexist and single-polarization behavior is not possible. The single-mode single-polarization (SMSP) property exists in asymmetric slab waveguides, but occurs in a tiny wavelength range very close to the cutoff. The constraints relax a bit more in 2-D waveguides. Especially, TE-only operation with limited bandwidth is possible in shallowly-etched ridge waveguides, but again for wavelengths close to cutoff and at the expense of large lateral mode size and poor confinement.



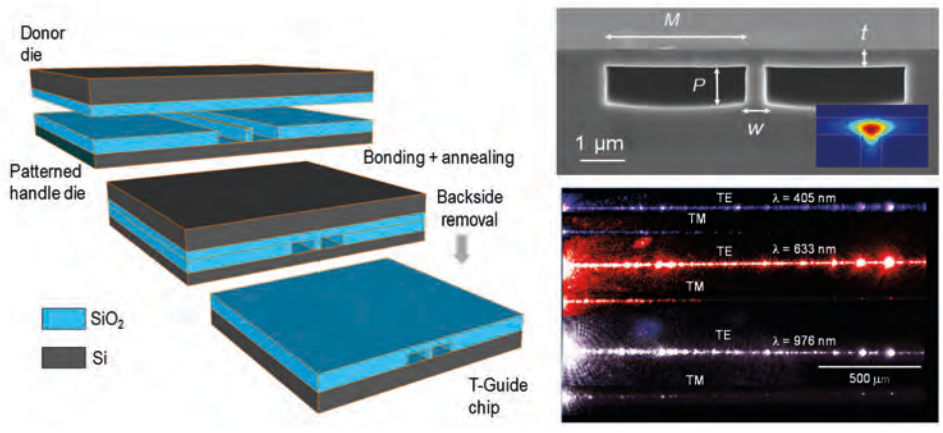
Possible basic states for TAP and how to arrange them to implement a PBS. Experimental camera images, showing how the TE and TM modes are split and a scanning-electron microscopy image of the employed SiO2/SiN multilayer stack films.

Another challenge of managing polarization in integrated photonics has been realizing polarization-manipulating components. A good example is polarization beam-splitters (PBS), a device not easily achievable in integrated photonics. To date, integrated PBS with optical bandwidths of up to 150 nm have been achieved in the telecommunication band through the use of mode-evolution in complicated silicon photonic tapered directional couplers. However, higher optical bandwidth are challenging due to limits imposed by multimode operation at short wavelengths, and by weaker effective index contrast between polarizations at longer wavelengths.

These challenges were taken up by the now-gradated CREOL Ph.D. student, Jeff Chiles, at Prof. Sasan Fathpour's group. Jeff was working on a novel type of all-silicon (air-clad) anchored membrane waveguide for mid-infrared applications, when he discovered that the T-shaped structures appear to have enormous SMSP bandwidths. Detailed simulations showed 2.75 octaves (1.2 – 8.1 µm wavelength range) bandwidths in the silicon T-Guides. Jeff later experimentally demonstrated a record SMSP window of > 1.27 octaves (405 – 976 nm) in silica T-Guides, limited only by the available measurement equipment. Such ultrabroadband SMSP operation is, in essence, possible because of the high asymmetry of the T-Guides, when compared to conventional channel or ridge waveguide. The SMSP devices may find applications in, e.g, on-chip optical gyroscopes, which can suffer from polarization-fluctuation-induced noise.

Later, Fathpour's team took the idea of highly asymmetric waveguiding structures even further and realized a complete new way of making polarization-sensitive integrated photonics, by a scheme coined topographically anisotropic photonics (TAP). The core idea of TAP mimics the concept of bulk-optics wire-grid polarizers to some degree. Imagine a polarized beam travelling parallel to the interfaces of a multilayer stack of nanometer-scale films of periodic alternating indices. It is expected intuitively that such an engineered anisotropic medium possesses uniaxial birefringence for polarizations parallel or perpendicular to the film interfaces. By embedding regions of such anisotropic films as well as standard regions of isotropic media into different configurations of waveguide core and lateral cladding materials, unique polarization-dependent behavior can be achieved over exceptionally broad bandwidths. The relevant fundamental "states" can be TE-only, TM-only or bipolarized. Hybrid states, with symmetric and antisymmetric guiding properties, are also feasible. Polarization-selective devices can be constructed by selecting a series of these states and introducing adiabatic transitions between them. For example, integrated PBSs with an unprecedented bandwidth of 116 THz (0.52 octaves), insertion loss of < 1.2 dB and extinction ratio of > 16 dB are experimentally demonstrated using multilayer stacks of silicon dioxide (SiO2) and silicon nitride (SiN). Other demonstrated devices include TE- and TM-pass polarizers and single-polarization microring resonators.

Fabrication method, scanning-electron microscopy image, optical mode simulation and top-view camera images of SMSP measurements on silica T-Guides.



Jeff Chiles graduated in 2016 and is currently a postdoctoral associate at NIST. Tracy Sjaardema, a second-year CREOL Ph.D. student, has been continuing the TAP work and some of the later results are her courtesy. The work is funded by the NSF CAREER Program.

Sasan Fathpour

Self-Contained On-chip Integrated Sensor of Biomolecular or Chemical Agents

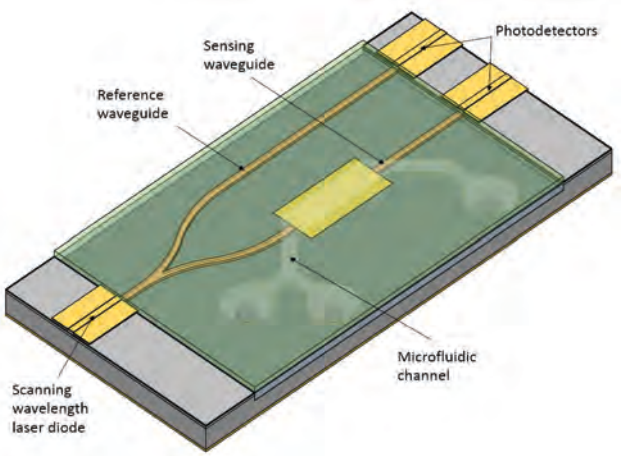
Highly portable compact integrated sensors that are capable of fast response times are very attractive and in great demand for many applications in the medical field as well as for homeland security purposes. In order to have sensor modules that are fully integrated on-chip, it is imperative that both active and passive devices be compatible and easily implemented using conventional device fabrication techniques. Such devices include among others, a broad spectrum continuously scanning laser diode, an integrated photodetector, and an optical waveguide integrated sensor, as well as a compatible system for microfluidic channels.

Patrick LiKamWa

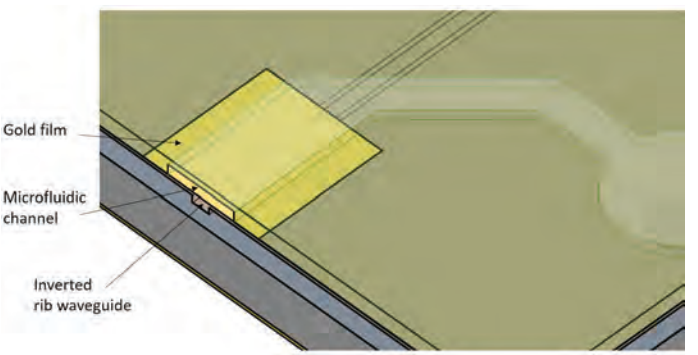
At CREOL, we have been working on a highly effective scheme that consists of monolithically integrated tunable laser and photodetectors that are fabricated on semiconductor epitaxial layers grown on a single substrate. The other components are fabricated in silicon nitride and/or silicon oxynitride platforms that are grown by plasma enhanced chemical vapor deposition (PECVD). The sensor waveguides are surface plasmon resonance (SPR) inverted rib waveguides that are fabricated using a highly stable epoxy (SU-8). Finally, the microfluidic channels are patterned in a polydimethylsiloxane (PDMS) silicone membrane that is fitted on top of the waveguide structure.

First, the tunable laser and the photodetectors are fabricated on the semiconductor epitaxial structure. The two photodetectors are p-i-n waveguide photodiodes that absorb practically all of the photons that pass through the reference and sensing waveguides respectively. By employing two identical photodiodes, differential signal monitoring yields very sensitive measurements that are also fairly insensitive to environmental changes that the device may be subjected to. The tunable laser diode is a multiple-section single-stripe semiconductor quantum-well laser in which the sections have been modified in a post-growth selective area intermixing process to yield different optical bandgap energies. By injecting varying currents in the separate sections the lasing wavelength can be controlled finely over a broad range of wavelength. This allows for the scanning of the wavelength of the probing light source for monitoring the SPR wavelength.

The section between the laser and the photodetectors are etched off and the passive components are fabricated in PECVD grown silicon dioxide and/or silicon oxynitride. First, a layer of silicon oxynitride is deposited on the substrate. Channels that will eventually form optical waveguides are delineated in the silicon oxynitride film by

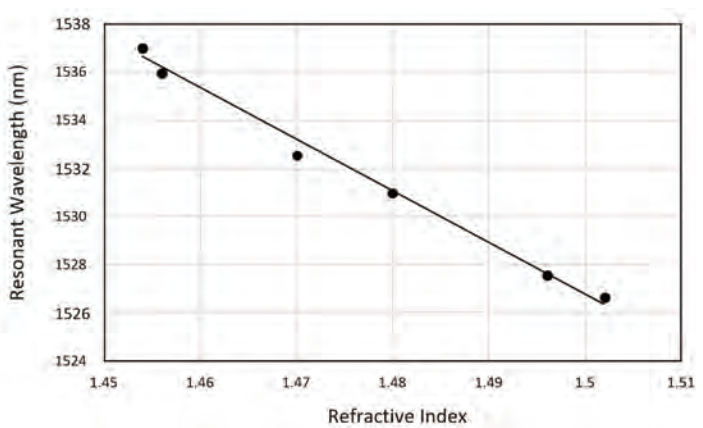


Schematic of fully integrated SPR sensor module



Cross-section of inverted rib SPR waveguide sensor and a microfluidic channel

The principle of operation is as follows: a liquid with suspected contaminants is passed through a microfluidic channel to the gold sensing surface that has been prepped to accept only a specific contaminant. When the contaminants attach to the sensing metal, the effective index of the plasmonic waveguide and its SPR wavelength are altered. By measuring the relative transmission of the waveguides while scanning the laser wavelength, a quantitative analysis of the concentration of the detected contaminant is obtained after several successive scans.



photolithography and reactive ion etching. The surface is spin-coated with a thin layer of a SU-8 epoxy that fills out the etched-out channels forming inverted rib waveguides with a top surface that is totally flat, and therefore is ideally suited for coating with a very thin layer of gold sensing film. The top PDMS membrane has an etched groove through which fluids can be pumped over the sensing membrane. First, a solution containing an activating enzyme agent is flowed through the channel, that coats the gold surface with a layer of biomolecular recognition element. Then, a solution containing the test sample is flowed through. If the target analyte is present in that solution, these molecules will lock onto the coated gold surface. While scanning the wavelength of the laser, a change in the surface plasmon resonance wavelength is readily detected.

An array of sensors can easily be integrated that can efficiently rule out or detect the presence of a large assortment of suspected biomolecular agents in the solution. With simply modifications such scheme can also be used for detection of gases and gaseous agents.

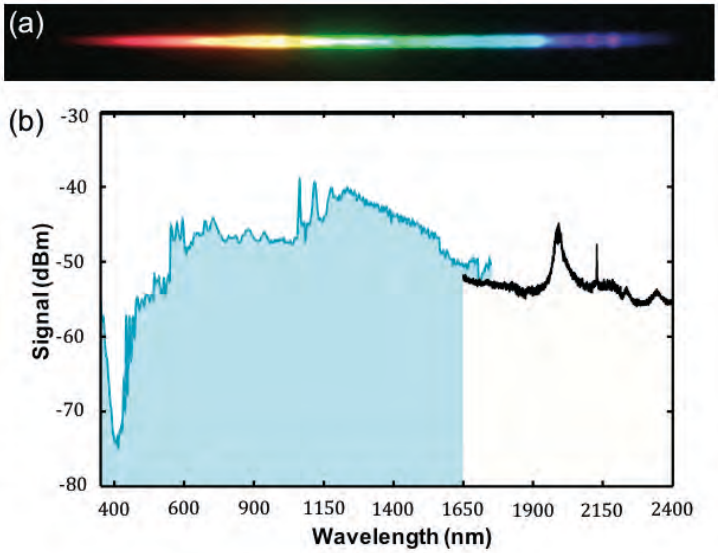
Professor Patrick LiKamWa has been with CREOL since 1989. His research interests include optoelectronics and integrated optics devices. This work is a collaboration with Professor Hyoung Jin (Joe) Cho in the Department of Mechanical and Aerospace Engineering at UCF.

Nonlinear interactions and supercontinuum generation in multimode optical fibers

Optical supercontinuum (SC) results from the synergy of several nonlinear and linear processes, all acting together. Supercontinuum generation is these days finding applications in biomedical imaging, optical metrology, spectroscopy, and sensing, to mention a few. In this regard, single-mode photonic crystal fibers with pre-engineered dispersion characteristics are currently commercially used in implementing spatially coherent ultra-bright SC sources, spanning the wavelength range from ultraviolet to the mid-infrared. Given that most SC sources have so far relied almost exclusively on single mode or few mode fiber technologies, it will not be long before limits are reached in terms of output power capabilities, especially for applications where high spectral power densities are required. A possible avenue to overcome these hurdles could be through the use of large-area multimode fibers (MMFs). Multimode fibers, having been overlooked for decades, are nowadays making a strong comeback because of space-division multiplexing applications. These fibers are by nature complex structures: they can support thousands of modes that can in turn interact among themselves in a variety of ways. Even though over the years, some of their nonlinear properties have been intermittently investigated, in general, the manner nonlinear processes unfold in such convoluted multimode environments still remains an issue that is largely unexplored.

Quite recently, the nonlinear properties of nonlinear MMFs have been reconsidered in both the normal and anomalous dispersion regimes. In this respect, the observation of multimode optical solitons in parabolic MMFs has been reported. Supercontinuum generation has also been successfully demonstrated in graded index MMFs by launching ultra-short pulses in the anomalous dispersion region (1550 nm). In these experiments, discrete spectral components were generated in the visible domain – features that were subsequently explained through the interplay between spatiotemporal soliton oscillations and dispersive waves that are only possible in parabolic fibers.

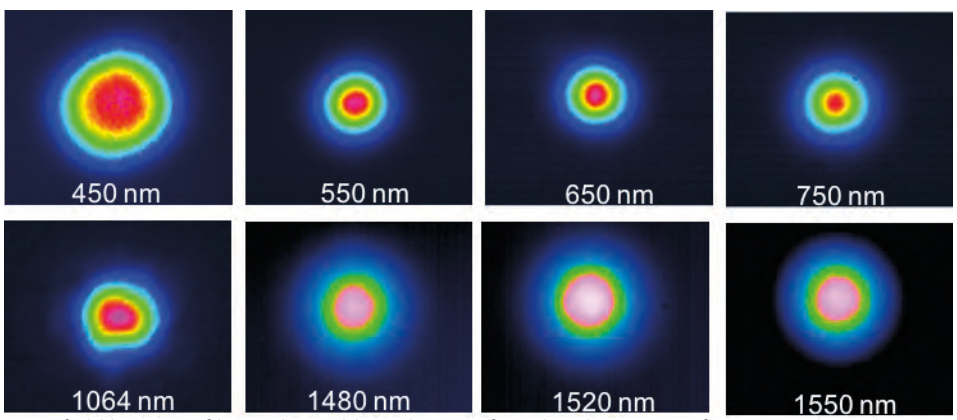
Lately, efficient supercontinuum generation, extending from the visible to mid-infrared (when pumped in the normal dispersion regime, 1064 nm), was demonstrated for the first time by our group in low DGD (differential group delay) parabolic MMFs [1] by making use of a newly observed mechanism – better known as geometric parametric instability. This process can be understood by keeping in mind that light in parabolic graded-index fibers experiences periodic expansions/contractions. This in turn leads to the generation of spectrally symmetric high and low-frequency sidebands, something that is now possible even in the normal dispersive region. A nonlinearly induced mode cleanup was also found to occur at the pump wavelength. While at low power levels, the output mode profiles were considerably speckled, at higher powers (above 35kW) a beam cleanup was evident. This effect is induced by the Kerr nonlinearity and is unrelated to Raman filtering effects. Remarkably, the M^2 is significantly reduced from 7.5 to 2.1 during this process in this multimode fiber. This represents a significant increase in the beam brightness. Given that Raman cleanup is not a factor at the pump wavelength, we attribute these effects to four-wave-mixing. In addition, the modal cleanup happens to be quite robust to intentional fiber bends and twists.



Experimental supercontinuum spectra obtained in a 28.5 m long graded index MMF using 185 kW peak pump power at 1064 nm. (a) Image of the visible component of the dispersed output spectrum. (b) Spectrum recorded using two different optical spectrum analyzers.

Such MMF supercontinuum sources could potentially display spectral densities that are orders of magnitudes higher than those currently obtained in single-mode fiber systems. These studies indicate that MMFs can provide a rich setting where nonlinear effects can be potentially molded by exploiting the sheer complexity offered by a multitude of wave-mixing paths. In addition, the input beam modal composition can provide additional degrees of freedom in tailoring the output spectral content resulting from nonlinear interactions in graded-index multimode fibers.

[1] G. Lopez-Galmiche, Z. Sanjabi Eznaveh, M. A. Eftekhar, J. Antonio Lopez, L. G. Wright, F. Wise, D. Christodoulides, and R. Amezcua Correa, "Visible supercontinuum generation in a graded index multimode fiber pumped at 1064 nm," Opt. Lett. 41, 2553-2556 (2016).



Near-field beam profiles in the visible and near-infrared at the output of a 30 m multimode optical fiber at 185 kW pump power.

Rodrigo Amezcua-Correa

Demetri Christodoulides

Engineering a nanoscale plasmonic sensor pixel

The advent of plasmonics has enabled the focusing of visible light down to few-nanometer spot sizes, more than an order of magnitude below the diffraction limit. This extreme focusing enables the optical probing of volumes as small as a thousandth of an attoliter (10-24 m3), enabling biochemical sensors that operate at the few-molecule level even in high-concentration solutions. To enable practical plasmonic sensors, such nanoscale sensing structures should be chemically and structurally stable, as well as easily optically accessible. A recent study by the NanoPhotonics and Near-field Optics Group demonstrates a low-cost, stable nanoscale sensing pixel design that could enable ultrasensitive plasmonic sensor arrays.

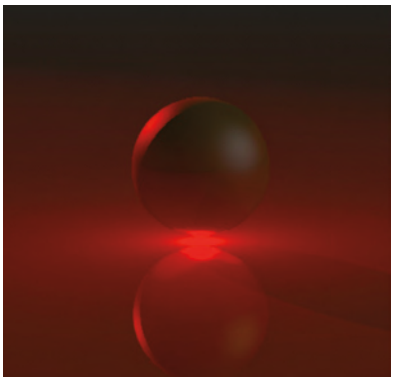


Fig. 1: Artist's impression of a gold nanoparticle on an oxide coated gold film

The field of plasmonics has advanced tremendously over the past decade. Surface plasmons are optical modes that occur at the surface of conducting structures. The collective motion of free charges near metal surfaces allows metallic particles to act as resonant nanoscale optical antennas. These nanoantennas can generate unprecedented light concentration thanks to two separate contributions. First, optical excitation of a metallic nanostructure can resonantly drive charge motion, producing large charge oscillations and large optical fields at the particle surface. This effect alone can enhance the local light intensity by over two orders of magnitude. Second, the shape of the nanoparticle can affect the optical field enhancement, in the same way a lightning rod can concentrate electric field lines near the tip. Combined, these effects can efficiently concentrate light in few-nanometer spot sizes, which enables optical biochemical sensors with unprecedented sensitivity, down to the involve individual molecule level.

practical utility of the structure. To overcome this challenge, graduate student Chatdanai Lumdee investigated a related nanostructure called the hole-in-one structure, consisting of a nanoaperture in a metallic film that is occupied by a single plasmon resonant nanoparticle.

The structures were fabricated at CREOL through nanosphere lithography using polystyrene nanospheres to produce 110 nm diameter apertures in an aluminum film on a glass substrate. After deposition, the Al film developed a conformal few-nanometer thick native oxide on the top surface and on the sidewall of the apertures. Gold nanoparticles with a 60 nm diameter were deposited from colloidal solution, resulting in the capture of a single gold nanoparticle by some of the apertures. The generated structures were imaged using scanning electron microscopy (SEM) with the assistance of Kirk Scammon at the Materials Characterization Facility, revealing that the gold nanoparticles attached to the oxide coated sidewall (Figure 2). This geometry corresponds to the desired 'nanoparticle on a mirror' geometry, where in this case the inner wall of the aperture acts as a curved mirror and the native oxide acts as a chemically and structurally stable spacer layer that ensures a reliable resonance wavelength. Numerical simulations of the generated structures predict large field enhancement and strong field confinement (Figure 3). Experimental proof for the existence of gap-plasmons in these structures was obtained by comparing the measured and simulated transmission spectra of a single aperture (Figure 4). The numerical and experimental results show clear evidence of plasmon enhanced optical transmission at a wavelength of ~650 nm, indicative of the presence of

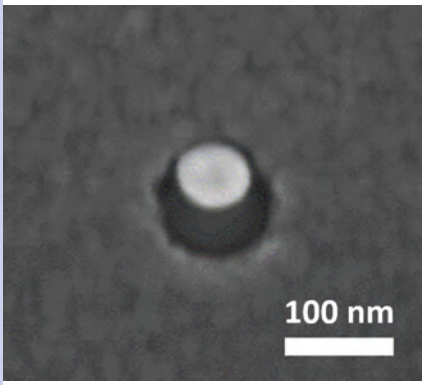


Fig. 2: A Hole-in-one structure.

