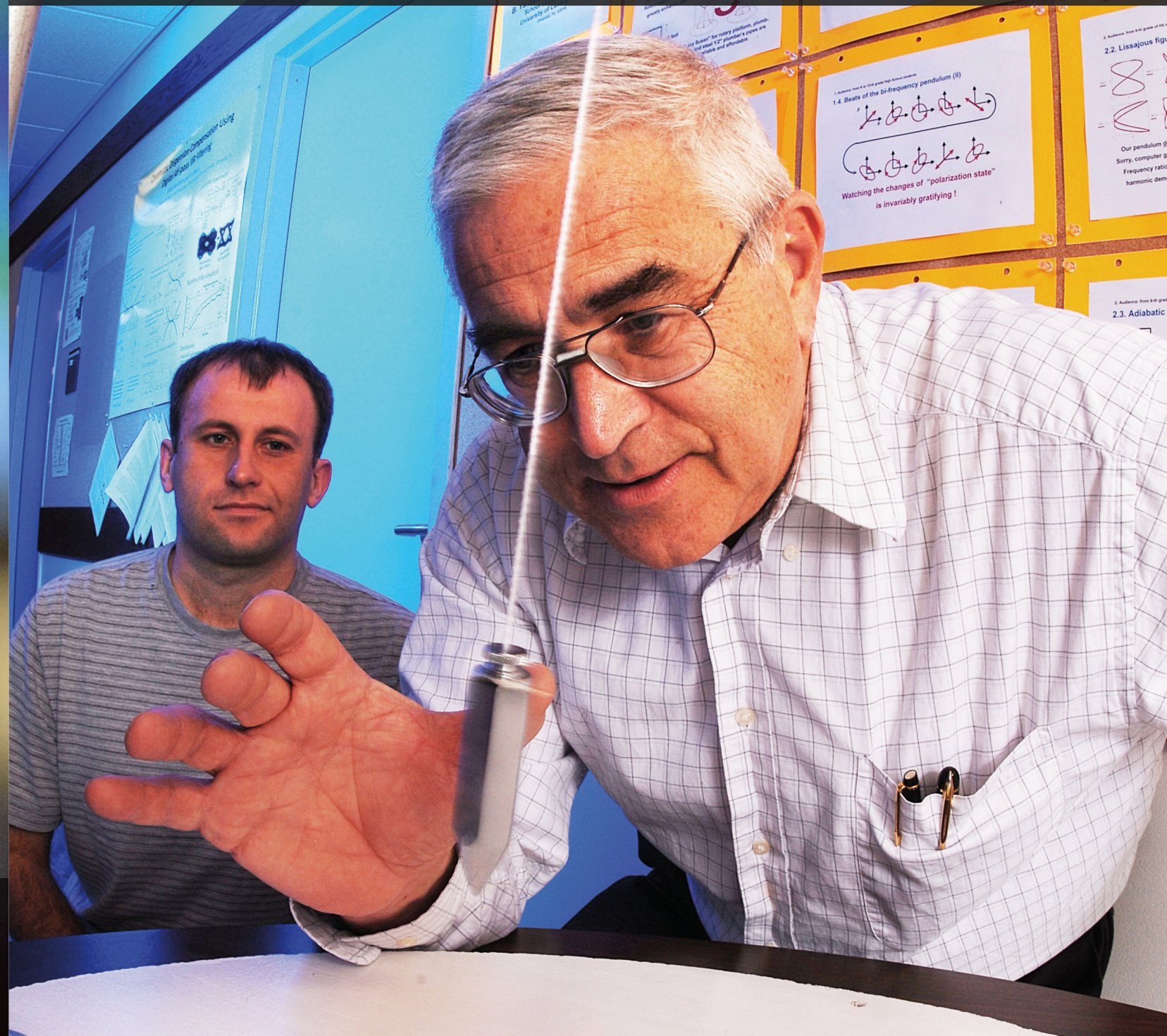


# CREOL, THE COLLEGE OF OPTICS AND PHOTONICS



**CREOL, The College of  
Optics and Photonics**

UNIVERSITY OF CENTRAL FLORIDA

**ANNUAL REPORT**

**2018**



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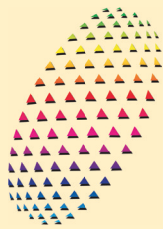
## Photo Credits

Front Cover: Dr. Boris Zeldovich demonstrating a pendulum for Sergiy Mokhov (I).

Back Cover: Photo of an inverted image taken through a lens at the 2018 Industrial Affiliates Symposium



# 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 and Education in 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. World-renowned for their scholarly contributions to fundamental and applied optics and photonics, the faculty have published a total of 34 books and more than 4,200 journal papers with more than 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 205 different industrial members since its founding. The faculty have produced 309 patents, and spun off 28 photonics-based companies involving a wide variety of technologies.

Highlights of 2018 include the recruitment of Dr. Miguel Bandres whose appointment as Assistant Professor began in January 2019. Dr. Bandres received his Ph.D. from the California Institute of Technology and was a postdoctoral fellow at the Technion in Israel. His research interests include novel optical beams and topological photonics. Sasan Fathpour was promoted to Full Professor, and Romain Gaume and Mercedeh Khajavikhan were promoted to Associate Professor with tenure.

Sadly, 2018 witnessed the passing of Emeritus Professor Boris Zeldovich at the age of 74. Zeldovich made outstanding contributions in research and education in optics and photonics and has been a great asset to the College for more than two decades.

The BS program, which began in Fall 2013, and received accreditation from ABET in 2017, continues to grow. In AY 2017-18, a total of 140 undergraduate students were enrolled in the program. Graduate enrollment was 132, and 12 Ph.D. degrees and 21 M.S. degrees were awarded. Graduate students continue to receive national scholarships, fellowships, travel grants, and best papers/poster awards.

In 2018, Demetrios Christodoulides received the OSA Max Born Award. At the university level, Aristide Dogariu received the University Trustee Chair award and Kathleen Richardson received the Pegasus Professor award. In addition, Rodrigo Amezcua Correa received the Reach for the Stars Award.

At the college level, Patrick LiKamWa received the Teaching Incentive Award and the Excellence in Undergraduate Teaching Award. Stephen Kuebler received the Research Incentive Award. The Excellence in Graduate Teaching Award went to Shin-Tson Wu and the Excellence in Research Award to Rodrigo Amezcua Correa. Ayman Abouraddy, Zenghu Chang, Patrick LiKamWa and Bahaa Saleh became members of the UCF Chapter of the National Academy of Inventors.

This year, the research conducted by the CREOL faculty, students, and scientists was disseminated nationally and internationally in 3 book chapters, 189 journal papers, including 18 papers in Nature journals, 2 in Science and 7 in Optica. In FY 2018 research and educational programs were funded by contracts and grants totaling approximately \$17M. Our tradition of innovation has also continued, and the faculty and students were issued 14 patents.

Partnership with industry continues to be strong. Approximately \$4.4M were received from industry or from federal grants flow through industrial partners, a connection that gives our students a leg up on industry positions after they graduate. The 2018 Industrial Affiliates Day events were attended by 293 guests and 21 exhibitors; the students presented 30 posters, and 4 short courses were offered. CREOL maintains an ongoing relation with its alumni and holds regular alumni reunions at key conferences. The CREOL Association of Optics Students (CAOS) has maintained its strong involvement in outreach and professional development. Another highlight of 2018 is the Florida Science Olympiad, which was held at UCF in March and CREOL was a key participant.

This annual report provides an overview of the education, research, and partnership activities of the faculty, staff, and students in 2018. Key data are also compared to previous years to show progress and identify trends. Academic data are reported for the academic year AY 2017-2018 (Summer 2017, Fall 2017, Spring 2018). Fiscal data, grants, and patents are reported for the fiscal year FY 2018 (July 2017–June 2018). Publications are reported for the 2018 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**

Professor of Optics and Photonics

Ph.D., Electrical Engineering, Boston University, 2003

raddy@creol.ucf.edu | (407) 823-6809

## Research

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

## Other Experience

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

## Professional Activities

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

## Honors and Awards

- ▲ Florida Photonics Center of Excellence (FPCE) Professorship
- ▲ Fellow, OSA 2016
- ▲ Research Initiative Award University-wide 2015
- ▲ Reach for the Stars Award 2014
- ▲ Teaching Incentive Program Award 2014



**Rodrigo Amezcua Correa**

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

luca.argenti@ucf.edu | (407) 823-0780

## 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 Conference on Attosecond Physics, 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

demetri@creol.ucf.edu | (407) 882-0074

**Research**

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

**Professional Activities**

- ▲ QELS 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

delfyett@creol.ucf.edu | (407) 823-6812

**Research**

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

**Other Experience**

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

**Professional Activities**

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

**Honors and Awards**

- ▲ Townsend Harris Medal
- ▲ 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

ddeppe@creol.ucf.edu | (407) 823-6870

**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**

University Trustee Chair; Pegasus Professor of Optics and Photonics

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

adogariu@creol.ucf.edu | (407) 823-6839

**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**

- ▲ University Trustee Chair Award
- ▲ Fellow, APS, OSA
- ▲ Florida Photonics Center of Excellence (FPCE) Professorship
- ▲ UCF Pegasus Professor



**Ronald Driggers**

Professor of Optics and Photonics

Ph.D., Electrical Engineering, University of Memphis, 1990

ron.driggers@creol.ucf.edu | 407-823-0323

**Research**

Imaging systems, sensors, and components. Applications include target acquisition, intelligence-surveillance-reconnaissance (ISR), threat warning, and mobility (including degraded visual environments). Atmospheric, optics, detectors, signal and image processing, displays, and human vision.

**Other Experience**

- ▲ Superintendent, Optical Sciences Division, Naval Research Laboratory
- ▲ Chief, Electro-Optics and Photonics Division, Army Research Laboratory
- ▲ Director, Modeling and Simulation Division, Army Night Vision Laboratory

**Professional Activities**

- ▲ Editor-in-Chief, Applied Optics
- ▲ Board of Editors, Optical Society of America
- ▲ Conference Committee, SPIE Defense and Security
- ▲ Executive Committee, Military Sensing Symposium
- ▲ Past Editor-in-Chief of Optical Engineering
- ▲ Past Board of Directors SPIE

**Honors and Awards**

- ▲ US Army Engineer of the Year 2002
- ▲ CERDEC Technical Employee of the Year 2001
- ▲ Night Vision Laboratory Employee of the Year 2000
- ▲ US Navy Engineering Duty Officer of the Year 2001
- ▲ University of Memphis Alumni of the Year 2010
- ▲ Fellow SPIE, OSA, MSS

**Sasan Fathpour**

Professor of Optics and Photonics, ECE

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

fathpour@creol.ucf.edu | (407) 823-6961

**Research**

Integrated photonics, heterogeneous integration in silicon photonics, Integrated nonlinear optics, semiconductor optoelectronics.

**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**

- ▲ Fellow of OSA and Senior Member of IEEE and SPIE
- ▲ Chair of Short Courses at the Conference on Lasers and Electro-Optics (CLEO), 2014-16
- ▲ Symposium Co-Chair, "Emerging Materials and Devices for on-chip Optoelectronics," MRS Fall Meeting 2015
- ▲ Guest Editor of SPIE's Journal of Nanophotonics Special Issue on Nanoplasmonics

**Honors and Awards**

- ▲ Fellow of OSA, The Optical Society, 2017
- ▲ UCF Research Incentive Award (RIA), 2017
- ▲ 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**

Associate Professor of Optics and Photonics, NanoScience Technology

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

gaume@creol.ucf.edu | (407) 823-5683

**Research**

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

**Other Experience**

- ▲ Postdoctoral Research scientist, Applied Physics Dept., Stanford University 2002-06
- ▲ Research Scientist, Applied Physics Dept., Stanford University, 2006-11

**Professional Activities**

- ▲ Member, 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

ryan5@creol.ucf.edu | (407) 823-1385  
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 and photoinduced processes in glasses, photosensitive glasses for hologram recording, holographic optical elements, lasers controlled by holographic optical elements.

**Other Experience**

- ▲ Founder of OptiGrate Corporation, an IPG Company

**Professional Activities**

- ▲ Member: American Ceramic Society (ACS), International Society for Optics and Photonics (SPIE), Optical Society of America (OSA), National Academy of Inventors (NAI).
- ▲ Boulder Damage Symposium, International Program Committee
- ▲ Optical Components and Materials at Photonics West, Program Committee
- ▲ Center for Research, Technology and Education in Vitreous Materials (Brazil), International Advisory Board

**Honors and Awards**

- ▲ Fellow of ACS, OSA, SPIE, NAI
- ▲ Dennis Gabor Award in Holography (SPIE)
- ▲ Frontiers in Glass Technology Award (ACS)
- ▲ Florida Photonics Center of Excellence (FPCE) professorship

**David J. Hagan**

Associate Dean of Academic Programs; Pegasus  
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**

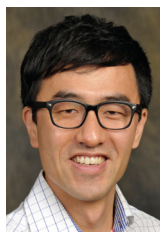
- ▲ Founder, Polara, LLC.
- ▲ Photonics consultant, National Research Council "Defense After Next"

**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"

**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
- ▲ Journal Advisory Panel, Journal of Physics D: Applied Physics

**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

akar@creol.ucf.edu | (407) 823-6921

**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**

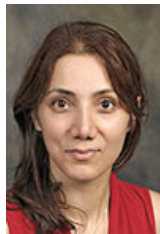
- ▲ Interdisciplinary science and technology
- ▲ Cross disciplinary courses (thermal science, materials and optics)
- ▲ Technology transfer from research to industrial implementation

**Professional Activities**

- ▲ Member, LIA
- ▲ Editorials Board Member

**Honors and Awards**

- ▲ Fellow, LIA
- ▲ Numerous Patents

**Mercedeh Khajavikhan**

Associate Professor of Optics and Photonics  
Ph.D., Electrical Engineering, University of Minnesota, 2009

mercedeh@creol.ucf.edu | (407) 823-6829

**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  
Ph.D., 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, OSA
- ▲ 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

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**Research**

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

**Other Experience**

- ▲ Nonlinear surface polaritons
- ▲ Phase conjugation
- ▲ Nonlinear dynamics

**Professional Activities**

- ▲ Associate Editor-in-Chief, Frontiers of Optoelectronics
- ▲ Associate Editor, IEEE Photonics Journal
- ▲ Associate Editor, Optica

**Honors and Awards**

- ▲ ONR Young Investigator Award, 1995
- ▲ NSF CAREER Award, 1996
- ▲ IEEE EDS Distinguished Lecturer
- ▲ Fellow, OSA, SPIE, IEEE, NAI
- ▲ Florida Photonics Center of Excellence (FPCE) Professorship
- ▲ IEEE PS Distinguished Lecturer
- ▲ UCF Teaching Incentive Award, 2004, 2014
- ▲ UCF Research Incentive Award, 2007



**Patrick L. LiKamWa**

Professor of Optics and Photonics, ECE

Ph.D., Electronic &amp; 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

moharam@creol.ucf.edu | (407) 823-6833

**Research**

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

**Other Experience**

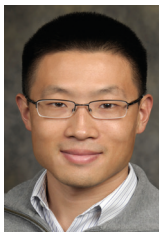
- ▲ Wave propagation in periodic and anisotropic media
- ▲ Analysis and design of optical filters
- ▲ Thin film optics

**Professional Activities**

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

**Honors and Awards**

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

**Shuo "Sean" Pang**

Assistant Professor of Optics and Photonics

Ph.D., Electrical Engineering, Caltech 2013

pang@creol.ucf.edu | 407-823-6869  
oisl.creol.ucf.edu**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

**Kumar Patel**

University Distinguished Professor of Optics and Photonics

Ph.D., Electrical Engineering, Stanford University, 1961

Chandra.Patel@ucf.edu

**Research**

Optics and laser physics and technology; infrared nonlinear optics

**Other Experience**

- ▲ Founder, President, and CEO of Pranalytica, Inc. (2000-present)
- ▲ Vice Chancellor for Research, UCLA (1993-1999)
- ▲ Executive Director, Physics Division and Materials Research Division, AT&T (now Lucent Technologies) Bell Laboratories (1961-1993)

**Professional Activities**

- ▲ Honorary Member, Gynecologic Laser Surgery Society (1980)
- ▲ Honorary Member, American Society for Laser Medicine and Surgery (1985)
- ▲ Board of Directors, Newport Corporation

**Honors and Awards**

- ▲ Optical Society Adolph Lomb Medal (1966) and Townes Medal (1976), Frederic Ives Medal (1989)
- ▲ IEEE Medal of Honor (1989)
- ▲ APS George E. Pake Prize (1988)
- ▲ New Jersey Governor's Thomas Alva Edison Science Award (1987)
- ▲ National Academy of Engineering (1978) and the National Academy of Science (1974)
- ▲ Coblentz Prize (American Chemical Society, 1974)
- ▲ IEEE Lamme Medal (1976)
- ▲ National Inventors' Hall of fame (2012)
- ▲ National Medal of Science awarded by President Bill Clinton (1996)
- ▲ Fellow, IEEE, APS, OSA, American Academy of Arts and Sciences, AAAS, LIA, ASLMS

**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

**Other Experience**

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

**Professional Activities**

- ▲ Member, Materials Research Society

**Kathleen A. Richardson**

Pegasus Professor of Optics and Photonics,  
Material Science and Engineering

Ph.D., Ceramics, Alfred University, 1992

kcr@creol.ucf.edu | (407) 823-6815

**Research**

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

**Professional Activities**

- ▲ 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**

- ▲ Pegasus Professor Award, 2018
- ▲ Florida Photonics Center of Excellence (FPCE) Professorship
- ▲ Sir Richard Brook International Award, European Ceramic Society, 2017
- ▲ George W. Morey Award, American Ceramic Society, 2017
- ▲ Malcolm G. McClaren Distinguished Lecturer Award, Rutgers University Department of Materials Science and Engineering, 2017
- ▲ Fellow, OSA, SPIE, ACerS and SGT
- ▲ Academician, World Academy of Ceramics, 2015
- ▲ I.D. Varshnei Award, Indian Ceramic Society
- ▲ Outstanding Educator Award, American Ceramic Society
- ▲ Samuel R. Scholes Lecture and Award, Alfred University

**Martin C. Richardson**

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

Ph.D., Physics, London University, 1967

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**Research**

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

**Professional Activities**

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

**Honors and Awards**

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

**Bahaa E. A. Saleh**

Dean & Director, Professor of Optics and  
Photonics

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

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**Research**

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

**Other Experience**

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

**Professional Activities**

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

**Honors and Awards**

- ▲ OSA 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**

Professor of Optics and Photonics; Director,  
Solar Technologies Research Division (FSEC)

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

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

**Research**

MBE growth of oxide semiconductors, oxide and nitride semiconductor UV  
detectors, advanced passivation and cell architectures for c-Si photovoltaics

**Other Experience**

- ▲ Director, cSi Photovoltaic Manufacturing Consortium (PVMC) 2011-17
- ▲ President/CEO, Medical Lighting Solutions, 2003-04
- ▲ Device Manager, Uniroyal Optoelectronics, 2000-03

**Professional Activities**

- ▲ Member, SPIE, OSA, IEEE
- ▲ Principal Editor, Journal of Materials Research
- ▲ Chair, MOEMS/MEMS Conference – SPIE Photonics West
- ▲ Energy Sub-Committee Member, National Photonics Initiative (NPI), 2013
- ▲ NSF Research Experience for Undergraduates Program PI, 2005-11

**Honors and Awards**

- ▲ Fellow, SPIE
- ▲ UCF RIA Award for Research Excellence, 2016
- ▲ UCF ORC Millionaire Award, 2013/2014/2015
- ▲ UCF Innovator, 2013/2014
- ▲ UCF TIP Award for Teaching Excellence, 2010
- ▲ UCF Presidential Initiative Award, 2006
- ▲ USA Triathlon All-American 2016, 2017, 2018

**Axel Schülzgen**

Professor of Optics and Photonics

Ph.D., Physics, Humboldt University, 1992

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**Research**

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

**Other Experience**

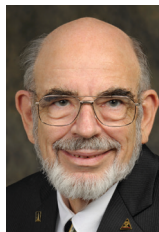
- ▲ College of Optical Sciences, The University of Arizona, 1996-09
- ▲ Department of Physics, Trinity College, Dublin, Ireland, 1995
- ▲ Department of Physics, Humboldt University, Berlin, Germany, 1991-95

**Professional Activities**

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

**Honors and Awards**

- ▲ Fellow, OSA
- ▲ Excellence in Graduate Teaching Award, 2017
- ▲ CREOL Excellence in Research Award, 2015
- ▲ Habilitation Fellowship, German Research Foundation, 1993
- ▲ Carl Ramsauer Award, AEG Corporation, 1992
- ▲ Heinrich Gustav Magnus Award, Humboldt University, Berlin, 1988

**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**

- ▲ Officer, USAF, 1967-73
- ▲ 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
- ▲ Co-Chair, SPIE Boulder Damage Symposium

**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
- ▲ Florida Inventors Hall of Fame
- ▲ Foreign Member of the Russian Academy of Science

**Eric W. Van Stryland**

University Trustee Chair; Pegasus Professor of  
Optics and Photonics; Founding Dean

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

ewvs@creol.ucf.edu | (407) 823-6835  
nlo.creol.ucf.edu

**Research**

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

**Other Experience**

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

**Professional Activities**

- ▲ President, Optical Society of America (OSA), 2006, Board of Directors,
- ▲ Fellow, OSA, SPIE, IEEE, 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

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mir.creol.ucf.edu

**Research**

Mid-Infrared Combs Group (MIR). Broadband mid-infrared ( $\lambda > 2.5 \mu\text{m}$ ) 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 (ISPD), Beijing, China, 2013
- ▲ Photonics West, LA106 Conference Chair (2010-present)
- ▲ CLEO General Chair, 2010, CLEO Program Chair, 2008
- ▲ Associate Editor, Optica
- ▲ Co-author, Solid-State Mid-Infrared Laser Sources, Springer, 2003

**Honors and Awards**

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

**Shin-Tson Wu**

Pegasus Professor of Optics and Photonics

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

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**Research**

Advanced displays including LCDs, OLEDs, augmented reality and virtual reality, adaptive lenses, and adaptive optics.

**Other Experience**

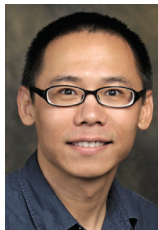
- ▲ Senior Scientist, Hughes Research Labs

**Professional Activities**

- ▲ Chair, SID Honors and Awards 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
- ▲ 2008 SPIE G.G. Stokes Award
- ▲ 2008 SID Jan Rajchman Prize
- ▲ Fellow, OSA, SPIE, IEEE, SID

**Xiaoming Yu**

Assistant Professor of Optics and Photonics

Ph.D., Industrial and Manufacturing Systems Engineering, Kansas State University, 2016

yux@creol.ucf.edu | (407) 823-6872  
<https://sites.google.com/site/yulabucf2/>

**Research**

Developing novel for laser-based advanced manufacturing, and seeking fundamental understanding of light-matter interaction. Research interests include laser-induced nonequilibrium, electron dynamics control, ultrafast laser micro/nano processing, and laser-based additive manufacturing.