Fig. 3: side view of the simulated gap plasmon enhanced field enhancement

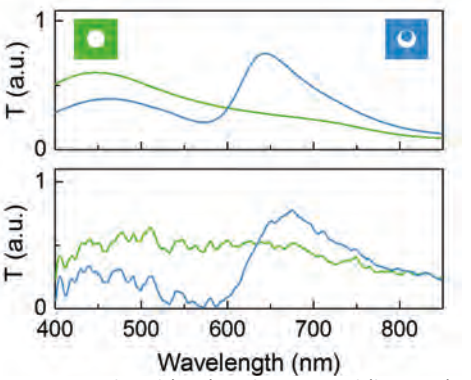


Fig. 4: Simulated (top) and measured (bottom) transmission spectra from a single nanohole (green) and a fabricated hole-in-one structure (blue).

An example of a stable and easily prepared structure that combines these two effects is the "particle on a mirror" geometry. Figure 1 shows an artist's rendering of a gold nanoparticle on an aluminum oxide coated gold mirror, illuminated with red light. Vertically oscillating charges on the 80 nm diameter gold particle are known to concentrate between the particle and its electric mirror image, producing what is known as a gap plasmon oscillation. In an earlier study, the concentrated optical field directly beneath the nanoparticle was shown to enhance metal photoluminescence by over five orders of magnitude. The strongly enhanced and focused optical field can also enhance other optical processes such as molecular fluorescence and Raman scattering, enabling optical sensing in nanoscale volumes. One challenge with this particular geometry is the fact that the vertically polarized gap plasmon mode cannot be excited efficiently by normally incident light, limiting the the predicted gap plasmons. Arrays of such hole-in-one structures could act as immersible sensing pixels for plasmon enhanced high-sensitivity molecular detection. Lumdee et al., APL Photonics 1, 031301 (2016)

Pieter Kik

The Nanophotonics and Near-field Optics group current research includes near-field optical interactions, plasmon optical devices, and nanoscale energy transfer processes.

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Conference Papers and Presentations

J.J. Kaufman, C. Bow, F.A. Tan, A.M. Cole, and **A.F. Abouraddy**, *3D Printing of preforms for fiber drawing and in-fiber structured functional particle fabrication,* OSA Photonics and Fiber Technology Congress, Sydney, Australia, September, paper AW4C.1 (2016).

S. Shabahang, H.E. Kondakci, M.L. Villinger, J. Perlstein, and **A.F. Abouraddy**, *Achromatic resonances in an optical micro-cavity*, FiO, Rochester, NY, October (2016).

J.J. Kaufman, M. Patel, A. Cole, S. Moore, and **A.F. Abouraddy**, *Agarose dry gel films for drug delivery,* MRS Spring Meeting, Phoenix, AZ, March, paper SM7.3.09 (2016).

F.A. Tan, J.J. Kaufman, and **A.F. Abouraddy**, *Benchtop production of polymeric optical fibers*, OSA Photonics & Fiber Technology Congress, Australian Conference of Optical Fiber Technology, Syndey, Australia, September (2016).

A.F. Abouraddy, *Classical optical entanglement in space and time: From diffraction-free beams to omni-resonant optical devices*, OSA Incubator Meeting, Emerging Connections: Quantum and Classical Optics, Washington, November (2016).

L.N. Pye and **A.F. Abouraddy**, *Coherent perfect absorption in silicon*, SPIE Photonics West, San Francisco, CA, February (2016).

J.J. Kaufman, S. Shabahang, G. Tao, Y. Qiao, L. Wei, T. Bouchenot, A. Gordon, Y. Fink, Y. Bai, R. Hoy, and **A.F. Abouraddy**, *Cold-drawing of multimaterial fibers and films to produce micro- and nanoparticles*, MRS Spring Meeting, Phoenix, AZ, March, Paper MD10.3.03 (2016).

H.E. Kondakci, R. Keil, A. Perez-Leija, A. Szameit, **A.F. Abouraddy, D.N. Christodoulides, and B.E.A. Saleh**, *Controlling Mandel's Q-parameter in disordered lattices via excitation-symmetry breaking*, FiO, Rochester, NY, October (2016).

A.K. Jahromi and **A.F. Abouraddy**, *Controlling the direction of optical power flow in an active photonic cavity*, FiO, Rochester, NY, October (2016).

L. Martin, W.D. Larson, H.E. Kondakci, D. Mardani, S. Shabahang, A.K. Jahromi, T. Malhotra, A.N. Vamivakas, G.K. Atia, and **A.F. Abouraddy**, *Hilbert-space analyzers: Basis-neutral modal analysis via generalized optical interferometry*, FiO, Rochester, NY, October (2016).

S. Shabahang, F. Tan, J. Perlstein, G. Tao, M. Algarni, Y. Bai, O. Alvarez, G. Tsvid, C.K.N. Patel; F. Chenard, K.L. Schepler, and **A.F. Abouraddy**, *Hybridized fabrication of robust low-loss multimaterial chalcogenide fibers for infrared applications*, CLEO, San Jose, CA, June, paper JF1K.3 (2016).

A.F. Abouraddy, *Mid-infrared nonlinear photonics in multimaterial chalcogenide fibers*, 46th Winter Colloquium on the Physics of Quantum Electronics (PQE), Snowbird, Utah, January (2016).

F.A. Tan, J.J. Kaufman, and **A.F. Abouraddy**, *Multi-scale processes and devices for fabrication of functional composite fibers*, MRS Spring Conference, Phoenix, AZ, March, paper MD6.1.08 (2016).

A.K. Jahromi and **A.F. Abouraddy**, *Observation of Poynting's Vector Reversal in an Active Optical Cavity,* CLEO, San Jose, CA, June, paper STh4Q.6 (2016).

A.K. Jahromi and **A.F. Abouraddy**, *Observation of Poynting's vector reversal in an active optical cavity*, CLEO, San Jose, CA, June (2016).

T. Malhotra, W. Farriss, J.R. Fienup, **A.F. Abouraddy**, and N. Vamivakas, *Optical beam spatial modal analysis using a two-path generalized Michelson interferometer*, FiO, Rochester, NY, October (2016).

S. Shabahang, F.A. Tan, J. Perlstein, G. Tao, M. al Garni, Y. Bai, O. Alvarez, F. Chenard, K.L. Schepler, and **A.F. Abouraddy**, *Robust low-loss multimaterial chalcogenide fiber for infrared applications fabricated by a hybridized approach*, OSA Photonics & Fiber Technology Congress, Australian Conference of Optical Fiber Technology, Syndey, Australia, September (2016).

J.J. Kaufman, F. Tan, R. Ottman, R. Chakrabarti, and **A.F. Abouraddy**, *Scalable production of digitally designed multifunctional polymeric particles by in-fiber fluid instabilities*, OSA Photonics and Fiber Technology Congress, Sydney, Australia, September (2016).

D. Mardani, G. Atia, and **A.F. Abouraddy**, *Sparse reconstruction under sensing constraints: A controlled approach*, 54th Annual Allerton Conference on Communication, Control, and Computing, Allerton, IL (2016).

H.E. Kondakci, R. Keil, A. Szameit, **A.F. Abouraddy, D.N. Christodoulides, and B.E.A. Saleh**, *Tailoring photon-number distribution in disordered lattices with chiral symmetry*, CLEO, San Jose, CA, June, paper SM2E.3 (2016).

J.J. Kaufman, G. Tao, S. Shabahang, and **A.F. Abouraddy**, *Thermal drawing of high-density in-fiber arrays of well-ordered 5-nm-diameter nanowires,* OSA Photonics and Fiber Technology Congress, Sydney, Australia, September (2016).

A.K. Jahromi, S. Shabahang, H.E. Kondakci, and **A.F. Abouraddy**, *Transparent perfect mirror via non-Hermitian systems*, FiO, Rochester, NY, October (2016).

R. Rezvani Naraghi, G. Tao, J.J. Kaufmann, S. Shabahang, S. Sukhov, **A.F. Abouraddy, and A. Dogariu**, *Tuning light with photonic particles*, CLEO, San Jose, CA, June, paper SM1R.2 (2016).

J. van Weerdenburg, A.M. Velázquez-Benítez, R.G.H. van Uden, E. Antonio-Lopez, P. Sillard, D. Molin, M. Bigot, A. Amezcua-Correa, F. Huijskens, F. Achten, H. de Waardt, T. Koonen, **R. Amezcua-Correa**, and C.M. Okonkwo, *10 spatial mode transmission over 40km 50μm core diameter multimode fiber*, OSA Optical Fiber Communication Conference, Anaheim, CA, March, paper Th4C.3, OFC (2016).

R. Amezcua-Correa, *All-fiber mode multiplexers*, OSA Optical Fiber Communication Conference, Anaheim, CA, March, paper Tu3I.3 (2016).

H. Wen, Q. Mo, P. Sillard, **R. Amezcua-Correa, and G.F. Li**, *Analog transmission over few-mode fibers,* OSA Optical Fiber Communication Conference, Anaheim, CA, March, paper Th4A.3 (2016).

J. van Weerdenburg, J. Antonio-Lopez, J. Alvarado-Zacarias, D. Molin, M. Bigot-Astruc, R. van Uden, H. de Waardt, T. Koonen, **R. Amezcua-Correa**, P. Sillard, and C. Okonkwo, *Exploiting selective excitation of strongly coupled modes to reduce DMGD in multi-mode transmission systems*, ECOC 2016 - 42nd European Conference on Optical Communication, Dusseldorf, Germany (2016).

H. Chen, R. Ryf, N.K. Fontaine, A.M. Velázquez-Benítez, J. Antonio-López, C. Jin, B. Huang, M. Bigot, D. Molin, F. Achten, P. Sillard, and **R. Amezcua-Correa**, *High spectral efficiency mode-multiplexed transmission over 87-km 10-mode fiber*, OSA Optical Fiber Communication Conference, Anaheim, CA, March, paper Th4C.2 (2016).

A. Van Newkirk, J. E. Antonio-Lopez, J. Anderson, R. Alvarez-Aguirre, **R. Amezcua-Correa, and A. Schülzgen**, *Higher order modes in anti-resonant hollow core fibers*, OSA Specialty Optical Fibers, Vancouver Canada, July, paper SoM3F.4 (2016).

R. Ryf, J.C. Alvarado, B. Huang, J. Antonio-Lopez , S.H. Chang, N.K. Fontaine, H.S. Chen, R.J. Essiambre, E. Burrows, **R. Amezcua-Correa**, T. Hayashi, Y. Tamura, T. Hasegawa, and T. Taru, *Long-distance transmission over coupled-core multicore fiber*, ECOC 2016 - 42nd European Conference on Optical Communication, Dusseldorf, Germany (2016).

A. Van Newkirk, J. E. Antonio-Lopez, J. Anderson, R. Alvarez-Aguirre, Z. S. Eznaveh, **R. Amezcua-Correa, and A. Schülzgen**, *Modal analysis of anti-resonant hollow core fibers*, CLEO, San Jose, CA, June, paper STu4P.7 (2016).

R. Amezcua-Correa, A. Schülzgen, A. Van Newkirk, J.E. Antonio-Lopez, Z. Sanjabi Eznaveh, and J. Villatoro, *Multicore optical fiber and their applications*, OSA Specialty Optical Fibers, Vancouver Canada, July, paper SoM2F.5 (2016).

D. Yu, J. van Weerdenburg, E. Silekens, R.G.H. van Uden, M. Tang, D. Liu, A.M. Velazquez-Benitez, P. Sillard, D. Molin, M. Bigot, **R. Amezcua-Correa**, H. de Waardt, T. Koonen, S. Fu, and C.M. Okonkwo, *Trellis coded modulation transmission over 40km 6-LP mode fiber*, OSA Optical Fiber Communication Conference, Anaheim, CA, March, paper Th4C.5 (2016).

M. Parto, M.A. Eftekhar, M.A. Miri, **R. Amezcua-Correa, G.F. Li, D.N. Christodoulides**, *Zero-DGD Multicore Optical Fibers*, CLEO, San Jose, CA, June, paper JTu5A (2016).

L. Argenti, *A hybrid-basis close-coupling interface to quantum chemistry packages for the treatment of ionization problems*, Joint Attosecond-MURI annual meeting, University of Arizona, Tucson, AZ, November (2016).

L. Argenti, *Birth of a resonant attosecond wavepacket*, 47th Regular DAMOP Meeting, Providence, Rhode Island, May (2016).

L. Argenti, *Birth of a resonant photoelectron wavepacket*, 25th International Conference on Atomic Physics (ICAP), Seoul, Korea, (2016). **Invited**

L. Argenti, C. Marante, M. Klinker, I. Corral, J. Gonzalez Vazquez, and F. Martín, *Merging quantum chemistry with B-splines to describe molecular photoionization*, DAMOP, Providence, RI, May 23-27 (2016).

L. Argenti, *Reconstruction of electronic and vibrational wavepackets with attosecond spectroscopies*, Gordon Research Conference, Multiphoton Processes, Proctor Academy, Andover, NH, June 19-24 (2016).

L. Argenti, *Theoretical Atomic Attosecond Spectroscopies*, 2016 ISSNAF Awards for Young Investigators, Italian Embassy, Washington DC, October 18 (2016).

Z. Chang, *Attosecond light sources in the water window*, Frontiers in Optics (FIO), Rochester, NY, (2016). **Invited**

Z. Chang, *Below and above threshold high harmonic generation with Two-cycle MIR Lasers*, MURI 15 Kickoff - Strong Field Laser Matter Interaction at MIR-Infrared Wavelength, Jan. 21-22, Arlington VA, (2016). **Invited**

Y. Yin, J. Li, X. Ren, W. Yi, E. Cunningham, and **Z. Chang**, *High-energy, high-efficiency, and high-repetition-rate OPCPA at 1.7 μm*, CLEO:QELS, San Jose, CA, June, paper FTh1M.7 (2016).

Z. Chang, P. Corkum, S. Leone, and D. Neumark, *Microjoule isolated attosecond pulses for atto pump-atto probe,* DARPA PULSE Program Review Meeting, September 28-29, Berkeley CA, (2016). **Invited**

Z. Chang, *Next generation attosecond light sources,* 19th Annual Southeast Ultrafast Conference, North Carolina State University, Raleigh, North Carolina, (2016). **Invited**

J. Li, X. Ren, Y. Yin, Y. Cheng, E. Cunningham, W. Yi, and **Z. Chang**, *Polarization gating of high harmonic generation in the water window*, CLEO, San Jose, CA, June, paper FTh1M.2 (2016).

Z. Chang, *Short course, SC439 - Attosecond Optics*, CLEO, San Jose, CA, June, (2016). **Invited**

A. Chew, Y. Yin, J. Li, X. Ren, E. Cunningham, Y. Wu, and **Z. Chang**, *Studies in above-and below-threshold harmonics in argon with an infrared femtosecond laser*, 47th Regular DAMOP Meeting, Providence, Rhode Island, May (2016).

Z. Chang, *Studying ultrafast electron dynamics in condensed matter with next generation attosecond x-ray sources*, MURI Review Meeting, August 22 -23, Arlington VA, (2016). **Invited**

P. Aleahmad, T. Tabbakh, **D.N. Christodoulides, and P.L. LiKamWa**, *Controllable red and blue bandgap energy shifted LEDs and modulators on InGaAsP quantum well platform*, SPIE 9750, Integrated Optics: Devices, Materials, and Technologies XX, 97500N (2016).

A. Alhalawany, S. He, H. Hodaei, N.J.J. Johnson, **D.N. Christodoulides, A. Almutairi, and M. Khajavikhan**, *Enhanced UV upconversion emission using plasmonic nanocavities*, CLEO San Jose, CA, June (2016).

Y.X. Ren, T. Kelly, A. Samadi, A. Bezryadina, **D.N. Christodoulides**, and Z.G. Chen , *Guiding and Coupling Light through Nonlinear Plasmonic Nanosuspensions*, CLEO, San Jose, CA, June, paper FTh3A.2 (2016).

D.N. Christodoulides, *Intrinsic localized modes in optical photonic lattices and arrays*, APS, Baltimore, Maryland, March, paper C12.005 (2016). **Invited**

Z. Zhu, L.G. Wright, **D.N. Christodoulides**, F.W. Wise, *Multimode Solitons in Few-Mode Fiber*, Laser Science, Rochester, NY, October, paper JW4A.196 (2016).

M. Heinrich, H. Hodaei, M.A. Miri, A.U. Hassan, W.E. Hayenga, **D.N. Christodoulides, M. Khajavikhan,** *Non-Hermitian microring systems: PT-symmetric lasers, mode management and enhanced emission efficiency*, Advanced Electromagnetic Materials in Microwaves and Optics, September (2016).

D.N. Christodoulides, *Non-Hermitian photonics: Parity-time and other symmetries in optics*, Nonlinear Photonics, Sydney Australia, September, paper NT5A.1 (2016).

U. Peschel, M. Wimmer, M.A. Miri, A. Regensburger, and **D.N. Christodoulides**, *Nonlinear Dynamics in Photonic Mesh Lattices*, Nonlinear Photonics, Sydney Australia, September, paper NT5A.4 (2016).

A.K. Jahromi, A.U. Hassan, **D.N. Christodoulides, and A.F. Abouraddy**, *Observation of robust statistical parity-time symmetry breaking in ultra-long cavities,* 2016 IEEE Photonics Conference, 29th Annual Conference of the IEEE Photonics Society, Waikoloa, Hawaii, October (2016).

A.A. Dovgiy, A.E. Miroshnichenko, A. Moroz, A. Szameit, **D.N. Christodoulides**, and A.A. Sukhorukov, *Optical Simulation of Nonlinear Twisted-Ring Defect States with Planar Waveguide Arrays*, Laser Science, Rochester, NY, October, paper JTh2A.141 (2016).

M. Heinrich, M.A. Miri, S. Stützer, S. Nolte, **D.N. Christodoulides**, and A. Szameit, *Probing the scattering characteristics of supersymmetric photonic lattices*, CLEO: QELS Fundamental Science, San Jose, CA, June, paper FTh1A.6 (2016).

M. Heinrich, M.A. Miri, S. Stutzer, S. Nolte, **D.N. Christodoulides**, and A. Szameit, *Probing the scattering characteristics of supersymmetric photonic structures*, CLEO, San Jose, CA, June, paper FTh1A.6 (2016).

A.U. Hassan, H. Hodaei, M.A. Miri, **D.N. Christodoulides, and M. Khajavikhan**, *Reversing the transition from an unbroken to a broken phase in a PT-symmetric dimer laser*, CLEO, San Jose, CA, June, paper FTh1A.1 (2016).

A.K. Jahromi, A.U. Hassan, **D.N. Christodoulides, and A.F. Abouraddy**, *Robust statistical parity-time symmetric lasers in fiber cavities*, FiO, Rochester, NY, October (2016).

L. Ge, K. Makris, **D.N. Christodoulides**, and L. Feng, *Scattering in PT and RT Symmetric Multimode Waveguides: Generalized Conservation Laws beyond 1D*, FIO, Rochester, NY, October, paper JTh2A.81 (2016).

O.V. Shramkova, K.G. Makris, G.P. Tsironis, and **D.N. Christodoulides**, *Scattering properties of one-dimensional non-hermitian dispersive heterostructures*, FIO, Rochester, NY, October, paper FF3H.5 (2016).

Z. Liu, L.G. Wright, **D.N. Christodoulides**, and F.W. Wise, *Self-Cleaning of Femtosecond-Pulsed Beams in Graded-Index Multimode Fiber*, FIO, Rochester, NY, October, paper FTu2I.2 (2016).

L. Wright, Z. Liu, D.A. Nolan, M.J. Li, **D.N. Christodoulides**, and F.W. Wise, *Self-Organized Instability in Nonlinear Graded-Index Multimode Fiber With Disorder*, Nonlinear Photonics, Sydney Australia, September, paper NW4A.5 (2016).

L. Wright, A. Fusaro, A. Picozzi, **D.N. Christodoulides,** and F.W. Wise, *Spatiotemporal Complexity in Step-Index Multimode Fibers*, Nonlinear Photonics, Sydney Australia, September, paper NW4A.3 (2016).

G. Harari, M.A. Bandres, Y. Lumer, Y. Plotnik, **D.N. Christodoulides**, and M. Segev, *Topological Lasers*, CLEO, San Jose, CA, June, paper FM3A.3 (2016).

H. Hodaei, A.U. Hassan, J. Ren, W.E. Hayenga, **D.N. Christodoulides, and M. Khajavikhan** , *Ultra-sensitive PT-symmetric coupled cavities*, CLEO, San Jose, CA, June, paper FTh1A.3 (2016).