**Other Experience**

- ▲ Session Chair for conferences MSEC 2017, IMECE 2017

**EMERITUS FACULTY****Larry C. Andrews**

Emeritus Professor of Mathematics, Optics and Photonics

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

Larry.andrews@ucf.edu

**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@unc.edu

**Research**

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

**Other Experience**

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

**Professional Activities**

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

**Honors and Award**

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

**Ronald L. Phillips**

Emeritus Professor of EECS, Optics 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

## JOINT FACULTY

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**Matthieu Baudelet**

Assistant Professor of Chemistry, National Center for Forensic Science

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

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Associate Professor of Physics, AMPAC/NSTC

Ph.D., University of Toronto

debashis.chanda@creol.ucf.edu

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Assistant Professor of Physics

Ph.D., University of Central Florida

Physics

michael.chini@ucf.edu

**Louis Chow**

Professor and University Chair in Mechanical & Aerospace Engineering

Ph.D., University of California, Berkeley

Heat Transfer Issues in Electro-Optics

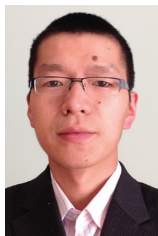
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**Kristopher Davis**

Assistant Professor of Materials Science & Engineering

Ph.D., University of Central Florida

Kristopher.Davis@ucf.edu

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Assistant Professor of Material Science & Engineering

Ph.D., Harvard University

Nanoelectronics and nanophotonics

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Associate Professor of Chemistry, Nanoscience Technology Center

Ph.D., University of Leuven

Optoelectronic Materials, Nanobiology

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Professor of Chemistry

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

Optical Materials

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Provost Distinguished Research Professor of Math

Ph.D., University of Maryland

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Professor of Physics, Nanoscience Technology Center

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Quantum Information

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Assistant Professor of Physics, Nanoscience Technology Center

Ph.D., University of Florida

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Professor of Physics

Ph.D., Cornell University

Defects in Semiconductors

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**Seetha Raghavan**

Associate Professor of MAE

Ph.D., Purdue University

Optical Characterization of Advanced Materials

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**Alfons Schulte**

Professor of Physics

Dr. rer. Nat, Technical University of Munich

Near-IR Raman Spectroscopy

alfons.schulte@ucf.edu



**Mubarak A. Shah**

University Trustee Chair; Professor of Computer Science; Director CRCV  
Ph.D., Wayne State University  
Computer Vision  
mubarak.shah@ucf.edu

**Michael Sigman**

Professor of Chemistry  
Ph.D., Florida State University  
Explosives, Chemistry & Forensics  
michael.sigman@ucf.edu

**Jayan Thomas**

Associate Professor of Physics, Nanoscience Technology Center  
Ph.D., Cochin University of Science & Technology  
jayan.thomas@ucf.edu

**Subith Vasu**

Associate Professor of Mechanical and Aerospace Engineering  
Ph.D., Stanford University  
Mechanical Engineering  
subith@ucf.edu

**Murat Yuksel**

Associate Professor of Electrical and Computer Engineering  
Ph.D., Rensselaer Polytechnic Institute  
murat.yuksel@ucf.edu

## COURTESY FACULTY

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Professor, Institute of Physics, Kiev, Ukraine  
Ph.D., Inst of Physics, NASU, Ukraine  
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**Bruce H. Chai**

President, Crystal Photonics  
Ph.D., Yale University  
chai@crystalphotonics.com

**Jean-Claude Diels**

Professor of Physics & EE, Univ. of New Mexico  
Ph.D., UC-Berkeley  
jcdiels@unm.edu

**Jason Eichenholz**

CTO, Luminar Technologies, INC.  
Ph.D., 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

**Vassilios Kovanis**

AFRL, Sensors Directorate  
Ph.D., University of New Mexico  
Semiconductor lasers, nonlinear optics  
vassilios.kovanis@ucf.edu

**Ilya Mingareev**

Assistant Professor, Florida Institute of Technology  
Ph.D., RWTH Aachen University  
imingareev@fit.edu

**Clara Rivero Baleine**

Mechanical Engineer Staff, Lockheed Martin  
Missiles and Fire Control  
Ph.D., University of Central Florida  
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**Jannick Rolland**

Brian J. Thompson Professor of Optical Engineering,  
Professor of Biomedical Engineering,  
University of Rochester  
Ph.D., University of Arizona  
rolland@optics.rochester.edu

**Kenneth Schepler**

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

**Mordechai Segev**

Robert J. Shillman Distinguished Professor of Physics  
Ph.D., Technion University  
msegev@technion.ac.il

**Robert Stegeman**

Sr. Optical Investigator - LGS Innovations, Inc.  
Ph.D., University of Central Florida

**C. Martin Stickley**

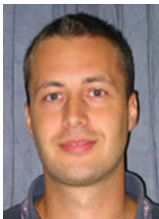
Special Assistant to the Vice President, Research and Commercialization  
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**Emil Wolf**

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

**IN MEMORIAM**

## ADJUNCT FACULTY

**George Curatu**

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Ph.D., University of Central Florida  
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**Umar Piracha**

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Ph.D., University of Central Florida  
Electrical Engineering  
Umar.Piracha@imec-int.com

## IN MEMORIAM



Boris Zeldovich, Emeritus Professor of Optics and Photonics, and Physics, passed away on Sunday, December 16, at the age of 74. He joined the UCF faculty in 1994 and made outstanding contributions in research and education in optics and photonics and has been a great asset to the College for more than two decades. He made significant contributions in the areas of optical phase conjugation and optical speckle waves and his work was published in two well-known books, chapters in books, and many journal papers. He has been recognized at the national and international levels. He is Fellow of the Optical Society (OSA), member of the USSR Academy of Sciences, and recipient of the prestigious Max Born Award in Physical Optics from the Optical Society (OSA) and the USSR State Prize. He has served on numerous editorial boards and leadership roles in professional societies.



## 2018 FACULTY AWARDS AND HONORS

### NATIONAL AND INTERNATIONAL AWARDS

Townsend Harris Medal  
Fellow of The Optical Society

Peter Delfyett  
Axel Schülzgen

### UNIVERSITY AWARDS

University Trustee Chair  
UCF Pegasus Professor Award  
Reach for the Stars Award  
Reach for the Stars Award  
Excellence in Graduate Teaching\*  
Excellence in Undergraduate Teaching\*  
Excellence in Research\*  
Teaching Incentive Program Award\*  
College of Optics and Photonics Research Incentive Award\*  
College of Optics and Photonics Research Incentive Award\*  
College of Sciences Research Incentive Award\*  
NanoScience Technology Center Research Incentive Award\*  
Luminary Award  
Luminary Award

Aristide Dogariu  
Kathleen Richardson  
Rodrigo Amezcua Correa  
Debashis Chanda  
Shin-Tson Wu  
Patrick LiKamWa  
Rodrigo Amezcua Correa  
Patrick LiKamWa  
Rodrigo Amezcua Correa  
Mercedeh Khajavikhan  
Stephen Kuebler  
Jayan Thomas  
Mercedeh Khajavikhan  
Jayan Thomas

\*College Level



Hong Shu (Ph.D. 2004), S.T. Wu, and M.J. Soileau pose with Michael Bass (second from right) at his retirement celebration.



## HISTORICAL FACULTY AWARDS AND HONORS

	1997 Max Born Award	Boris Zeldovich (in memoriam)
	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 (in memoriam)
	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
	2018 Max Born Award	Demetrios Christodoulides
	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
	2003 Engineering Achievement	Dennis Deppe
	2008 Jan Rajchman Prize	Shin-Tson Wu
	2011 Slottow–Owaki Prize	Shin-Tson Wu
	2011 Edward A. Bouchet Award	Peter Delfyett
	ACerS Outstanding Educator Award (2009)	Kathleen Richardson
	NSF Presidential Early Career Award (PECASE) (1997)	Peter Delfyett
	NSF Presidential Young Investigator Award (1991)	Dennis Deppe
	NSF Career Award (2012)	Sasan Fathpour
	NSF CAREER Award (2007)	Pieter Kik
	NSF CAREER Award (2008)	Stephen Kuebler
	NSF CAREER Award (1996)	Guifang Li
	NSF CAREER Award (2015)	Mercedeh Khajavikhan
	ONR Young Investigator Award (1991)	Dennis Deppe
	ONR Young Investigator Award (1995)	Guifang Li
	ONR Young Investigator Award (2013)	Sasan Fathpour
	ONR Young Investigator Award (2016)	Mercedeh Khajavikhan
	Ralph E. Powe Junior Faculty Award (2009)	Ayman Abouraddy
	Guggenheim Fellow (1984)	Bahaa Saleh

## FELLOWS OF PROFESSIONAL SOCIETIES AND ACADEMIES

 The Optical Society	Ayman Abouraddy Michael Bass Zenghu Chang Demetrios Christodoulides Peter Delfyett Dennis Deppe Aristide Dogariu Ronald Driggers	Sasan Fathpour Leonid Glebov David Hagan Guifang Li Jim Moharam James Pearson Kathleen Richardson Martin Richardson	Bahaa Saleh Axel Schülzgen William Silfvast M.J. Soileau George Stegeman (in memoriam) Eric Van Stryland Konstantin Vodopyanov Shin-Tson Wu Boris Zeldovich (in memoriam)
	Glenn Boreman Peter Delfyett Ronald Driggers 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 Konstantin Vodopyanov Shin-Tson Wu
	Michael Bass Peter Delfyett Dennis Deppe Guifang Li	Martin Richardson Bahaa Saleh William Silfvast	M.J. Soileau Eric Van Stryland Shin-Tson Wu
 AMERICAN PHYSICAL SOCIETY	Zenghu Chang Aristide Dogariu Demetrios Christodoulides Peter Delfyett	Martin Richardson Bahaa Saleh Eric Van Stryland Konstantin Vodopyanov	
 Laser Applications and Safety	Aravinda Kar Michael Bass		
	Leonid Glebov Kathleen Richardson		
 SOCIETY FOR INFORMATION DISPLAY	Shin-Tson Wu		
 ADVANCING SCIENCE. SERVING SOCIETY	Michael Bass Martin Richardson		
 NATIONAL ACADEMY OF INVENTORS	Michael Bass Peter Delfyett Leonid Glebov	Aravinda Kar Guifang Li	M.J. Soileau Shin-Tson Wu
	M.J. Soileau Shin-Tson Wu		

### UCF Chapter of the National Academy of Inventors Third Annual Gala and Induction Ceremony

At the University of Central Florida, we celebrate innovation. We recognize that the discoveries made in our labs today will be the breakthrough solutions of tomorrow. To honor the men and women that are pursuing and sharing these discoveries, we opened a local chapter of the National Academy of Inventors. Through this chapter we will also celebrate the leadership who foster and nurture innovation at UCF and within our local community.

The 2018 CREOL Inductees are:

- ▲ Ayman Abouraddy
- ▲ Zenghu Chang
- ▲ Patrick LiKamWa
- ▲ Bahaa Saleh
- ▲ Boris Zeldovich (in memoriam)

## PRESIDENTS, DIRECTORS, & OFFICERS OF PROFESSIONAL SOCIETIES



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

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



M.J. Soileau  
Glenn Boreman  
James Harvey  
Kathleen Richardson

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



Shin-Tson Wu  
Peter Delfyett  
Jim Moharam  
Kathleen Richardson

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



**Laser Institute  
of America**  
*Laser Applications and Safety*

Michael Bass  
Michael Bass  
Aravinda Kar  
Bahaa Saleh  
Eric Van Stryland

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



Peter Delfyett

President (2008–2011)



Kathleen Richardson  
Kathleen Richardson

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



Peter Delfyett

Vice-Chair (2015–Present)



**National Institute of  
Ceramic Engineers**  
(NICE)

Kathleen Richardson

President (2008–2009)



Demetrios Christodoulides (r) receives the Max Born Award from OSA for outstanding contribution to the field of physical optics.



## 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)
Shin-Tson Wu	Honorary Professorship, National Chiao Tung University, Taiwan (2018)
Boris Zeldovich (in memoriam)	USSR Academy of Sciences (1987)
Boris Zeldovich (in memoriam)	USSR State Prize (1983)

## 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
Applied Optics (2015–present)	Ronald Driggers
Optical Engineering (2012–2015)	Ronald Driggers
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

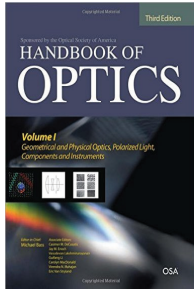
## ASSOCIATE AND TOPICAL EDITORS

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
Journal of Experimental Nanoscience (2008–present)	Stephen Kuebler
Journal of Micro/Nanolithography, MEMS, & MOEMS (2008–present)	Stephen Kuebler
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
Journal of the Optical Society of America B (2016–2017)	Axel Schülzgen
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

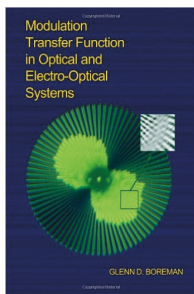
## BOOKS



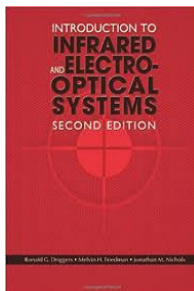
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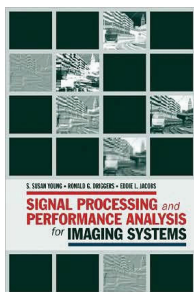
**Michael Bass,** Casimer DeCusatis, Jay Enoch and Vasudevan Lakshminarayana,  
**Guifang Li,** Carolyn MacDonald, Virenda Mahajan, and **Eric Van Stryland,**  
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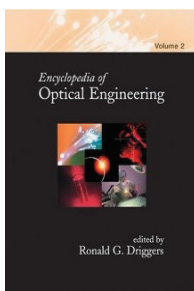
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*Modulation Transfer Function in Optical and Electro Optical Systems,*  
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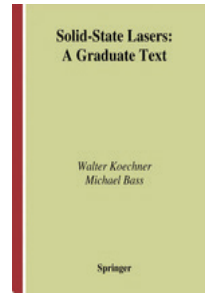
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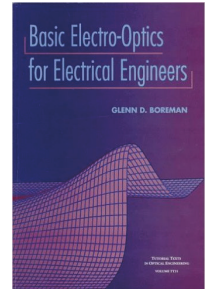
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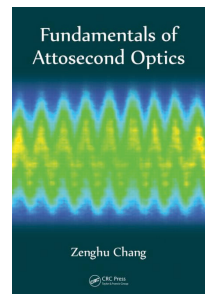
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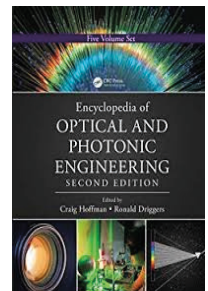
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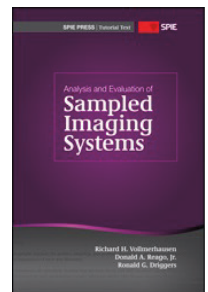
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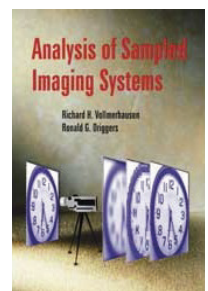
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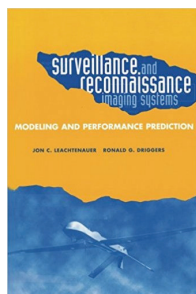
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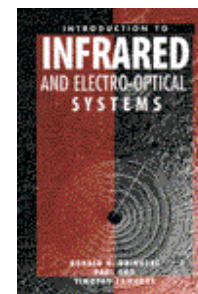
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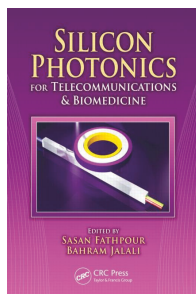
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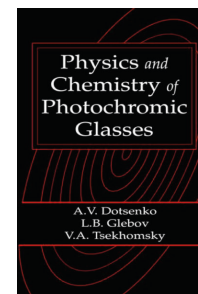
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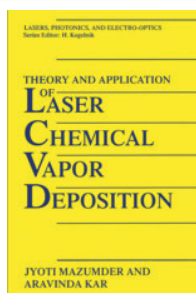
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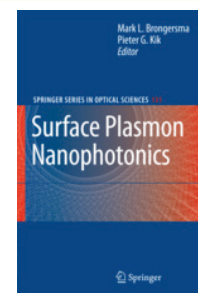
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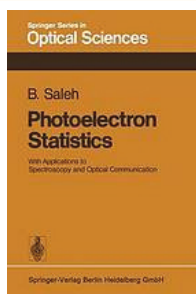
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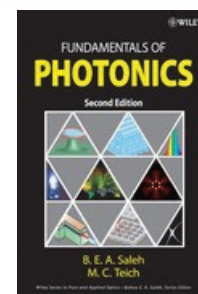
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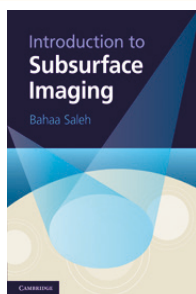
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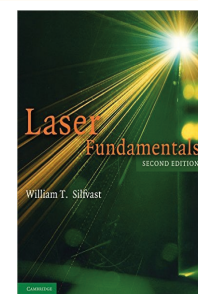
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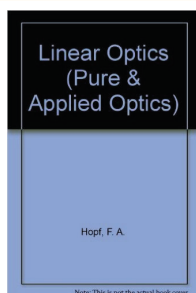
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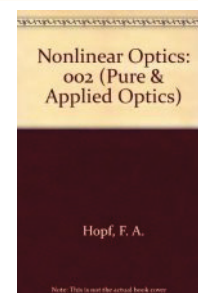
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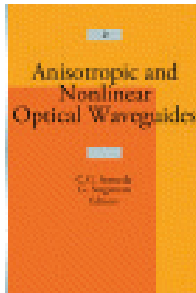


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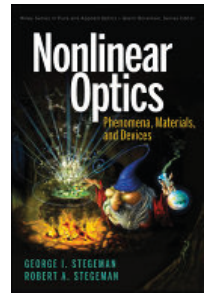
**George I. Stegeman** and Frederic A. Hopf,  
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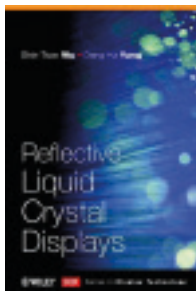
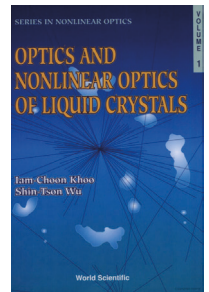
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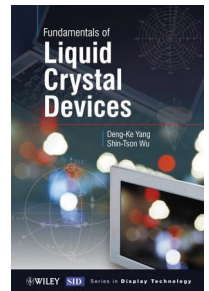
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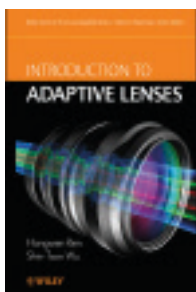
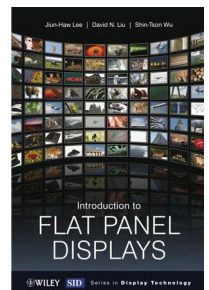
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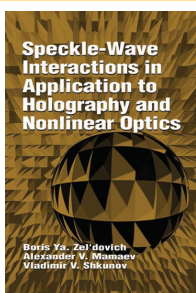
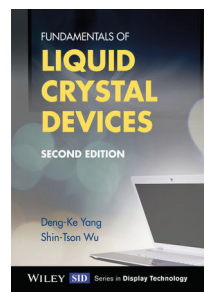
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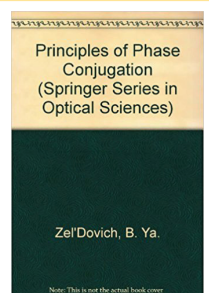
Hongwen Ren and **Shin-Tson Wu**,  
*Introduction to Adaptive Lenses*,  
Wiley, (2012).

Deng-Ke Yang and **Shin-Tson Wu**,  
*Fundamentals of Liquid Crystal Devices*  
2nd, Ed ,  
Wiley (2014).



**Boris Ya. Zeldovich**, Alexander V. Mamaev  
and Vladimir V. Shkunov,  
*Speckle-Wave Interactions in Application to Holography and Nonlinear Optics*,  
CRC Press, (1995).

**Boris Ya. Zeldovich**, N. F. Pilipetsky, and  
Vladimir V. Shkunov  
*Principles of Phase Conjugation*,  
Springer Verlag (1985).



## RESEARCH STAFF

### SENIOR RESEARCH SCIENTISTS

Robert Crabbs (TISTEF)  
Ivan Divliansky (Prof. Glebov)

Ilya Mingareev (Prof. M. Richardson)  
Scott Webster (Prof. Abouraddy)

### RESEARCH SCIENTISTS

Jose Enrique Antonio Lopez (Profs. Amezcua/Schülzgen)  
Catia Bernabini (Prof. Schülzgen)  
Robert Bernath (Prof. M. Richardson)  
Bruce Berry (TISTEF)  
Basanta Bhaduri (Prof. Abouraddy)  
Shi Chen (Prof. Abouraddy/Gaume)  
Joseph Coffaro (TISTEF)  
Larissa Glebova (Prof. Glebov)  
Shikha Kalbele (Prof. Deppe)  
Joshua Kaufman (Prof. Abouraddy)  
Esat Kondakci (Prof. Abouraddy)  
Majid Masnavi (Prof. M. Richardson)  
Helene Mingareev (Prof. Glebov)  
Morgan Monroe (Prof. Abouraddy)  
Andrey Muraviev (Prof. Vodopyanov)

Sarvesh Rane (Prof. Deppe)  
Shermineh Rostami Fairchild (Prof. M. Richardson)  
Zeinab 'Zahoorah' Sanjabi Eznaveh (Prof. Amezcua)  
Frank Sanzone (TISTEF)  
Soroush Shabahang (Prof. Abouraddy)  
Hong Shu (Prof. Bass)  
Christopher Smith (TISTEF)  
Jonathan Spsychalsky (TISTEF)  
Robert Stegeman (Prof. Li)  
Sergey Sukhov (Prof. Dogariu)  
Chetan Swamy (Prof. Deppe)  
Guangming Tao (Prof. Abouraddy)  
Franklin Titus (TISTEF)  
Absar Ulhassan (Prof. Christodoulides)  
Robert Wingo (Prof. Abouraddy)

### POST-DOCTORAL RESEARCH ASSOCIATES

Nathan Bodnar (Prof. M. Richardson)  
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Jaehyuck Choi (Prof. Khajavikhan)  
Daniel Cruz Delgado (Prof. Amezcua)  
Xinpeng Du (Profs. Kar/Yu)  
Asaf Farhi (Prof. Khajavikhan)  
Claudia Goncalves (Prof. K. Richardson)  
Md Selim Habib (Prof. Amezcua)  
William Hayenga (Prof. Khajavikhan)  
Hossein Hodaieshani (Prof. Khajavikhan)

Mohammad Hokmabadi (Prof. Khajavikhan)  
Myungkoo Kang (Prof. K. Richardson)  
Saeed Khan (Prof. Fathpour)  
Gisela Lopez Galmiche (Prof. Christodoulides)  
Amirreza Mahigir (Prof. Khajavikhan)  
Oussama Mhibik (Prof. Glebov)  
Natalia Munera Ortiz (Profs. Hagan/Van Stryland)  
Maryam Raftari (Prof. Dogariu)  
Anupama Yadav (Prof. K. Richardson)

### VISITING RESEARCH SCIENTISTS

Cristian Acevedo Caceres (Prof. Dogariu)  
Mohammed Al-Mumin (Prof. Li)  
Mykhailo Bondar (Profs. Hagan/Van Stryland)  
Enguo Chen (Prof. Wu)  
Sang Hun Choi (Prof. Wu)  
Xiaoming Duan (Prof. Li)  
Jabir Wali Hakami (Prof. Khajavikhan)  
Pawel Jung (Prof. Christodoulides)  
Kang Taek Lee (Prof. Han)

Xiaomin Liu (Prof. Wu)  
Partha Mukhopadhyay (Prof. Schoenfeld)  
Vishwa Pal (Prof. Abouraddy)  
Felix Jose Salazar Bloise (Prof. Dogariu)  
He Wen (Prof. Li)  
Guangye Yang (Prof. Christodoulides)  
Peng Zhang (Prof. Li)  
Jian Zhao (Prof. Li)  
Hongbo Zhu (Prof. Li)

### LAB TECHNICIANS

Michael Costello (Prof. Abouraddy)  
Arthur Freeman (Prof. M. Richardson)  
Ethan Lane (Prof. M. Richardson)

Douglas Maukonen (Prof. M. Richardson)  
Mishal Patel (Prof. Abouraddy)

### SENIOR ELECTRICAL ENGINEER

Michael Costello (Prof. Abouraddy)  
Arthur Freeman (Prof. M. Richardson)

Mishal Patel (Prof. Abouraddy)

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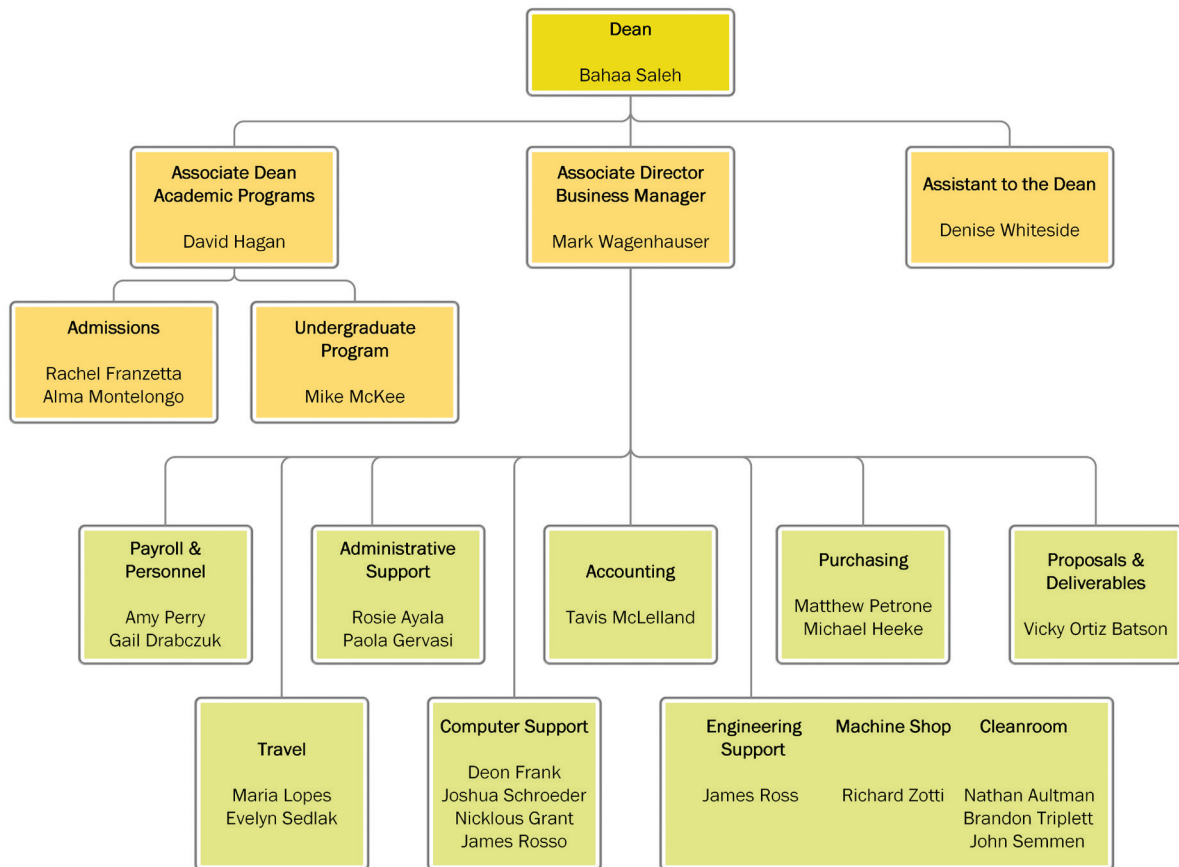
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# ORGANIZATIONAL CHART



Staff members Gail Drabczuk (l), Amy Perry (c), and Alma Montelongo at the Industrial Affiliates Symposium in April 2018.