G. Lopez-Galmiche, Z. Sanjabi Eznaveh, M.A. Eftekhar, J.E. Antonio-Lopez, F.W. Wise, **D.N. Christodoulides, and R. Amezcua-Correa**, *Visible supercontinuum generation in a low DGD graded index multimode fiber*, CLEO, San Jose, CA, June, paper STh4O.6 (2016).

A.A. Dovgiy, A. Miroshnichenko, A. Moroz, A. Szameit, **D.N. Christodoulides**, and A.A. Sukhorukov, *Optical simulation of multi-dimensional nonlinear defect states with planar waveguide arrays*, Nonlinear Photonics, Sydney Australia, September, paper NTh1A.4 (2016).

K. Bagnell, A. Klee, J. Plant, P. Juodawlkis, and **P.J. Delfyett**, *A 10-GHz optical frequency comb from a SCOWA-based laser with an intra-cavity 10,000 finesse etalon*, CLEO, San Jose, CA, June, paper JTh2A.145 (2016).

K. Bagnell, A. Klee, and **P.J. Delfyett**, *A 10-GHz optical frequency comb from a SCOWA-based mode-locked laser with 600-hz optical mode linewidth*, FIO, Rochester, NY, October, paper JW4A.84 (2016).

M. Malinowski, **P.J. Delfyett, and S. Fathpour,** *Efficient frequency comb generation*, IEEE International Frequency Control Symposium (IFCS), New Orleans, LA, May 2016. (2016).

P.J. Delfyett, *Lasers - the light fantastic - Science and applications from pointers to DVDs*, UCF Optics Week, Orlando FL, April (2016).

A. Rao, M. Malinowski, A. Honardoost, J. R. Talukder, P. Rabiei, **P.J. Delfyett, and S. Fathpour**, *Second-harmonic generation in periodically-poled thin film lithium niobate on silicon*, Frontiers in Optics Conference, paper FTh5G.7, Rochester, NY, October 2016. (2016).

P.J. Delfyett, *Semiconductor laser based optical frequency combs - application in communications and signal processing*, OSA IONS University Laval, Quebec City, Quebec, Canada, May, (2016). **Invited**

P.J. Delfyett, S. Bhooplapur, A. Klee, E. Sarailou, and K. Bagnell, *Semiconductor laser based optical frequency combs - Applications in communications and signal processing*, IEEE International Conference Laser Optics (LO), St. Petersburg, Russia, June (2016).

M. Malinowski, A. Rao, **P.J. Delfyett, and S. Fathpour,** *Synchronously-pumped microring resonator for efficient optical comb generation*, CLEO, San Jose, CA, paper JTu5A.50, June 2016. (2016).

P.J. Delfyett, *Ultrawideband coherent optical signal processing using semiconductor laserbased optical frequency combs*, University of South Florida, Physics Department Seminar, (2016). **Invited**

M. Li, X. Yang, N. Cox, J. Beadsworth, and **D.G. Deppe,** *Record Low Differential Resistance Using Lithographic VCSELs*, CLEO, San Jose, CA, June, paper (2016).

J. Beadsworth, J. Leshin, M. Li, X. Yang, N. Cox, J. Leshin, L. Eifert, F. Tucker, and **D.G. Deppe**, *Record Single Mode Laser Diode Packing Density Using High Uniformity Lithographic VCSEL Arrays With Narrow Spectral Width*, CLEO, San Jose, CA, June, paper SF1L.2 (2016).

R. Rezvani Naraghi, M. Burdge and **A. Dogariu**, *Anomalous diffusion of light in complex media*, APS March Meeting, 61(2), G1.237 (2016).

C. Constant, S. Sukhov, and **A. Dogariu**, *Artificial thermodynamics with optical stochastic pumps*, CLEO, San Jose, CA, June, paper FF1A.4 (2016).

S. Sukhov, C. Constant, V. Kajorndejnukul, and **A. Dogariu**, *Colloids manipulation with optical radiation,*META16, 7th International Conference on Metamaterials, Photonic Crystals and Plasmonics, Malaga, Spain, July, (2016). **Invited**

J.R. Guzman-Sepulveda and **A. Dogariu**, *Continuous characterization of structural dynamics in complex systems*, FLAVS Annual Joint Symposium and Exhibition, Orlando, FL, March (2016).

J.R. Guzman-Sepulveda and **A. Dogariu**, *Continuous monitoring of structural dynamics in polymer assemblies.*, APS March Meeting, Baltimore, MD, March, 61(2), F42.7 (2016).

F.A. Tan, R. Rezvani Naraghi, M. Burdge, S. Sukhov, **A. Dogariu, and A.F. Abouraddy**, *Diffusive multi-scale spheres based on composite polymer systems*, SPIE Photonics West, San Francisco, CA, February, paper 9759-57 (2016).

F.A. Tan, R.R. Naraghi, M. Burdge, S. Sukhov, **A. Dogariu, and A.F. Abouraddy**, *Diffusive optical scattering from TiO2/polymer composite microspheres*, MRS Spring Meeting, Phoenix, AZ, March, paper EE14.4.20 (2016).

F.A. Tan, R. Rezvani Naraghi, S. Sukhov, **A. Dogariu, and A.F. Abouraddy**, *Diffusive scattering from a single composite microsphere fabricated by an in-fiber fluid instability*, OSA Photonics & Fiber Technology Congress, Australian Conference of Optical Fiber Technology, Sydney, Australia, September, paper AW3C.3 (2016).

F.A. Tan, R. Rezvani Naraghi, M. Burdge, **A. Dogariu, and A.F. Abouraddy**, *Diffusive scattering from single microspheres with well-dispersed dielectric nano-scale inclusions*, CLEO, San Jose, CA, June, paper JW2A.25 (2016).

G. Tao, J.J. Kaufmann, S. Shabahang, R.R. Naraghi, S.V. Sukhov, J.D. Joannopoulos, Y. Fink, **A. Dogariu**, and A. F. Abouraddy, *Digital design of multimaterial photonic particles*, Proceedings of the National Acadamy of Sciences, 113(25), pp.6839–6844 (2016).

R. Rezvani Naraghi, S. Sukhov, and **A. Dogariu**, *Disorder fingerprint - the distribution of local density of states in random media*, CLEO, San Jose, CA, June, paper FM3D.1 (2016).

R. Rezvani Naraghi, S. Sukhov, and **A. Dogariu**, *Light transport in dense composite media: role of near-field coupling*, APS March Meeting, Baltimore, MD, March, 61(2), V43.11 (2016).

R. Rezvani Naraghi, M. Burdge, S. Sukhov, and **A. Dogariu**, *Near-field interactions and anomalous diffusion of light in disordered media*, CLEO, San Jose, CA, June, paper FW4D.4 (2016).

A. Dogariu, *Non-universal Correlations in Complex Electromagnetic Fields*, CLEO, San Jose, CA, June, paper FW4D.1 (2016).

S.V. Sukhov , M.I. Petrov, A.A. Bogdanov, A.S. Shalin, and **A. Dogariu**, *Optical negative forces on particles near plasmonic interfaces*, META16, 7th International Conference on Metamaterials, Photonic Crystals and Plasmonics, Malaga, Spain, July (2016).

A.A. Bogdanov, M.I. Petrov, S.V. Sukhov, A.S. Shalin, and **A. Dogariu**, *Optical pulling force in the vicinity of plasmonic interfaces*, CLEO San Jose, CA, June, paper FM2B.5 (2016).

J.R. Guzman-Sepulveda, R. Argueta-Morales, K.K. Pourmoghadam, W.M. DeCampli, and **A. Dogariu,** *Optical rheology of blood during cardiovascular surgery*, CLEO, San Jose, CA, June, paper ATu1O (2016).

R. Rezvani Naraghi, L. Gustavo Cançado, F. Salazar-Bloise, and **A. Dogariu**, *Quantifying defect densities in monolayer graphene using near-field coherence measurements*, OSA Frontiers in Optics (FIO), Rochester, NY, October, paper FF5B.3 (2016).

C. Constant, S. Sukhov, and **A. Dogariu**, *Self-similarity in active colloid motion*, APS March Meeting, Baltimore, MD, March, H34.5 (2016).

M.I. Akhlaghi and **A. Dogariu**, *Sensing through obscurants - using fluctuations in stochastic coherent scattering*, CLEO, San Jose, CA, June, paper AM4K.3 (2016).

M.I. Akhlaghi and **A. Dogariu**, *Non-imaging statistical method for characterizing scattering media*, SPIE Newsroom (2016).

J. Chiles and **S. Fathpour**, *A reliable approach to membrane photonics: the T-guide*, CLEO, San Jose, CA, June, paper STu4R.3 (2016).

A. Rao, A. Patil, P. Rabiei, R. DeSalvo, A. Paolella, and **S. Fathpour**, *Analog performance of compact lithium niobate optical modulators on silicon*, IEEE Avionics and Vehicle Fiber-Optics and Photonics Conference (AVFOP), Long Beach, CA, November 2016. (2016).

J. Chiles, S. Toroghi, A. Rao, M. Malinowski, G. F. Camacho-Gonzalez, and **S. Fathpour**, *Experimental demonstration of poling-free and non-resonant second-harmonic generation in single-mode integrated waveguides*, OSA Frontiers in Optics Conference, paper FF2B.3 Rochester, NY, October 2016 (POSTDEADLINE). (2016).

S. Toroghi, S. Khan, and **S. Fathpour**, *Grating-assisted tunable optical delay line in microring resonators*, CLEO, San Jose, CA, June, paper JW2A.124 (2016).

S. Fathpour, A. Rao, P. Rabiei, A. Patil, R. DeSalvo, A. Paolella, J. Chiles, and M. Malinowski, *Heterogeneous integration of compact lithium niobate microring and Mach-Zehnder modulator on silicon*, IEEE Photonics Conference (IPC), Waikoloa, HI, October 2016 . (2016). **Invited**

S. Fathpour, A. Rao, P. Rabiei, A. Patil, R. DeSalvo, A. Paolella, J. Chiles, and M. Malinowski, *Heterogeneous lithium niobate microring and modulator integration on silicon*, IEEE International Topical Meeting on Microwave Photonics (MWP), Long Beach, CA, October 2016). (2016). **Invited**

A. Rao, A. Patil, P. Rabiei, R. DeSalvo, A. Paolella, and **S. Fathpour**, *Lithium niobate modulators on silicon beyond 20 GHz*, IEEE Optical Interconnects Conference (OI), San Diego, CA, May 2016. (2016).

J. Chiles and **S. Fathpour**, *Supra-octave-spanning single-mode and single-polarization operation in nanophotonic waveguides*, Frontiers in Optics Conference, paper FW5D.2, Rochester, NY, October 2016. (2016).

R.M. Gaume, *Monitoring the Fabrication of Optical Ceramics by LIBS*, 6th International Workshop on Photoluminescence in Rare-Earths: Photonic Materials and Devices (PRE'16), Greenville SC, June (2016). **Invited**

W.T. Shoulders, E. Bourret, G. Bizarri, and **R.M. Gaume**, *Sintering and optical performance of Eu:BaCl2 transparent ceramic scintillators*, 40th American Ceramic Society Conference ICACC, Daytona Beach, FL, January (2016).

M. Baudelet, S.J. Pandey, R. Locke, B. Seesahai, R.M. Gaume, and M.C. Richardson, *Study of matrix effects for reproducible LIBS analysis of powders*, Pittcon, Atlanta GA, March (2016).

V.O. Smirnov, E. Rotari, R. Vasilyeu, O. Smolski, A. Glebov and **L.B. Glebov**, *Efficient chirped Bragg gratings for stretching and compression of high power ultra short laser pulses at 800-2500 nm*, SPIE Photonics West, San Francisco, CA, February (2016).

B.M. Anderson, E. Hale, G. Venus, D. Ott, I. Divliansky, and **L.B. Glebov**, *High brightness sub-nanosecond Q-switched laser using volume Bragg gratings*, SPIE 9726, Solid State Lasers XXV: Technology and Devices (2016).

E. Hale, B. Anderson, G. Venus, D. Ott, I. Divliansky, **L.B. Glebov**, *High brightness, sub-nanosecond Q-switched laser using volume Bragg gratings,* CREOL Industrial Affiliates Symposium, March (2016).

F. Kompan, G. Venus, L. Glebova, H. Mingareev, and **L.B. Glebov**, *Photo-thermo-refractive glass with long wavelength photosensitivity*, CREOL Industrial Affiliates Symposium, March (2016).

F. Kompan, G. Venus, L. Glebova, H. Mingareev, and **L.B. Glebov**, *Photo-thermo-refractive glass with sensitivity extended to near infrared region*, SPIE 9744, Optical Components and Materials XIII, 97440I (2016).

V. Smirnov, O. Mokhun, A.L. Glebov, **L.B. Glebov, A. Sincore, J. Bradford, L. Shah, and M.C. Richardson,** *Volume Bragg gratings for 2-micron laser systems,* SPIE Photonics West, San Francisco, CA, February (2016).

D.J. Hagan, P. Zhao, M. Reichert, E.W. Van Stryland, *Comparison of second hyperpolarizability in liquid and gas phases of carbon disulfide*, OSA Novel

Optical Materials and Applications, Vancouver Canada, July, paper NoW2D.2 (2016).

N. Kinsey, A.A. Syed, D. Courtwright, C. DeVault, C.E. Bonner, V.I. Gavrilenko, V.M. Shalaev, **D.J. Hagan, E.W. Van Stryland**, and A. Boltasseva, *Effective third-order nonlinearities in refractory plasmonic tin thin films*, CLEO, San Jose, CA, June, paper FW4A.4 (2016).

D.J. Hagan and E.W. Van Stryland, *Electronic and nuclear optical nonlinearities in organic materials and solvents*, 14th International Conference on Frontiers of Polymers and Advanced Materials, Dajeon, South Korea, paper 1A1-1, (2016). **Invited**

S. Tofighi, P. Zhao, M. Bondar, R. O'Donnell, J. Shi, **D.J. Hagan, and E.W. Van Stryland**, *Electronic nature of new Ir (III)-complexes: Linear spectroscopic and nonlinear optical properties*, OSA Frontiers in Optics, Rochester, NY, paper JW4A.183 (2016).

P. Zhao, M. Reichert, **D.J. Hagan, E.W. Van Stryland,** *Measurement of nonlinear optical response functions of common organic solvents*, CLEO, San Jose, CA, June, paper JW2A.54 (2016).

D.J. Hagan, M. Reichert, P. Zhao and E.W. Van Stryland, *Measurements of the second hyperpolarizability and nuclear rotational response of liquids and gases*, 17th International Conference, Laser Optics, St. Petersburg, Russia, paper WeR4-01, (2016). **Invited**

D.J. Hagan, *Measuring the impulse response function in nonlinear optics*, OSA Latin American Optics & Photonics Conference, Medellin, Colombia, August, (2016). **Invited**

D.J. Hagan, T.R. Ensley, M. Reichert, M.R. Ferdinandus, H. Hu, and E.W. Van Stryland, *New methods for characterizing the nonlinear optical properties of organic materials*, 13th International Conference on Frontiers of Polymers and Advanced Materials, Marrakesh, Morocco, keynote presentation (2016).

P. Zhao, M. Reichert, **D.J. Hagan, and E.W. Van Stryland**, *Nondegenerate nonlinear refraction in semiconductors*, FIO, Rochester, NY, October, paper JTh2A.26 (2016).

M. Reichert, P. Zhao, H.S. Pattanaik, **D.J. Hagan, and E.W. Van Stryland** , *Nondegenerate two- and three-photon nonlinearities in semiconductors*, SPIE 9835, Ultrafast Bandgap Photonics, 98350A (2016).

P. Zhao, M. Reichert, T.R. Ensley, W.M. Shensky, A.G. Mott, **D.J. Hagan, and E.W. Van Stryland**, *Nonlinear refraction dynamics of solvents and gases,* SPIE 9731, Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications XV, 97310F (2016).

D.J. Hagan, P. Zhao, T. Ensley, M. Reichert and E.W. Van Stryland, *The nonlinear refraction temporal response function of solvents and gases,* Southeastern Ultrafast Conference, 2016, North Carolina State University, January, (2016). **Invited**

J. Donnelly and **F.E. Hernandez**, *Multiphoton spectroscopy on Thioflavin T: a nonlinear approach for amyloid detection*, 251st ACS Annual Meeting 2016, San Diego, California, USA (2016).

J. Donnelly and **F.E. Hernandez**, *OCTET & BIOTEC: a model of a summer intensive camp designed to cultivate the future generation of young leaders in stem*, Florida Educational Research Association (FERA) Annual Meeting, Lakeland, FL, November 16-18 (2016).

J. Donnelly, C. Diaz, and **F.E. Hernandez**, *OCTET & BIOTEC: a model of a summer intensive designed to cultivate the future generation of young leaders in stem*, 251st ACS Annual Meeting, San Diego, California, USA (2016).

T. Wickramasooriya, A. Kaul, **A. Kar**, and R. Vaidyanathan, *Laser induced diffusion in metallic implants for reduced heating in MRIi environments*, AMPAC-MSE Industrial Board Meeting (2016).

M. Khajavikhan, *Lasing characteristics in parity-time-symmetric microcavities*, META16, 7th International Conference on Metamaterials, Photonic Crystals and Plasmonics, Malaga, Spain, (2016). **Invited**

P. Aleahmad, **M. Khajavikhan, P.L. LiKamWa, and D.N. Christodoulides**, *Monolithically integrated unidirectional circulators utilizing non-hermiticity and nonlinearity on InP*, CLEO, San Jose, CA, June, paper FW1A.5 (2016).

A.U. Hassan, H. Hodaei, M.A. Miri, **M. Khajavikhan, and D.N. Christodoulides**, *Nonlinear reversal of PT-symmetric phase transition in a system of coupled micro-ring cavities*, SPIE 9920, Active Photonic Materials VIII, September (2016).

M. Khajavikhan, *Novel metallic sub-wavelength nanolasers*, SPIE Photonics North, Canada, (2016). **Invited**

M. Khajavikhan, *Parity-time symmetric lasers*, SPIE Photonics West, San Francisco, (2016). **Invited**

J.L. Digaum, R. Sharma, D. Batista, J.J. Pazos, R.C. Rumpf, and **S.M. Kuebler**, *Beam-bending in spatially variant photonic crystals at telecommunications wavelengths*, SPIE 9759, Advanced Fabrication Technologies for Micro/Nano Optics and Photonics IX, 975911 (2016).

J.M. Kahn, **G.F. Li**, X. Li, and N. Zhao, *Are OAM states an optimal basis for spatially multiplexed free-space links?*, IEEE Photonics Society Summer Topical Meeting Series (SUM), Newport Beach, CA, July, (2016). **Invited**

B. Huang, H. Chen, N. K. Fontaine, C. Jin, K. Shang, R. Ryf, R. Essiambre, B. Ung, Y. Messaddeq, S. LaRochelle, and **G.F. Li**, *Characterization of space-division multiplexing amplifiers using a swept wavelength coherent reflectometer*, OSA Optical Fiber Communication Conference, Los Angeles, CA, March, paper W4F.2 (2016).

R. Mi, N. Zhao, Z. Yang, L. Zhang, and **G.F. Li,** *Integrated chromatic and modal dispersion measurement using microwave photonic techniques,* Asia Communications and Photonics Conference, Wuhan China, November, paper AS3G.2 (2016).

L. He, Y. Guo, Z. Han, K. Wada, L. C. Kimerling, J. Michel, A. M. Agarwal, **G.F. Li** and L. Zhang, *Low-loss SOI waveguides at Mid-IR wavelengths (4800 nm) using the second-order TE mode*, IEEE 13th International Conference on Group IV Photonics (GFP), Berlin Germany, paper FB3 (2016).

M. Yang, Y. Guo, J. Wang, Z. Han, K. Wada, L. C. Kimerling, A. M. Agarwal, J. Michel, **G.F. Li** and L. Zhang, *Mid-infrared supercontinuum generation in a low-dispersion Ge-on-Si waveguide using sub-picosecond pulses*, IEEE 13th International Conference on Group IV Photonics (GFP), Berlin Germany, paper WD4 (2016).

Y. Guo, J. Wang, Z. Han, L. C. Kimerling, A. M. Agarwal, J. Michel, Z. Zheng, **G.F. Li**, and L. Zhang, *Mid-IR Kerr frequency comb generation from 4000 to 10000 nm in a CMOS-compatible Germanium microcavity*, CLEO, San Jose, CA, June, paper JTh2A.92 (2016).

J. Wang, Y. Guo, **G.F. Li**, and L. Zhang, *On-chip spectral broadening of Kerr frequency combs: towards a fully integrated frequency metrology system with f-2f self-reference*, CLEO, San Jose, CA, June, paper JTh2A.135 (2016).

J. Wang, Z. Han, Y. Guo, L.C. Kimerling, J. Michel, A.M. Agarwal, **G.F. Li**, and L. Zhang, *Robust generation of Kerr frequency combs with strong and localized spectral loss*, IEEE 13th International Conference on Group IV Photonics (GFP), Berlin Germany, paper FA5 (2016).

G.F. Li, *Space-division multiplexing for PON applications*, OSA Signal Processing in Photonic Communications, Vancouver Canada, July, paper SpTu3F.1, (2016). **Invited**

L. Yu, J. Zhao, **G.F. Li**, and Q. Mo, *The beat-length of polarization maintaining few-mode-fiber measurement based on polarized interference,*15th International Conference on Optical Communications and Networks, Hangzhou, China, paper T2-O-11, September (2016).

J.M. Kahn, **G.F. Li**, X. Li, and N. Zhao, *To twist or not to twist: capacity limits for free-space channels*, OSA Signal Processing in Photonic Communications, Boston, Massachusetts, June, paper SpM4E.1, (2016). **Invited**

J. Li, F. Ren, T. Hu, Z. Li, Y. He, Z. Chen, Q. Mo, and **G.F. Li**, *Recent progress in mode-division multiplexed passive optical networks with low modal crosstalk,* Science Direct, Optical Fiber Technology, Paper (2016). **Invited**

H. Wen, Y. Alahmadi, **P.L. LiKamWa, C. Xia, C. Carboni, G.F. Li**, *Four-mode semiconductor optical amplifier*, SPIE 9774, Next-Generation Optical Communication: Components, Sub-Systems, and Systems V, 977406, (2016). **Invited**

W. Hayenga, H. Garcia-Garcia, H. Hodaei, **P.L. LiKamWa, and M. Khajavikhan**, *Second-order coherence measurement of a metallic coaxial nanolaser*, CLEO, San Jose, CA, June, paper FTh1B.7 (2016).

X. Yuan, Y. Sun, **S. Pang**, *Compressive temporal stereo-vision imaging*, OSA Imaging and Applied Optics (Imaging) Congress, Heidelberg, Germany, paper JT3A.30 (2016).

X. Yuan and **S. Pang**, *Compressive video microscope via structured illumination*, IEEE International Conference on Image Processing (ICIP), Phoenix AZ, September (2016).

Y. Sun and **S. Pang**, *Incoherent light Talbot microscopy*, SPIE Photonics West, BIOS (2016).

Z. Ma and **C.K. Renshaw**, *Hemispherical focal plane array using vertically-stacked anti-polar diodes,* Graduate Research Forum, University of Central Florida (2016).

C. Rivero-Baleine, A. Kirk, S. Aiken, C. Bungay, S. Tuenge, **K.A. Richardson**, C. Smith, L. Sisken , T. Mayer, A. Swisher, A. Pogrebnyakov, M. Kang, and C. Pantano , *Advanced optical materials for next generation EO/IR sensors*, Glass and Optical Materials Division (GOMD) meeting, Madison WI, (2016). **Invited**

K.A. Richardson, *Advanced optical materials for next generation infrared components*, 2016 Corning Glass Summit, Corning NY, (2016). **Invited**

L. Li, H. Lin, S. Geiger, A. Zerdoum, P. Zhang, T.O. Ogbuu, Q. Du, X. Jia, S. Novak, C. Smith, **K.A. Richardson**, J.D. Musgraves, and J. Hu, *Amorphous thin films for mechanically flexible multi-material integrated photonics*, KREIDL award lecture, Glass and Optical Materials Division (GOMD) meeting, Madison WI, (2016). **Invited**

L. Li, H.T. Lin, S. Geiger, A. Zerdoum, P. Zhang, O. Ogbuu, Q.Y. Du, X.Q. Jia, S. Novak, C. Smith, **K.A. Richardson**, J.D. Musgraves, and J.J. Hu, *Amorphous thin films for mechanically flexible, multimaterial integrated photonics*, American Ceramic Society Bulletin 95(4), pp.34-36 (2016).

S. Novak, P.T. Lin, C. Li, L. Sisken, W. Deng, J. Hu, A. Agarwal, and **K.A. Richardson**, *Chalcogenide glasses for planar devices*, 229th ECS Meeting, San Diego CA, paper 71258 (2016).

B. Gleason, L. Sisken, C. Smith, **K.A. Richardson**, *Designing mid-wave infrared (MWIR) thermo-optic coefficient (dn/dT) in chalcogenide glasses* , SPIE 9822, Advanced Optics for Defense Applications: UV through LWIR, 9822-6 (2016).

S. Novak, V. Singh, C. Monmeyran, A. Ingram, Z. Han, H. Lin, N. Borodinov, N. Patel, Q. Du, J. Hu, I. Luzinov, R. Golovchak, A. Agarwal, and **K.A. Richardson,** *Effect of gamma exposure on chalcogenide glass films for microphotonic devices*, IEEE Nuclear and Space Radiation Effects Conference, Portland OR, July (2016).

A. Buff, L. Sisken, C. Smith, and **K.A. Richardson,** *Engineering GRIN profiles in chalcogenide glasses,* Department of Materials Science and Engineering (MSE), External Advisory Board poster session (2016).

K.A. Richardson, A. Buff, C. Smith, L. Sisken, J.D. Musgraves, P. Wachtel, T. Mayer, A. Swisher, A. Pogrebnyakov, M. Kang, C. Pantano, D. Werner, C. Rivero-Baleine, A. Kirk, and S. Aiken, *Engineering novel infrared glass ceramics for advanced optical solutions* , SPIE 9822, Advanced Optics for Defense Applications: UV through LWIR, 9822-4 (2016).

K.A. Richardson, *Engineering novel materials for infrared photonics*, CREOL Industrial Affiliates Symposium, March (2016).

L. Li, H. Lin, S. Geiger, A. Zerdoum, X. Jia, J. Michon, Q. Du, C. Smith, S. Novak, **K.A. Richardson**, S. Qiao, N. Lu, J. D. Musgraves, J. Hu, and T. Gu, *Flexible integrated photonics: shedding light into the flexible electronics toolkit*, TechConnect World Innovation Conference, Washington DC (2016).

J. Hu, X.Y. Sun, Q. Du, T. Goto, M.C. Onbasli, C.A. Ross, L. Li, H. Lin, D. Kita, J. Michon, C. Smith, **K.A. Richardson**, *Glass and polycrystalline thin films for monolithic photonic integration*, Global Forum on Advanced Materials and Technologies for Sustainable Development, Toronto Canada (2016).

N. Borodinov, A.P. Soliani, J. Giammarco, C. Tysinger, Y. Galabura, B. Zdyrko, S. Novak, **K.A. Richardson,**V. Singh, Q. Du, A. Agarwal, L. Kimerling, J. Hu, and I. Luzinov, *Gradient films from shape memory nanofoams for waveguide coating*, 251st meeting of the American Chemical Society, San Diego CA (2016).

J.E. Trembla, Y.H. Lin, M.N. Sakib, M. Malinowski, S. Novak, P. Qiao, C. Chang-Hasnain, **K.A. Richardson, S. Fathpour**, and M.C. Wu, *High-Q and low-loss chalcogenide waveguide for nonlinear supercontinuum generation*, IEEE Photonics Conference (IPC), Waikoloa, HI, October (2016).

J. Marro, A. Kapat, T. Darroudi, C. Okoro, Y. Obeng, and **K.A. Richardson**, *Microstructural investigation of pulse electroplated copper trenches, deposited with organic additives*, 229th ECS Meeting, San Diego CA, paper 02-1099 (2016).

L. Li, H. Lin, Y. Zou, Q. Du, C. Smith, S. Novak, **K.A. Richardson**, and J.J. Hu , *Multi-material integration in glass photonics*, International Congress on Glass, Shanghai China, (2016). **Invited**

C.M. Schwarz, S. Labh, J.E. Barker, R.J. Sapia, G.D. Richardson, C. Rivero-Baleine, B. Gleason, **K.A. Richardson, A. Pogrebnyakov, T.S. Mayer, and S.M. Kuebler**, *Multi-photon lithography of 3D micro-structures in As2S3 and Ge5(As2Se3)95 chalcogenide glasses*, SPIE 9759, Advanced Fabrication Technologies for Micro/Nano Optics and Photonics IX, 975916-1-8 (2016).

K.A. Richardson, *Novel chalcogenide optical materials: linking optical performance-tailoring with manufacturability - a Tutorial*, CLEO tutorial, San Jose CA, (2016). **Invited**

K.A. Richardson, A. Buff, L. Sisken, C. Smith, C. Rivero-Baleine, A. Kirk, T. Mayer, C. Pantano, A. Swisher, M. Kang, A. Pogrebnyakov, C. Schwarz, and S. Kuebler, *Optical glass ceramics for GRIN - engineering microstructure for optical function*, Ceramic Society of Japan (CerSJ) – ACerS Glass and Optical Materials Division (GOMD) joint symposium on Glass Science and Technologies, Kyoto Japan, (2016). **Invited**

K.A. Richardson, A. Buff, C. Smith, L. Sisken, J. D. Musgraves, P. Wachtel, T. Mayer, A. Swisher, A. Pogrebnyakov, M. Kang, C. Pantano, D. Werner, C. Rivero-Baleine, A. Kirk, and S. Aiken, *Optical glass ceramics for GRIN - engineering microstructure for optical function*, Materials Science and Technology (MS&T), Salt Lake City UT, (2016). **Invited**

A. Lepicard, F. Adamietz, V. Rodriguez, **K.A. Richardson**, and M. Dussauze, *Study of the second harmonic generation stability and mechanisms in thermally poled alkali-doped chalcogenide glasses,* The 7th International Conference on Optical, Optoelectronic and Photonic Materials and Applications (ICOOMPA), Montreal Canada, June (2016).

J.W. Choi, Z. Han, B.U. Sohn, G.F.R. Chen, L.C. Kimerling, **K.A. Richardson**, A.M. Agarwal, and D.T.H. Tan, *Supercontinuum generation beyond 2μm in GeSbS waveguides*, OSA Frontiers in Optics, Rochester NY, paper JTh2A.163 (2016).

D. Kita, H. Lin, J. Li, Z. Han, P. Su, T. Gu, A. Agarwal, A. Yadav, **K.A. Richardson**, and J. Hu, *Suspended chalcogenide microcavities for ultra-sensitive chemical detection*, Proceedings of the 2016 IEEE Conference on SENSORS (2016).

K.A. Richardson, *The role of nano-scale heterogeneity fluctuations on the properties of optical composites*, Turner Symposium, 100th Annual Meeting of the Society of Glass Technology, Sheffield England, (2016). **Invited**

A. Yadav, D. M. Kita, P. Su, A. M. Agarwal, J. Hu, M. Dussauze and **K.A. Richardson**, *Thermal conductivity of chalcogenide glasses measured by raman spectroscopy*, International conference on Ceramics, Glass and Refractories - Emerging Innovations organized by the Indian Ceramic Society at Hyderabad, India, December (2016).

M.C. Richardson, C. Jeon, E. Lane, and M. Baudelet, *Challenges facing long distance propagation of high power laser beams*, High Power Laser Ablation/ Directed Energy, Santa Fe, NM, (2016). **Invited**

B. Ealy, L. Calderon, W. Wang, R. Valentin, I. Mingareev, **M.C. Richardson**, and J. Kapat, *Characterization of LAM-fabricated porous superalloys for turbine components*, ASME Turbo Expo 2016: Turbomachinery Technical Conference and Exposition, paper GT2016-58080 (2016).

I. Mingareev, S. Isenberg, and **M.C. Richardson,** *High-density micro-perforation of stainless steel using ultrafast lasers*, International Congress on Applications of Lasers & Electro-Optics (ICALEO) (2016).

M.C. Richardson, *Laser-based technologies that will transform manufacturing*, International Scientific Spring Workshop in Physics, National Center for Physics, Qaid-i-Azam University, Islamabad, Pakistan, (2016). **Invited**

M.C. Richardson, *Light and and our photonic futures,* Public Lecture, February 17, Jazan University, Saudi Arabia, (2016). **Invited**

M.C. Richardson, C. Jeon, E. Lane, and M. Baudelet, *Long distance propagation of high power laser beams*, Singapore Defense Sciences Orgnization, Singapore April, (2016). **Invited**

M.C. Richardson, *Photonics and the changing energy scene*, International Scientific Spring Workshop in Physics, National Center for Physics, Qaid-i-Azam University, Islamabad, Pakistan, (2016). **Invited**

M.C. Richardson, *The mysteries of ultrafast laser filamentation in air*, Fifth Saudi International

Meeting on Frontiers of Physics, February 16-18, Jazan University, Saudi Arabia, (2016). **Invited**

M.C. Richardson, *Ultrafast laser filamentation in air,* International Scientific Spring Workshop in Physics, National Center for Physics, Qaid-i-Azam University, Islamabad, Pakistan, (2016). **Invited**

W.D. Larson and **B.E.A. Saleh**, *Ancilla-aided recovery of quantum super-sensitivity diminished by decoherence*, FIO, Rochester, NY, October, paper FF5D.6 (2016).

E. Schneller, H. Seigneur, K. Davis, and **W.V. Schoenfeld**, *Effect of diamond wire saw marks on solar cell performance*, Silicon PV 2016 - 6th International Conference on Silicon Photovoltaics, Chambery, France (2016).

F. Alema, O. Ledyaev, R. Miller, V. Beletsky, B. Hertog, A. Osinsky, and **W.V. Schoenfeld**, *High Mg content wurtzite phase MgxZn1-xO epitaxial film grown via pulsed-metal organic chemical vapor deposition (PMOCVD)*, SPIE 9749, Oxide-based Materials and Devices VII, 97490Y (2016).

H.P. Seigneur, S. Ostapenko, I. Tarasov, C. Rodrigues, Y. Zaikin, K. Murrow, and **W.V. Schoenfeld**, *Inline diamond wire inspection based on resonant vibrations*, Photovoltaics International, 31 (2016).

Z. Sanjabie Znaveh, E. Antonio-Lopez, J. Rodriguez Asomoza, G. Galmiche, D. Vanras, P. Sillard, **A. Schülzgen, C.M. Okonkwo, and R. Amezcua-Correa,** *Few-mode multicore photonic lantern multiplexer,* OSA Optical Fiber Communication Conference, Anaheim, CA, March, paper Tu3I.5 (2016).

G. Lopez-Galmiche, Z. Sanjabi Eznaveh, J.E. Antonio-Lopez, A.M. Velazquez-Benitez, J. Rodriguez-Asomoza, L.A. Herrera-Piad, J.J. Sanchez-Mondragon, C. Gonent, P. Sillard, G. Li ; **A. Schülzgen, C. Okonkwo, and R. Amezcua-Correa,***Gain-controlled erbium-doped fiber amplifier using mode-selective photonic lantern*, SPIE 9774, Next-Generation Optical Communication: Components, Sub-Systems, and Systems V, 97740P (2016).

N. Wang, J. Enrique Antonio-Lopez, J.C. Alvarado Zacarias, Z. Sanjabi Eznaveh, H. Wen, P. Sillard, S. Leon-Saval, A. **A. Schülzgen, R. Amezcua-Correa, and G.F. Li**, *Mode-selective fiber laser using a photonic lantern*, ECOC 2016 - 42nd European Conference on Optical Communication, Dusseldorf, Germany (2016).

N.K. Fontaine, B. Huang, Z. Sanjabie Znaveh, H. Chen, C. Jin, B. Ercan, A. Velázquez-Benetez, S.H. Chang, R. Ryf, **A. Schülzgen, J. Carlos Alvarado, P. Sillard, C. Gonnet, E. Antonio-Lopez, and R. Amezcua-Correa**, *Multi-mode optical fiber amplifier supporting over 10 spatial modes*, OSA Optical Fiber Communication Conference, Anaheim, CA, March, paper Th5A.4 (2016).

A. Schülzgen, *Sensors and lasers based on multicore optical fibers*, International Workshop, New Frontiers in Fiber Optics, Jena, Germany, (2016). **Invited**

J. Villatoro, E. Antonio-Lopez, A. Van Newkirk, J. Zubia, **A. Schülzgen, and R. Amezcua-Correa**, *Supersensitive sensors based on multicore optical fibres*, SPIE 9886, Micro-Structured and Specialty Optical Fibres IV, 98860E (2016).

A. Sincore, J. Cook, W. Li, E. Johnson, J. Bradford, **L. Shah, and M.C. Richardson**, *Beam propagation of Gaussian and annular beams at 2 um in presence of thermal lensing*, CLEO, San Jose, CA, June, paper JTh2A.77 (2016).

A. Sincore, **L. Shah, V. Smirnov, and M.C. Richardson,** *Comparison of in-band pumped Tm:fiber and Ho:fiber*, SPIE 9728, Fiber Lasers XIII: Technology, Systems, and Applications, 97280S (2016).

S. Wittek, R. Bustos Ramirez, J. Alvarado Zacarias, Z. Sanjabi Eznaveh, G. Lopez Galmiche, J. Bradford, J.E. Antonio-Lopez, **L. Shah, and R. Amezcua-Correa,** *High-power mode-selective amplification in large mode area ytterbium-doped fiber using photonic lanterns*, CLEO, San Jose, CA, June, paper SM2Q.3 (2016).

S. Gausmann, A. Abdulfattah, A. Sincore, J. Bradford, **L. Shah, and M.C. Richardson**, *Influence of wavelength and temperature on nanosecond pulse amplification in Tm:fiber*, SPIE Defense, Sensing and Security, Baltimore, MD, April (2016).

L. Shah, N. Bodnar, P. Roumayah, B. Webb, J. Bradford, and M.C. Richardson, *Integrated pulse stretchers for high-energy CPA and OPCPA systems,* SPIE 9730, Components and Packaging for Laser Systems II, 97300V (2016).

C.H. Jeon, J. Lane, S. Rostami, **L. Shah, M. Baudelet, and M.C. Richardson**, *Laser induced filamentation propagation through adverse conditions*, OSA: Propagation Through and Characterization of Atmospheric and Oceanic Phenomena, paper Tu2A.3 (2016).

S. Shabahang, A. Sims, G. Tao, **L. Shah, M.C. Richardson, and A.F. Abouraddy**, *Multi-octave mid-infrared supercontinuum generation in robust chalcogenide nanowires using a thulium-fiber laser,* OSA Photonics and Fiber Technology Congress, Sydney, Australia, 5 - 8 September (2016).

J.D. Miller, N. Jiang, **D.J. Thul**, M. Slipchenko, J. Mance, T.R. Meyer, S. Roy, and J.R. Gord, *100-kHz burst-mode particle image velocimetry: space-time correlations and considerations for spatial and temporal resolution*, 54th AIAA Aerospace Sciences Meeting, AIAA SciTech, San Diego, CA, January (2016).

B.R. Halls, J.R. Gord, T.R. Meyer, **D.J. Thul,** M. Slipchenko, and S. Roy, *20-kHz-rate three-dimensional tomographic imaging of the concentration field in a turbulent jet*, Proceedings of the Combustion Institute, July (2016).

B.R. Halls, N. Jiang, **D.J. Thul**, M.N. Slipchenko, S. Roy, T.R. Meyer, and J.R. Gord, *High-speed three-dimensional imaging of turbulent flows*, OSA Laser Applications to Chemical, Security and Environmental Analysis, Heidelberg Germany, July (2016).

T.R. Meyer, B.R. Halls, N. Jiang, **D.J. Thul**, M.N. Slipchenko, S. Roy, and J.R. Gord, *High-speed three-dimensional tomography of soot and combustion intermediates in jet diffusion flames*, IEEE International Conference Laser Optics (LO), St. Petersburg, Russia, July (2016).

B.R. Halls, N. Jiang, **D.J. Thul**, M. Slipchenko, S. Roy, T. Meyer, and J. Gord, *High-speed, three-dimensional tomographic imaging of concentration fields in turbulent flows*, CLEO, San Jose, CA, June, paper AW4K.2 (2016).

E.W. Van Stryland and D.J. Hagan, *Extremely nondegenerate enhancement of third-order nonlinearities in semiconductors*, Photonics 2016, Kanpur India, December, (2016). **Invited**

E.W. Van Stryland and D.J. Hagan, *Extremely nondegenerate nonlinear responses of semiconductors*, LAOP, Medellin, Columbia, August, (2016). **Invited**

Q. Ru, Z. Loparo, P.G. Schunemann, and **K.L. Vodopyanov** , *Femtosecond opo based on orientation-patterned gallium phosphide (OP-GaP)*, CLEO:QELS, San Jose, CA, June, paper STu1Q.6 (2016).

V.O. Smolski, H. Yang, J. Xu, and **K.L. Vodopyanov**, *Massively parallel dual-comb molecular detection with subharmonic optical parametric oscillators*, arXiv:1608.07318 (2016).

K.F. Lee, C. Mohr, J. Jiang, P.G. Schunemann, **K.L. Vodopyanov**, and M.E. Fermann, *Narrow linewidth midinfrared frequency combs from doubly-resonant OPOs*, High-Brightness Sources and Light-Driven Interactions, in Mid-Infrared Coherent Sources 2016 (OSA conference), Long Beach, CA, (2016). **Invited**

K.L. Vodopyanov, and K.L. Schepler (editors), *Nonlinear frequency generation and conversion: materials, devices, and applications XV*, SPIE 9731 (2016).

V.O. Smolski, J. Xu, P.G. Schunemann, and **K.L. Vodopyanov**, *Octave-wide frequency comb centered at 4 μm based on a subharmonic OPO with Hz-level relative linewidth*, SPIE 9731, Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications XV, 973103 (2016).

V.O. Smolski, J. Xu, P.G. Schunemann, and **K.L. Vodopyanov**, *Octave-wide frequency comb centered at 4 μm based on a subharmonic OPO with Hz-level relative linewidth*, SPIE 9731, Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications XV, 973103, March (2016).

K.L. Vodopyanov, *Real-time detection of biomarkers in human breath with lasers*, Mayo - UCF Symposium, Orlando FL, May (2016).