# ACADEMIC PROGRAMS



## UNDERGRADUATE PROGRAM

Enrollment in the Bachelor of Science in Photonic Science and Engineering program continues to show strong growth, with a large increase in enrollment in Fall 2018 over the previous year.

At the end of 2018, 132 students were enrolled in the major, and 41 students have graduated since 2013.

Through informal surveys, graduates are working at companies such as Harris, Northrop Grumman, Lockheed, Luminar, Verizon. Reported starting salaries are averaging at approximately \$70,000, with at least two students reporting starting salaries at \$90,000.

### COURSE ADDITIONS

In the 2017-2018 academic year, several changes were made to the curriculum. The program closely parallels the Electrical and Computer Engineering (ECE) program for the first two years. Originally, students were required to complete Statics and Dynamics, but in 2017, ECE decided to remove these requirements.

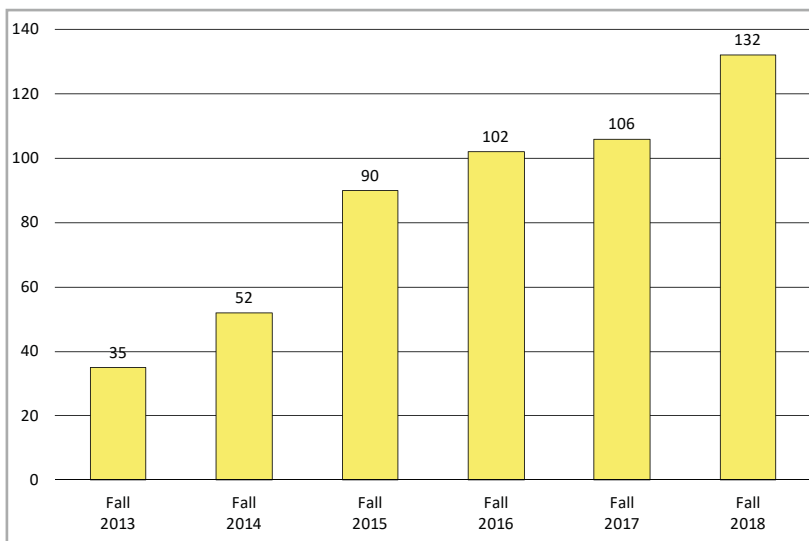
The change to their program provided an opportunity to make some curricular changes to the PSE program. We followed suit in dropping the statics and dynamics requirements and then added

Signal Analysis and Communication as a prerequisite to Fiber Optic Communications.

We also added Geometric Optics, taught by Kyle Renshaw, which was designed to increase the students knowledge of physical optics. Until spring 2017, this content was taught in

Introduction to Photonics, but in a limited manner. By moving content from Introduction to Photonics into a dedicated Geometric Optics course, students gain a deeper knowledge of physical optics.

However, the Introduction to Photonics Lab course continued to contain labs with physical optics content. In fall 2018, a separate Geometric Optics Lab was added to the curriculum and we moved the physical optics content from the Introduction to Photonics Lab into Geometric Optics Lab.



History of of Undergraduate Student Enrollment

### NEW ELECTIVE APPROVED

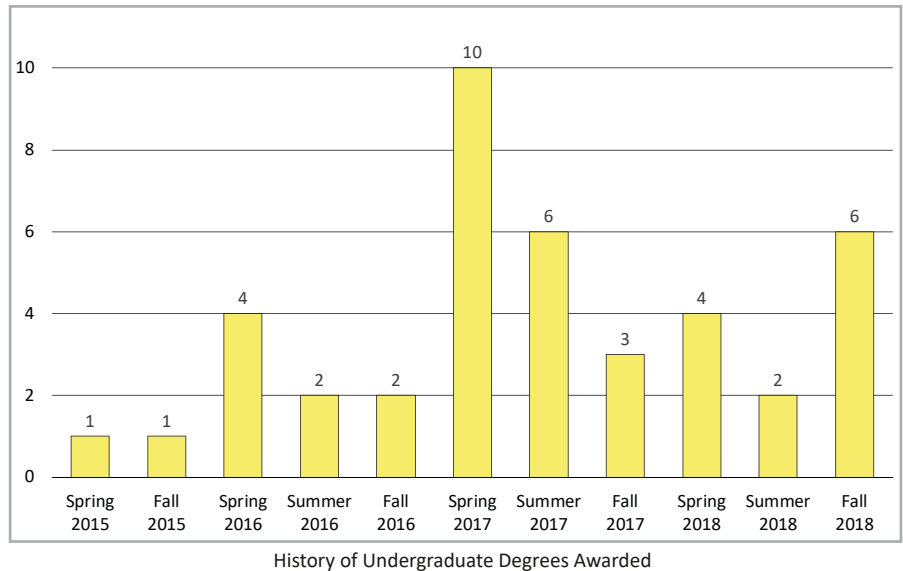
Most of the restricted electives available to students are offered by electrical engineering, physics, or mathematics. Until fall 2018, CREOL offered three restricted electives for undergraduates: Biophotonics, Optics and Photonics Design, and Visual Optics. With input from faculty and at the suggestion of faculty member

Ryan Gelfand, a new restricted elective course was approved. The new course, Analytical Methods of Optics, incorporates python coding, Matlab, and other essential skills students need in various coursework and by industry partners. The new course is offered for students in spring 2019.

#### INTERNSHIPS

Students in the program actively pursue internships and use new online search tool called Handshake, a national subscription platform that UCF's Center for Experiential Learning uses. However, students often find few listings in photonics. Often students find internships by searching job descriptions for keywords that are commonly used in the field, such as "optical engineering." Companies can help by posting jobs with photonics and optics clearly listed in their job descriptions to assist students in their searches.

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 one of only a six ABET programs in the nation.



## GRADUATE PROGRAM

#### GRADUATE RECRUITMENT AND ENROLLMENT

Enrollment in the PhD program in Fall 2018 at 114 represents an increase over the previous seven years. This is primarily due to the hiring of new faculty, along with increase in external funding for the prior year. As new faculty increase their research funding portfolios, we expect the PhD enrollment to grow over the next 5 years.

A combined total of 26 new students (20 Ph.D. and 6 MS) enrolled in Fall 2018.

The following tables reflect the enrollment recorded at the beginning of the fall semester in each academic year. (This number fluctuates slightly throughout the year due to students entering and graduating in different terms.)

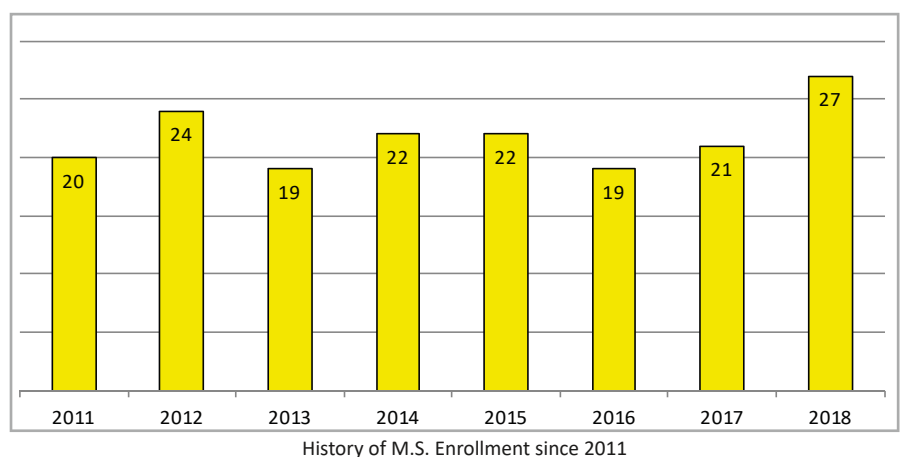
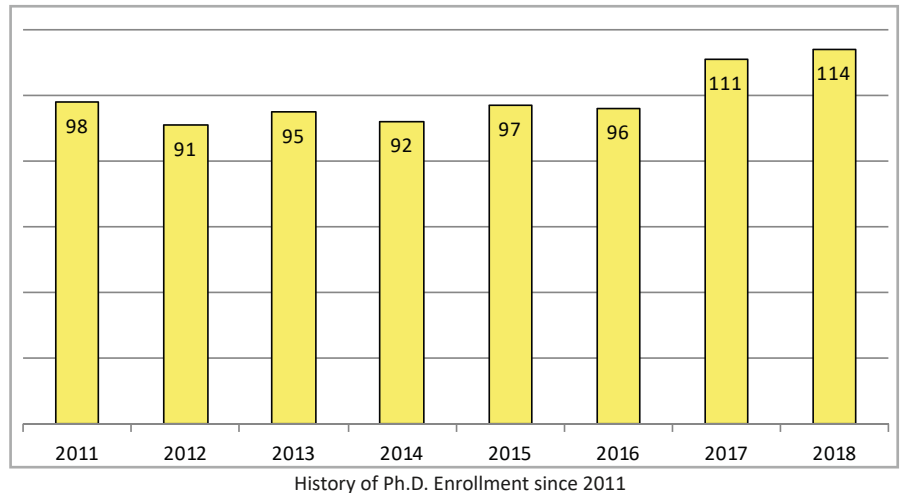
Overall, we received 221 pre-applications and 138 full applications to the graduate programs for Fall 2018.

The pre-application that has been used for over a decade, has been discontinued as of Fall 2018. Beginning in Fall 2019, the university is using a new admissions tool that is expected to provide more advanced technology with enhanced, faster document processing.

The average MS enrollment has remained roughly constant over the past five years.

New initiatives for future years, including the offering of Photonics courses at Lockheed-Martin, are expected to grow enrollment in the MS program. Interest from other Industrial Affiliates have been received and we look forward to expanding to meet the community needs.

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.





## Fall 2018 Mean GRE Scores

The mean GRE percentile scores for admitted students of 91% for Fall 2018 is above the five year average of 84% for the Quantitative Scores. The highest Mean Percentile Ranking achieved over the last five years was 91% in 2018.

## New Matriculant Demographic Fellowships & Scholarships

Attracting a balance of gender is a target that CREOL is attempting to achieve. In fall 2018, 30% of PhD and 33.3% of MS students were female. Our goal is to grow the number of female students admitted by 10% each year. The College maintains a strong focus on education at both undergraduate and graduate levels. We are taking advantage of the ORC Fellowship that is funded by the Office of Research, College of Optics and Photonics, and Academic Affairs.

Fall 2018 Mean GRE Scores						
		Quantitative	%	Verbal	%	Analytic Writing
Ph.D.	US	166	91%	157	76%	4
	Intl	167	94%	153	61%	3
M.S.	US	159	79%	155	69%	4
	Intl	0		0		0

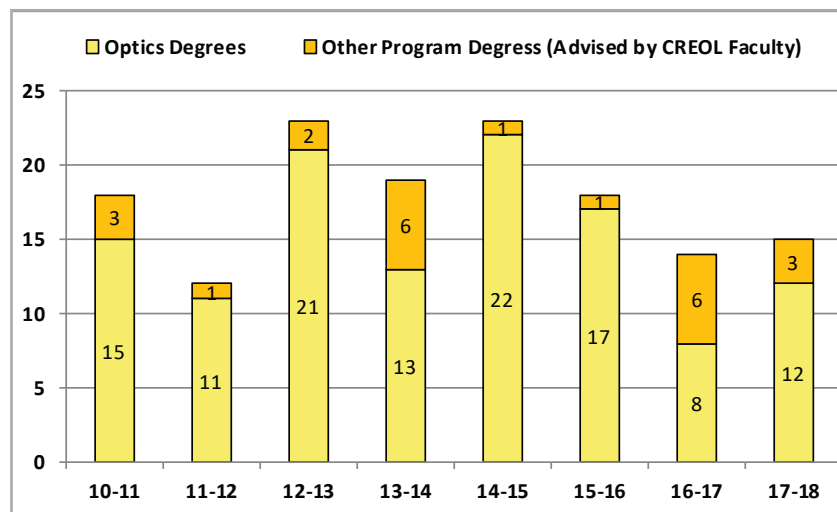
New Matriculant Demographic					Fellowships & Scholarships				
		Male	Female	FT	PT	ORC Fellowship	CREOL Fellowship	Endowed Fellowship Award	UCF Trustee
Ph.D.	US	2	1	6	0	5	1	1	0
	Intl	12	5	17	0	16	1	0	0
M.S.	US	4	2	4	2	0	0	0	0
	Intl	0	0	0	0	0	0	0	0
Total New Students		26							

\* Northrop Grumman, Schwartz, Suchoski, Frances Townes

## DEGREES AWARDED

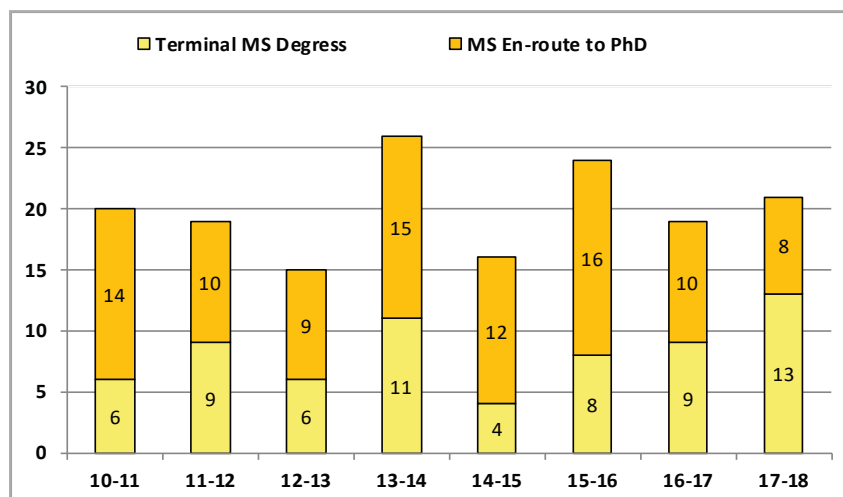
The charts below display the number of graduate degrees awarded in each academic year for the last eight years.

The PhD chart below, shows that there was a slight increase in the number of PhD degrees awarded in the past year. A total of 177 degrees were awarded between 2008 to 2018, and the average awarded is 17.7 per year. Note: the UCF academic year begins in the summer term.



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

Although the number of MS graduates in 2017-18 has slightly increased over the previous year, we believe that this increase will continue due to the recent program changes. The degrees awarded for the last 10 years in the MS program is 200 with an average of 20 per year.



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 PhD. degree ("En-route to PhD").

## COURSES TAUGHT

The Academic Program changes that have taken place during the last year include:

The Doctoral program changed the core requirements to six academic courses:

- ▲ OSE 5115 Interference, Diffraction and Coherence
- ▲ OSE 5312 Light Matter Interaction
- ▲ OSE 6111 Optical Wave Propagation
- ▲ OSE 6211 Imaging and Optical Systems
- ▲ OSE 6474 Fundamentals of Optical Fiber Communications
- ▲ OSE 6525 Laser Engineering

The Masters Program is now requiring all students to take the MS Comprehensive Examination immediately following completion of the program core courses.

COURSE NUMBER AND NAME		SPRING 2018	SUMMER 2018	FALL 2018
CORE GRADUATE COURSES				
OSE 5115	Interference, Diffraction and Coherence	Yu		Kar
OSE 5414	Fundamentals of Optoelectronics			Gelfand
OSE 5203	Geometrical Optics and Imaging Systems			Moharam
OSE 5312	Light Matter Interaction	Gaume		Kik
OSE 6111	Optical Wave Propagation	Argenti		Moharam
OSE 6211	Imaging and Optical Systems			Dogariu
OSE 6265	Optical Systems Design		Curatu	
OSE 6421	Integrated Photonics	Fathpour		
OSE 6474	Optical Communication Systems	Christodoulides		
OSE 6525	Laser Engineering	Schülzen		Khajavikhan

COURSE NUMBER AND NAME		SPRING 2018	SUMMER 2018	FALL 2018
OTHER GRADUATE COURSES				
OSE 5313	Materials for Optical Systems		K. Richardson	
OSE 6125	Computational Photonics	Moharam		
OSE 6143	Fiber Optics Communication	Li		
OSE 6334	Nonlinear optics	Van Stryland		
OSE 6335	Nonlinear Guided Wave Optics			Christodoulides
OSE 6349	Applied Quantum Mechanics for Optics			Kik
OSE 6416	Organic Photonics	Thomas		
OSE 6445	Fundamentals of Ultrafast Optics			Delfyett
OSE 6447	Attosecond Optics			Chang
OSE 6455C	Photonics Laboratory			Yu
OSE 6526C	Laser Engineering Laboratory	Vodopyanov	M. Richardson	
OSE 6615L	Optoelectronic Device Fabrication Laboratory	Chanda		Chanda
OSE 6650	Optical Properties of Nanostructured Materials	Kik		
OSE 6820	Flat Panel Displays		Wu	
OSE 6938	ST: Infrared Systems	Driggers		
OSE 6938	ST: Modern Methods of Optical Spectroscopy	Gelfand		
UNDERGRADUATE COURSES				
OSE 3052	Introduction to Photonics	Amezcuca		LiKamWa
OSE 3052L	Introduction to Photonics Laboratory	Divliansky		Divliansky
OSE 3053	Electromagnetic Waves for Photonics	Moharam		
OSE 3200	Geometric Optics	Han		Renshaw
OSE 3200L	Geometric Optics Laboratory			Renshaw
OSE 4240	Optics and Photonics Design	Pang		
OSE 4410	Optoelectronics	Khajavikhan		
OSE 4410L	Optoelectronics Laboratory	Kar		
OSE 4470	Fiber-Optic Communications			Amezcuca
OSE 4470L	Fiber-Optic Communications Laboratory			Piracha
OSE 4520	Laser Engineering	Delfyett		
OSE 4520L	Laser Engineering Laboratory	LiKamWa		
OSE 4720	Visual Optics	Soileau		
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	Hagan	Hagan	Hagan
OSE 4952	Senior Design II	Hagan	Hagan	Hagan
UNDERGRADUATE COURSES AT OTHER COLLEGES				
AST 2002H	Honors Astronomy			Soileau
CHM 6711	Chemistry of Materials	Kuebler		
EEL 4440	Optical Engineering			LiKamWa
EMA5140	Intro to Ceramic Materials			Gaume
PHY 3220	Mechanics I			Argenti



## DOCTORAL DISSERTATIONS

Degrees granted in academic year Summer 2017 – Spring 2018

STUDENT	PROGRAM	ADVISOR	DISSERTATION TITLE
Kristina Bagnell	Optics & Photonics	Peter Delfyett	Noise, stability, and linewidth performance of 10-GHZ optical frequency combs generated from the nested cavity architecture
Milad Akhlaghi Bouzan	Optics & Photonics	Aristide Dogariu	Harnessing Spatial Intensity Fluctuations for Optical Imaging and Sensing
Joshua Bradford	Optics & Photonics	Martin Richardson	Fiber Optimization for Operation Beyond Transverse Mode Instability Limitations
Haiwei Chen	Optics & Photonics	Shin-Tson Wu	Advanced Liquid Crystal Displays with Supreme Image Qualities
Mohammad Amin Eftekhar	Optics & Photonics	Demetrios Christodoulides	Nonlinear Dynamics in Multimode Optical Fibers
Bin Huang	Optics & Photonics	Guifang Li	Mode Evolution in Fiber Based Devices for Optical Communication Systems
Ali Kazemi Jahromi	Optics & Photonics	Ayman Abouraddy	Analysis and Design of Non-Hermitian Optical Systems
Jie Li	Optics & Photonics	Zenghu Chang	Generation and Characterization of Isolated Attosecond Pulse in the Soft-X-Ray Regime
Ashutosh Rao	Optics & Photonics	Sasan Fathpour	Thin-Film Lithium Niobate Photonics for Electro-Optics, Nonlinear Optics and Quantum Optics on Silicon
Laura Sisken	Optics & Photonics	Kathleen Richardson	Laser-Induced Crystallization Mechanisms in Chalcogenide Glass Materials for Advanced Optical Functionality
Absar UHassan	Optics & Photonics	Demetrios Christodoulides	Non-Hermitian Optics
Abraham Vazquez-Guardado	Optics & Photonics	Debashis Chanda	Cavity-Coupled Plasmonic Systems for Enhanced Light-Matter Interactions
Yang Wang	Optics & Photonics	Zenghu Chang	Generation of High-Flux Attosecond Pulses and Towards Attosecond-Attosecond Pump-Probe Experiments
Ruidong Zhu	Optics & Photonics	Shin-Tson Wu	High Dynamic Range Display Systems
Nathan Bodnar	Electrical Engineering	Martin Richardson	Design and Engineering Criteria for Optical Parametric Chirped Pulse Amplifier Systems
Nizamettin Kortan Ogutman	Electrical Engineering	Winston Schoenfeld	Hole Selective Tunneling Oxide Applications with Insight into Sophisticated Characterization Techniques
John Szilagyi	Electrical Engineering	Martin Richardson	Precision Metrology of Laser Plasmas in the XUV Band

# MASTER'S THESES 2018

Degrees granted in academic year Summer 2017 – Spring 2018

STUDENT	PROGRAM	ADVISOR	THESIS TITLE
Justin Cook	Optics MS	Martin Richardson	Photothermal Lensing in Mid-Infrared Materials
Daniel Thul	Optics MS	Martin Richardson	Propagation of Tailored Filaments
Haley Kerrigan	Optics MS	Martin Richardson	Enhanced Ablation By Femtosecond and Nanosecond Laser Pulses
Matthew Suttinger	Optics MS	Arkadiy Lyakh	Thermal and WaveGuide Optimization of Broad Area Quantum Cascade Laser Performance
Hanfu Kong	Optics MS	Zenghu Chang	Development of a Tabletop Coherent Soft X-ray Source

## STUDENT SCHOLARSHIPS AND AWARDS

### National

#### SCHOLARSHIPS AND FELLOWSHIPS

**Lawrence Trask**, The Science, Mathematics And Research for Transformation (SMART) Scholarship for Service Program  
**Latifah Maasarani, Alex Sincore, Austin Singh, Guanjun Tan, and Juan He**, SPIE Optics and Photonics Education Scholarship  
**Latifah Maasarani**, Astronaut Scholarship  
**Haiwei Chen**, Glenn Brown Prize, International Liquid Crystal Society  
**Patrick Roumayah, Justin Cook**, Directed Energy Professional Society (DEPS) Scholarship  
**Yuge Huang**, SID Metro Detroit Academic Award  
**Juan He, Guanjun Tan**, IEEE Section Graduate Student Scholarship Award  
**Derek Burrell**, SMART Fellowship - AFRL

#### BEST PAPERS OR POSTERS

**Juan He**, Best Poster Award, DOE Solid State Lighting R&D Workshop  
**Fangwang Gou, Yun-Han Lee, Hao Chen and Juan He** (joint paper with Prof. Yajie Dong's group), SID Distinguished Paper Award  
**Hao Chen & Juan He**, J. SID Outstanding Student Paper of the Year Award

#### TRAVEL GRANTS

**Ran Chen, Ziqian He, Guanjun Tan, Juan He, Yun-Han Lee, Fangwang Gou, Yuge Huang, Hao Chen, Kun Yin, Tao Zhan, Daniel Franklin**, SID  
**Justin Cook, Patrick Roumayah**, Photonics West Student Travel Grant

### UCF

#### UNDERGRADUATE

**Latifah Maasarani, UCF Founders' Award**, Astronaut Scholarship Foundation Award

### GRADUATE

**Hao Chen**, Research Forum Poster Award, First Place Doctoral, Math, Optics and Physical Sciences  
**Benjamin Croop**, Multidisciplinary Doctoral Fellowship  
**Chun Xia**, College of Graduate Studies Doctoral Research Support Award

### College of Optics & Photonics Awards

**Alex Sincore**, College of Optics & Photonics Student of The Year Award  
**Ashutosh Rao**, finalist, Student of the Year Award  
**Yun-Han Lee**, finalist, Student of the Year Award  
**Juan He**, Best Poster Award



Bahaa Saleh (r) with undergraduate student Latifah Maasarani who received the UCF Founders' Day Award.