K.F. Lee, C. Mohr, J. Jiang, P.G. Schunemann, **K.L. Vodopyanov**, and M.E. Fermann , *Self-stabilized 3-5 μm frequency comb based on frequency-divide-by-two GaAs OPO*, SPIE 9731, Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications XV, 973102 (2016).

K.F. Lee, C. Mohr, J. Jiang, P.G. Schunemann, and **K.L. Vodopyanov**, *Self-stabilized 3-5 μm frequency comb based on frequency-divide-by-two GaAs OPO*, Photonics West (LASE), San Francisco, (2016). **Invited**

V.O. Smolski, S. Vasilyev, P.G. Schunemann, S.B. Mirov, and **K.L. Vodopyanov**, *Subharmonic GaAs OPO pumped by a Cr:ZnS laser with an instantaneous bandwidth 3.6-5.6 μm*, Laser Optics, St Petersburg, Russia, June, (2016). **Invited**

S.T. Wu, *Liquid crystals for photonics applications*, BOE, Beijing, China, (2016). **Invited**

S. Wandel, M.W. Lin, **Y. Yin**, G. Xu, and I. Jovanovic, *Bandwidth-tunable ultrafast mid-infrared source using a dual-chirped optical parametric amplifier*, CLEO: San Jose, CA, paper JTu5A.76 (2016).

S.L. Cousin, J. Li, X. Ren, **Y. Yin**, S.M. Teichmann, K. Zhao, F. Silva, A. Chew, M. Reduzzi, Y. Cheng, M. Devetta, E. Cunningham, G. Sansone, Y. Wu, I. Leon, M. Chini, J. Biegert, and Z. Chang, *Isolated attosecond water-window pulses driven by 1.8 μm lasers*, OSA International Conference on Ultrafast Phenomena, Santa Fe, NM, July, paper UTh5A.5 (2016).

Invited Lectures and Tutorials

L. Argenti, *Attosecond interferometric spectroscopy of resonant transitions*, ITAMP Workshop, The electronicstructure problem in theoretical strong-field physis, Harvard-Smithsonian Center for Astrophysics, Cambridge, MA (2016).

Z. Chang, *Advances in attosecond optics frontier,* Xi'an Jiaotong University, May 23, Xi'an, China (2016).

Z. Chang, *Advances in attosecond optics frontier,* Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, May 24 (2016).

L.B. Glebov, *Volume holographic elements for spectroscopy and high-power laser applications*, Institute of Physics HILASE. June 26, Prague, Czech Republic (2016).

L.B. Glebov, *Volume holographic elements for spectroscopy and laser applications*, Short course. CREOL Industrial Affiliates Symposium. (2016).

D.J. Hagan, *Pulsed IR detection using nondegenerate two-photon absorption in uncooled photodiodes,* SPIE Lecture seminar, Michigan Technological University, Houghton, MI, April 7 (2016). **Invited**

M.C. Richardson, *Single cycle laser pulses and their applications*, Workshop on Optics & Photonics, King Abdullah University for Science & Technology, Riyadh, February 21 (2016).

B. E. A. Saleh, *Optics of Ibn-Alhaytham and Photonics of the 21st Century*, Zewail University, Cairo, Egypt, May 16 (2016).

B. E. A. Saleh, *Correlation Imaging, Image Science Gordon Conference, Stonehill College*, Stonehill, MA, June 10 (2016).

B. E. A. Saleh, *Advances in quantum metrology, West Lake Photonics Symposium*, Zhejiang University, Hangzhou, China, November 7 (2016).

E.W. Van Stryland, *Characterization and modeling of nonlinear optical materials for various applications*, University of Dayton, January 22 (2016).

E.W. Van Stryland, *Characterization and modeling of nonlinear optical materials for various applications*, WPAFB, Jananuary 22 (2016).

E.W. Van Stryland, *History of OSA*, Local student section, University of Aveiro, Aveiro, Portugal, July 18 (2016).

E.W. Van Stryland, *History of OSA*, ICFO, Barcelona, Spain, July 25 (2016).

E.W. Van Stryland, *Nonlinear optical spectroscopy: absorption and refraction*, Local OSA student section, Medellin, Columbia (2016).

E.W. Van Stryland, *Nonlinear optical spectroscopy: absorption and refraction*, Makenzie University, Sao Paulo, Brazil, November 16 (2016).

E.W. Van Stryland, *Nonlinear optics*, Siegman School on Lasers, ICFO, Barcelona, Spain, July 25 & 27 (2016).

E.W. Van Stryland, *Nonlinear spectroscopy: absorption and refraction*, Unicamp, Campinas, Brazil, November 9 (2016).

E.W. Van Stryland, *Nonlinear spectroscopy: absorption and refraction*, University of San Paulo at Sao Carlos, Sao Carlos, Brazil, November 11 (2016).

E.W. Van Stryland, *Nonlinear spectroscopy: absorption and refraction*, IIT Kanpur, India, December 5 (2016).

E.W. Van Stryland, *OSA history*, Local Student Section, Univ. of San Paulo at Sao Carlos, Sao Carlos, Brazil, November (2016).

E.W. Van Stryland, *OSA history*, Local OSA Student Section, Kanpur, India, December (2016).

E.W. Van Stryland, *OSA history*, Local Student Section, UNICAMP, Campinas, Brazil, November (2016).

E.W. Van Stryland, *Publishing your manuscript,* Plenary Address, Photonics 2016, Kanpur, India, December 5 (2016).

K.L. Vodopyanov, *Coherent mid-infrared sources and applications*, CLEO Short Course (2016).

K.L. Vodopyanov, *Frequency divide-and-conquer approach to creating ultrabroadband frequency combs in the infrared*, Caltech, 11-Feb 2016 (2016).

K.L. Vodopyanov, *Mid-IR and THz*, CREOL seminar, Highlights series (2016).

S.T. Wu, *Liquid crystal devices for augmented reality and virtual reality*, 5th Symposium on Liquid Crystal Photonics, Beijing, China (2016).

Patents

A.F. Abouraddy; Banaei, S.E.; Kaufman, J.; Shabahang, S.; Tao, G.; Deng, D.; Fink, Y.; Johnson, S.; Liang, X., *In-Fiber Particle Generation*, US 9,512,036 (2016).

A.F. Abouraddy, S. Shabahang, and G. Tao, *Systems and Methods For Producing Robust Chalcogenide Optical Fibers (US)*, US 9,488,775 (2016).

A.F. Abouraddy, S.E. Banaei, J. Kaufman, S. Shabahang, G. Tao, D. Deng, Y. Fink, S. Johnson, and X. Liang, *Thermal Fiber Drawing (TFD) with Added Core Break-Up Process and Particles Therefrom (JP)*, 5863814 (2016).

P.J. Delfyett; E. Sarailou, and C. Williams, *Stabilization of an Injection Locked Harmonically Mode-Locked Laser via Polarization Spectroscopy for Frequency Comb Generation*, US 9,502,856 (2016).

D.G. Deppe, *Branched Shape Optical Isolator and Laser Apparatus, Method, and Applications*, US 9,442,247 (2016).

A. Kar; R. Vaidyanathan, *Surface Modification of Materials for Tailoring Responses to Electromagnetic Fields NAT (CHN)*, ZL 201280024525.8 (2016).

G.F. Li, I. Kim, and X. Xie, *Electronic Wavefront Correction for Free-Space Optical Communications*, US 9,374,158 (2016).

G.F. Li, I. Ozdur, and H. Shu, *Systems and Methods for Amplifying Space-Multiplexed Optical Signals*, US 9,263,846 (2016).

G.F. Li, B.E.A. Saleh, *Systems And Methods For Performing Digital Holography*, US 9,301,805 (2016).

K.A. Richardson, J. David Musgraves, P. Wachtel, C. Rivero-Baleine, and T. Mayer, *Method of forming an optical device and optical apparatus*, US9340446 (2016).

W.V. Schoenfeld, H. Zhou, *LED Backlight Apparatus and Method (DIV)*, US 9,9303,826 (2016).

A. Marandi, **K.L. Vodopyanov**, and R.L. Byer, *Optical quantum random number generator*, US9423819 (2016).

S.T. Wu, Y. Lan, Y.F. Liu, and C.Y. Tsai, *Display Apparatus*, I521270 (2016).

Y. Gao, Z. Luo, **S.T. Wu**, C.C. Lee, and K.C. Lee, *Optical film and display assembly applying the same (TW)*, I561900 (2016).

S.T. Wu, D. Xu,H.C. Cheng, Y.F. Lan, C.Y. Tsai, and J. Yan, *Optical Film and Display Device Having the Same*, I536050 (2016).

Provisional/Utility

A.F. Abouraddy, A. Dogariu, J. Kaufman, R. Rezvani Naraghi, S. Sukhov, and F. Tan , *Structured granular composite materials, methods of fabrication thereof and applications thereof*, United States Patent Application 20160139305 (2016).

S. Fathpour and J. Chiles, *Heterostructure-based integrated photonic devices, methods, and applications*, USPTO #62/345,393, Patent Pending (2016).

J. Chiles and **S. Fathpour**, *Photonic apparatus, methods, and applications*, USPTO #62/347,212, Patent Pending (2016).

M. Dussauze, A. Lepicard, M. Bondu, V. Rodriguez, F. Adamietz, T. Cardinal, E. Fargin and **K.A. Richardson,** *Device and method for inducing by thermal poling a spatially controlled refractive index gradient inside an amorphous inorganic material*, European Patent application EP16176689.4 (2016).

C. Rivero-Baleine, C. Smith, and **K.A. Richardson,** *Glass composites having a gradient index of refraction and methods for production thereof*, United States Patent Application 5/157,223 (2016).

A. Marandi, **K.L. Vodopyanov**, and R.L. Byer, *Optical quantum random number generator*, United States Patent Application 13/783,128 (2016).

Disclosures

R. Amezcua-Correa and D.N. Christodoulides, *Mid-ir supercontinuum laser source pumped by geometric instabilities side bands originated in graded index in multimode fibers*, Patent disclosure to UCF (2016).

C. Rivero-Baleine, **K.A. Richardson**, B.H. Gleason, and J. Ruckman, *Ternary glass materials with low refractive index variability*, US Patent application, US 15/240,975 (2016).

Theses and Dissertations

Y. Cheng, *Attosecond transient absorption spectroscopy of atoms and molecules*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

P. Aleahmad, *Monolithically integrated InP-based unidirectional circulators utilizing non-hermiticity and nonlinearity*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

A. El Halawany, *Optical parity time metasurface structures*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

A. Klee, *Broad bandwidth optical frequency combs from low noise, high repetition rate semiconductor mode-locked lasers*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

X. Yang, *Electrical parasitic bandwidth limitations of oxide-free lithographic VCSELs*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

M. Li, *Intrinsic modulation response modeling and analysis for lithographic vertical-cavity surface-emitting lasers*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

J. Chiles, *Hybrid integrated photonic platforms and devices*, Ph.D. Dissertation, S. Fathpour, Advisor, University of Central Florida, June 2014. (2016).

T. Shoulders, *Stress-induced phase change sintering: a novel approach to the fabrication of barium chloride transparent ceramic scintillators*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

J. Digaum, *Fabrication and characterization of spatially-variant self-collimating photonic crystals*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

J. Marro, *Defect and microstructural evolution of thermally cycled through silicon vias (TSVs)*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Materials Science and Engineering (MSE), Clemson University (2016).

A. Lepicard, *Design of surface chemical reactivity and optical properties in glasses*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Materials Science and Engineering (MSE), University of Central Florida, Orlando FL USA and the Department of Chemistry, University of Bordeaux, France (2016).

A. Buff, *The effects of phase separation on crystallization in GeSe2-As2Se3-PbSe glasses*, A thesis submitted in partial fulfillment of the requirements for the degree of Masters of Science in Materials Science and Engineering (MSE), University of Central Florida, Orlando FL (2016).

B.M. Webb, *Design and engineering of ultrafast amplifier systems*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

C.H. Jeon, *Laser filament interaction with aerosols and clouds*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

N.A. Mehta, *Multi-purpose device for analyzing and measuring ultra-short pulses*, A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in CREOL, The College of Optics and Photonics at the University of Central Florida, Orlando (2016).

A. Van Newkirk, *Sensing using specialty optical fibers* , A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

D. Kepler, *Coupling of Laser Beams for Filament Propagation*, A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in CREOL, The College of Optics and Photonics at the University of Central Florida, Orlando (2016).

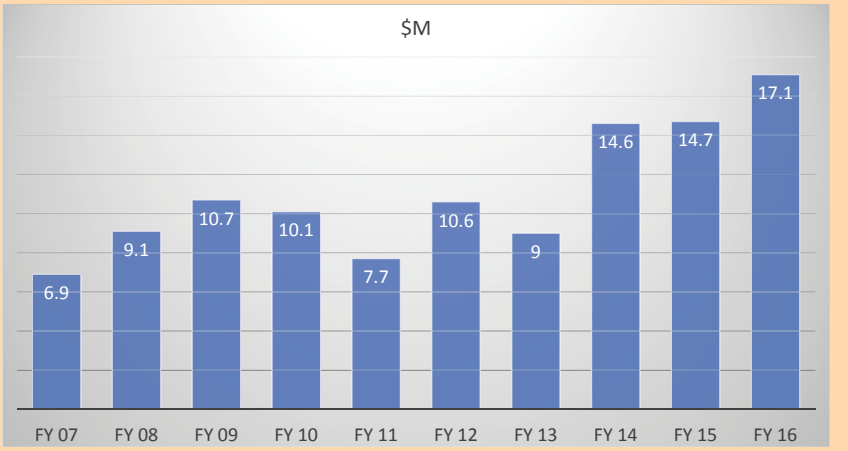
P. Roumayah, *Design and verification of multi-terawatt ti-sapphire lasers for use in a mobile filamentation system*, A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in CREOL, The College of Optics and Photonics at the University of Central Florida, Orlando (2016).

D. Xu, *Advanced blue phase liquid crystal displays*, A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in CREOL, The College of Optics and Photonics at the University of Central Florida Orlando (2016).

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.

Federal	$11,920,953
Federal through Industry	$1,966,854
Industry R&D	$1,085,586
International	$1,519,814
Foundation	$592,512
TOTAL	$17,085,720



Recepient	Source	Title of Award	Begin	End	Awarded
Abouraddy, A., Atia, G.	University of Rochester	Exploiting Multidimensional Classical Optical Entanglement for Enhanced Spatial Scene Recognition	6/1/2014	5/31/2017	$61,200
Abouraddy, A.	Massachusetts Institute of Technology	Harnessing in-fiber fluid instabilities for scalable and universal multidimensional nanosphere design, manufacturing, and applications	12/1/2014	9/30/2016	$90,035
Abouraddy, A.	Various	RF: CREOL Fiber Tower/ Extruder	11/1/2015	11/1/2016	$7,500
Amezcua Correa, R., Schülzgen, A.	BEAM Photonic Technologies, Inc.	Ultra-high Capacity DMGD Compensated Fiber	4/1/2016	12/1/2016	$248,846
Amezcua Correa, R., Schülzgen, A.	Mesa Photonics, LLC	Compact Raman Air Sensor	7/22/2015	6/17/2016	$35,481
Amezcua Correa, . R., Schülzgen, A., Shah, L.	US Army Research Office	DURIP: HIGH-RESOLUTION IMAGING AND MATERIAL COMPOSITION ANALYSIS FACILITY FOR HIGH POWER FIBER LASERS	8/15/2015	8/14/2016	$124,200
Amezcua Correa, R., Glebov, L., Schülzgen, A., Shah, L., Richardson, M.	US Army Research Office	Fiber Laser Light Engines - A New Platform to Collectively Address Power-limiting Constraints	8/20/2012	8/19/2018	$500,000
Bass, M.	Di Amante Industries, LLC	Measurement of Optical Properties of CVD Grown Type IIa Diamond	9/21/2015	3/31/2016	$2,500
Chang, Z.	National Science Foundation (NSF)	Collaborative Research: Attosecond Charge Dynamics in Atoms and Molecules	9/15/2015	8/31/2018	$75,000
Chang, Z.	Defense Advanced Research Projects Agency (DARPA)	Microjoule-level isolated attosecond pulses for atto pump-atto probe	7/25/2013	7/24/2017	$715,713

Chang, Z.	The Regents of The University of California	Post-Born-Oppenheimer Dynamics Using Isolated Attosecond Pulses	7/21/2014	7/20/2017	$103,154
Chang, Z.	"US Air Force Office of Scientific Research (AFOSR) "	Studying Ultrafast Electron Dynamics in Condensed Matter with Next Generation Attosecond X-ray Sources	12/15/2014	3/14/2017	$735,000
Christodoulides, D.	Georgia State University	Novel Nonlinear Optical Processes in Active, Random, And Nanostructured Systems	7/1/2013	5/31/2017	$119,675
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	$1,073,279
Crabbs, R.	Freedom Photonics	Optical Link Demonstration on SLF	3/17/2016	3/18/2016	$2,348
Crabbs, R., Richardson, M.	University of Maryland/College Park	Optical Turbulence Instrumentation	8/15/2012	11/14/2016	$280,897
Delfyett, P., Fathpour, S.	University of California at Berkeley	Heterogeneously Integrated Optical Synthesizer	3/31/2015	9/30/2016	$536,410
Deppe, D.	US Air Force Research Laboratory (AFRL)	Reliability Study of New VCSEL Technology for Very High Speed (= 50G) Optical Interconnects for Harsh Environments	8/12/2015	11/11/2016	$84,998
Deppe, D.	US Army Research Office	Scalable High Speed Laser Diode for Silicon Integration	10/1/2015	11/30/2016	$163,258
Dogariu, A.	National Institutes of Health (NIH)	Development of Multimodal Correlation Imaging Microscopy for Cell Biology	9/1/2014	6/30/2017	$175,307
Dogariu, A., Abouraddy, A., Tamasan, A., Atia, G.	Defense Advanced Research Projects Agency (DARPA)	UNCOVER: Unconstrained Natural-light Coherency Vector-field-imaging by Exploiting Randomness	2/3/2016	1/31/2018	$855,080
Dogariu, A., Abouraddy, A.	Sherwin Williams Company	Composite Optics Scatter	9/1/2014	12/31/2016	$197,488
Dogariu, A., DeCampli, W.	National Institutes of Health (NIH)	Real-time monitoring of blood viscoelasticity index during cardiopulmonary bypass	4/1/2015	3/31/2017	$145,773
Fathpour, S.	Partow Technologies, LLC	Advanced QPSK Optical Modulators Based on Thin Film Lithium Niobate (SBIR Phase 2)	5/25/2016	4/10/2017	$70,000
Fathpour, S.	Partow Technologies, LLC	Advanced QPSK Optical Modulators Based on thin Film Lithium Niobat	7/31/2015	11/16/2015	$45,000
Fathpour, S.	Harris Corporation	Hybrid lithium niobate on silicon integrated circuits for RF photonic applications	1/1/2016	12/31/2016	$50,000
Fathpour, S.	Office of Naval Research	Hybrid Second-Order Nonlinear Photonic Devices on Silicon	5/20/2013	12/31/2016	$81,000

Fathpour, S.	Partow Technologies, LLC	Thin film lithium niobate microring modulators for analog photonics	7/13/2016	6/9/2017	$30,991
Gaume, R.	Government of Israel: Ministry of Defense	Transparent Ceramics for Nonlinear Optics	4/30/2013	4/30/2017	$100,000
Glebov, L., Schülzgen, A.	OptiGrate Corporation	Magneto-optical isolator for free space and waveguide applications operating at 0.4 5 µm	7/1/2015	6/18/2017	$225,000
Glebov, L., Venus, G.	US Department of Defense	DURIP: Tunable laser system for complex volume holographic optical elements recording	4/25/2016	4/24/2017	$71,400
Glebov, L., Vodopyanov, K.	OptiGrate Corporation	Solid state narrowband Thz emitter	8/17/2015	2/16/2016	$60,000
Hagan, D.	University of Michigan	Measurement of Magneto-Electric Susceptibilities	12/1/2015	7/14/2017	$13,266
Hagan, D., Van Stryland, E.	US Army Research Laboratory	Characterization of Novel Nonlinear Optical Materials	7/27/2015	9/12/2017	$200,000
Kar, A., Cho, H., Kumar, R.	National Science Foundation (NSF)	Laser-based Additive Manufacturing Process Using Water Droplets Carrying Nanoparticles for Microlayer Deposition of Semiconductor Materials on Flexible Substrates	8/1/2016	7/31/2018	$65,000
Khajavikhan, M.	Office of Naval Research	YIP: Parity-Time (PT) Symmetric Photonics	6/1/2016	5/31/2019	$85,000
Khajavikhan, M., LiKamWa, P.	US Army Research Office	Design, fabrication and characterization of Electrically Pumped Coaxial Nanoscale Lasers	11/16/2015	11/15/2016	$150,000
Kik, P.	NanoSpective	RF - Research Nanophotonic Material and Devices	7/1/2011	4/15/2018	$800
Kuebler, S.	Academy of Applied Science	High School Summer Research Experience in the Kuebler-Group at UCF with the REAP/AEOP Program	5/1/2016	9/30/2017	$750
Li, G.	ZTE Inc	RF: CREOL LI ZTE Research in high-speed optical communication	5/1/2016	4/30/2018	$10,000
Li, G., Abouraddy, . A., Bai, Y. Schülzgen, A., Richardson, M.	Harris Corporation	Monolithic Multimaterial Buoyant Optical Fiber Cable	3/4/2015	7/22/2016	$799,783

Li, G., Amezcua Correa, R.	Hong Kong FSPhotonics Technology Limited	Development of 6-mode mode-selective photonic lantern	3/1/2016	2/28/2017	$21,705
Li, G., Amezcua Correa, R.	Huawei Technologies Co., Ltd.	Mode-Division Multiplexed PON	7/22/2015	1/21/2017	$148,109
Mingareev, H.	OptiGrate Corporation	Barium disilicate glass services	4/26/2016	8/31/2016	$25,000
Mingareev, H.	OptiGrate Corporation	Barium Silicate Glass Services	8/12/2015	11/30/2015	$20,000
Mingareev, I.	Synfuels Americas	Evaluation of process performance for high-speed micro-perforation of 316L stainless steel tubes using ultrafast lasers	1/4/2016	4/3/2016	$39,984
Pang, S.	Oak Ridge National Laboratory	Reconstruction methods for small-angle x-ray scattering tomography with an energy-discriminative detector array	6/1/2016	5/31/2017	$5,000
Richardson, K.	Lockheed Martin Missiles and Fire Control	Broadband Gradient Index (GRIN) Optics Phase 3	12/14/2015	11/27/2016	$123,590
Richardson, K.	Pennsylvania State University	Innovative Design and Manufacturing of Gradient-Index-Based Transformation Optics Components	12/24/2013	8/15/2016	$25,000
Richardson, K.	Various	RF K. Richardson Equipment Use Account	1/1/2015	12/31/2017	$160
Richardson, K.	Semplastics	Ultra-low Cost, Lightweight, Molded, Chalcogenide Glass-Silicon Oxycarbide Composite Mirror Components	6/17/2015	12/17/2015	$41,000
Richardson, K.	Massachusetts Institute of Technology	Uncooled Chipscale Mid-infrared Photothermal Sensor for Ultra-sensitive Chemical Detection	8/1/2015	7/31/2017	$100,000
Richardson, M.	US Army Research Office	Light Filamentation Science Add on (Topological photonic structures based on light filamentation)	5/20/2016	10/31/2017	$91,703
Richardson, M., Baudelet, M., Chang, Z.	DOD/Army/Army Research Office	Light Filamentation Science	8/1/2011	10/31/2017	$1,348,843
Richardson, M., Baudelet, M.	"US Air Force Office of Scientific Research (AFOSR) "	Fundamentals of Filament Interaction	10/15/2010	8/14/2016	$253,163

Richardson, M., Baudelet, M., Shah, L,	US Army Research Office	Extended Studies of Air Filamentation - Topic 6.4	10/1/2015	10/31/2017	$879,950
Richardson, M., Amezcua Correa, R., Schülzgen, A., Shah, L.	US Air Force Office of Scientific Research (AFOSR)	Fundamental Fiber Laser Science for High Powers	8/1/2015	4/30/2017	$1,973,183
Saleh, B.	UCF Foundation, Inc	CREOL - UCF Foundation Gifts	7/1/2014	6/30/2016	$591,762
Schoenfeld, W., Davis, K., Seigneur, H., Walters, J.	US Photovoltaic Manufacturing Consortium, Inc (PVMC)	PV Manufacturing Consortium	1/1/2014	4/30/2017	$353,399
Schülzgen, A.	Multicore Photonics Inc	Multicore Fiber Sensor Fabrication and Testing	3/1/2016	4/30/2016	$3,971
Shah, L.	IRradiance Glass, Inc.	Mid-IR Cylindrical Lens Characterization	10/7/2015	11/11/2016	$45,000
Vodopyanov, K.	Defense Advanced Research Projects Agency (DARPA)	Ultra-compact comb source with instantaneous bandwidth of 3 - 10 µm for massively parallel spectroscopic sensing	6/9/2015	9/22/2017	$1,012,586
Vodopyanov, K., Gaume, R.	Office of Naval Research	Ultra broadband mid-infrared frequency combs from transparent ZnSe ceramics	7/1/2015	9/30/2018	$186,480
Wu, S.T.	a.u. Vista, Inc.	Advanced LCDs	9/1/2015	8/31/2020	$1,250,000
Wu, S.T.	US Air Force Office of Scientific Research (AFOSR)	Submillisecond-response liquid crystal spatial light modulators	9/1/2014	8/31/2017	$155,000

UCF Millionaires Club 2016

Thirty three researchers in areas ranging from optics, medicine, psychology and education were recognized as bringing in over a million dollars to UCF in 2016. Eight of them were CREOL faculty.

Ayman Aboraddy

Rodrigo Amezcua Correa

Zenghu Chang

Martin Richardson

Winston Schoenfeld

Lawrence Shaw

Konstantin Vodopyanov

ST Wu

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), the MS Program in Biotechnology (thesis), and a new MS Professional Science in Biotechnology. The interdisciplinary Ph.D. and MD-Ph.D. 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

The Florida Space Institute (FSI) supports space research, development, and education activities. In addition, FSI supports the development of Florida's space economy—civil, defense, and commercial.

Since 1996, FSI has been an institute of the State University System of Florida. FSI is made up of researchers, educators, and staff from various science and engineering departments at the University of Central Florida. FSI research ranges from studying the Earth's upper atmosphere to the origin of the planets and from the workings of asteroids to propulsion technologies for high-Mach aerospace vehicles.

FSI is involved in space missions as diverse as high altitude rocket launches, next-gen suborbital flights, the NASA Cassini mission to Saturn, and NASA's Explorer program. In addition, one FSI faculty is the Principal Investigator for the Global-scale Observations of the Limb and Disk (GOLD) project which was recently awarded a $55 million grant from NASA. This grant makes UCF the first university in Florida to lead a satellite mission for NASA. The Center for Lunar and Asteroid Surface Science (CLASS), a NASA sponsored Center, is also housed at FSI and the Physics department. FSI administratively houses the Florida Space Grant Consortium (FSGC) for NASA, and operates the Space Research Initiative (SRI) for the State of Florida.

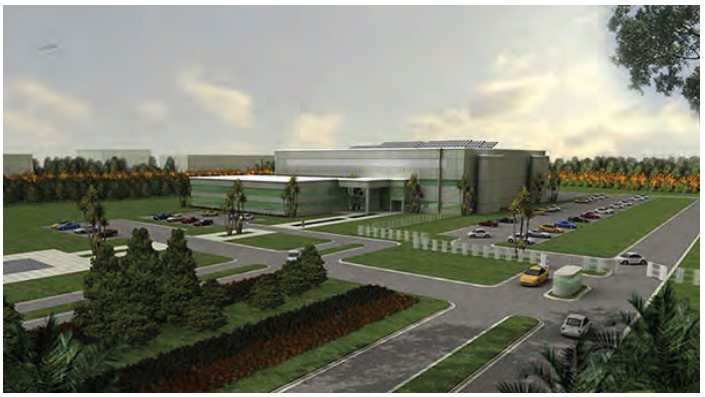
Institute for Simulation and Training

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.

International Consortium for Advanced Manufacturing Research



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)

Facilities and equipment in the Optical Materials Laboratory

Partnership and Outreach

Since its early years, the College has benefitted from a strong partnership with industry. 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. The College has established a large industrial affiliates program (with current membership of 63 companies, sustained over many years). Our Industrial Affiliates Day brings in optics companies from around the country to learn about the ongoing research, recruit students, and identify new partnering opportunities.

Industrial Affiliates Program

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 Highlights 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.

2016 Industrial Affiliates Members

Life Members

Cobb Family Foundation
Northrop Grumman Corporation
Nufern

Memoriam Members

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

Medallion Members

ALIO Industries
Breault Research

Coherent, Inc.
Newport
Northrop Grumman Laser Systems

Synopsys
Paul G. Suchoski, Jr

Senior Members

AFL
Amplitude Laser, Inc
CST of America
DataRay, Inc

LAS-CAD GmbH
Lockheed Martin
Open Photonics
Ophir-Spiricon
Optimax Systems, Inc

Tektronix
TRUMPF, Inc.
Zygo Corporation
Zemax

Affiliate Members

Albany International Corp.
Aerotech Inc.
Asphericon, Inc.
Beam Co.
Edmund Optics
eVision, LLC
Fiberguide Industries
FLIR Systems, Inc.
Gentec-EO, Inc
Gooch & Housego, LLC
Harris Corporation
HORIBA Jobin Yvon

IRadiance Glass, INC
JENOPTIK Optical Systems Inc
Laser Institute of America
Lee Laser, Inc
Ocean Optics
Optigrate Corp.
OptoSigma
OIDA
Photonics Media
Photonics Online
Plasma-Therm
Plasmonics

Princeton Instruments
Q-Peak, Inc
SPIE - The International Society for Optics & Photonics
Synfuels Americas
The Optical Society
Thorlabs
Tower Optical Corporation
TwinStar Optics, Coatings & Crystals
ULVAC Technologies, Inc
Vytran LLC

Attendees at the 2016 Industrial Affiliates Symposium

Industrial Affiliates Day

Industrial Affiliates Symposium: *Advances in Optics & Photonics* March 10-11, 2016

The CREOL Industrial Affiliates event brings in optics companies from around the country to learn about the ongoing research, recruit students, and identify new partnering opportunities. The 2016 event, held on March 10 & 11 2016, drew over 250 attendees including industrial affiliates, guests from industry and academia, representatives from photonics professional societies, faculty and students, and 20 exhibitors. Four technical sessions covered advances in various areas of optics and photonics. Four distinguished speakers from around the country and four UCF faculty speakers participated (see program details on the next page). In addition to the technical talks, four industrial affiliates gave brief overviews of their respective companies, a special guest Liz Rogan gave a presentation on OSA's 100th Anniversary entitled "OSA: Reflecting a Century of Innovation".

Events also included four short courses, four student talks, tours of the CREOL facilities and viewing of posters featuring research of 32 graduate and undergraduate students (see poster titles on page ??). The Best Poster Award went to graduate student Roxana Rezvani Naraghi for her poster entitled "Near-field Effects in Mesoscopic Light Transport", The Student of the Year Award went to CheonHa Jeon. The following Saturday, the attendees were invited to the traditional annual event: The Spring Thing, hosted by Dr. M. J. Soileau, Founding Director of CREOL. The festivities included great fellowship and featured Cajun cuisine.

Short Courses

Laser Safety

Instructor: Tony Imm, Founder & CEO, Laser Guardian LLC

This short course is a comprehensive overview of laser safety as it applies to academic and industrial sites. Improper use of hazard class 3B and 4 lasers can result in permanent injury to the eyes and health of individuals who are subjected to laser radiation over the maximum permissible exposure limits. Potential harmful physiological effects of beam and no beam hazards are minimized through use of engineering and administrative control measures. Use of such measures is required by the State of Florida under administrative code 64E-4. The course will focus on the practical application of ANSI standard Z136.1 to ensure a laser safe environment.

Volume Holographic Elements for Spectroscopy and Laser Applications

Instructor: Leon Glebov, Research Professor of Optics & Photonics, UCF CREOL

This short course summarizes the results of volume holographic elements development for spectroscopy and fine laser control. The basics of holographic recording in photo-thermo-refractive (PTR) glass are discussed. Comparison of conventional diffraction gratings with volume Bragg gratings (VBGs) is shown. The main types of holographic optical elements recorded in PTR glass are described: reflecting and transmitting VBGs, longitudinal and transverse chirped Bragg gratings (CBGs), along with tunable and achromatic holographic phase masks (HPMs). Applications of those elements for conventional and Raman spectroscopy, spectral and angular mode selection in lasers, mode conversion, spectral and coherent beam combining, ultrashort pulse stretching, compression and shaping, and monolithic solid state lasers with distributed Bragg reflector (DBR) are discussed. Interaction of such holograms with high power laser radiation is discussed. The methods of heat management enabling operations at multikilowatt CW regimes are described.

Fiber Lasers

Instructor: Larry Shah, Research Assistant Professor of Optics & Photonics, UCF CREOL

Fiber lasers, and more generally fiber optic elements, have become modular building blocks that are configured into systems ranging from high bitrate long-haul telecommunications networks to directed energy weapons systems. As fiber lasers continue to become more and more common in our every day lives, the definition of what is a fiber laser continues to evolve. This course will review the fundamental waveguide and material properties that are critical to the performance of fiber lasers. The ability to precisely and controllably engineer both the waveguide and material properties makes fiber lasers extremely attractive for generation/amplification of light that can be relatively easily integrated into systems providing temporal modulation, phase modulation, broadband wavelength tunability, dispersion management, polarization control, etc.

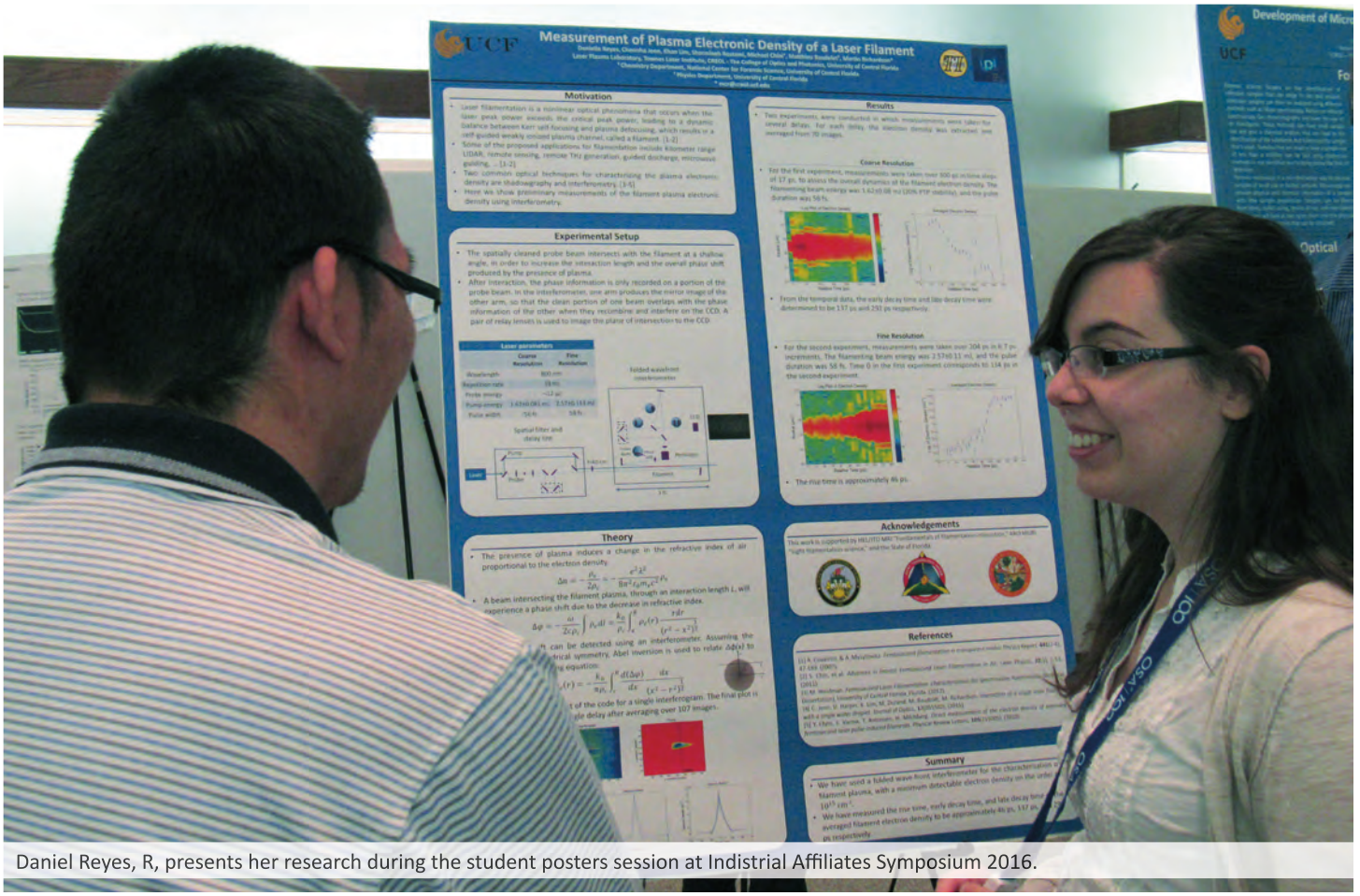
Optical Modulators

Instructor: Patrick LiKamWa, Associate Professor of Optics & Photonics, UCF CREOL

This tutorial sets out to explain the different types of optical modulators that have evolved over the years. Devices that are presently in use and others that have been developed for future use will be examined.

Liz Rogan, CEO of The Optical Society, addresses attendees at the 2016 Industrial Affilates Symposium at UCF.

Presenters at the Industrial Affiliates Symposium		
MJ Soileau	Vice President for Research, UCF	Welcoming Remarks
Bahaa Saleh	Dean & Director, CREOL, UCF	Welcome and overview
Fred Schubert	Rensselaer Polytechnic Institute	Solid state lighting - the remaining challenges
Ryan Gelfand	CREOL, UCF	Playing with proteins: optical trapping and spectroscopy of a single molecule
Eli Yablonovitch	UC-Berkeley	Optoelectronics: Is there anything it cannot do; can opto-electronics provide the motive power for future vehicles?
Kyle Renshaw	CREOL, UCF	Hemispherical focal plane arrays using organic semiconductors
Liz Rogan	Executive Director and CEO, OSA – The Optical Society	OSA's 100th Anniversary
Mark Brongersma	Stanford University	Device applications of metafilms and metasurfaces
Mercedeh Khajavikhan	CREOL, UCF	Single-mode microring lasers
Nelson Tabiryan	President-Beam Engineering for Advanced Measurements Co.	The fourth generation of optics
Kathleen Richardson	CREOL, UCF	Engineering novel materials for infrared photonics
Product Reviews		
Gary Manche	Ocean Optics	
Marc D. Himel	Jenoptik	
Tony Van Heugten	EVision Inc.	
Alex Fong	Gooch & Housego, LLC	
Student Talks		
Cheonha Jeon	Student of the Year: Fundamental studies of ultrashort laser pulse interaction with aerosols	
Amy Van Newkirk	Sensing with special optical fibers	
Jie Li	Mid-IR OPCPA laser for generating isolated attosecond pulse in the water window	
Peng Zhao	Ultrafast nonlinear response of organic solvents and molecular gases	



Daniel Reyes, R, presents her research during the student posters session at Indistrial Affiliates Symposium 2016.