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 Akhlaghi Bouzan, Milad  
 Alvarado Zacarias, Juan Carlos  
 Alvarez Aguirre, Roberto Alejandro  
 Anderson, James  
 Azim, Ahmad  
 Bagnell, Kristina  
 Batarseh, Mahed  
 Bayat, Mina  
 Biswas, Aritra  
 Bradford, Joshua  
 Bustos Ramirez, Ricardo  
 Butrimas, Steven  
 Camacho Gonzalez, Guillermo Fernando  
 Chang, Hao-Jung  
 Chen, Haiwei  
 Chen, Hao  
 Chen, Suyuan  
 Chew, Andrew  
 Cook, Justin  
 Cox, Nicholas  
 Croop, Benjamin  
 Eftekhari, Mohammad Amin  
 Fan, Shengli  
 Fardoost, Alireza  
 Faryadras, Sanaz  
 Fudala, Nicolette  
 Gao, Munan  
 Gausmann, Stefan  
 Gemar, Heath  
 Gholipour Vazimali, Milad  
 Gou, Fangwang  
 Guzman Sepulveda, Jose Rafael  
 Hale, Evan  
 Haq, A F M Saniul  
 Hatipoglu, Isa  
 Hayenga, William  
 He, Juan  
 He, Ziqian  
 Hossain, Mohammed Jobayer  
 Hu, Shuyuan  
 Hu, Xiaowen  
 Huang, Bin  
 Huang, Di  
 Huang, Yuge  
 Kawamori, Taiki  
 Kazemi Jahromi, Ali  
 Kerrigan, Haley  
 Keys, Brittany  
 Khaw, Ian  
 Kompan, Fedor  
 Larson, Walker  
 Lee, Yun Han  
 Leshin, Jason  
 Li, Jie  
 Li, Jinxin  
 Liu, Huiyuan  
 Liu, Yuzhou  
 Lopez Aviles, Helena  
 Ma, Zhao  
 Mach, Lam  
 Malinowski, Marcin  
 Martinez-Martinez, Ricardo  
 Modak, Sushrut  
 Mohammadian, Nafiseh  
 Nicholas, Robert  
 Nye, Nicholas  
 Parto, Midya  
 Pena, Jessica  
 Plascak, Michael  
 Rahaman, Arifur  
 Rao, Ashutosh  
 Ren, Jinhan  
 Roumayah, Patrick  
 Ru, Qitian  
 Sampson, Rachel  
 Sanchez Cristobal, Enrique  
 Shen, Zhean  
 Shin, Dong Jin  
 Short, Robert  
 Sincore, Alex

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 Hagan/Van Stryland  
 Dogariu  
 Amezcua-Correa  
 Glebov  
 Schülzgen  
 Lyakh  
 Delfyett  
 Dogariu  
 Deppe  
 Chanda  
 M. Richardson  
 Delfyett  
 Driggers  
 Fathpour  
 Hagan/Van Stryland  
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 Christodoulides  
 Li  
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 Schoenfeld  
 Schülzgen  
 Driggers  
 Driggers  
 Wu  
 Dogariu  
 Glebov  
 Yuksel  
 Schoenfeld  
 Khajavikhan  
 Wu  
 Wu  
 Davis  
 Chang  
 Schülzgen  
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 Delfyett  
 Wu  
 Vodopyanov  
 Abouraddy  
 M. Richardson  
 Gelfand  
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 Glebov  
 Saleh  
 Wu  
 Khajavikhan  
 Chang  
 Gelfand  
 Li  
 Khajavikhan  
 Christodoulides  
 Renshaw  
 Abouraddy  
 Fathpour  
 Gelfand  
 Chanda  
 Driggers  
 Driggers  
 Christodoulides  
 Christodoulides  
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 Delfyett  
 Yu/Kar  
 Fathpour  
 Khajavikhan  
 M. Richardson  
 Vodopyanov  
 Li  
 Lyakh  
 Dogariu  
 M. Richardson  
 Driggers  
 M. Richardson

Singh, Mamta  
 Sissen, Laura  
 Sjaardema, Tracy  
 Smith-Dryden, Seth  
 Sun, Mengdi  
 Sun, Yangyang  
 Suttinger, Matthew  
 Talukder, Mdjavedrouf  
 Tan, Felix  
 Tan, Guanjun  
 Tang, Jialei  
 Thul, Daniel  
 Tofighi, Salimeh  
 Trask, Lawrence  
 Ulhassan, Absar  
 Vazquez-Guardado, Abraham  
 Wang, Ning  
 Wang, Yang  
 Weng, Chun Hung  
 Wittek, Steffen  
 Wu, Fan  
 Wu, Ruitao  
 Xiong, Jianghao  
 Xu, Chi  
 Yessenov, Murat  
 Yin, Kun  
 Zhan, Tao  
 Zhang, Chenyi  
 Zhang, Yuanhang  
 Zhao, Jian  
 Zhou, Boyang  
 Zhu, Ruidong  
 Zhu, Zheyuan

Chini  
 K. Richardson  
 Fathpour  
 Saleh  
 Kik  
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 Amezcua-Correa  
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 Dogariu  
 Wu  
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 Wu  
 Gelfand  
 Li/LiKamWa  
 Schülzgen  
 Yu  
 Wu  
 Pang

## Master's Students

### STUDENT

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 Calkins, Eric  
 Casas, Andres  
 Chen, Hao  
 Chen, Haiwei  
 Cheng, He  
 Childs, Joshua  
 Cook, Justin  
 Cox, Nicholas  
 Cramer, Alexander  
 Croop, Benjamin  
 De Larosiere, Allison  
 Foster, Joshua  
 Fudala, Nicolette  
 Gao, Munan  
 Gausmann, Stefan  
 Go, Rowel  
 Hale, Evan  
 Hatipoglu, Isa  
 He, Juan  
 Hu, Shuyuan  
 Hu, Xiaowen  
 Jia, Fei  
 Kassel, Jennifer  
 Kerrigan, Haley  
 Khaw, Ian  
 Kompan Fedor  
 Kong, Hanfu  
 Kumar, Jitesh  
 Lee, Hee Cheon  
 Leshin, Jason  
 Leshin, Jeremy  
 Li, Chih-Hao  
 Lopez Aviles, Helena  
 Ma, Zhao  
 Maloof, William  
 McGill, Daniel  
 Mohammadian, Nafiseh  
 Morone, Nicholas  
 Nergard, Christopher

### ADVISOR

Fathpour  
 Delfyett  
 Dong  
  
 Dong  
 Wu  
 Pang  
  
 M. Richardson  
 Hagan/Van Stryland  
  
 Han  
  
 Driggers  
 Schoenfeld  
 Schülzgen  
 Lyakh  
 Glebov  
 Khajavikhan  
 Wu  
 Chang  
 Schülzgen  
 Amezcua-Correa  
 Renshaw  
 M. Richardson  
 Han  
 Glebov  
 Chang  
 Thomas  
  
 Khajavikhan  
  
 Fathpour  
 Christodoulides  
 Renshaw  
  
 K. Richardson/Gaume  
 Driggers



## Master's Students Continued

### STUDENT

Oh, Bumjin  
Plascak, Michael  
Rolon, Lee  
Rose, Roger  
Ross, Brett  
Ru, Qitian  
Saghaye Polkoo, Sajad  
Shah, Tarj  
Shin, Dong Jin  
Short, Robert  
Singh, Mamta  
Sjaardema, Tracy  
Smucz, Joseph  
Steele, Grayson  
Suttinger, Matthew  
Tang, Jialei  
Thul, Daniel  
Tofighi, Salimeh  
Venegas, Rebecca  
White, Jonathon  
Wittek, Steffen  
Woodruff, Justin  
Wu, Fan  
Wu, Ruitao  
Yang, Geng  
Yin, Kun  
Zhang, Chenyi  
Zhu, Ruidong

### PROGRAM/ADVISOR

M. Richardson  
Delfyett  
  
Vodopyanov  
Renshaw  
  
M. Richardson  
Driggers  
  
Fathpour  
  
Lyakh  
Han  
M. Richardson  
Hagan/Van Stryland  
  
Amezcu-Correa  
Christodoulides  
Dogariu  
Kuebler  
Wu  
Gelfand  
Wu

## Master's Graduates

### STUDENT

Bustos Ramirez, Ricardo  
Chen, Haiwei  
Cook, Justin  
Gao, Munan  
Gausmann, Stefan  
Hale, Evan  
He, Juan  
Hu, Shuyuan  
Kassel, Jennifer  
Kerrigan, Haley  
Khaw, Ian  
Kompan, Fedor  
Kong, Hanfu  
Kumar, Jitesh  
Leshin, Jeremy  
Plascak, Michael  
Ru, Qitian  
Short, Robert  
Suttinger, Matthew  
Thul, Daniel  
Zhu, Ruidong

### PROGRAM/ADVISOR

Non-Thesis -Delfyett  
Non-Thesis - Wu  
Thesis -M. Richardson  
Non-Thesis -Hagan/VanStryland  
Non-Thesis -Schülzgen  
Non-Thesis -Glebov  
Non-Thesis -Wu  
Non-Thesis -Chang  
Non-Thesis -Renshaw  
Thesis -M. Richardson  
Non-Thesis -Han  
Non-Thesis -Glebov  
Thesis -Chang  
Non-Thesis -Thomas  
Non-Thesis  
Non-Thesis -Delfyett  
Non-Thesis -Vodopyanov  
Non-Thesis -Driggers  
Thesis -Lyakh  
Thesis -M. Richardson  
Non-Thesis -Wu



Spring 2018 commencement ceremonies at the CFE Arena.



Abraham Vazquez-Guardado, Mohammad Amin Eftekhari, and Jie Li at Spring 2018 commencement ceremonies.

## PHD POST-GRADUATION EMPLOYMENT



**Kristina Bagnell**

Ph.D. Optics & Photonics, Summer 2017

Advisor: Peter Delfyett  
Title: Electrical Engineer III  
Employer: Harris Corporation



**Milad Akhlaghi Bouzan**

Ph.D. Optics & Photonics, Fall 2017

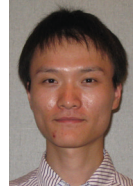
Advisor: Aristide Dogariu  
Title: Display Exploration Engineer  
Employer: Apple, Inc.



**Joshua Bradford**

Ph.D. Optics & Photonics, Spring 2018

Advisor: Martin Richardson  
Title: Senior Engineer  
Employer: Nufern/Coherent



**Haiwei Chen**

Ph.D. Optics & Photonics, Fall 2017

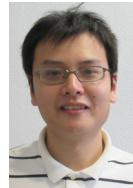
Advisor: Shin-Tson Wu  
Title: Hardware Display Engineer  
Employer: Amazon



**Mohammad Amin Eftekhari**

Ph.D. Optics & Photonics, Spring 2018

Advisor: Demetrios Christodoulides  
Title: Optical Engineer  
Employer: Microsoft



**Bin Huang**

Ph.D. Optics & Photonics, Fall 2017

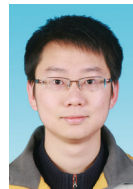
Advisor: Guifang Li  
Title: Research Scientist  
Employer: UCF, Optical Fiber Comm. Group



**Ali Kazemi Jahromi**

Ph.D. Optics & Photonics

Advisor: Ayman Abouraddy, Summer 2018  
Title: Post Doctoral Scholar  
Employer: California Institute of Technology



**Jie Li**

Ph.D. Optics & Photonics, Spring 2018

Advisor: Zenghu Chang  
Title: Associate Professor  
Employer: Chinese Academy of Science, Beijing



**Ashutosh Rao**

Ph.D. Optics & Photonics, Spring 2018

Advisor: Sasan Fathpour  
Title: Post Doc  
Employer: NIST, Univ of MD



**Laura Siskin**

Ph.D. Optics & Photonics, Fall 2017

Advisor: Kathleen Richardson  
Title: Adjunct Faculty  
Employer: Messiah College



**Absar UHassan**

Ph.D. Optics & Photonics, Summer 2018

Advisor: Demetrios Christodoulides  
Title: Research Scientist  
Employer: UCF, Nonlinear Waves Group



**Abraham Vazquez-Guardado**

Ph.D. Optics & Photonics, Spring 2018

Advisor: Debashis Chanda  
Title: Post Doctoral Associate  
Employer: UCF, Nano-Optics Group



**John Szilagyi**

Ph.D. Electrical Engineering, Summer 2017

Advisor: Martin Richardson  
Title: Research Scientist  
Employer: KLA-Tencor Corporation



**Ruidong Zhu**

Ph.D. Optics & Photonics, Fall 2017

Advisor: Shin-Tson Wu  
Title: Display Calibration Color Scientist  
Employer: Apple, Inc.



**Nathan Bodnar**

Ph.D. Electrical Engineering, Summer 2018

Advisor: Martin Richardson  
Title: Research Scientist  
Employer: UCF, LPL Research Group



**Nizamettin Kortan Ogutman**

Ph.D. Electrical Engineering, Spring 2018

Advisor: Winston Schoenfeld  
Title: Design Engineer  
Employer: ASML, Nuern

## COLLOQUIA AND SEMINARS

DATE	SPEAKER	TITLE
1/08/2018	Murat Yuksel ECE/UCF	Multi-Element Optical Wireless Modules for Mobile Networking and Lighting
1/12/2018	Kristopher O. Davis ECE/UCF	Contact Passivation for Silicon Photovoltaics: Limiting Carrier Recombination with Metal Oxide Heterostructures
1/25/2018	Luat Vong Queens College	Lorentz Forces in Plasmonic Systems
1/26/2018	Debashis Chanda NSTC/CREOL	Nanophotonics for Real Life Applications
2/01/2018	Christiano J. S. de Matos Mackenzie Presbyterian University	Nonlinear Optical Frequency Conversion in 2D Materials
2/02/2018	Chia-Wei Hsu Yale University	New Frontiers of Electromagnetic Phenomena at the Nanoscale (Optical Imaging and Sensing Faculty Candidate Seminar)
2/05/2018	Julie Siv Irisiome Solutions	High Power Picosecond Laser with Adjustable Pulse Duration and Repetition Rate
2/05/2018	Will Suleiman Roxana Rezvani Naraghi ASML	ASML: Faster, Smaller, Greener
2/07/2018	William T. Silfvast Emeritus Professor TLI/CREOL	The Periodic Table and the Amazing Cadmium Atom (Distinguished Seminar Series)
2/08/2018	Sang Hak Lee University of Illinois at Urbana-Champaign	Super-Resolution Imaging and Tracking of Synaptic Receptors in Live Neurons (Biophotonics Faculty Candidate Seminar)
2/08/2018	Tobias Bonhoff RWTH Aachen University, Germany	Thermo-Optical and Dispersive Effects in Laser Materials Processing
2/09/2018	Daniel Wasserman University of Texas, Austin	The Mid-Infrared as an Optical Playground (IEEE Photonics Society Distinguished Lecture)
2/14/2018	Ya Wang State University of New York, Stony Brook	Optically Chopped PIR Sensor for Occupancy Detection (SID Student Chapter Seminar)
2/15/2018	David Burghoff Massachusetts Institute of Technology	Chip-Scale Platforms for Long-Wavelength Nanophotonics: Frequency Combs, Spectrometers, and Beyond (Optical Imaging and Sensing Faculty Candidate Seminar)
2/23/2018	Jayan Thomas NSTC/CREOL	Polymers and Nanoengineered Materials for Optoelectronic Applications
3/05/2018	Miguel A. Bandres Technion – Israel Institute of Technology	Topological Insulator Lasers
3/08/2018	Mohammad Hokmabadi CREOL/UCF	Labview Workshop (WiLO Event)
3/09/2018	Haitan Xu Yale University	Topological and Nonreciprocal Dynamics in an Optomechanical System (Optical Imaging and Sensing Faculty Candidate Seminar)
3/22/2018	Yun-Sheng Chen Stanford University	Detecting Cancer Using Nano-Molecular Photoacoustic Imaging: When Light and Sound Join Forces with Nanomaterials (Biophotonics Faculty Candidate Seminar)
3/30/2018	Cathie Ventalon Ecole Normale Supérieure	Functional Fluorescence Imaging and Photoactivation in Freely-Behaving Rodents
4/02/2018	Juergen Czarske TU Dresden, Germany	Novel laser systems using digital wavefront shaping (SPIE Student Chapter Seminar)
4/13/2018	Peter Delfyett CREOL/UCF	Optics Day/Laser the Light Fantastic
4/16/2018	Michelle Povinelli University of Southern California	Rare-Earth-Doped Single-Crystal YAG Fibers Grown by the Laser Heated Pedestal Growth Technique



4/16/2018	Andrey Matsko OEwaves Inc.	Resonant Micro-Photonics: Advantages and Disadvantages of Small Size
4/17/2018	Zubin Jacob Purdue University	Quantized Photonic Spin and New Bosonic Phases of Matter
4/17/2018	Cheng-Wei Qiu National University of Singapore	Hybridized Metasurfaces: A New Twist in Flat Optics
4/19/2018	Elizabeth Rogan OSA	Women in Optics & Photonics (WiLO Student Chapter Seminar)
4/24/2018	Sönke Wittek Becker Marine Systems	100 days in Antarctica (SPIE Student Chapter Seminar)
5/04/2018	Julien Lumeau Institute Fresnel	Optical Interference Filters: A Survey and Outlook
5/04/2018	Daniel M. Litynski Western Michigan University	Career Planning: An Academic Leader's Perspective
5/04/2018	Yang Zhao Stanford University	'Handy' Nanophotonic Tools: Probing Molecular Chirality with Metamaterials and Optical Forces (Faculty Candidate Seminar)
5/07/2018	Vitaly Gruzdev University of Missouri	Laser-Driven Electronic Processes in Condensed Matter: From Controlled Modification of a Single Biomolecule to Controlled Enhancement of Laser Ablation
5/29/2018	Ghanshyam Singh Malaviya National Institute of Technology Jaipur	Photonic Integrated Devices and Systems: Technology for next Generation Telecom Networks (IEEE Photonics Society Distinguished Lecture)
5/31/2018	Patrick Roumayah Jie Li CREOL/UCF	High Average Power Pulsed Multi-Mode Raman Fiber Laser in Graded Index Fiber (OSA Graduate Research Symposium) Generation and Characterization of Isolated Attosecond Pulse in the Soft X-Ray Regime (OSA Graduate Research Symposium)
6/05/2018	Melissa Seitz II-VI Optical Systems	Development in EFG Sapphire at II-VI Optical Systems
6/05/2018	Christian Ott Max Planck Institute for Nuclear Physics	Resonant Nonlinear Ultrafast Dynamics in Atoms and Molecules Driven by an Intense XUV Free-Electron Laser
6/26/2018	Lihong V. Wang California Institute of Technology	World's Deepest-Penetration and Fastest Optical Cameras: Photoacoustic Tomography and Compressed Ultrafast Photography
6/28/2018	Partha Banerjee University of Dayton	Applications of Interferometric and Non-interferometric Methods for 3D Imaging (WiLO/SPIE Student Chapter Seminar)
6/29/2018	Paul F. McManamon Exciting Technology LLC	Lidar, an Up and Coming, Multi-Phenomenology, Sensor
6/29/2018	Boris Gramatikov Wilmer Eye Institute	Polarization-Sensitive Scanning of the Retina – from Moving to No-Moving Part Designs (SID Student Chapter Seminar)
8/20/2018	Christian A. Nijhuis National University of Singapore	Mechanism of Plasmon Excitation and Light Emission from (Molecular) Tunneling Junctions (COS/CREOL Seminar)
8/24/2018	Gisele Bennett Florida Tech/Georgia Tech	Coherence Theory as applied to Imaging Systems and Research Career Paths (WiLO Student Chapter Seminar)
8/24/2018	Eric VanStryland Kyu Han CREOL-UCF	Introduction to Research at CREOL
8/28/2018	Tuan Trinh University of Michigan	Generation of Rotations and Charge Separation with Magneto-Electric Nonlinearities
8/31/2018	S.T. Wu Ayman Abouraddy CREOL-UCF	Introduction to Research at CREOL
9/05/2018	Rodrigo Amezcua Sasan Fathpour CREOL-UCF	Introduction to Research at CREOL

9/12/2018	Luca Argenti Peter Delfyett CREOL-UCF	Introduction to Research at CREOL
9/14/2018	Winston Schoenfeld Debashis Chanda CREOL-UCF	Introduction to Research at CREOL
9/17/2018	Xiaoming Yu Kyle Renshaw CREOL-UCF	Introduction to Research at CREOL
9/21/2018	Ho-Kyoon Chung Sungkyunkwan University (SKKU), Korea	AMOLED Display Evolution, What is the Final Destination? (NSTC/CREOL Distinguished Seminar)
9/26/2018	Ron Driggers Sean Pang CREOL-UCF	Introduction to Research at CREOL
9/27/2018	Kang Taek Lee Gwangju Institute of Science and Technology (GIST)	Upconversion Nanoparticles (UCNPs): Photophysical Properties and Biological Applications
9/28/2018	David Hagan Ryan Gelfand CREOL-UCF	Introduction to Research at CREOL
10/11/2018	Eva Lindroth Stockholm University	How to get a Nobel Prize in Physics
10/24/2018	Yehuda Braiman ORNL/University of Tennessee	Phase-Locking of Arrays of Weakly Coupled Semiconductor Lasers
10/29/2018	James Chung Northrop Grumman Electronic Systems	Careers in Optical/Laser Engineering (IEEE Photonics Society Industrial Speaker Series)
11/19/2018	Jean-Claude Diels University of New Mexico	Differential Intracavity Interferometry with Double-Frequency Combs for High Precision Sensing
12/11/2018	Niklas Waasem Hübner Photonics	New Widely-Tunable and Multi-Wavelength Lasers



Construction of Phase II addition to the CREOL building is underway in 2018. Addition will add over 12,000 square feet of research and office space.

# 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)

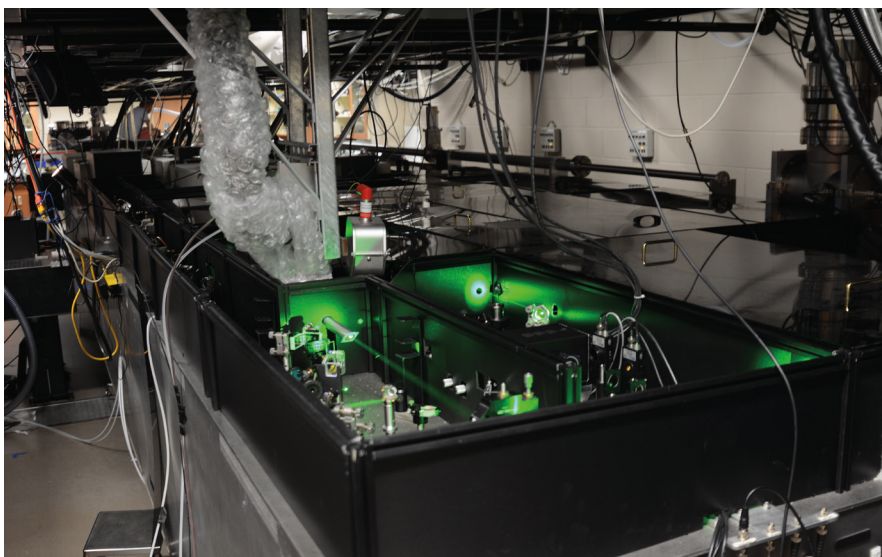
The FPCE was established with a \$10 million grant from the State of Florida to create a new center of excellence within The College of Optics and Photonics at the University of Central Florida. The program began in 2003 with three primary goals: Advance excellence in research and graduate education 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.

### INSTITUTE FOR THE FRONTIER OF ATTOSECOND SCIENCE AND TECHNOLOGY (iFAST)

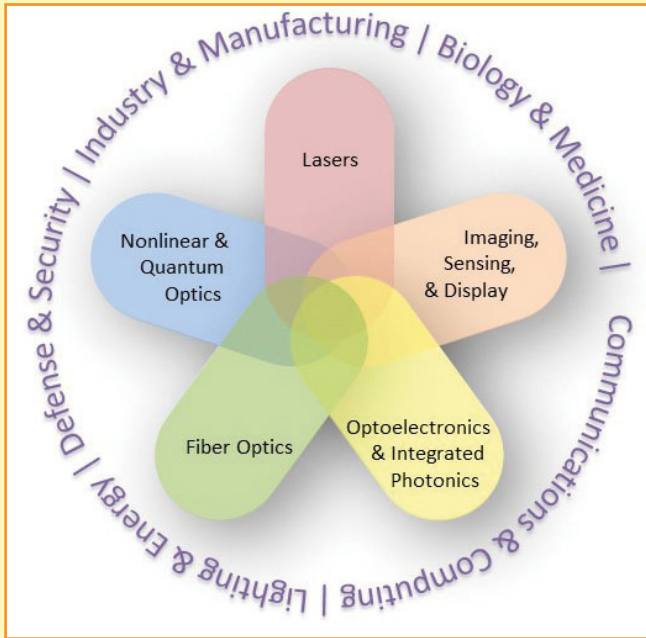
The Institute for the Frontier of Attosecond Science and Technology (iFAST), directed by Prof. Zenghu Chang, is established in 2013. At the present time, iFAST has 6 research groups dedicated to research, education and outreach of attosecond physics and optics. The mission is to provide unique opportunities for faculty, scientists and students from the College of Sciences 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 have been awarded to Chang and his collaborators to develop high energy and ultrashort attosecond light sources.



Dr. Zenghu Chang's Attosecond Laboratory.



## 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, attosecond 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/>.

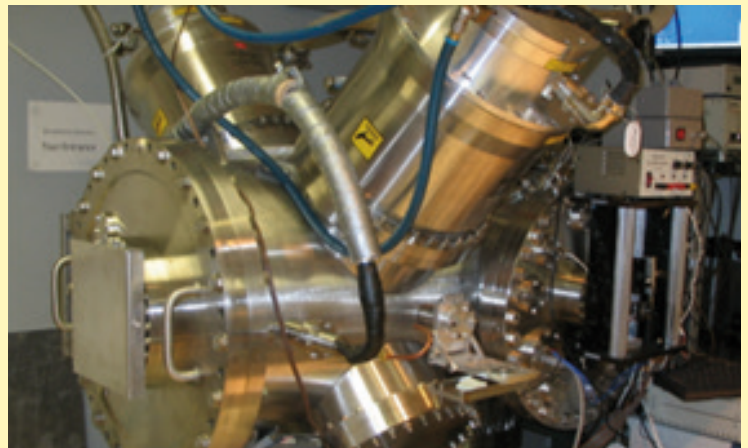
### LASERS

#### 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

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

### Applications

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



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

#### OPTOELECTRONIC FABRICATION CLEANROOM

800 square foot 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, scribe, and microscope. Rm 211

#### SCANNING ELECTRON MICROSCOPE (SEM) FACILITY

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

#### 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 12871 Ara Drive) in close proximity to the Material Characterization Facility (MCF).