Student Posters at the Industrial Affiliates Symposium	
Sarmad Fawzi Hamza Alhasan	BaTiO3 film grown by water-based process
James Anderson	Mode-locking in a monolithic seven-core fiber laser
Ahmad Azim	Hybrid divided-pulse amplification
Seth Calhoun	Microdevice prototyping facility
Jeff Chiles	A reliable approach to membrane photonics: the t-guide
Jennefir L. Digaum	Spatially-variant self-collimating photonic crystal for beam bending at telecommunication wavelength
Pedro Figueiredo	Emission of carbon black
Chris Grabill	Improving energy harvesting using plasmonic optical horns.
Evan Hale	High brightness, sub-nanosecond Q-switched laser using volume bragg gratings.
Daniel Kepler	Filamentation by combining sub-critical peak power ultrashort pulses.
Fedor Kompan	Photo-thermo-refractive glass with long wavelength photosensitivity.
Kelsi Kuehn	Applications of laser-Induced breakdown spectroscopy (LIBS) in forensic anthropology
Jesse Lane	Observation of raman solitons in filamentation
Yun-Han Lee	Switching of the image plane utilizing twisted nematic liquid crystals for virtual and augmented realities
Richard Locke	Quantification of non-stoichiometry in transparent ceramics using laser-induced breakdown spectroscopy (LIBS)
Marcin Malinowski	Optical frequency comb generation by pulsed pumping
Bryan McCullough	Development of microscopic tools for forensic analysis of trace evidence
R. Rezvani Naraghi	Near-field effects in mesoscopic light transport
Danielle Reyes	Dynamics of the plasma electronic density induced by a laser filament.
Rashi Sharmaa,	Comparison of beam bending efficiency of waveguides and spatially variant photonic crystals (SVPCs).
Z. Sanjabi Eznaveh	Few mode multicore photonic lantern mode multiplexer
Casey M. Schwarz	Fabrication and characterization of micro-structures created in arsenic trisulfide chalcogenide glasses by multi-photon lithography
Thamer Tabbakh	Controlled red and blue bandgap energy shifted LEDs and modulators integrated on a single InP substrate
Guanjun Tan	High ambient contrast ratio OLED and QLED without a circular polarizer
Daniel Thul	Wavefront characterization of a multi-terawatt femtosecond laser pulses for filamentation
Seyfollah Toroghi	Performance comparison of grating-assisted optical delay lines
Steffen Wittek	Spatial mode-selective amplification in large mode area double-clad Yb:fiber using a photonic lantern
Jian Zhao	High-power laser beamline
Peng Zhao	Extremely nondegenerate nonlinear refraction in direct-gap semiconductors
Ruidong Zhu	A high ambient contrast augmented reality system

One of the many exhibitors at the 2016 Industrial Affiliates Symposium

Industrial Projects

In Fiscal Year 2016, CREOL had industry sponsored research totaling over $4.5M. Some of these projects are Federal Flow Thru while others are direct industry supported research and development. These collaborations gives our students experience and a leg up on industry positions after they graduate. Projects total: $4,549,417

Recepient	Source	Title of Award	Begin	End	Awarded
Abouraddy, A.	Various	RF: CREOL Fiber Tower/ Extruder	11/1/2015	11/1/2016	$7,500
Amezcua Correa, R., Schülzgen, A.	BEAM Photonic Technologies, Inc.	Ultra-high Capacity DMGD Compensated Fiber	4/1/2016	12/1/2016	$248,846
Amezcua Correa, R., Schülzgen, A.	Mesa Photonics, LLC	Compact Raman Air Sensor	7/22/2015	6/17/2016	$35,481
Bass, M.	Di Amante Industries, LLC	Measurement of Optical Properties of CVD Grown Type IIa Diamond	9/21/2015	3/31/2016	$2,500
Crabbs, R.	Freedom Photonics	Optical Link Demonstration on SLF	3/17/2016	3/18/2016	$2,348
Dogariu, A., Abrouraddy, A.	Sherwin Williams Company	Composite Optics Scatter	9/1/2014	12/31/2016	$197,488
Fathpour, S.	Partow Technologies, LLC	Advanced QPSK Optical Modulators Based on Thin Film Lithium Niobate (SBIR Phase 2)	5/25/2016	4/10/2017	$70,000
Fathpour, S.	Partow Technologies, LLC	Advanced QPSK Optical Modulators Based on thin Film Lithium Niobat	7/31/2015	11/16/2015	$45,000
Fathpour, S.	Harris Corporation	Hybrid lithium niobate on silicon integrated circuits for RF photonic applications	1/1/2016	12/31/2016	$50,000
Fathpour, S.	Partow Technologies, LLC	Thin film lithium niobate microring modulators for analog photonics	7/13/2016	6/9/2017	$30,991
Gaume, R.	Government of Israel: Ministry of Defense	Transparent Ceramics for Nonlinear Optics	4/30/2013	4/30/2017	$100,000
Glebov, L., Schülzgen, A.	OptiGrate Corporation	Magneto-optical isolator for free space and waveguide applications operating at 0.4 5 µm	7/1/2015	6/18/2017	$225,000
Glebov, L., Vodopyanov, K.	OptiGrate Corporation	Solid state narrowband Thz emitter	8/17/2015	2/16/2016	$60,000
Kik, P.	NanoSpective	RF - Research Nanophotonic Material and Devices	7/1/2011	4/15/2018	$800

Li, G.	ZTE Inc	RF: CREOL LI ZTE Research in high-speed optical communication	5/1/2016	4/30/2018	$10,000
Li, G., Abouraddy, . A., Bai, Y. Schülzgen, A., Richardson, M.	Harris Corporation	Monolithic Multimaterial Buoyant Optical Fiber Cable	3/4/2015	7/22/2016	$799,783
Li, G., Amezcua Correa, R.	Hong Kong FSPhotonics Technology Limited	Development of 6-mode mode-selective photonic lantern	3/1/2016	2/28/2017	$21,705
Li, G., Amezcua Correa, R.	Huawei Technologies Co., Ltd.	Mode-Division Multiplexed PON	7/22/2015	1/21/2017	$148,109
Mingareev, H.	OptiGrate Corporation	Barium disilicate glass services	4/26/2016	8/31/2016	$25,000
Mingareev, H.	OptiGrate Corporation	Barium Silicate Glass Services	8/12/2015	11/30/2015	$20,000
Mingareev, I.	Synfuels Americas	Evaluation of process performance for high-speed micro-perforation of 316L stainless steel tubes using ultrafast lasers	1/4/2016	4/3/2016	$39,984
Richardson, K.	Lockheed Martin Missiles and Fire Control	Broadband Gradient Index (GRIN) Optics Phase 3	12/14/2015	11/27/2016	$123,590
Richardson, K.	Various	RF K. Richardson Equipment Use Account	1/1/2015	12/31/2017	$160
Richardson, K.	Semplastics	Ultra-low Cost, Lightweight, Molded, Chalcogenide Glass-Silicon Oxycarbide Composite Mirror Components	6/17/2015	12/17/2015	$41,000
Saleh, B.	UCF Foundation, Inc	CREOL - UCF Foundation Gifts	7/1/2014	6/30/2016	$591,762
Schoenfeld, W., Davis, K., Seigneur, H., Walters, J.	US Photovoltaic Manufacturing Consortium, Inc (PVMC)	PV Manufacturing Consortium	1/1/2014	4/30/2017	$353,399
Schülzgen, A.	Multicore Photonics Inc	Multicore Fiber Sensor Fabrication and Testing	3/1/2016	4/30/2016	$3,971
Shah, L.	IRradiance Glass, Inc.	Mid-IR Cylindrical Lens Characterization	10/7/2015	11/11/2016	$45,000
Wu, S.T.	a.u. Vista, Inc.	Advanced LCDs	9/1/2015	8/31/2020	$1,250,000

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 2016 clients:

LC Matter Corp.

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. Contact: Sebastian Gauza. www.lcmatter.com

Plasmonics, Inc.

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. Contact: David Shelton. www.plasmonics-inc.com

sdPhotonics LLC

Is an emerging leader in the development of high power laser diode technologies that provide improved power, efficiency, brightness and reliability. Contact: Dennis Deppe, Sabine Freisem.

Partow Technologies, LLC

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 nionbate on silicon substrates. The devices can fit into small form factor transceivers used in data-centers and in telecommunication coherent systems.and reliability. Contact: Payam Rabiei

Visitors

Government Visitors

- Phillip A. Singerman, NIST, January 14
- Steven Taulbee, ARL, February 10
- Pavel Bělobrádek, Czech Republic, March 24
- European American Investment Council, Matthias Beier, Ullrich Kämmerer, Florian Stamm, November 14
- Canadian Consul, Susan Harper, Elaine Brouca, November 18

Industry Visitors

- Dan Abercrombie, Nikon Optical Materials, January 20
- Paul Mitchell, Enterprise Florida, March 3
- Michael Hass, Alex Bothmann, EFI Germany, March 3
- Lars Weimer, ese Aerospace, March 23
- Bert Gyselinckx, IMEC, April 4
- David York, Northrop Grumman, April 29
- Bonghoon Kim, MAXtin Global Company LTD., May 23
- Bela Malik, Wearable Networks, LLC, June 3
- Chris Riehl, Kishore Lankalapalli, FARO, June 24
- Young Kwon, Powerlase, July 5
- Bill Fair, Ron Mattson, Tavistock. July 27
- Rick Mathews, Northrop Grumman, August 22
- John Fremstad, Annie Baxter, Margaret O'Riley Marc Hoenstine, Duke Energy, August 23
- James E. Gervais, Greg Anderson, LaserStar Technologies Corp., August 31
- Ankush Oberai, Synopsys Inc., October 14
- Ken Kaufmann, Hamamatsu, October 31
- Dana Eagles, Albany International Corp., November 14
- Jonathan Arenberg, Northrop Grumman Aerospace Systems, November 29

University and Research Center Visitors

- Hui Cao, Yale University, February 24
- Jiří Drahoš, The Academy of Sciences of the Czech Republic, March 24
- Jie Qiao, Rochester Institute of Technology, April 1
- Magesh Thiyagarajan, Texas A&M University – Corpus Christi, April 11
- Xiaoming Yu, Kansas State University, April 25
- Pavel Polynkin, University of Arizona, April 28
- L. Jay Guo, University of Michigan, May 27
- Bong Hoon Kim, Hanyang University, August 5
- Jannick Rolland, University of Rochester, September 9
- Teri W. Odom, Northwestern University, October 27
- Daniel M. Litynski, Western Michigan University, November 3
- Brian H. Kolner, University of Wisconsin, November 10
- Oscar N. Garcia, University of North Texas, December 2
- Rick Trebino, Georgia Institute of Technology, December 19

Other Visitors

- Samindranath Mitra, Editor, Physical Review Letters, October 25

College Events

Attendees at the Stegeman Memorial Symposium

George Stegeman Memorial Symposium

This symposium was dedicated to the legacy and memory of Dr. George Ian Stegeman. Professor Stegeman joined the UCF faculty in 1990 and was the first recipient of the Cobb Family Chair in Optical Sciences and Engineering at UCF. He was a Fellow of the Optical Society of America (OSA) and the American Physical Society (APS). Dr. Stegeman received OSA's R.W. Wood Prize, the Hertzberg Medal for achievement in Physics of the Canadian Associate of Physics, and UCF's Researcher of the Year award. He received his Ph.D. from the University of Toronto, along with honorary doctorates from NRS University in Canada and INAOE in Mexico. January 7-8.

Eindhoven Visit

A delegation from the high-tech region of Eindhoven Netherlands (consider a world leader in innovation and technical knowledge) visited Osceola, UCF and the College to better understand how they could collaborate around next generation technologies and advanced manufacturing. The delegation include members from the Netherland's national government, PhotonDelta, Technical University of Eindhoven, and BrainPort (an Eindhoven technology and industry based association). Their focus was on photonics and advanced technology collaboration opportunities with ICAMR, the Florida Advanced Manufacturing Research Center, UCF, and associated industry partners. Discussions continue on how the leadership teams from these two high-tech regions of the world can come together to advance the development and commercialization of next generation products and systems. February 24.

Changchun Institute of Optics

A group of 5 scientists from Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences, visited the College. They are: Dr. Ping Jia (President), Dr. Yuhong Bai (General Editor of Light: Science and Applications), Prof. Quanquan Mu (Deputy Director), Prof. Lingtong Zhang, and Prof. Honglei Ma (Engineer).

The purposes for their visit are twofold: 1) to learn CREOL's academic curriculum, and 2) to recruit Deputy Directors for their Applied Optics and Luminescence Materials Directorates, engineers and postdocs. During their visit, they met Bahaa, Eric, Mike Bass, Axel, Sean and ST. Afterwards, they gave a recruiting seminar to introduce the mission, funding sources, research activities and major accomplishments at CIOMP. About 40 people attended the seminar. February 24.

Enterprise Florida German Representatives Visit

Enterprise Florida Director of International Trade, Mr. Paul Mitchell visited CREOL, The College of Optics and Photonics with Messrs. Michael Hass, Director EFI Germany and Alex Bothmann, Deputy Director EFI Germany.

Key briefings were those from the College of Optics and Photonics and the UCF Business Incubator Program. The result of the visit was the realization by our visitors from Germany of the high caliber research and talent that emanates from UCF. This information will be related to German companies interested in research collaborations and/or the potential of locating an operation here in Florida. March 3.

Czech Republic Delegation Visit

CREOL, The College of Optics and Photonics hosted Dr. Pavel Bělobrádek, Deputy Prime Minister of Science, Research and Innovation with the Czech Republic and over 30 government and business leaders.

The purpose of the meeting was to introduce UCF research and potential partnerships. The intent was to enhance relationships that could lead to research and business opportunities between Florida and the Czech Republic.

In addition to an overview of the College, the delegation toured CREOL gaining additional insight into the capabilities here at UCF.

At the conclusion of their visit to UCF, Dr. Jiří Drahoš, Chairman, The Academy of Sciences of the Czech Republic stated that the visit to CREOL confirmed that UCF holds the potential for collaborations in a number of areas. March 24.

OSA Centennial Celebration Symposium

The event included an address from Dr. Bahaa Saleh, presentation on history of the OSA by Dr. Eric Van Stryland, a talk about industrial researchers/entrepreneurs and career path choices by OSA Chief Scientist, Dr. Gregory Quarles. April 5, 2016

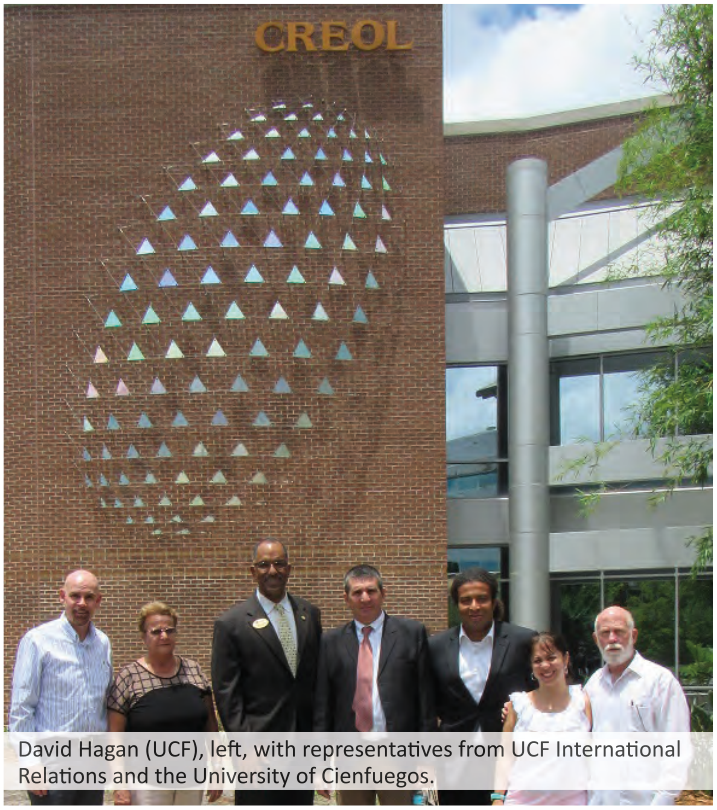
Senior Design Day

This event showcased senior design student projects from Mechanical & Aerospace Engineering (MAE), Industrial Engineering & Management Systems (IEMS), Electrical & Computer Engineering (ECE), and Computer Science (CS) and Photonic Science and Engineering (PSE). As part of senior design, students in interdiscplinary groups design and build a project which is evaluated by a professional and faculty team. At the

end of spring semester, students exhibit and demonstrate their projects for the public. In spring 2016, three PSE projects were demonstrated: Laser Data Transfer, SunLED, and Bragg Optical Spectrum Analyzer. Completion of Senior Design is a requirement for graduation. April 22.

University of Cienfuegos (Cuba) Visit

The College hosted a visit by Representatives from the University of Cienfuegos (Cuba). this was an opportunity for a delegation to visit UCF and meet with representatives from multiple colleges to explore collaborative opportunities (faculty research/training, student & faculty exchange, etc.). June 9.



David Hagan (UCF), left, with representatives from UCF International Relations and the University of Cienfuegos.

SPIE Industry Tour

15 students in the SPIE Student Chapter traveled to the Florida Solar Energy Center. Here they toured 3 research facilities centered around vehicle charging, photovoltaics, and fuel cells. July 26.

Korean Delegation Visit

Delegates from Hanyang University visited CREOL with 5 other Korean officials from the ministry and government agencies. Dr. Saleh presented an overview of the facilities and the guests toured the building with Dr. Kye Young Han.

ICAMR has teamed up with a private institute in Florida, Florida International College (FIC), and members from Hanyang University to engage in R&D and industry participation from Korea for sensor and imager technologies for smart communities, advanced medical applications, automotive and autonomous systems, and other sensor enabling next generation products. Goals of the partnership with ICAMR and UCF are to lead to development of the technologies, expert workforce, and innovative products necessary to become a leader in these future markets. UCF will potentially play a key role in the educational and technology development aspects of this partnership. August 1.

Northrop Grumman Visit

On August 22, 2016 members of Northrop Grumman (NG) visited UCF to confirm the assets that UCF can help them grow from talent to research. This meeting was the direct result of a meeting in Melbourne FL with NG leadership on February 22, 2016. At this first meeting, Dean Bahaa Saleh was a key member of a team that represented UCF.

In 2004, UCF received its largest ever donation, a patent licensing and equipment gift from NG with a future estimated value of roughly $24 million. UCF spokesman said an independent auditor valued the potential patent value of the gift at $22 million. About $2 million came to the College in cash and equipment.

In 2008, NG signed a five-year research and license agreement, to provide financial support and engineering expertise to the Center for Research and Education in Optics and Lasers (CREOL) and the Florida Photonics Center of Excellence (FPCE), two research centers within UCF's College of Optics & Photonics. In exchange, the company received preferential rights to any resulting research.

In 2014, UCF supported the State's project to bring about the expansion of NG in Florida by 1500 employees.

The briefings and tours at the College of Optics and Photonics with presentations by Dean Bahaa Saleh and Dr. Martin Richardson on August 22, 2016 assisted in demonstrating/confirming UCF as a key resource for Northrop Grumman company-wide. August 22.

Duke Energy Visit

On August 23, 2016 representatives from Duke Energy's Economic Development team met with Dean Bahaa Saleh who provided an overview and a brief tour of the College that assisted them in gaining insight into the importance of the College of Optics and Photonics.

The purpose of the visit was to make the Duke team aware of the key research and talent that has been produced at CREOL since its creation. The meeting offered them our insight into one of the world's foremost institutions for research and education in optical and photonic science and engineering.

They departed with a better understanding of how our faculty and students are engaged in research covering all aspects of optics and photonics including lasers; optical fibers; integrated photonics; nonlinear and quantum optics; and imaging, sensing and display.

At the conclusion of the visit they were better grounded on how these technologies have applications in industry and manufacturing, communication and information technology, biology and medicine, energy and lighting, and defense and homeland security. August 23.

Ankush Oberai and Dr. Kumar Patel Visit

Ankush Oberai, Senior Director for Research and Development at Synopsys Inc. and Dr. Kumar Patel, CEO & Chairman, Pranalytica Inc. visited UCF to guest lecture to current students. Ankush spoke to CECS students on "Engineering to Entrepreneurism" and Dr. Patel spoke with CREOL students on "All About Useful Infrared Lasers". The gentlemen met with campus leadership including Provost Dale Whittaker, COP Dean Bahaa Saleh, and CECS Dean Michael Georgiopoulos. October 13.

Hamamatsu Photonics K.K.

Ken Kaufmann, Motoyuki Watanabe, Yuji Kobayashi and Katsuhiro (Keith) Kobayashi visited CREOL to better familiarize themselves with faculty research areas so they could identify potential areas

for research collaboration. October 31.

European American Investment Council Visit

Dean Saleh hosted Matthias Bauer and Florian Stamm who were representing the European American Investment Council. The Council is a membership organization promoting European Foreign Direct Investment and they were in Orlando to understand and learn more about the "tech-based" side of Central Florida. The guests left with an understanding of opportunities for European companies to establish operations in Florida. They were not aware of UCF or our key Colleges that could represent both the talent and research partnerships UCF can offer their European clients. The visit with Dean Saleh and CREOL was important in conveying the assets UCF can offer. The meeting with UCF was arranged by our partners with the Orlando Economic Development Council. November 14.

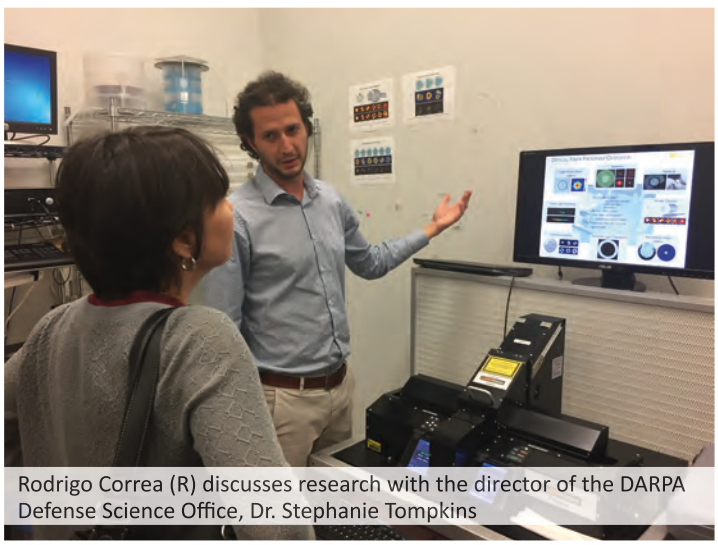
DARPA Visit

The director of the DARPA Defense Science Office (DSO), Dr. Stephanie Tompkins, visited UCF, coming to UCF on the recommendation of Dr. Prem Kumar and Dr. Adam Russell, two of DSO's program managers.

DSO is the basic research funding arm of DARPA with a budget of over $400 million a year. DARPA funds about a dozen UCF faculty including Prof. Zhenghu Chang's $5 million atto second laser project, Xun Gong's antenna research, and novel work fiber optics technology at CREOL.

Dr. Tompkins first stop was with Deans Saleh, Johnson, and Georgiopoulos and then she gave an hour long talk to faculty on the topic of working with the DARPA. About 60 faculty and students were in attendance at CREOL. She later toured several labs and met with numerous faculty and researchers at CREOL, College of Sciences, and CECS.

At the conclusion of her visit she said she was impressed by the large number of DARPA programs that UCF researchers are participating in and thanked Dean Saleh and AVP ONeal for an outstanding engagement with UCF. November 15.



Rodrigo Correa (R) discusses research with the director of the DARPA Defense Science Office, Dr. Stephanie Tompkins

Army Visit

Members the US Army's Project Manager for Instrumentation, Test, and Training Systems visited CREOL and were led by Trung Nguyen, Project Director, Pulse Neutron Environment Executing Agent, Directed Energy & Electronic Warfare Test. Mr. Nguyen's office is responsible for developing test systems for Directed Energy and Electro Optical and Infrared systems. His office is located in Partnership III of Research Park and his stated goal is to develop closer ties with PEO STRI's university partner, UCF.

Nguyen and his team met with Dean Saleh, Drs. Rodrigo Correa, Leonid Glebov, Robert Peale and Lawrence Shah. During their visit they were surprised and impressed by the fact that have met and worked with several of the researchers in the past. There were several discussions of possible opportunities for research and subject matter expertise.

They indicated interest in the topics of wideband RF detection and also Quantum Cascade Lasers and were referred to Xun Gong in CECS and Arkadiy Lyakh at the Nanocenter. November 16.

Consulate General of Canada Visit

Consulate General of Canada Susan Harper and New Senior Trade Commissioner Elaine Brouca visited UCF and CREOL to get a high-level overview of the research centers to give them a better understanding of the magnitude of research happening at the Universit and any current linkages we have to Canada, such as the artificial intelligence research being done by Royal Bank of Canada at the university. November 18.

CREOL student Jennefir Digaum (L) and Dr. Kuebler characterize 3D-printed nano-photonic devices that can direct light beams through ultra-sharp turns, in areas as small as a white blood cell.

Student Organizations

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 seven optics and photonics societies.

Chair:	Fan Wu
Member:	Yuge "Esther" Huang
Member:	Steffen Wittek
Member:	Guanjun Tan
Member:	Sepehr Ahmadzadeh Benis

The Society aids in promoting close cooperation with other IEEE societies and councils in the form of joint publications, sponsorships of meetings, and other forms of information exchange. Appropriate cooperative efforts will also be undertaken with non-IEEE societies.

President:	Juan "Rachel" He
Vice President:	Fan Wu
Treasurer:	Yuge "Esther" Huang
Secretary:	Chenyi Zhang
Webmaster:	Tao "Tommy" Zhan

The purpose of the chapter shall be to promote the discipline of Optics through a organized effort of study, research, and discussion. We shall disseminate the knowledge of the field of Optics to the general public and further the professional development of all our student members.

President:	Midya Parto
Vice President:	Sepehr Ahmadzadeh Benis
Treasurer:	Rachel Sampson
Secretary:	Mohammad Jobayer Hossain
Webmaster:	Seth Smith-Dryden

The mission of SPIE Student Chapter is to advance an interdisciplinary approach to the science and application of light and provide professional development opportunities for UCF students.

President:	Yangyang Sun
Vice President:	Steffen Wittek
Treasurer:	Stefan Gausmann
Secretary:	Colin Constant
Webmaster:	Burdley Colas

The mission of the Society of Optics Students is to uphold the principles of academic excellence, peer mentoring, leadership, and entrepreneurship to make an impact in the discipline of optics and photonics. The purpose of this Chapter shall be the advancement and diffusion of knowledge of the science of optics/photonics and the encouragement of student interest in optics/photonics throughout the academic and local communities. SOS is geared towards representing the new undergraduate population at CREOL.

President:	Latifah Maasarani
Vice President:	Aaron Coville
Secretary:	Rafaela Frota
Treasurer:	Matthew Kalinowski
Outreach:	Brandon Triplett

SID, the society for information display is comprised of the top scientists, engineers, corporate researchers, and business people of the display industry.
The SID UCF chapter is aimed to disseminate the knowledge of the field of displays to the general public and further the professional development of all our student members

President:	Yun-Han "John"
Vice President:	Guanjun Tan
Treasurer:	Fangwang "Grace"
Secretary:	Tao "Tommy" Zhan
Webmaster:	Ziqian He

The mission of WiLO is to promote personal and professional growth for women of CREOL in the field of Optics, Photonics and Lasers though community building, networking opportunities, and encouraging young women to choose optics as a career. This organization will also work towards preparing all CREOL students, enrolled in undergraduate and graduate degrees, for the transition from student to professional life.

President:	Tracy Sjaardema
Vice President:	Yuge "Esther"
Treasurer:	Walker Larson
Secretary:	Alex Sincore
Webmaster:	Jinhan Ren

Educational Outreach

227th American Astronomical Society Education and Public Outreach Program

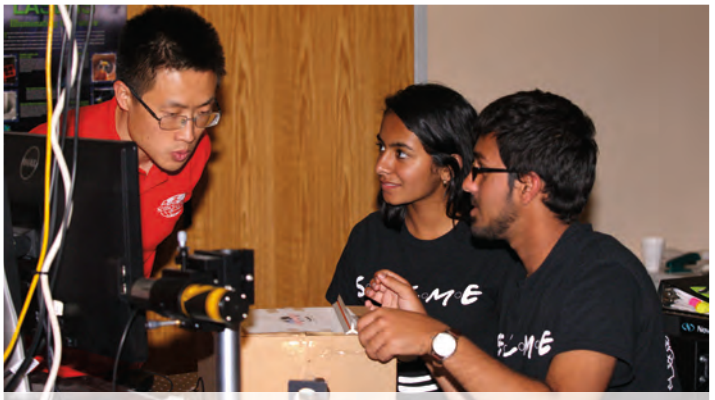
SPIE volunteered at the American Astronomical Society's meeting for the Student Education & Public Outreach program. Several groups of middle to high school students visited booths at the meeting for demos and live demonstrations. SPIE President Alex Sincore and Webmaster Colin Constant explained diffraction and spectroscopy using color-changing LED bulbs and gas discharge tubes. Students left with an activity sheet, diffraction glasses, and prizes such as posters and bookmarks for engaging in the demonstration. January 6.

Tuskawilla Montessori Academy Science Fair

CREOL Association of Optics Students (CAOS) was invited for the second year to judge a science fair at Tuskawilla Montessori Academy. CAOS provideed four judges from CREOL. There were a total of 35 students from 4th to 8th grade who participated in the science fair. January 20.

Florida Science Olympiad

The College of Optics and Photonics helps sponsor the Florida Science Olympiad State Tournament where middle and high students compete in 23 science and engineering events and vie for honors to attend the national tournament. Several events are used to highlight optics based events. Science Olympiad is a national competition in which teams of fifteen students compete in regional, state, and national competitions, receiving medals and other recognitions. UCF hosts 84 schools around the state of Florida, with nearly 2000 spectators and participants in attendance. March 19.



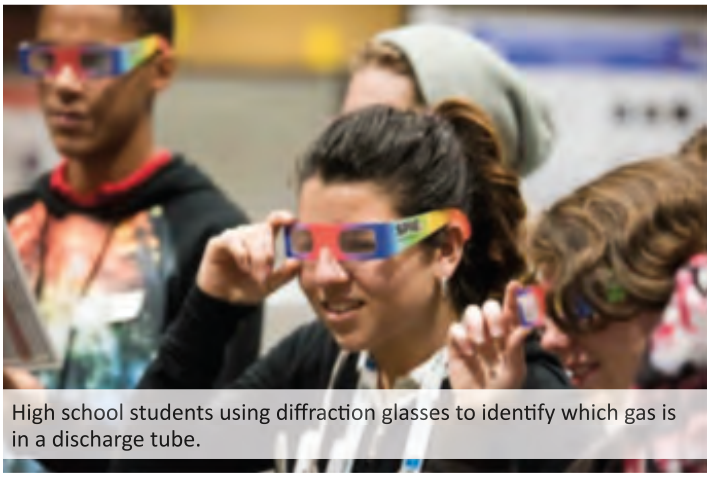
Sean Pang, left, presents an imaging challenge to students competing at Florida Science Olympiad.

UCF STEM / Optics Day

CREOL opened its doors for the annual Optics Day, a fun-filled event of lab tours, optic demos, exciting talks, and prizes. The CREOL lobby was filled from back to front with demos, and our leading researchers presented exciting talks on their research for the attendees. 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. April 8.

Science Day

WiLO joined with the Physics Women's Society to host 50 Deltona High School girls for a day full of science. The students watched a photonics video, listened to a talk in astronomy, saw demonstrations in both CREOL and the Physics building, and played a game using lasers and mirrors. The theme of the event was "Science in your Life", so each demonstration had a direct application to something used in our everyday lives. April 22.



High school students using diffraction glasses to identify which gas is in a discharge tube.

SWEet College Day

WiLO assisted the Society of Women Engineers with their SWEet College Day for high school girls. Ten girls came to CREOL and participated in optics demonstrations as well as the Hit the Target laser and mirror game. The girls also took lab tours and were introduced to life in college and CREOL's various degree programs. April 23.

SPIE / COP Outreach Presentations

Mike McKee presented two workshops at SPIE San Diego. The first, with nearly 30 attendees concentrated on how to conduct outreach. It included information on contacting and arranging for activities as well as promoting the event and the development of materials for teachers.

A second workshop, specifically for elementary and middle school teachers, was attended by about 25 San Diego area teachers. They learned about the basics of light, waves and optics. SPIE provided a kit of materials and the book of lesson plans developed by the College. August 28, 30.

DiSTI Charity Golf Tournament

A charity golf tournament whose aim was to benefit K-12 STEM education through the Central Florida STEM alliance. S.O.S. members provided a range of miscellaneous services during the event including setup, photography, manning the check-in booth, and clean up. October 23.

STEM Day

S.O.S. got to give what has become an annual presentation on light and spectroscopy for a variety of schools that visited CREOL. Learning about the wave properties of light, how colors work, and how diffraction grating glasses work, kids got to discover the answer to the question: how do we know what the sun is made from? October 28.

SWE Mystery Design

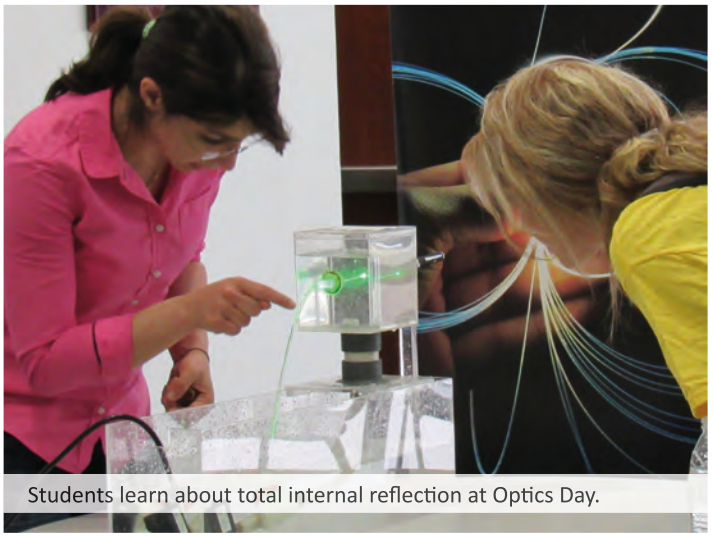
Partnering with the Society of Women Engineers, S.O.S. demonstrated the potential of photonics to a bunch of middle-school aspiring women engineers. Borrowing from the presentation given on STEM Day, the students were taught how

scientists use spectroscopy to learn what elements make up the stars we see in the sky. November 5.

Introduce a Girl to Photonics Day

IEEE sponsored an "Introduce a Girl to Photonics" event to excite more girls' interest in photonics. Based on last year's successful experience, WiLO held this event again with 35 girls from Deltona High School. The girls were introduced to how photonics influences their daily life with videos, demonstrations and games. November 14.

Students view a demonstration of Discharge Tube.



Students learn about total internal reflection at Optics Day.

SPIE / COP Outreach

Sponored by SPIE, Mike McKee presented a workshop for 50 elementary teachers at the National Science Teachers Association conference in Columbus Ohio. They learned about the basics of light, waves and optics. SPIE provided a kit of materials and the book of lesson plans developed by the College. December 1.

Student Professional Development

Distinguished Seminar Series: "Harnessing Disorder for Photonics Applications"

WiLO invited Hui Cao, Professor of Applied Physics at Yale University, to speak to CREOL students about her research, as well as personal career experience. She presented her research, which focuses on harnessing disorder for photonics applications. After the presentation, she participated in an informal question and answer session with students, where she outlined her career path and experience in the field of optics. February 24.

CREOL Alumni Invited Talk: Dr. Jason Eichenholz

SPIE, along with the Society of Optics Students (SOS), held an exciting talk on "A Career in the Optics and Photonics Industry". Dr. Jason Eichenholz discussed what it is like to work in the field, where the future opportunities lie, and what is currently being worked on at Open Photonics. March 14.

CREOL Alumni Invited Talk: Dr. Hooman Banaei

Dr. Hooman Banaei shared a roller coaster ride experience from his own entrepreneurial journey since 2013. He explained some of his challenges, how he overcame them, and what he would do differently if a time machine would take him back to 2013 or before. He also shared personal views on dangers of staying in a comfort zone which could potentially be more severe than those involved in roller coaster rides outside of the comfort zone. March 16.

SPIE Student Chapter Post-Graduate Talk Series: Dr. Kristopher Davis

Dr. Kristopher Davis provided his perspective as a recent Ph.D. graduate from CREOL. Dr. Davis is currently developing new methods of characterizing crystalline silicon photovoltaic devices to improve the manufacturing process. He shared his experiences in post-graduate life, along with the post-graduate experiences of others working on solar energy R&D. May 11.

Florida Solar Energy Center (FSEC) Industry Tour

15 students in the SPIE Student Chapter traveled to the Florida Solar Energy Center. Here they toured 3 research facilities centered around vehicle charging, photovoltaics, and fuel cells. July 26.

Two-Part Resume Workshop

Dr. Igor Volkov from UCF's Office of Experiential Learning gave a presentation on how to develop a strong professional resume for engineers. The following week, one-on-one resume critiques were provided to give students personalized feedback on their resumes after the first presentation. October 21, 27.

IRradiance Lab Tour

S.O.S. visited the UCF Business Incubator and got a tour through IRradiance's lab. Students got a chance to ask questions after the tour about what it was like to be part of a small start-up, and what kind of work is required. Afterwards, the students attended a presentation given by an engineer from Burns Technology. November 4.

Northrop Grumman Panel of Engineers

A panel of engineers from Northrop Grumman was invited to speak at CREOL. The panelists included two CREOL alumni and the Vice President of Engineering and Global Development. After a half hour of questions from the moderator, the floor was opened for questions from the audience. This was followed by free time for the audience to meet and greet with each other as well as with the panel members. November 19.

OSA Graduate Research Symposium

In this series of talks sponsored by the student chapter of OSA at CREOL, graduate students presented on research they've been conducting at CREOL. The purpose of the new symposium is to internally educate our researchers, promote collaboration, and give students practice at presenting. With 6 graduate student speakers, these talks have spanned 6 research groups covering the vast breadth of activities here at CREOL.

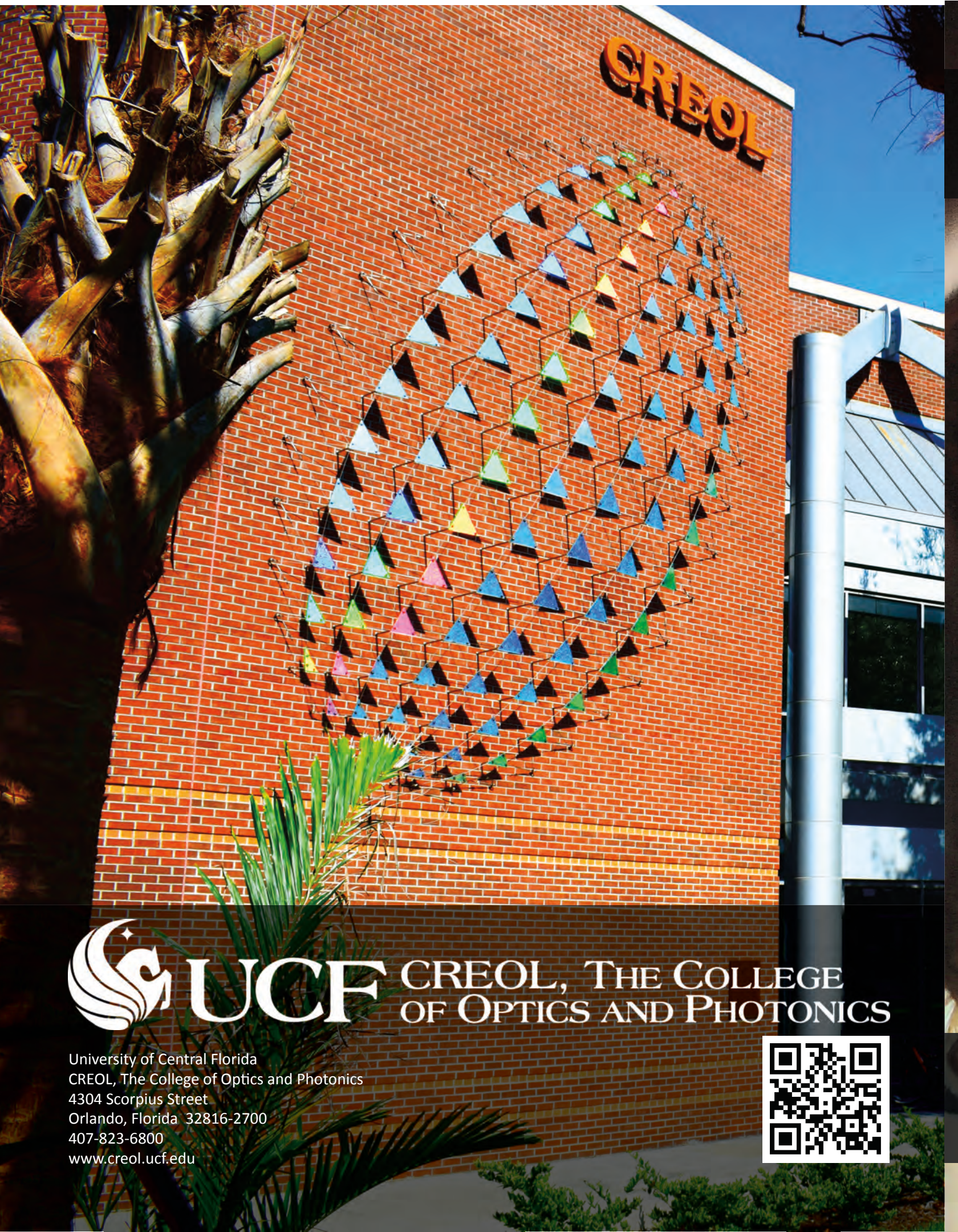
Feb 3, 2016	"Mesoscopic interactions in complex photonic media" by Roxana Rezvani Naraghi "Recent advances in IR liquid crystal spatial light modulators" by Fenglin Peng
Aug 10, 2016	"PT-symmetry and phase transitions" by Absar Hassan "Photo-thermo-refractive glass with photosensitivity to the visible/IR light" by Fedor Kompan
Nov 2, 2016	"Ultrafast Spectroscopy of Nonlinear Refractions and Two-Photon Photochromism" by Peng Zhao "Recovering of 3D video from single frame" by Yangyang Sun

Professional Society Faculty Talk Series

In a series of talks hosted by one of the professional student societies in the college, faculty members give a non-technical talk geared around professional development, soft skills, or broader perspectives. These talks provide an intimate setting for the students to better know the CREOL Faculty, while simultaneously passing down knowledge from career experts.

DATE	SPEAKER	AFFILIATION	TITLE	SPONSOR
1/13/2016	Sung Tae Shin	Kyung Hee University	"The Second Korean War in the Display Industry"	SID
1/14/2016	K. Käläntär	Japan Global Optical Solutions	"BLU Optics: Optics for LCD Backlighting Unit"	SID
2/25/2016	Robert W. Boyd	University of Ottawa and University of Rochester	"Quantum Nonlinear Optics: Nonlinear Optics Meets the Quantum World"	IEEE-PS
3/4/2016	Mercedeh Khajavikhan	University of Central Florida	"Thresholdless nanoscale lasers and the promises of metallic nano-cavities"	SPIE
3/14/2016	Jason Eichenholz	Open Photonics Inc.	"A career in the Optics and Photonics Industry"	SPIE and SOS
3/16/2016	Hooman Banaei	Everix Optical Filters	"Dangers of Comfort Zone"	SPIE
5/11/2016	Kristopher Davis	Solar Technologies Research	"Perspective of post-graduate life from a researcher working in solar energy"	SPIE
5/20/2016	Kristiaan Neyts	Ghent University	"Light Emission from Liquid Crystal and Quantum Rods"	IEEE-PS SID
6/08/2016	Jiun-Haw Lee	National Taiwan University	"Light Extraction of OLED Display by Micro-structured Film Attachment"	IEEE-PS SID
8/18/2016	Yundong Zhang	Harbin Institute of Technology	"Engineering Dispersion: A Way to Enhance Sensing Sensitivity of Our Instruments"	IEEE-PS SID
10/14/2016	Michelle Young	OptoSigma	"OptoSigma Lunch & Learn"	OSA
11/09/2016	Chris A. Mack	Lithoguru.com	"The End of the Semiconductor Industry as We Know It"	SPIE
11/10/2016	Brian H. Kolner	University of California, Davis & Stanford University	"Space-Time Dualities and Temporal Imaging of Optical Waveforms"	IEEE-PS
10/26/2016	J.J. Saenz	Donostia International Physics Center (DIPC)	"Casimir-like forces between particles under fluctuating optical fields"	OSA
11/16/2016	Leonid Glebov	University of Central Florida	"Long and Sinuous Way in Optics Research - Part II"	SPIE
11/29/2016	Jonathan Arenberg	Northrop Grumman	"Designing the James Webb Space Telescope"	SPIE
12/19/2016	Rick Trebino	Georgia Institute of Technology	"Measuring Everything You've Always Wanted to Know About a Light Pulse"	OSA

CREOL lobby as viewed through the Sail, created by Christopher Ries and commissed by Schott Technologies. Donated in 2000.



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