#### CARY SPECTRA-PHOTOMETER AND MICROSCOPE

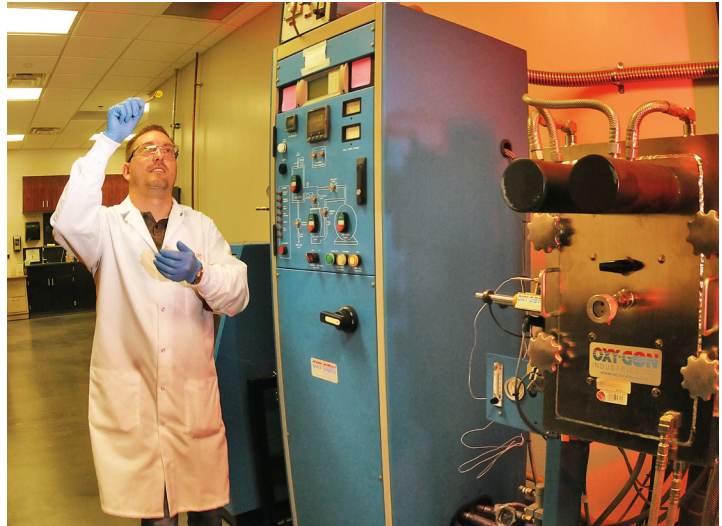
Cary 500 is Spectrophotometer that is capable of measuring light absorption in both transmitted and reflected light in the UV, visible and near IR spectrum. Rm 159

#### 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 SSCPAC operated facility, but is now an Air Force facility on NASA property, managed and operated by UCF.



Graduate student Matt Julian is inspecting a transparent laser ceramic after vacuum sintering.

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 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.

#### DISPLAY AND PHOTONICS LAB

Developing 1) Advanced displays including LCDs, quantum dots, perovskites, LEDs, OLEDs, augmented reality and virtual reality,



and sunlight readable displays, 2) Adaptive lenses for tunable-focus lens, optical imaging and light field displays, and 3) Adaptive optics for wavefront correction and laser beam control. Shin-Tson Wu.

#### **FIBER OPTICS LAB**

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

#### **FLORIDA ATTOWECOND SCIENCE AND TECHNOLOGY LAB**

Generation of attosecond (10-18 s) and zeptosecond (10-21 s) X-ray pulses. Zenghu Chang.

#### **GLASS PROCESSING AND CHARACTERIZATION LABORATORY (GPCL)**

Investigating the design, processing methodologies, fabrication and characterization of novel oxide and non-oxide glass and glass ceramic materials for the infrared. Applications include, on-chip sensors, bulk and film materials for GRIN, optical nanocomposites, 3D printing of chalcogenide materials. Kathleen Richardson.

#### **INTEGRATED PHOTONIC EMERGING SOLUTIONS (IPES) LAB**

Specialized in groundbreaking research on ultracompact integrated photonic device physics and circuit design, nanofabrication and characterization, as emerging solutions for a variety of engineering applications, such as data- and tele-communication, microwave engineering and nonlinear and quantum information systems in the visible to the mid-infrared wavelengths and on materials ranging from silicon and III-V compound semiconductors, to nonlinear dielectrics and glasses. 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 foreveated 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 ( $\lambda > 2.5 \mu\text{m}$ ) 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 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 nanolithography. Winston Schoenfeld.

#### **NANOBIPHOTONICS LAB (NBPL)**

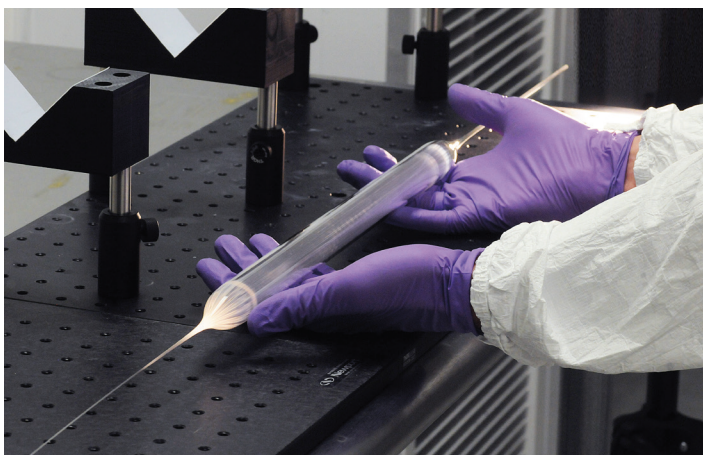
Developing nanoaperture optical trapping based single molecule biophysics methods for studying protein dynamics, structure, and behavior; protein-protein and protein-small molecule interactions; drug discovery; and fundamental life sciences. Ryan Gelfand

#### **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 LAB**

Research on nonlinear optical effects in semiconductors, dielectrics and gasses with characterization from femtosecond to nanoseconds for applications in devices including in waveguides, e.g. Optical Power Limiting, 2-Photon Absorption and gain, Laser-Induced Damage: David Hagan, Eric Van Stryland, and M.J. Soileau.



Fabrication of optical fibers.

#### **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.

#### **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)**

Research in OISL 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.

#### **PHOTONICS DIAGNOSTIC OF RANDOM MEDIA**

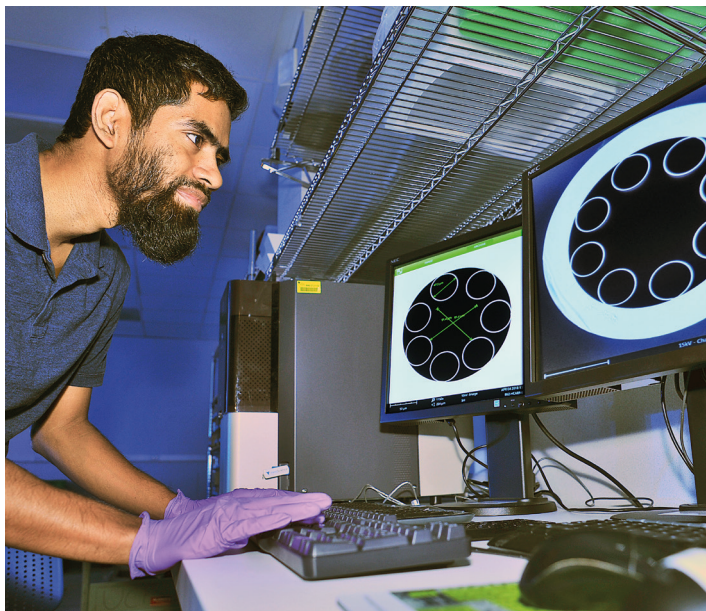
Exploring different principles for optical sensing, manipulation of electromagnetic fields, and phenomena specific to optical wave interactions with complex media. Aristide Dogariu.

#### **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.

#### **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.



Postdoctoral Research Associate Md Selim Habib inspects microstructured optical fibers.

#### **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 the generation, modulation, transmission and detection of ultrafast optical signals from semiconductor quantum based materials, for applications in applied photonic networks and signal processing systems. Peter Delfyett

### **INSTRUCTIONAL LABORATORIES**

#### **LASER ENGINEERING LABORATORY**

Designing and device implementation of diode pumped solidstate lasers, nonlinear frequency conversion, Q-switching, mode locking, and pulse second harmonic generation.

#### **PHOTONICS LABORATORY**

Experimental study of photonic devices and systems including liquid crystal displays, fiber-optic sensors, laser diodes, electro optic modulation, acousto-optic modulation, lightwave detection, optical communications, and photonic signal processing.

#### **OPTOELECTRONIC DEVICE FABRICATION LABORATORY**

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

#### **UNDERGRADUATE LABORATORY**

A multipurpose space that accomodates laboratory courses for Optoelectronics, Fiber Optics, Introduction to Photonics, Laser Engineering, and Imaging and Display. The space includes basic instrumentation necessary to conduct experiments.

#### **SENIOR DESIGN LABORATORY**

Comprised of six laboratory benches, the Senior Design laboratory space is designed to permit students with flexibility to design, test, and construct their Senior Design projects. Students have access to this space in the semester in which they are enrolled in OSE 4951 and OSE 4952, the Senior Design Courses. They are able to work in this space at any time, day or night.

## LCD is entering virtual reality

Virtual reality (VR) is an emerging wearable display technology with potential applications for entertainment, education, training, design, advertisement, and medical diagnostics. Both liquid crystal display (LCD) and organic light-emitting diode (OLED) are applicable for such head-mounted displays. Currently, OLED is a favored choice because of its fast response time, which helps to suppress image blurs and latency. However, OLED is a current-driven device and it has some shortcomings, such as image burn-in and compromised lifetime for getting high luminance. On the other hand, LCD is a voltage-driven device, and it offers high resolution, high brightness, long lifetime and low cost, but its response time is about 1000 times slower than that of OLED (ms versus  $\mu$ s). As a result, LCD is generally perceived to exhibit much more severe image blurs than OLED. This long-lasting “common perception”, however, was recently proven to be incorrect, according to the research led by Prof. Shin-Tson Wu at CREOL. Wu’s group demonstrated that a LCD is capable to achieve comparable or even faster motion picture response time (MPRT) than OLED.

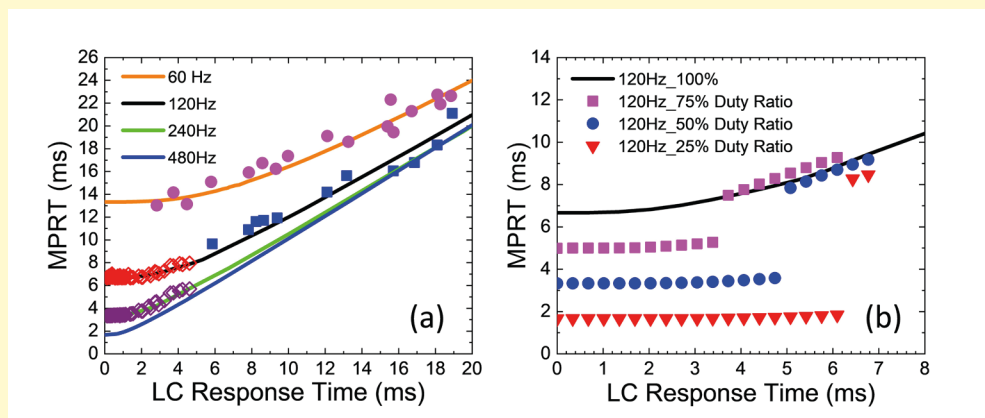
MPRT is a common display metric to quantify the visual performance of a moving object. MPRT is jointly determined by the response time of LC or OLED, the frame rate of thin-film transistor (TFT),

blur, but its improvement gradually saturates. As shown in the figure, from 60 fps to 120 fps the MPRT exhibits a big jump, but as the TFT frame rate continues to increase to 240 fps and 480 fps, the improvement gradually saturates. 2) As the LC response time decreases, MPRT decreases almost linearly, and then saturates. It means MPRT is mainly determined by the TFT frame rate once LC response time is fast enough. 3) When the LC response time is less than 2 ms, its MPRT is comparable to that of OLED, even if OLED’s response time is assumed to be 0.

Another effective approach to reduce MPRT without increasing TFT’s frame rate is to decrease the duty ratio. For LCDs, it is the on-time of the backlight in each frame. As duty ratio decreases, the effective MPRT decreases linearly, and the MPRT is insensitive to the LC response time. This is because the backlight is turned on only after the LC molecules have reached their designed gray levels, so that the beginning slow-response part is obscured. Although low duty ratio significantly reduces the MPRT, an obvious tradeoff is reduced brightness. To compensate for the decreased luminance, we could boost the driving current of the LED backlight or OLED panel. However, LED/OLED lifetime and efficiency would be degraded. Fortunately, these negative effects for LED are substantially weaker than the efficiency roll-off and compromised lifetime for OLED.



Shin-Tson Wu



(a) Simulated (lines) and measured (dots) MPRT at different TFT framerates; (b) Duty ratio effects on MPRT at 120 Hz framerate.

and duty ratio. Previously, calculating MPRT was rather difficult because multiple effects are involved, like sample-and-hold effect, motion pursuing, and human vision effect. But this task becomes incredibly simple, as Wu’s group analyzed the origin of MPRT and derived an analytical equation to calculate MPRT. These results have been published in Optica and J. Appl. Phys. recently.

This equation serves as a powerful tool to mitigate LCD/OLED image blurs. At the same time, it unveils several important physical insights: 1) Increasing frame rate is an effective approach to suppress image motion

That is to say, OLED is much more vulnerable than LCD to impulse driving.

In summary, Wu’s group has demonstrated an advanced LCD with comparable or even faster MPRT than OLED. This provides a solid foundation for LCD to enter virtual reality space. As a matter of fact, in 2018 Facebook did switch from OLED to LCD in its 2nd Generation VR headset, called Oculus Go. Meanwhile, several high-tech companies are also exploring this possibility. It is expected that more and more LCD-based VR devices will be announced in the near future.



## Clear and wide field of view single-molecule fluorescence microscopy

Wide-field epi-illumination fluorescence microscopy is an indispensable tool in many biological studies due to its high sensitivity and high specificity (Fig. 1). Especially, single-molecule imaging is a powerful approach for quantitative analysis since it is capable of counting the number of molecules in a digital fashion and observing the dynamics of individual molecules in real-time. This can be used for super-resolution fluorescence imaging when the density of molecules is properly controlled by photoactivation.

To visualize individual fluorescent molecules, it is critical to ensure a high signal-to-noise ratio. Total internal reflection fluorescence (TIRF) microscopy has been widely used for single-molecule imaging since the late 1990s. A shallow evanescent field excites near the surface selectively, which minimizes unwanted out-of-focus fluorescent signal (Fig. 1). However, TIRF microscopy is only capable of probing the bottom most  $\sim 1\text{--}2\ \mu\text{m}$  of the cell, i.e. not suitable for imaging inside cells. Note that confocal laser scanning microscopy is not adequate for low-light applications because the high excitation power results in severe photobleaching and photodamage, and the limited number of photons from a single emitter leads to a poor signal-to-noise ratio of images.

In 2008, highly inclined and laminated optical sheet (HILO) microscopy was reported for 3D single-molecule imaging. A basic idea was to use a thin illumination that was generated by an incident beam passing through the center of the imaging plane refracted at glass/water

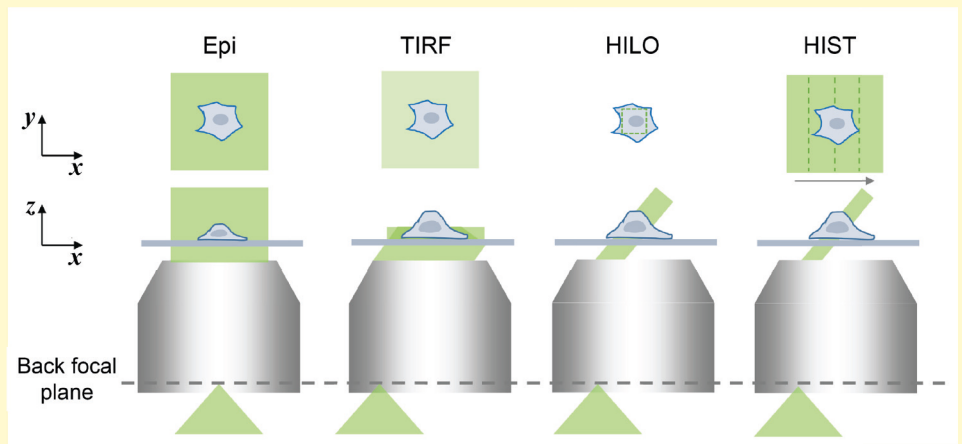


Figure 1. Various single-molecule fluorescence imaging microscopy based on illumination methods.

interface with an angle slightly smaller than the critical angle (Fig. 1). This inclined beam reduces out-of-focus background signal and allows high contrast 3D imaging. Because of its simplicity, HILO microscopy has been the most common imaging tool for greater imaging depth in single-molecule imaging.

However, a usable field-of-view (FOV) of HILO is less than  $20 \times 20\ \mu\text{m}^2$ , which is much smaller than the average size of human cells. This is because in HILO illumination, the beam thickness is closely related to the diameter of illumination beam, i.e., a thinner illumination always results in a smaller imaging area.

Professor Kyu Young Han and his graduate student, Jialei Tang, have overcome this limitation by sweeping a highly inclined beam elongated in one direction in conjunction with a confocal slit while maintaining advantages of HILO imaging.

First, they created an elongated beam using a pair of cylindrical lenses and sent it to a microscope with a high incidence angle like HILO illumination. This approach generated a tile-like beam elongated along the y axis on the sample plane. Next, in order to extend the imaging area, the tile beam was swept along the x-axis by rotating a galvo mirror. Since the highly inclined beam produced out-of-focus background and blurred the image, a confocal slit is necessary, which should move along the beam sweeping. Fortunately, current state-of-art scientific grade CMOS cameras provides a dynamic slit with a rolling shutter readout, which facilitated the rejection of background in real time without additional optical or mechanical components. This new imaging technique has been named highly inclined swept tile (HIST) microscopy (Fig. 1).

The main feature of HIST microscopy is that FOV is no longer coupled to the beam thickness. Remarkably, HIST was able to visualize single-molecules across  $\sim 130 \times 130\ \mu\text{m}^2$  FOV, which is

more than 40 times larger than conventional HILO imaging. The signal to background ratio was also improved due to the thinner beam of HIST (Fig. 2).

The team applied this new imaging technique to detect RNA transcripts with a single probe or a few probes that has significant potentials for studying gene expression and diseases (Fig. 2). Furthermore, they demonstrated that HIST imaging enabled single-molecule imaging in thick mouse brain tissues, which has been challenging due to high background.

Unlike other approaches, HIST requires only a single high numerical aperture objective lens without an additional illuminator or reflector, and is compatible with typical sample chambers. These advantages along with large FOV and high contrast will make HIST microscopy a prominent tool in biology and medicine.

For further information, see Optica 5, 1063-1069 (2018).

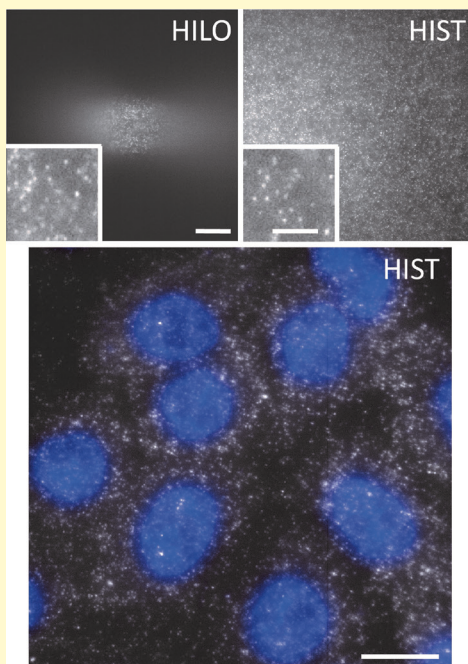
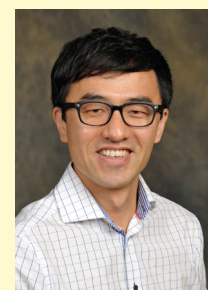
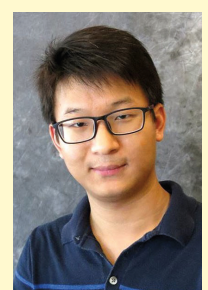


Figure 2. 3D single-molecule imaging on DNA in hydrogel (top) and mRNA in human cells. Scale bar, 20  $\mu\text{m}$  and 5  $\mu\text{m}$  (inset).



Kyu Young Han



Jialei Tang

# Optical Parametric Oscillation First Demonstrated in Random $\chi^{(2)}$ Medium

It has commonly been assumed that perfect crystals are paramount for the operation of frequency converters based on quadratic nonlinearity,  $\chi^{(2)}$ , such as optical parametric oscillators (OPOs). The necessary phase-matching condition is usually achieved either by a proper crystal orientation, or via quasi-phase matching through controlled flipping of crystalline domains. Apparently, as our recent results show, a disordered material consisting of randomly-oriented domains, with the nonlinear wave-coupling coefficient arbitrarily varying between its maximum (dNL) and minimum (-dNL) values, can perform equally well.

Our approach is based on the phenomenon known as random phase matching (RPM) [1,2]. RPM in disordered  $\chi^{(2)}$  materials can be described by the random walk ('drunken sailor walk') theory that also accounts for diffusion and heat transfer. RPM eliminates the need for orientation flipping and, most importantly, enables 3-wave interactions with extremely large bandwidths. A broadband and flat response in RPM is the result of phase randomization due to arbitrary distribution of the crystalline domains, which eliminates destructive interference. The price to pay, however, is a slow growth of the output signal since the output intensity in RPM scales linearly with sample length, as opposed to the quadratic dependence for both perfect phase and quasi-phase matching. Although in continuous-wave and nanosecond laser regimes RPM is much less efficient, than the conventional quasi-phase matching process [2], our finding is that RPM works nicely with femtosecond laser pulses.

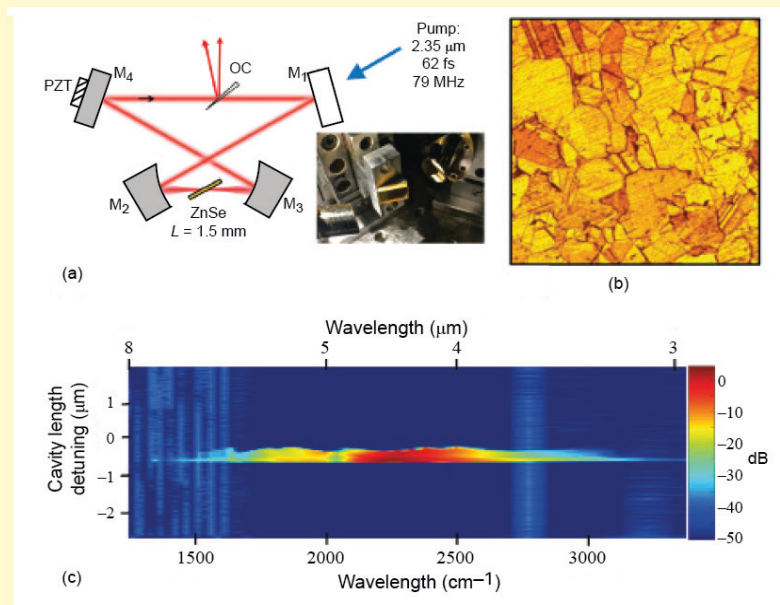
Konstantin Vodopyanov and his team demonstrated the world's first OPO based on RPM [3]. The main trick was to prepare a sample (a 1.5-mm-thick plane-parallel polished ZnSe ceramic) such that the average grain size was close to the coherence length of a 3-wave interaction ( $\sim 100 \mu\text{m}$ ). The bow-tie ring-cavity OPO was synchronously pumped by a Kerr-lens mode-locked  $\text{Cr}^{2+}:\text{ZnS}$  laser ( $\lambda = 2.35 \mu\text{m}$ ) and operated near degeneracy. The OPO oscillation threshold was only 90 mW of the average pump power and the output spectrum spanned more than an octave (3–7.5  $\mu\text{m}$ ), thanks to the broadband nature of RPM. The observed pump depletion, as high as 79%, indicates that with an optimized outcoupling, one can obtain conversion efficiency approaching 100%. This result is essential for numerous applications, e.g. for producing ultrabroadband frequency combs in the challenging mid-IR range.



Konstantin  
Vodopyanov

## References:

1. E. Yu. Morozov, A. S. Chirkin, Quantum Electron. 34, 227 (2004).
2. M. Baudrier-Raybaut, R. Haïdar, Ph. Kupecek, Ph. Lemasson, and E. Rosencher, Nature 432, 374 (2004).
3. Q. Ru, N. Lee, X. Chen, K. Zhong, G. Tsoy, M. Mirov, S. Vasilyev, S. Mirov, and K. Vodopyanov, Optica 4, 617 (2017)



(a) Schematic of the first OPO based on random phase matching. M1, incoupling dielectric mirror; M2-M4, gold-coated mirrors; OC, an OPO outcoupler; PZT, piezo-actuator for cavity-length control. Inset: OPO 'engine' including the ZnSe ceramic sample located between two parabolic mirrors. (b) 500 x 500  $\mu\text{m}$  cross section of the chemically etched ZnSe ceramic sample. (c) OPO output spectrum vs. cavity-length detuning showing a continuous spectral span of 3–7.5  $\mu\text{m}$ .

## Laser beam shaping enables high-speed microfabrication

Ever since lasers were invented almost 60 years ago, they have been used in welding, drilling, cutting, forming and other manufacturing processes. A new generation of lasers has been developed in the past few decades. Commonly referred to as “ultrafast lasers” or “ultrashort-pulsed lasers,” this type of laser can output flashes of light (“pulses”) that have very short pulse duration ( $< 1$  picosecond). This period of time is so short that thermal energy, which is the main cause of collateral damage using other types of lasers, cannot dissipate too far from the laser irradiated region. The result is that the precision of laser processing can be improved to micron or even nanometer scale, enabling new applications including eye surgery, cutting display panels, and the fabrication of medical implants.

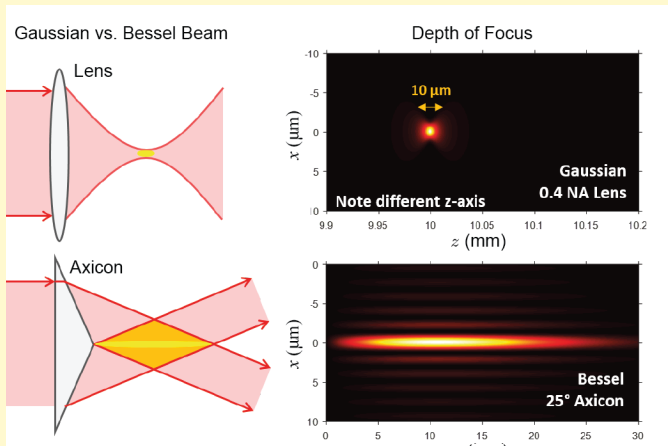


Figure 1

Despite the unparalleled precision, so far ultrafast laser processing is largely considered as a slow fabrication method. This is because in most cases the laser beam is focused to a single “spot” (“Gaussian focus”) in space, which limits how fast the laser beam can cover a large area or volume. One way to increase processing speed is projecting a 2D image instead of focusing to a single spot. This is a laser beam shaping technique and it can increase the processing speed for 2D patterns that are on the transverse plane (perpendicular to the laser propagation direction). However, for complex 3D structures, it is necessary to extend the technique to the axial direction (parallel to the beam propagation).

Recently, a collaboration between Xiaoming Yu’s group and Stephen Kuebler’s group (with external collaborators) applied the spatial beam shaping technique to the axial direction, and greatly reduced the processing time for fabricating structures that have a high aspect ratio (narrow in width and tall in height). The laser beam used by the team is called the “Bessel beam” (Figure 1). The key advantage of a Bessel beam is the long depth of focus, which is important for producing structures like thin fibers and walls. Finding the correct beam shape is only one piece of the puzzle. In order to fabricate tall structures, the laser beam needs to penetrate deep inside the material. The team utilized a process called “two-photon polymerization (2PP)” by which a liquid photopolymer (“resin”) solidifies

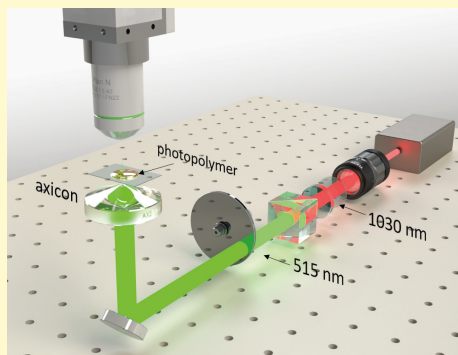


Figure 2

when it absorbs laser energy. The unique feature of 2PP is that the chemical reaction that drives the transition only takes place when the laser intensity reaches its peak, so the other part of the beam is nearly unaffected. The team’s idea was that by combining Bessel

beam exposure with 2PP, high-aspect-ratio structures could be fabricated using a single or a few exposures, so the fabrication time could be a fraction of what it normally takes using the conventional Gaussian beam.

The team used the setup shown in Figure 1 to demonstrate this idea. The setup is similar to other two-photon polymerization methods, except that the lens, which is used to produce a Gaussian focus, is replaced by an axicon that produces a Bessel beam. Using this setup, the team is able to fabricate microstructures at a speed much faster than before. One example is shown in Figure 3(a-b), which shows polymer fibers that are fabricated without changing the relative position of the laser and the resin. At low dose (low laser power and short exposure time), polymer fibers with width as small as 400 nm are fabricated. These are among the thinnest structures ever fabricated using Bessel beam exposure. At high dose, the teams observe a completely different type of structure, which looks like a tree trunk. The length of these fibers is  $>200$   $\mu\text{m}$ , and

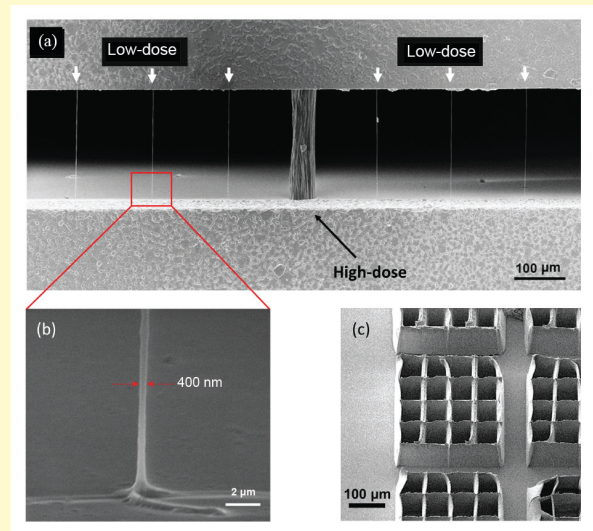
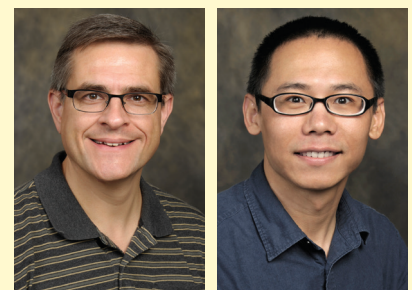


Figure 3

for the thinnest fibers, this yields an aspect ratio  $>500$ . Such high-aspect-ratio structures are time-consuming to make using conventional Gaussian beams. Using data published by other researchers, the team estimates that Bessel beam polymerization is approximately 200 times faster.

The team also tried to use this setup to fabricate more complex structures. By scanning the Bessel beam in the direction perpendicular to the beam propagation direction (transverse plane), the team fabricated mesh-like structures (Figure 3(c)). If Gaussian beams were used to fabricate the same type of structures, multiple layers would be needed to build from bottom to top. By taking advantage of the long depth of focus of the Bessel beam, the team was able to fabricate these structures using a single pass, which again reduced the fabrication time. Obviously, the quality of these structures is not as good as those fabricated using commercial machines, but the team is improving the quality including geometry accuracy and surface roughness by studying the mechanism of Bessel-beam-activated polymerization. They believe that by extending laser beam shaping to the axial direction and combining the image projection technique, people could one day 3D print an object instantly in a way similar to holography.



Stephen Kuebler

Xiaoming Yu



# Microdroplet duality for subwavelength focusing in nanomanufacturing

Much research has been carried out to produce nanoparticles of various materials due to their excellent mechanical, chemical, electrical, and optical properties. However, it is difficult to deposit and transform nanoparticles into large two-dimensional and three-dimensional structures, such as thin films or discrete arrays of nanodots, in a controlled manner. Recently subwavelength phenomena have drawn considerable interest in developing innovative laser-material interactions to harness the novel properties of nanostructures by depositing nanoparticles in various patterns on rigid or flexible substrates. An interdisciplinary mechanism involving laser-microdroplet interactions yields a new paradigm for next generation nanomanufacturing technology. The novelty lies in the dual role of each microdroplet that carries nanoparticles to the substrate surface and simultaneously acts as a superlens to focus a laser beam to a subwavelength diameter. The laser-microdroplet interaction is achieved by injecting the microdroplets into a conical hollow laser beam so that they meet the laser beam immediately above the substrate surface as illustrated in Fig. 1.

This figure also shows that microdroplets are produced at the tip of a capillary tube from an aqueous suspension of different materials, such as germanium or silicon nanoparticles, by an electrospray process. Professor Aravinda Ranganathan Kar and Kumar observed a new microdripping mode for generating the microdroplets and this mode enabled repeatable deposition of nanoparticles. An axicon lens and a biconvex lens are used to shape a Nd:YAG Gaussian laser of wavelength  $\lambda = 1064 \text{ nm}$  into an annular beam of nearly uniform radial irradiance distribution. A special hollow parabolic mirror is used to focus the annular laser beam while microdroplets are injected into the hollow beam through the hole in the mirror. The laser beam is focused by the



Aravinda Kar

mirror to form a hollow laser cone and refocused by the microdroplet superlens during the laser-droplet interactions in the vicinity of the apex of the cone near the substrate surface. Laser heating of the droplets evaporates the water and sinters the nanoparticles to form microlayers on the substrate. The laser-droplet interactions can be implemented for depositing thin films, lines and regular arrays of microdots as well as nanodots. This process is versatile, efficient, scalable, and provides a convenient method for advanced manufacturing using nanoparticles.

Various stages of the laser-droplet interaction are illustrated in Fig. 2. The evaporation of water provides a cooling mechanism to enable deposition of thin films on flexible substrates such as papers and plastics. The laser-droplet interaction mechanism is envisaged to evolve further to fabricate nanopatterns for wide spread applications

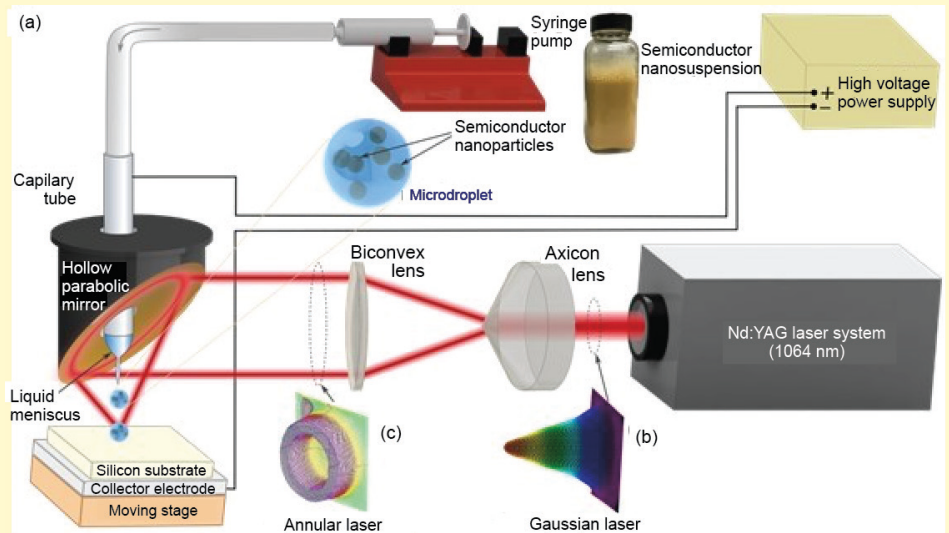


Figure 1. Dual role microdroplet superlens for carrying nanoparticles and subwavelength focusing.

including conformal solar cells and ultra-flexible electrodes in biological implants. This technology is readily amenable to roll-to-roll manufacturing of optoelectronic components, sensors, actuators, and ultra-flexible electrodes for neuro-stimulators and prosthetics. In addition, microdroplets of pure water containing no nanoparticles can be utilized for nanomachining applications to produce subwavelength ( $\sim \lambda/10$ ) structures in substrates.

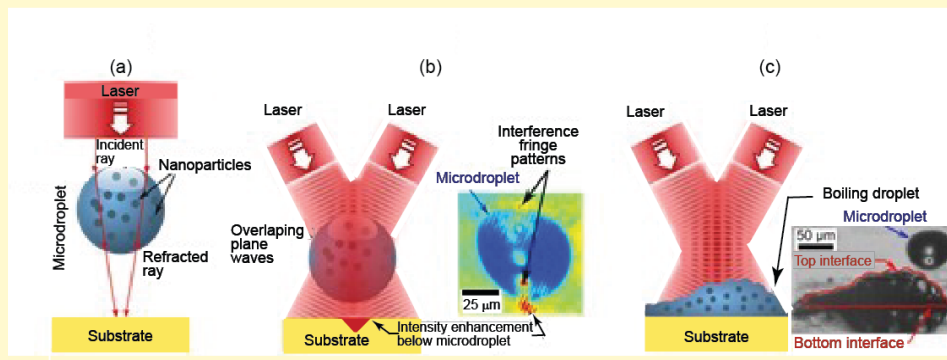


Figure 2. Laser-droplet interactions for heating the droplets: (a) Geometrical focusing of the laser beam when the microdroplet acts as a lens. (b) Incident laser on top of the microdroplet and intensity enhancement below the same microdroplet. (c) Incident laser on an evaporating droplet after the droplet impinges on the substrate, exhibiting a wavy top surface with ripples of radii much smaller than the radius of the microdroplet so that each curved segment can focus a portion of the laser beam.

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M. Gebhardt, C. Gaida, F. Stutzki, J.E. Antonio-Lopez, **A. Schülzgen**, **R. Amezcua-Correa**, and J. Limpert, *Nonlinear pulse compression stage delivering 43-W few-cycle pulses with GW peak-power at 2- $\mu$ m wavelength*, SPIE Photonics West, OPTO, Fiber Lasers XV: Technology and Systems, paper: 10512-30, San Francisco, California ) (2018). **Invited**

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S.B. Mirov, S. Vasilyev, V. Smolski, J. Peppers, M. Mirov, A. Muraviev, **K.L. Vodopyanov**, V. Gapontsev, and I. Moskalev, *Femtosecond mid-IR laser sources based on Cr<sup>2+</sup>:ZnS oscillators and sub-harmonic OPOs*, SPIE DCS talk 2018, Orlando FL (invited) (2018). **Invited**

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**K.L. Vodopyanov**, *Massively parallel sensing of trace molecules and their isotopologues with broadband subharmonic mid-infrared frequency combs*, OSA Light, Energy and the Environment Congress, Singapore (2018).

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A. Muraviev, V.O. Smolski, Z.E. Loparo, and **K.L. Vodopyanov**, *Massively parallel sensing of trace molecules with broadband mid-infrared subharmonic frequency combs*, OSA FIO, Washington, DC, Paper LTh3F.3 (2018).

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K. Vodopyanov, **K.L. Schepler** (Editors), *Nonlinear frequency generation and conversion: materials and devices XVII*, SPIE Conference, 10516 (2018).

Q. Ru, T. Kawamori, N. Lee, X. Chen, K. Zhong, M. Mirov, S. Vasilyev, S.B. Mirov, and **K.L. Vodopyanov**, *Optical parametric oscillation in a random polycrystalline medium: ZnSe ceramic*, SPIE 10516, Nonlinear Frequency Generation and Conversion: Materials and Devices XVII, 1051615-1 (2018).

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**S.T. Wu**, *Adaptive lens with photo- and electrical stimuli*, 2nd Device Integrated Responsive Materials Workshop, April 7-9 ) (2018). **Invited**

**S.T. Wu**, *Display technologies for AR/VR applications*, Second International Conference on Display Technology, Guangzhou, China, April 9-12 (2018).

**S.T. Wu**, *Mini-LED: Next round of LCD evolution*, 7th Symposium on Liquid Crystal Photonics, Nanjing, China, April 14-16 (2018).

He Cheng, Ankesh Todi, Hongmei Tang, **Xiaoming Yu**, *Bessel beams generated by a segmented deformable mirror for ultrafast laser material processing*, ICALEO, Orlando, FL (2018).

Xinya Wang, **Xiaoming Yu**, Hongyu Shi, Kansas State University; Xianhua Tian, Maxime Chambonneau, David Grojo, Brett DePaola, Shuting Lei, *Characterization and Control of Laser-induced Modification inside Silicon*, ICALEO, Orlando, FL (2018).

Y.Chai, H. Cheng, **X. Yu**, A. Chew; X. Ren, **Z. Chang**, and **M.J Soileau**, *Ultrashort laser-induced periodic structures on ZnSe substrate*, SPIE 10805, Laser-Induced Damage in Optical Materials: 50th Anniversary Conference (2018).

R. Sampson, H. Liu, H. Wen, Y. Zhang, R. Stegeman, P. Zhang, B. Huang, N. Wang, S. Fan, J.C. Alvarado Zacarias, **R. Amezcua-Correa**, and **G.F. Li**, *Improving the sensitivity of LiDARs using few-mode pre-amplified receivers*, OSA FIO, Washington, DC, paper FW7A.2 (2018).

## INVITED LECTURES AND TUTORIALS

**L. Argenti**, *A new time-dependent ab-initio close-coupling program for atomic ionization*, ITAMP workshop: Developing Flexible and Robust Software in Computational Atomic and Molecular Physics, Cambridge MA, May 14-16 (2018).

**L. Argenti**, *Attosecond studies of electronic concerted motion in atoms: an ab initio perspective*, AMO Seminar series at the Physics Department of University of Nebraska, Lincoln (upon invitation by Prof. Anthony Starace) April 25 (2018).

**L. Argenti**, and M. Chini, *Fast and furious: how new light sources enable new science*, UCF Scholar's Day, March 24, Pegasus Health & Public Affairs Building I, Room 119 (2018).

**P.J. Delfyett**, *Lasers - the light fantastic - Science and applications from pointers to DVDs*, UCF Optics Day, Orlando FL, April 13 (2018).

**P.J. Delfyett**, *Ultrafast coherent optical signal processing using stabilized optical frequency combs from mode-locked semiconductor diode lasers*, CREOL Industrial Affiliates Symposium ) (2018). **Invited**

**R.G. Driggers**, *Advanced infrared systems*, CREOL Industrial Affiliates Symposium ) (2018). **Invited**

**R.G. Driggers**, *Advanced infrared systems*, PEO STRICOM (Gen Cole and staff) (2018).

**R.G. Driggers**, *Research in infrared systems*, CREOL Seminar (2018).

Z. Ma, S. Saghaye-Polkoo, and **C.K. Renshaw**, *Hemispherical focal plane arrays*, CREOL Industrial Affiliates Symposium ) (2018). **Invited**

**M.C. Richardson**, *Mid-IR sources, materials and technologies for sensing and other applications*, Laser Focus webinar ) (2018). **Invited**

J. Thompson, S. Rostami-Fairchild, M Baudelet, and **M.C. Richardson**, *Shooting through raindrops with laser pulses*, UCF Research Undergraduate Conference (FURC) (2018).

**K.L. Vodopyanov**, *Detection of biomarkers and their isotopologues using laser spectroscopy: potential for non-invasive medical diagnostics*, Mayo Clinic guest lecture 14 February ) (2018). **Invited**

**K.L. Vodopyanov**, *Massively parallel sensing of trace molecules and their isotopologues with broadband subharmonic mid-IR frequency combs*, Ludwig Maximilian University / MPQ, Garching, Special Seminar 2 May ) (2018). **Invited**

**K.L. Vodopyanov**, *Sensing molecules and isotopes with frequency combs*, CREOL Industrial Affiliates Symposium ) (2018). **Invited**

**S.T. Wu**, *Display technologies for AR/VR applications*, Kent State University, Liquid Crystal Institute, May 2 (2018).

**S.T. Wu**, *Emerging display technologies for augmented/virtual reality displays*, SUSTech, Shenzhen, China, April 6 (2018).

## PATENTS

**A.F. Abouraddy**, J. Kaufman, M. Monroe, F. Tan, *Underwater Fiber Optic Cable with a Predetermined Bouyancy and Associated Methods*, Us Patent 10,001,616 (2018).

**M. Baudelet**, *Quantitative Elemental Profiling in Optical Emission Spectroscopy [CON of 32792]*, US Patent 10,001,410 (2018).

**Z. Chang**, E. Cunningham, and Y. Wu, *Apparatus and method for suppressing parasitic lasing and applications thereof*, US Patent 9,899,798 (2018).



D.N. Chistodoulides, P. Aleahmad, R. El-Ganainy, **M. Khajavikhan**, and **P.L. LiKamWa**, *Integrated Optical Circulator Apparatus, Method, and Applications*, US Patent 9,979,160 (2018).

**K.A. Richardson**, C. Smith, and C. Rivero-Baleine, *Glass Composites Having a Gradient Index of Refraction and Methods for Production Thereof*, US Patent 9,969,647 (2018).

C. Rivero-Baleine, T. Mayer, **K.A. Richardson**, J. D. Musgraves, and P. Wachtel, *Optical apparatus and method of forming a gradient index device*, US Patent 10,132,965, Ser. No. 15/135,813 (2018).

**K.A. Richardson**, B. Gleason, C. Rivero-Baleine, and J. Ruckman, *Ternary glass materials with low refractive index variability*, US Patent 9,908,808 (2018).

**S.T. Wu**, D. Xu, Y.F. Lan, S. Norio, and C.Y. Tsai, *Liquid crystal display systems and related methods*, US Patent 9,927,666 (2018).

## PROVISIONAL/UTILITY

**A.F. Abouraddy**, J. Kaufman, M. Monroe, and F. Tan, *Color-Changing Yarns Having Electrically Conductive Core and Thermochromic Pigments*, Patent Pending (ID: 33889) (2018).

**D.N. Christodoulides**, *Topological Insulator Laser* (ID: 33915), Patent Pending (ID: 33915) (2018).

**D. G. Deppe**, *Low resistance vertical cavity light source with pnpn blocking*, Patent Pending (ID: 33891) [CON of 33708] (2018).

**D.G. Deppe**, *Vertical-cavity surface-emitting device with epitaxial index guide and method of manufacture*, Patent Pending (ID: 33819) (2018).

**D.G. Deppe**, *Vertical-cavity surface-emitting device with epitaxial index guide and method of manufacture*

*ture*, Patent Pending (ID: 33835) (2018).

J. Chiles and **S. Fathpour**, *Optical waveguide, fabrication methods, and applications*, Patent Pending (ID: 33900) (2018).

**S. Fathpour**, A. Honardoost, and S. Khan, *Thin-Film Integration Compatible with Silicon Photonics Foundry Production*, Patent Pending (ID: 33857) (2018).

**A. Kar**, *Imaging Device with Loop Bolometer Array and Related Methods*, Patent Pending (ID: 33853) (2018).

**G.F. Li**, **D.N. Christodoulides**, B. Huang, H. Liu, and H. Wen, *Efficient Mode Coupling Using Ladder Fibers*, Patent Pending (ID: 33936) (2018).

**C.K. Renshaw** and S. Saghaye-Polkoo, *Imaging-based transmitter and receiver for free-space optical communications*, Patent Pending (ID: 33888) (2018).

**C.K. Renshaw** and Z. Ma, *Stretchable/conformable electronic and optoelectronic circuits, methods, and applications*, Patent Pending (ID: 33852) (2018).

**K.A. Richardson**, C. Smith, *Glass Composites Having a Gradient Index of Refraction and Methods for Production Thereof*, Patent Pending (ID: 33985) (2018).

L. Siskin and **K.A. Richardson**, *Optical device having laser-induced vitrification (liv) of a glass or ceramic material*, Patent Pending (ID: 33856) (2018).

**M.C. Richardson**, R. Bernath, N. Bodnar, H. Kerrigan, D. Reyes, and D. Thul, *Localized RF generation using pulsed periodic laser produced plasmas*, Patent Pending (ID: 33892) (2018).

**K.L. Vodopyanov**, S. Vasilyev, and M. Mirov, *Optical parametric oscillator based on random quasi-phase matching in a disordered polycrystalline nonlinear medium*, Patent Pending (2018).

H. Chen and **S.T. Wu**, *In plane switching liquid crystal display with trapezoid electrodes*, Patent Pending (ID: 33935) (2018).

## DISCLOSURES

**A. Kar**, R. Kumar and E. Castillo-Orozco, *Laser-assisted manufacturing process using microfluidic suspensions and dry powders*, Disclosure (2018).

**A. Kar**, *RF magnetic field imaging using loop bolometer array*, Patent application submitted (ID: 11287) (2018).

**A. Kar**, *Sensor and method for chemical sensing*, Patent application submitted (ID: 11319) (2018).

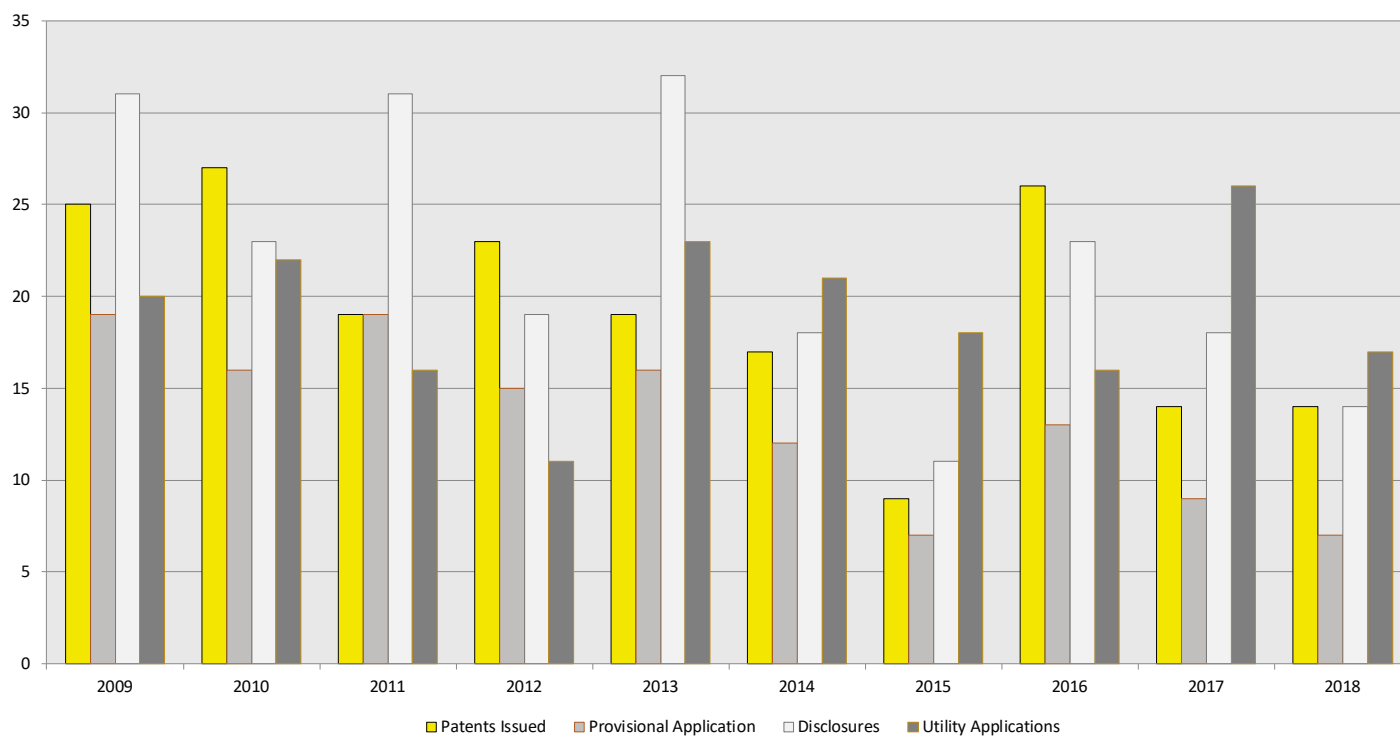
R. Stegeman and **G.F. Li**, *Brightness Enhancement of Laser Sources using Photonic Lanterns*, Patent application submitted (ID: 11304) (2018).

R. Sampson, **G.F. Li**, H. Liu, R. Stegeman, H. Wen, P. Zhang, and Y. Zhang, *Few-mode preamplified receiver for LIDAR for autonomous vehicles*, Patent application submitted (ID: 11331) (2018).

**C.K. Renshaw** and S. Saghaye-Polkoo, *Imaging-based transmitter and receiver for free-space optical communications*, Patent application submitted (ID: 11320) (2018).

**K.L. Schepler**, **K.A. Richardson**, **M.C. Richardson**, M. Kang, and C. Arias, *Dispersion engineered optical nanocomposites for fiber- and planar-infrared laser applications*, UCF disclosure: ref. # 11345, submitted (2018).

**M.C. Richardson**, R. Bernath, N. Bodnar, H. Kerrigan, D. Reyes, and D. Thul, *Localized RF generation using pulsed periodic laser produced plasmas*, Patent application submitted (ID: 11322) (2018).

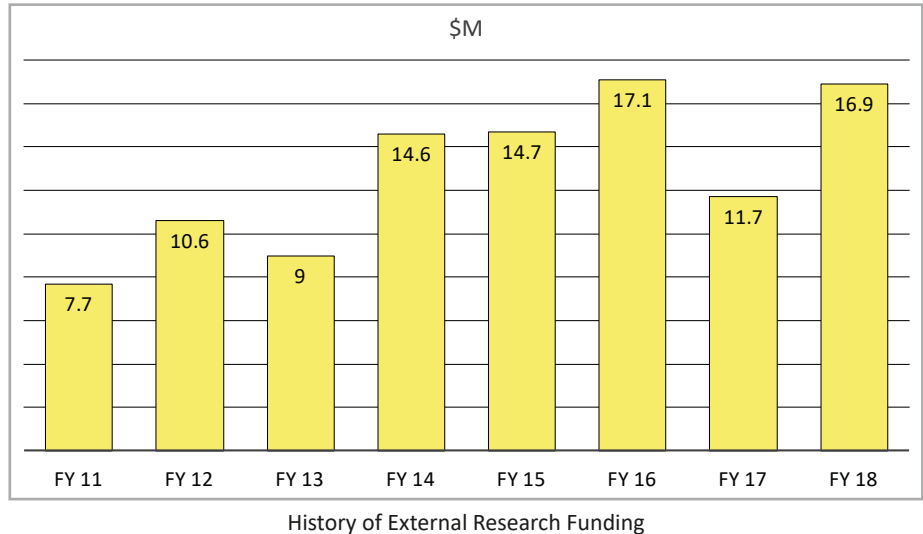


History of disclosures, applications and issued patents by fiscal year.

## 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	\$11,607,410
Federal Through Industry	\$2,557,350
Industry R&D	\$1,794,123
International	\$592,000
Foundation	\$304,216
<b>Total</b>	<b>\$16,855,098</b>



RECEIPT	SOURCE	TITLE OF AWARD	BEGIN	END	AWARDED
PI: Abouraddy, Ayman	U.S. Army Natick Soldier RD&E Center	EPA NRX-12 Research Scale Spunbound Fiber Extrusion Unit	5/29/2018	5/28/2021	\$476,000
PI: Abouraddy, Ayman	Massachusetts Institute of Technology	Electrically Controlled Color-Changing Fabrics	2/16/2018	8/15/2018	\$381,886
PI: Abouraddy, Ayman	Corning, Inc	Glass Polymer Composite Fibers	12/21/2017	8/30/2018	\$40,000
PI: Abouraddy, Ayman	Massachusetts Institute of Technology	Harnessing in-fiber fluid instabilities for scalable and universal multidimensional nanosphere design, manufacturing, and applications	12/1/2014	10/31/2018	\$94,584
PI: Abouraddy, Ayman	Harris Corporation	Mako Prime 1	3/5/2018	10/31/2018	\$165,830
PI: Abouraddy, Ayman; CoPI: Atia	Office of Naval Research	Development of Diffraction-Free Space-Time Optical Beams	7/1/2017	6/30/2021	\$165,710
PI: Abouraddy, Ayman; CoPI: Li, Atia	Harris Corporation	Strong Ultra-Small Highly Integrated (SUSHI) Phase 2 Fiber Optic Cable (Prime 1)	4/30/2017	12/15/2018	\$1,797,320
PI: Amezcua Correa, Rodrigo; CoPI: Christodoulides	National Science Foundation (NSF)	Tailoring nonlinear interactions in highly-multi-mode fibers for versatile light sources	7/15/2017	6/30/2020	\$359,960
PI: Amezcua Correa, Rodrigo; CoPI: Schülzgen	US Army Research Office	Antiresonant Hollow Core Fibers for Extreme Light Propagation (Research Area 4.2. Optoelectronics)	9/1/2017	8/31/2019	\$389,600
PI: Amezcua Correa, Rodrigo; CoPI: Glebov, Richardson, M., Schülzgen, Shah	US Army Research Office	Fiber Laser Light Engines - A New Platform to Collectively Address Power-limiting Constraints	8/20/2012	8/19/2020	\$793,718

PI: Argenti, Luca	National Science Foundation (NSF)	Theoretical atomic attosecond spectroscopy: Monitor and control of electron correlation in real time	9/1/2016	8/31/2019	\$43,169
PI: Bass, Michael	TRUMPF, Inc.	Modeling studies of Yb-doped slab amplifiers to determine spatially resolved inversion and spatially resolved gain profile, deriving influence on amplified beam profile as well as deriving origins...	9/15/2017	1/14/2018	\$49,449
PI: Chang, Zenghu	US Air Force Office of Scientific Research (AFOSR)	High Power Phase-Stabilized Few-Cycle Mid-IR Laser	9/30/2017	9/29/2018	\$208,835
PI: Chang, Zenghu	Regents of The University of California, The	Post-Born-Oppenheimer Dynamics Using Isolated Attosecond Pulses	12/15/2014	3/14/2019	\$55,939
PI: Chang, Zenghu	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	3/14/2019	\$918,750
PI: Christodoulides, Demetrios N	US Air Force Research Laboratory (AFRL)	Generating optical pulses with time-varying polarization states	2/2/2018	2/2/2019	\$50,000
PI: Christodoulides, Demetrios N	Pennsylvania State University	MRSEC - Center for Nanoscale Science	11/1/2014	10/31/2019	\$60,000
PI: Christodoulides, Demetrios N	Georgia State University	Novel Nonlinear Optical Processes in Active, Random, and Nanostructures Systems	6/1/2017	9/30/2018	\$146,866
PI: Christodoulides, Demetrios N	Office of Naval Research	Parity-Time Symmetric and Non-Hermitian Photonic Structures	6/1/2018	5/31/2020	\$150,000
PI: Christodoulides, Demetrios N	Texas A&M University System, The	Self-generated spatiotemporal nanostructuring of laser light applied to energy transport and reconfigurable guiding networks in nanophotonics, plasmonic, and hybrid nanoparticles metacolloids	12/13/2016	7/1/2019	\$58,921
PI: Christodoulides, Demetrios N; CoPI: Abouraddy, Khajavikhan	US Air Force Office of Scientific Research (AFOSR)	MURI: PT-Symmetric Optical Materials and Structures	10/15/2013	7/14/2019	\$1,067,768
PI: Christodoulides, Demetrios N; CoPI: Khajavikhan	United States-Israel Binational Science Foundation	RF: Non-Hermitian Topological Photonics	9/1/2017	8/31/2018	\$33,000
PI: Christodoulides, Demetrios N; CoPI: Khajavikhan	US Army Research Office	Supersymmetry in Optics & Photonics	9/1/2017	8/31/2019	\$300,000
PI: Crabbs, Robert F	Aegis Technologies Group, Inc.	ARI: Testing at SLF	3/9/2017	8/31/2017	\$4,800
PI: Crabbs, Robert F	Aegis Technologies Group, Inc.	ARI: Testing at SLF	3/9/2017	10/31/2017	\$73,697
PI: Crabbs, Robert F	Office of Naval Research	Atmospheric Propagation for High Energy Lasers, Supporting APSHEL Program	1/1/2017	12/31/2019	\$460,410



PI: Crabbs, Robert F	US Air Force	Laser Testing Support			\$80,656
PI: Crabbs, Robert F	Office of Naval Research	Modeling of the lower atmosphere to facilitate improved laser propagation	12/1/2017	11/30/2022	\$115,520
PI: Crabbs, Robert F	Saab Defense and Security USA LLC	SLF Testing	1/2/2018	1/31/2018	\$7,191
PI: Crabbs, Robert F	Inertial Labs, Inc	Testing Support for Next Gen MILES	10/28/2017	10/27/2018	\$297,600
PI: Crabbs, Robert F	Booz Allen Hamilton, Inc.	Testing, TISTEF and SLF	1/1/2018	3/31/2018	\$33,294
PI: Delfyett, Peter J; CoPI: Fathpour	University of California at Berkeley	Heterogeneously Integrated Optical Synthesizer (H-iOS)	3/31/2015	9/30/2018	\$372,851
PI: Deppe, Dennis G	University of Texas at Austin	Research and Development of Nanocavity Lasers for Integration with Single Mode Silicon Waveguides	12/1/2016	11/30/2019	\$160,123
PI: Divliansky, Ivan; CoPI: Glebov	IPG Photonics	Spectral Beam Combining of Multi-Kilowatt Class Lasers by Volume Bragg Gratings	3/1/2018	2/28/2019	\$290,000
PI: Dogariu, Aristide	Office of Naval Research	Stochastic Electromagnetics for Active Sensing	4/1/2018	3/31/2022	\$150,000
PI: Dogariu, Aristide; CoPI: Han	Defense Advanced Research Projects Agency (DARPA)	Electrodynamically mediated energy transduction in cytoskeleton	10/1/2017	9/30/2019	\$406,516
PI: Driggers, Ronald G	IMEC	IPA: Ron Driggers IMEC Support	8/8/2017	5/31/2019	\$154,035
PI; Driggers, Ronald G	DRS Network & Imaging Systems, LLC	Longwave Infrared Pitch-Well-Processing (PWP) Proof of Concept	11/9/2017	12/30/2018	\$190,000
PI: Driggers, Ronald G	St. Johns Optical Systems, LLC	Redstone Infrared Signature and L3 IRST Calculation Support	9/1/2017	5/31/2018	\$45,371
PI: Driggers, Ronald G	L3 Technologies	Research Support for L3 Technologies Infrared Search and Track and UAV Detection Efforts	4/19/2018	8/31/2019	\$296,600

PI: Fathpour, Sasan	Partow Technologies, LLC	Advanced QPSK Optical Modulators Based on Thin Film Lithium Niobate (SBIR Phase 2)	5/25/2016	6/9/2018	\$120,000
PI: Fathpour, Sasan	Northwestern University	Integrated Optics for Single-Photon Nonlinear Interactions	6/1/2017	5/31/2019	\$54,700
PI: Fathpour, Sasan	Harris Corporation	Photonic Integrated Circuit Lithium Niobate (LN) Modulator on Silicon (Si) Substrates for RF Photonic Systems	1/1/2018	6/30/2019	\$25,000
PI: Gaume, Romain	US Air Force Office of Scientific Research (AFOSR)	Optical Ceramic Science for High-Power Lasers	12/22/2017	12/21/2018	\$126,789
PI: Gaume, Romain; CoPI: Christodoulides, Richardson, K.	Lockheed Martin Missiles and Fire Control	Perform a trade-study with modeling and simulation of high-birefringent infrared materials	7/5/2017	12/22/2017	\$33,000
PI: Gaume, Romain; CoPI: Christodoulides, Richardson, K.	Lockheed Martin Corporation	Fabrication of Highly Birefringent Infrared Materials (Phase 1)	1/2/2018	10/31/2018	\$30,700
PI: Glebov, Leonid B; CoPI: Divliansky	IPG Photonics	Development of photo-thermo-refractive glass for high efficiency volume holographic elements	8/1/2017	11/30/2018	\$280,000
PI: Hagan, David J	University of Michigan	Measurement of Magneto-Electric Susceptibilities	12/1/2015	2/14/2019	\$76,970
PI: Hagan, David J; CoPI: Van Stryland	US Army Research Laboratory	Characterization of Novel Nonlinear Optical Materials	7/27/2015	7/26/2019	\$200,000
PI: Khajavikhan, Mercedes	National Science Foundation (NSF)	EAGER: Fundamental Considerations in Using Non-Hermitian Microscale Resonant Optical Structures for Rotation Sensing	9/15/2017	2/28/2019	\$200,000
PI: Khajavikhan, Mercedes	Office of Naval Research	YIP: Parity-Time (PT) Symmetric Photonics	6/1/2016	5/31/2019	\$170,000
PI: Khajavikhan, Mercedes; CoPI: LiKamWa	US Army Research Office	Design fabrication and characterization of Electrically Pumped Coaxial Nanoscale Lasers	11/16/2015	11/15/2018	\$110,000
PI: Kim, Yoon-Seong, CoPI: Han, Tatulian	National Institute of Neurological Disorders and Stroke (NINDS)	Contribution of transcriptional mutagenesis of oxidative DNA lesions to generating new mutant alpha-synuclein species and aggregation toward the pathogenesis of Parkinson's disease	2/15/2018	4/30/2019	\$10,950
PI: Kuebler, Stephen M; CoPI: Fathpour	National Science Foundation (NSF)	REU Supplement to NSF Award #1711356	5/17/2018	6/30/2020	\$6,880

PI: Li, Guifang	Fujitsu Laboratories America, Inc.	RF: Fijitsu gift for research in the area of few mode fiber amplifier and related optical communications technology	5/1/2018	4/30/2019	\$50,000
PI: Li, Guifang	US Army Research Laboratory	Towards AO-Free FSO Communication	9/6/2017	12/31/2018	\$60,000
PI: Li, Guifang; CoPI: Amezcua Correa	US Army Research Office	Beamforming Techniques for Focusing Light Through Atmospheric Turbulence - Topic 4.2 Optoelectronics	9/26/2017	9/25/2018	\$190,556
PI: Raghavan, Seetha, CoPI: Schülzgen, O'Neal	National Science Foundation (NSF)	Multi-scale and in-situ sensing technology for structural integrity	7/15/2017	9/30/2019	\$14,399
PI: Richardson, Kathleen A.	Lockheed Martin Missiles and Fire Control	Advanced Materials IRAD – Broadband Gradient Index (GRIN) Optics Characterization (Broadband GRIN #5)	1/26/2018	12/1/2018	\$20,000
PI: Richardson, Kathleen A.	Lockheed Martin Missiles and Fire Control	Advanced Materials IRAD - Broadband Gradient Index (GRIN) Optics	3/3/2017	12/22/2017	\$13,976
PI: Richardson, Kathleen A.	Massachusetts Institute of Technology	Large-scale Reconfigurable and Multifunctional 2.5-D Conformal Optics	4/1/2017	3/31/2019	\$227,455
PI: Richardson, Kathleen A.	Various	RF K. Richardson Equipment Use Account	1/1/2015	12/31/2018	\$43,290
PI: Richardson, Martin C	US Army Research Office	DURIP: LWIR picosecond source for Ultra-short High Intensity CO2 Laser	4/15/2017	4/14/2019	\$166,087
PI: Richardson, Martin C	EoL Co., Ltd	High Power Thulium Laser Marking System Development for Visibly Transparent Polymers	9/1/2017	12/31/2018	\$182,000
PI: Richardson, Martin C	US Army Research Office	Light Filamentation Science Add on (Topological photonic structures based on light filamentation)	5/20/2016	4/30/2019	\$178,486
PI: Richardson, Martin C	US Army Research Office	Workshop on Plasma Optics	5/1/2018	4/30/2019	\$20,000
PI: Richardson, Martin C; CoPI: Amezcua Correa, Schülzgen, Shah	US Air Force Office of Scientific Research (AFOSR)	Fundamental Fiber Laser Science for High Powers	8/1/2015	4/30/2019	\$1,173,266
PI: Saleh, Bahaa	UCF Foundation, Inc	CREOL - UCF Foundation Gifts	7/1/2014	6/30/2019	\$212,295
PI: Schoenfeld, Winston V	US Army Research Office	STIR: Solar Blind Sn-Alloyed Ga2O3 Schottky Photodetectors	8/15/2017	5/14/2018	\$60,000
PI: Schoenfeld, Winston V	Lightwave Photonics, Inc.	Ultraviolet III-Nitride Avalanche Photodiodes formed by a selective HfN substrate release layer	1/10/2018	6/11/2018	\$45,000
PI: Schülzgen, Axel	Multicore Photonics Inc	Multicore Fiber for Sensor Applications	7/1/2017	8/31/2017	\$3,434



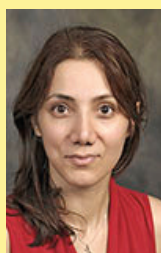
PI: Van Stryland, Eric W; CoPI: Hagan	Defense Advanced Research Projects Agency (DARPA)	Measurement of the nonlinear refractive index of air in the mid-ir around 3.5 microns	7/17/2017	1/16/2019	\$100,000
PI: Vodopyanov, Konstantin L	Office of Naval Research	DURIP: Stabilized femtosecond dual-comb fiber laser system as a pump source for the mid-IR frequency-comb standoff chemical sensor	6/15/2018	6/14/2019	\$349,804
PI: Vodopyanov, Konstantin L	University of California, Los Angeles	Fundamental Studies of Nonlinear Optics and Laser-plasma Phenomena in Gases and Solids Using High-Power LWIR Lasers	8/1/2017	10/31/2019	\$100,000
PI: Vodopyanov, Konstantin L; CoPI: Gaume	Defense Advanced Research Projects Agency (DARPA)	Ultra-compact comb source with instantaneous bandwidth of 3 - 10 $\mu\text{m}$ for massively parallel spectroscopic sensing	6/9/2015	9/22/2019	\$654,093
PI: Wu, Shin-Tson	Intel Corporate Research Council	Fast-response liquid crystal devices for light field displays	11/15/2016	11/14/2019	\$75,000
PI: Wu, Shin-Tson	GoerTek, Inc.	Near-Eye Displays	12/1/2017	11/30/2020	\$360,000
PI: Wu, Shin-Tson	US Air Force Office of Scientific Research (AFOSR)	Submillisecond-response liquid crystal spatial light modulators	9/1/2014	8/31/2019	\$165,000

## 2018 LUMINARY HONOREE FROM CREOL

Families, friends and colleagues celebrated 11 University of Central Florida faculty members during the second annual Luminary Awards Night.

The event, cosponsored by the Office of Research and Faculty Excellence, recognizes faculty members across all disciplines for being academic leaders in their field and conducting work that has a significant impact on the world.

"Luminaries, you shine a positive light on the university and illuminate the path for discovery and UCF's future successes," UCF President Dale Whittaker told the audience gathered at Orlando's Harry P. Leu Gardens. "I can't think of a better word to describe the work of tonight's honorees than 'impact.' These individuals embody UCF's promise to have a positive, lasting impact on our students and society."



The honoree from the College of Optics and Photonics is Associate Professor Mercedeh Khajavikhan. Her work is in experimental research in the field of optics and photonics to understand and use novel phenomena and concepts to develop fully integrated photonic components that outperform large-scale optical systems. She is a pioneer of topological insulator lasers.



Research Scientist Jose Enrique Antonio-Lopez (l) and Dr. Rodrigo Amezcua-Correa (r) inspect an optical fiber preform.

## 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 one 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.

### **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)

### **BRIDG**

BRIDG is a Florida not-for-profit industry-led smart sensor consortium founded by Osceola County, UCF, and the Florida High Tech Corridor Council, with the goal of accelerating technology commercialization by bridging technology and capability gaps across multiple fields. BRIDG is focused on manufacturing development of advanced technologies in smart sensors, imagers,



advanced devices, 2.5D/3D chip integration, and photonic devices. Service areas include research, development, and commercialization. BRIDG is located in Osceola County, FL, in a new 109,000 square foot facility inaugurated in March 2017. The facility includes approximately 40,000 square feet of cleanroom laboratory/manufacturing space.



# 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 CREOL. 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. The following is a list of other benefits.

- ▲ Affiliates establish a close association with a leading center in optics and photonics, and exposure to the latest research and development in cutting edge technologies.
- ▲ Close interaction with the world-renowned faculty at CREOL can result in research projects for which federal funding may be received.
- ▲ Membership in the IA program enables some access to state-of-the-art facilities for specialized optical measurement, testing, and calibration.
- ▲ Affiliates have access to students interested in internship opportunities, and receive early notice of students approaching graduation, and ability to post job openings on CREOL's website (an exclusive benefit for IA members).
- ▲ IA members receive notifications of seminars presented by leading figures in the optics and photonics community, and copies of CREOL's periodic newsletter, Highlights, which lists new discoveries and inventions in the field, awards and recognitions of the faculty and students, and alumni news.
- ▲ Companies that donate equipment get their hardware/software in the hands of faculty and students, providing visibility and product marketing for potential future customer prospects.
- ▲ Membership provides affiliates with an opportunity to promote their companies by making presentations about their products to the faculty and students, exhibiting and giving presentations at the CREOL annual Industrial Affiliates meeting, posting a link to their website from the College's website. Affiliates are listed in CREOL publications and website, and receive special recognition at the Industrial Affiliates Meeting, and plaques in their names are prominently displayed in the entrance lobby of the CREOL building.
- ▲ Affiliation is a venue for supporting the education of the future workforce. Members receive a certificate or plaque for display in their facility highlighting their partnership and cooperation with educational institutions.

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 at CREOL and the Florida Photonics Center of Excellence (FPCE), UCF facilities include the following major research centers:

- ▲ NanoScience & 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 connects. Through the IA program companies 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 and a large family of laser and optics companies in the Central Florida region.

# INDUSTRIAL AFFILIATES MEMBERS, 2018

## LIFE MEMBERS

Cobb Family Foundation  
Northrop Grumman Corporation  
Nufern

## MEMORIAM MEMBERS

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

## MEDALLION MEMBERS

Breault Research  
Coherent, Inc.

IPG Photonics  
Newport  
Northrop Grumman Laser Systems

Paul G. Suchoski, Jr  
Synopsis

## SENIOR MEMBERS

AFL Global  
Amplitude Laser, Inc  
ASML US  
CST of America

FARO Technologies  
LAS-CAD GmbH  
Lockheed Martin  
Lumentum  
Oculus Research

Optimax Systems, Inc  
Tektronix  
Zemax  
Zygo Corporation

## AFFILIATE MEMBERS

Aerotech Inc.  
Analog Modules  
Andor Technology  
Applicote  
Asphericon, Inc.  
Beam Co.  
DataRay  
Edmund Optics  
eVision, LLC  
Finetech  
Fiberguide Industries  
Gentec-EO

Harris Corporation  
HORIBA Jobin Yvon  
JENOPTIK Optical Systems Inc  
Laser Institute of America  
LGS Innovations  
Lightpath  
Luminar  
Menlo Systems  
Ophir-Spiricon  
Optigrate  
OIDA  
Photonics Media

Photonics Online  
Plasma-Therm  
Plasmonics  
Q-Peak, Inc  
SPIE - The International Society for Optics &  
Photonics  
The Optical Society  
Thorlabs  
Tower Optical Corporation  
TwinStar Optics, Coatings & Crystals  
ULVAC Technologies, Inc  
Yokogawa



Various affiliates exhibiting at the annual Industrial Affiliates Symposium in April, 2018.

# INDUSTRIAL AFFILIATES DAY

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## Industrial Affiliates Symposium: *Advances in Optics & Photonics* April 19-20, 2018

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 2018 event, held on April 19 & 20, 2018, drew 293 attendees including industrial affiliates, guests from industry and academia, representatives from photonics professional societies, faculty and students. It featured 21 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, three industrial affiliates gave brief overviews of their respective companies. Special guest Nathaniel Quick, Executive Director of LIA gave a presentation on advancing laser industrial applications and safety.

Events also included four short courses, four student talks, tours of the CREOL facilities and viewing of posters featuring research of 30 graduate and undergraduate students. Elizabeth Rogan, CEO of OSA, gave a presentation entitled “Women in Optics & Photonics”. The Best Poster Award went to graduate student Juan He for her poster entitled “Stable, cost-effective perovskite-polymer composites as tunable downconverters for tailored lighting”. The Student of the Year Award went to Alex Sincore. The following Saturday, the attendees were invited to the traditional annual event known as the “Spring Thing”. It is hosted annually by M.J. Soileau, who is the founding director of CREOL. The festivities included great fellowship and featured cajun cuisine.

### Short Courses

#### Advanced Infrared Systems

**Instructor: Ronald Driggers**

This short course covers the past fielded technology in infrared systems as well as current fielded technologies in the areas of target acquisition (TA) and intelligence, surveillance, and reconnaissance (ISR). More importantly, we cover new breakthroughs in cryogenically-cooled infrared systems to include dual band detectors, smaller infrared detector pitch, large format focal planes, higher operating temperature MWIR detectors, deeper well capacity readout integrated circuits, freeform and flat optics. These breakthroughs enable many different system capabilities which will be discussed. In addition, a short discussion about uncooled infrared systems on where they are currently and where they are going will be provided.

#### Validation and Application of the Army’s Electro-Optical Imager Targeting and Surveillance Model

**Instructor: Rich Vollmerhausen**

The Army purchases imaging hardware to help soldiers execute missions at some time in the future and somewhere in the world. The Targeting Task Performance (TTP) resolution metric is used to predict the utility of imaging hardware for targeting and surveillance purposes. This short course discusses the logic, validation scope, and correct application of the TTP metric. Some time is spent describing historical methods and the misapplication of the current model by mixing old and new methodologies.

#### LIDAR Design for Autonomous Vehicles

**Instructor: Umar Piracha**

This short course gives an overview of various laser ranging techniques and the performance achieved by various lidar manufacturers for enabling autonomous vehicles. Design trade-offs and challenges for designing a lidar system will also be discussed.

#### Deep Learning for Computer Vision

**Instructor: Mubarak Shah**

Computer vision, which is part of artificial intelligence, deals with the automatic analysis of images and videos using computers. Applications of computer vision include Biometrics (e.g. face recognition), UAV video analysis, human activity and action recognition, bio-medical image analysis, geo-localization, self-driving cars, video and image retrieval, robotics etc. Computer vision has been very active area of research for many decades and researchers have been working on solving important challenging problems. During the last few years, Deep Learning involving Artificial Neural Networks has been disruptive force in computer vision. Employing deep learning, tremendous progress has been made in a very short time in solving difficult problems and very impressive results have been obtained in image and video classification, localization, semantic segmentation, caption generation, geo-localization, etc. New techniques, datasets, hardware and software libraries are emerging almost every day. Deep Computer vision is impacting research in Robotics, Natural Language understanding, audio and speech recognition, Computer Graphics, multi-modal analysis etc.

In this tutorial, I will first briefly describe basics of deep neural networks and then present a quick overview of my research at UCF Center for Research in Computer Vision, employing deep learning.



Presenters at the Industrial Affiliates Symposium		
Bahaa Saleh	Dean & Director, CREOL, UCF	Welcome and overview
Stephen Forrest	University of Michigan	Organic Light Emitting Devices (OLEDs): A Revolution in Displays and Lighting
Konstantin Vodopyanov	CREOL, UCF	Sensing Molecules and Isotopes with Frequency Combs
Phil Perconti	USARL	U.S. Army Challenges and Opportunities for Positioning, Navigation and Timing (PNT) in Contested Environments
Peter Delfyett	CREOL, UCF	Ultrafast Optical Signal Processing Using Optical Frequency Combs
Nathaniel Quick	Executive Director, LIA	Laser Institute of America – Advancing Laser Industrial Applications and Safety
Jason Eichenholz	Luminar Technologies Inc	Building the Vision for Autonomous Mobility
Axel Schülzgen	CREOL, UCF	Fiber Optics at CREOL
Akhlesh Lakhtakia	Pennsylvania State University	Electromagnetic Surface Waves: Riding Two Horses While Straddling a Fence
Kyle Renshaw	CREOL, UCF	Development of Curved Image Sensors for Future Imaging Systems
Product Reviews		
Bert Gyselinckx	IMEC	
Brett Attaway	BRIDG	
Adel Joobeur	ASML	
Student Talks		
Student of the Year-Alex Sincore	2 μm Fiber Lasers: Power Scaling Concepts and Challenges	
Abraham Vazquez-Guardado	Superchiral Light Generation on Degenerate Achiral Surfaces	
Yun-Han Lee	Polarization Diffractive Optical Elements for Augmented and Virtual Reality Displays	
Marcin Malinowski	Towards Integrated and Stabilized Frequency-Comb Generation on Chip	
Awards Presentations		
Richard DeSalvo	Harris Corporation	Distinguished Alumni Award

**Stable, Cost-Effective Perovskite-Polymer Composites as Tunable Downconverters for Tailored Lighting**

Juan (Rachel) He, Colical Zhang<sup>a</sup>, Eric Collins<sup>a</sup>, Yanan Wang<sup>a</sup>, Hao Chen<sup>a</sup>, Shin-Tson Wu<sup>a</sup> and Yiqie Dong<sup>a,b,\*</sup>  
<sup>a</sup> College of Optics and Photonics, University of Central Florida, Orlando, Florida, USA  
<sup>b</sup> Department of Materials Science & Engineering, University of Central Florida, Orlando, Florida, USA  
<sup>c</sup> NanoScience Technology Center, University of Central Florida, Orlando, Florida, USA

**BACKGROUND**  
 Efficient spectral, intensity and spatial control is becoming increasingly applications. Working with blue/UV LEDs, tunable downconverters will provide the most cost effective approach for fine spectral control to prevent lighting applications.

**VERSATILITY OF SDM STRATEGY**  
 The SDM strategy can be applied through any solution processing (e.g. cotton swab painting, spincoating, etc.) and on any polymer substrates that can swell in solvents. The emission spectra can be tuned over entire visible region and beyond through perovskite composition variation.

**STRUCTURAL AND OPTICAL PROPERTIES**  
 Optical absorption and emission spectra can be tuned over entire visible region by adjusting the ratio of mixed halides. The gradually shifted X-ray diffraction patterns along with perovskite composition tuning show a lattice constant change trend of NPs, which is consistent with XRD characterization results.

**STABILITY I**  
 As results of good nanoparticle dispersion and polymer passivation, the perovskite polymer composite films exhibit unprecedented stability against water and heat exposure. Less than 10% intensity loss was observed after 1000h of continuous exposure in water for the composite films.

**STABILITY II**  
 Thermal stability: PL intensity of the perovskite-polymer films can fully recover after being heated up and cooled down. High bonding energy values are derived from the reversible temperature-dependent PL.

**PERSPECTIVE FOR TAILORED LIGHTING**  
 The controllably tunable emission spectra, lower encapsulation cost and outstanding environmental stability make these perovskite-polymer composite films highly promising downconverter options for tailored lighting. With continuous efforts to further expand the downconverter options, these perovskite-polymer composites can serve as exchangeable emission different color or tuning amount LEDs to provide entire spectrum control upon demand.

**REFERENCE**  
<https://doi.org/10.1038/s41566-020-00601-0>  
 L. Protesescu, M. V. Kovalenko et al. *Nano Lett.* 2015, 15, 3602-3608  
 Y. Wang, J. He, H. Chen, Y. Dong, et al. *Adv. Mater.* 2016, 28, 3070-3073  
 Y. Wang, J. He, H. Chen, Y. Dong, et al. *Opt. Express* 2013, 21, 12013-12025  
 J. He, H. Chen, Y. Dong, et al. *Opt. Express* 2013, 21, 12013-12025  
 Y. Dong, H. Chen, J. He, et al. *Information Display* 2017, 2, 9

**Acknowledgment**

Graduate student Juan He presents research at the Industrial Affiliates Symposium on Day 1.

## STUDENT POSTERS AT THE INDUSTRIAL AFFILIATES SYMPOSIUM

<b>Yuanhang Zhang</b>	An Integrated Mode-Transparent Power Splitter based on Multimode Interference
<b>Abraham Vázquez-Guardado</b>	Chiral Light-Matter Interaction on Degenerate Achiral Plasmonic Systems
<b>Jian Zhao</b>	Image Transport Through Glass-Air Disordered Fiber with Transverse Anderson Localization
<b>Thamer Tabbakh</b>	Liquid Sensor Based On Optical Surface Plasmon Resonance in a Dielectric Waveguide
<b>Juan He</b>	Stable, Cost-Effective Perovskite-Polymer Composites as Tunable Downconverters for Tailored Lighting
<b>Matthew Suttinger</b>	Semi-empirical model projections of high power quantum cascade lasers
<b>Eduardo Castillo Orozco</b>	Subwavelength focusing by microdroplets carrying semiconductor nanoparticles for deposition on flexible substrates
<b>Clay French</b>	Fabrication of transparent magneto-optical YIG ceramics
<b>Stefan Gausmann</b>	Multicore fiber saturable absorber for all-fiber normal dispersion femtosecond fiber lasers
<b>Evan Hale</b>	Femtosecond laser transverse mode conversion by an achromatic volume phase mask
<b>Fedor Kompan</b>	High-efficiency holographic optical elements recorded in photo-thermo-refractive glass by visible radiation
<b>Ian Khaw</b>	Flat-field illumination microscopy for large field-of-view quantitative imaging
<b>Zheyuan Zhu</b>	Volumetric X-ray diffraction tomography using a low-brilliance table-top source
<b>Haley Kerrigan</b>	Enhanced ablation with a femtosecond-nanosecond dual-pulse
<b>John Beetar</b>	Compression of Yb:KGW Laser Pulses with Multi-Plate and Hollow-Core Fiber Compressors
<b>Chi Xu</b>	Silicon nitride grating couplers with high efficiency and broad bandwidth
<b>Benjamin Croop</b>	Endogenous alpha-synuclein analysis using single-molecule pull-down assay
<b>Sajad Saghave Polkoo</b>	Hybrid Organic-Inorganic Perovskite LEDs
<b>Qitian Ru</b>	Optical parametric oscillation in a random polycrystalline medium: ZnSe ceramic
<b>Hao Chen</b>	Quantum Dot Light Emitting Devices (QLEDs) for Photomedical Application
<b>Jialei Tang</b>	Clear 3D single-molecule imaging inside cells with an extended imaging area via highly inclined swept illumination
<b>Nafiseh Mohammadian</b>	Performance Modeling of Terahertz and mm-Wave for pupil plane Imaging
<b>Mina Bayat</b>	Cryogenic (4 K) Performance Projections for Ultra-Small Cavity Oxide-Free VCSELs
<b>Nicolette Fudala</b>	UAV Infrared Signature and UAV Detection and Tracking Data Collection and Analysis
<b>Marcin Malinowski</b>	Nonlinear integrated optics for frequency comb offset stabilization
<b>Zhao Ma</b>	Vertically-stacked Anti-Polar Diode(VAD) Pixel for Organic Semiconductor Image Sensors
<b>Ashutosh Rao</b>	Broadband photon-pair generation on a silicon chip using nanophotonic periodically-poled lithium niobate waveguides
<b>Robert Short</b>	Evaluation of Triangle Orientation Discrimination for Field Testing of Imager Performance
<b>Natalia Munera Ortiz</b>	Broadband Near-Infrared Supercontinuum for Z-Scan Nonlinear Spectroscopy
<b>Shima Gholam-Mirzaei</b>	Anisotropic Polarization Dependence of High Harmonic Generation in Ferroelectric Crystal BaTiO <sub>3</sub>



Participants at the Industrial Affiliates Symposium on Day Two.



## INDUSTRIAL PROJECTS

In Fiscal Year 2018, CREOL had industry sponsored research totaling over \$4.7M. 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.

RECEPIENT	SOURCE	TITLE OF AWARD	BEGIN	END	AWARDED
PI: Abouraddy, Ayman	Corning, Inc.	Glass Polymer Composite Fibers	12/21/2017	8/30/2018	\$40,000
PI: Abouraddy, Ayman	Harris Corporation	Mako Prime 1	3/5/2018	10/31/2018	\$165,830
PI: Abouraddy, Ayman; CoPI: Li, Atia	Harris Corporation	Strong Ultra-Small Highly Integrated (SUSHI) Phase 2 Fiber Optic Cable (Prime 1)	4/30/2017	12/15/2018	\$1,797,320
PI: Bass, Michael	TRUMPF, Inc.	Modeling studies of Yb-doped slab amplifiers to determine spatially resolved inversion and spatially resolved gain profile....	9/15/2017	1/14/2018	\$49,449
PI: Crabbs, Robert F	Aegis Technologies Group, Inc.	ARI: Testing at SLF	3/9/2017	8/31/2017	\$4,800
PI: Crabbs, Robert F	Aegis Technologies Group, Inc	ARI: Testing at SLF	3/9/2017	10/31/2017	\$73,697
PI: Crabbs, Robert F	Saab Defense and Security USA LLC	SLF Testing	1/2/2018	1/31/2018	\$7,191
PI: Crabbs, Robert F	Inertial Labs, Inc	Testing Support for Next Gen MILES	10/28/2017	10/27/2018	\$297,600
PI: Crabbs, Robert F	Booz Allen Hamilton, Inc.	Testing, TISTEF and SLF	1/1/2018	3/31/2018	\$33,294
PI: Divliansky, Ivan; CoPI: Glebov	IPG Photonics	Spectral Beam Combining of Multi-Kilowatt Class Lasers by Volume Bragg Gratings	3/1/2018	2/28/2019	\$290,000
PI: Driggers, Ronald G	IMEC	IPA: Ron Driggers IMEC Support	8/8/2017	5/31/2019	\$154,035
PI; Driggers, Ronald G	DRS Network & Imag- ing Systems, LLC	Longwave Infrared Pitch-Well-Processing (PWP) Proof of Concept	11/9/2017	12/30/2018	\$190,000
PI: Driggers, Ronald G	St. Johns Optical Systems, LLC	Redstone Infrared Signature and L3 IRST Calcu- lation Support	9/1/2017	5/31/2018	\$45,371
PI: Driggers, Ronald G	L3 Technologies	Research Support for L3 Technologies Infrared Search and Track and UAV Detection Efforts	4/19/2018	8/31/2019	\$296,600



PI: Fathpour, Sasan	Partow Technologies, LLC	Advanced QPSK Optical Modulators Based on Thin Film Lithium Niobate (SBIR Phase 2)	5/25/2016	6/9/2018	\$120,000
PI: Fathpour, Sasan	Harris Corporation	Photonic Integrated Circuit Lithium Niobate (LN) Modulator on Silicon (Si) Substrates for RF Photonic Systems	1/1/2018	6/30/2019	\$25,000
PI: Gaume, Romain : CoPI: Christodoulides, Richardson, KI,	Lockheed Martin Missiles and Fire Control	Perform a trade-study with modeling and simulation of high-birefringent infrared materials	7/5/2017	12/22/2017	\$33,000
PI: Gaume, Romain; CoPI: Christodoulides, Richardson, K.	Lockheed Martin Corporation	Fabrication of Highly Birefringent Infrared Materials (Phase 1)	1/2/2018	10/31/2018	\$30,700
PI: Glebov, Leonid B; CoPI: Divliansky	IPG Photonics	Development of photo-thermo-refractive glass for high efficiency volume holographic elements	8/1/2017	11/30/2018	\$280,000
PI: Li, Guifang	Fujitsu Laboratories America, Inc.	RF: Fijitsu gift for research in the area of few mode fiber amplifier and related optical communications technology	5/1/2018	4/30/2019	\$50,000
PI: Richardson, Kathleen A.	Lockheed Martin Missiles and Fire Control	Advanced Materials IRAD – Broadband Gradient Index (GRIN) Optics Characterization (Broadband GRIN #5)	1/26/2018	12/1/2018	\$20,000
PI: Richardson, Kathleen A.	Lockheed Martin Missiles and Fire Control	Advanced Materials IRAD - Broadband Gradient Index (GRIN) Optics	3/3/2017	12/22/2017	\$13,976
PI: Richardson, Kathleen A.	Various	RF K. Richardson Equipment Use Account	1/1/2015	12/31/2018	\$43,290
PI: Richardson, Martin C	EoL Co., Ltd.	High Power Thulium Laser Marking System Development for Visibly Transparent Polymers	9/1/2017	12/31/2018	\$182,000
PI: Schoenfeld, Winston V	Lightwave Photonics, Inc.	Ultraviolet III-Nitride Avalanche Photodiodes formed by a selective HfN substrate release layer	1/10/2018	6/11/2018	\$45,000
PI: Schülzgen, Axel	Multicore Photonics Inc	Multicore Fiber for Sensor Applications	7/1/2017	8/31/2017	\$3,434
PI: Wu, Shin-Tson	Intel Corporate Research Council	Fast-response liquid crystal devices for light field displays	11/15/2016	11/14/2019	\$75,000
PI: Wu, Shin-Tson	GoerTek, Inc.	Near-Eye Displays	12/1/2017	11/30/2020	\$360,000

## 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 2018 clients:

### LC MATTER CORP.

LC Matter Corporation 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](http://www.lcmatter.com)

### OLKIN OPTICS, LLC

Olkin Optics is developing specialty fiber optics and fiber components for telecommunications, sensing, medical and laser applications. Contact: [info@olkinoptics.com](mailto:info@olkinoptics.com)

### PLASMONICS, INC.

Plasmonics 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: James Ginn. [www.plasmonics-inc.com](http://www.plasmonics-inc.com)

### SDPHOTONICS LLC

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

### LAMBDA PHOTONICS

Lambda Photonics (Scott Webster and Kenneth Schepler) is a research and development business solution for the manufacture and development of various optical systems, visible to mid-infrared, with the possibility of custom manufacturing after a full inspection the project scope is understood. The company has recently been awarded an STTR by partnering with Ayman Abouraddy of CREOL. They are also pursuing additional funded future challenges.

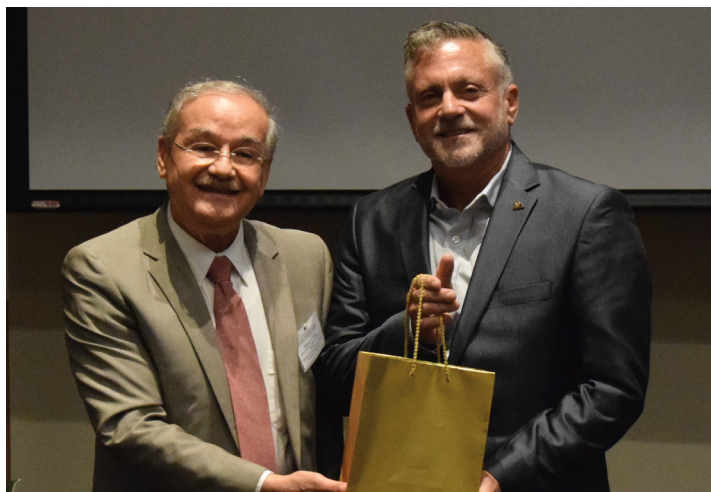
### ANDRITZ POWERLASE, INC

A subsidiary of Andritz Powerlase Holdings in the UK, focuses on the manufacturing high power solid state and fiber lasers for industrial laser applications, including automotive, aerospace and semiconductor-display manufacturing. Contact: Young Kwon

## ALUMNI NEWS

### Richard DeSalvo Receives the 2017-2018 Distinguished Alumni Award

Richard DeSalvo head of the Microwave Photonics Group at Harris Corporation in Melbourne, FL. He was one of CREOL’s first Florida native graduate students, and among the first to obtain the PhD in Physics at UCF in 1993. Dr. DeSalvo is a leader in the areas of microwave photonics integration, coherent lightwave communications, and virtual photonics. He continues strong interactions with CREOL, The College of Optics and Photonics as a Graduate Faculty Scholar, and he has lead partnerships with our faculty on major federal contracts. Dr. DeSalvo continues to give our students, both undergraduates and graduates, opportunities for internships at Harris as well as long-term employment. Currently at least nine of our graduates, or current students, are working in his group.



Bahaa Saleh and Alumni Award recipient Richard DeSalvo (r).

### CREOL Alumni Reunions

CREOL maintains an ongoing relation with its alumni. The online CREOL Highlights Newsletter, which is produced several times a year, is distributed to all alumni, and alumni profiles and alumni news are posted on the CREOL website. Alumni are invited to the Industrial Affiliates Day and alumni reunions are held at various locations during key meetings of professional societies. In 2018, a reunion was hosted on January 29 during the SPIE Photonics West meeting in San Francisco (at The Thirsty Bear Restaurant) with about 91 guests attending. At the CLEO meeting in San Jose, the alumni reunion was held on May 14 at the Gordon Biersch Brewery Restaurant.



Jannick Rolland (l), Guifang Li (c), and Jason Eichenholz (r) at the CREOL Alumni Reunion at Photonics West in San Francisco.

## COLLEGE EVENTS

### Second George Stegeman Symposium

This symposium is the second in a new series dedicated to the work and passion in optics shared by Dr. George Stegeman. Professor Stegeman was a world-renowned leader and pioneer in nonlinear optics and photonics. He 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 Association of Physics, and UCF's Researcher of the Year award. He received his PhD from the University of Toronto, along with honorary doctorates from NRS University in Canada and INAOE in Mexico. February 12-13.



Attendees at the Second George Stegeman Symposium in February.

## VISITORS

### Industry Visitors

- ▲ Will Suleiman, ASML, February 5
- ▲ Ankush Oberai, Synopsys Inc., February 20
- ▲ Jeff Crystal, Elbit Systems of America, February 26
- ▲ Eduardo Oteiza, Vescent Photonics, March 1
- ▲ Kyle Merritt, Ocean Optics, March 14
- ▲ Gustavo Kozuka, Kenko Patto LLC, March 15
- ▲ Gary Breton, Aurora Semiconductors, April 10
- ▲ Andrey Matsko, OEwaves Inc., April 16
- ▲ C.A. Vossberg, Electron Machine Corporation (EMC), April 30
- ▲ Paul McManamon, Exciting Technology LLC, June 29
- ▲ Ankush Oberai, Synopsys Inc., September 10, October 24
- ▲ Brittany Keller, Luminar, September 27
- ▲ Junho Jeong, Keunwoog Kim, LG Innotek, October 18
- ▲ Alex Haber, Magic Leap, October 23
- ▲ Bruce Chai, Crystal Photonics, November 14
- ▲ Neil Jetter, Jetter & Associates, P.A., November 15
- ▲ Jay Silverman, Optronics Laboratories, November 15
- ▲ Yoon Won Suh, Chae Lee, Scott Lee, LG Electronics, November 28
- ▲ Niklas Waasem, HÜBNER Photonics, December 11

### University and Research Center Visitors

- ▲ Christiano J. S. de Matos, Mackenzie Presbyterian University, February 1
- ▲ Chia-Wei Hsu, Yale University, February 2
- ▲ Sang Hak Lee, University of Illinois at Urbana-Champaign, February 8
- ▲ Daniel Wasserman, University of Texas, Austin, February 9
- ▲ David Burghoff, Massachusetts Institute of Technology, February 15
- ▲ Miguel A. Bandres, Technion – Israel Institute of Technology, March 5
- ▲ Haitan Xu, Yale University, March 9
- ▲ Yun-Sheng Chen, Stanford University, March 22
- ▲ Chandra Roychoudhuri, University of Connecticut, March 29
- ▲ Jürgen Czarske, Technische Universität Dresden, April 2
- ▲ Jean-Claude Diels, University of New Mexico, April 17
- ▲ Jianda Shao, Meiping Zhu, Shanghai Institute of Optics and Fine Mechanics (FIOM), April 19
- ▲ Yang Zhao, Stanford University, May 04
- ▲ Vitaly Gruzdev, University of Missouri, May 07
- ▲ Yoshio Hayasaki, Prof. Yamamoto, Utsunomiya University, June 29
- ▲ Boris Gramatikov, Johns Hopkins, June 29
- ▲ Antonio Vidiella-Barranco, Universidade Estadual de Campinas (UNICAMP), July 5
- ▲ Christian Nijhuis, National University of Singapore, August 20
- ▲ Kang Taek Lee, GIST Korea, August 24
- ▲ Gisele Bennett, Florida Tech/Georgia Tech, August 24
- ▲ Paul Voyles, University of Wisconsin, October 5
- ▲ Jianrong Qiu, Zhejiang University, October 15
- ▲ Kun Zhao, Chinese Academy of Sciences, October 16
- ▲ Guangming Tao, Huazhong University of Science and Technology, November 2
- ▲ Jean-Claude Diels, University of New Mexico, November 19
- ▲ Jean-Jacques Zondy, Nazarbaev University, December 4

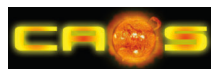
### Government Visitors

- ▲ Christian Keyser, AFRL, April 17
- ▲ Michael B. Cooney, Elevate Lake Economic Development, April 30
- ▲ Yehuda Braiman, Oak Ridge National Laboratory, July 23
- ▲ Christian Keyser, AFRL, August 6
- ▲ Thomas Russell, Army, August 27
- ▲ Yehuda Braiman, Oak Ridge National Laboratory, September 11, October 23
- ▲ Bindu Nair, OSD, October 19
- ▲ Sarwat Chappell, ONR, December 4
- ▲ Benjamin Lionel, Jagannath Nayak Govt. of India, Ministry of Defense, December 4



# STUDENT ORGANIZATIONS

The various student organization host annual events like optics day and the fall picnic but they also organize special events listed on the following pages. Furthermore, for the first time, the Women in Laser and Optics (WiLO), chapter received the competitive Women in Optics Activity Grant from SPIE, as a result of a joint effort of the SPIE Student Chapter and WiLO, under the umbrella of CAOS.



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 six optics and photonics societies listed below.

President: Zheyuan Zhu  
Vice President: Charles Volz  
Treasurer: Jessica Peña  
Event Manager: Sanaz Faryadras  
Webmaster: Ning Wang  
Secretary: En-lin Hsiang  
Faculty Advisor: David Hagan



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: Chenyi Zhang  
Vice President: Zheyuan Zhu  
Treasurer: Lawrence Trask  
Secretary: J.C. Alvarado-Zacarias  
Webmaster: Sandy Cline  
Faculty Advisor: Kyle Renshaw



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: Nicolette Fudala  
Vice President: Ning Wang  
Treasurer: Yuanhang Zhang  
Secretary: Vahid Ebrahimi  
Webmaster: Ehsan Ordouie  
Faculty Advisor: Eric Van Stryland



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: Stefan Gausmann  
Vice President: Sanaz Faryadras  
Treasurer: Nicholas Cox  
Secretary: Kamal Abdelsalam  
Webmaster: Weiyu Chen  
Faculty Advisor: M.J. Soileau



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: Samuel Knight  
Vice President: Charles Volz  
Secretary: Teodor Malendevych  
Treasurer: James Aurilio  
Outreach: Cesar Lopez-Zelaya  
Faculty Advisors: Stephen Kuebler  
Mike McKee



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: Kun Yin  
Vice President: En-lin Hsiang  
Treasurer: Jianghao Xiong  
Secretary: Yannanqi Li  
Webmaster: Junyu Zou  
Faculty Advisor: S.T. Wu



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: Salimeh Tofighi  
Vice President: Jessica Peña  
Treasurer: Mahed Batarseh  
Secretary: Sanaz Faryadras  
Webmaster: Weiyu Chen  
Faculty Advisor: Nafiseh Mohammadian  
Kathleen Richardson

## EDUCATIONAL OUTREACH

### Seminole County Science Fair

CREOL students Aaron Coville, Charles Volz, and Zheyuan Zhu volunteered to judge the engineering and physics category during the annual Seminole County Science Fair. A total of 310 students from 7th to 12th grade showcased their science projects during the fair. February 3.



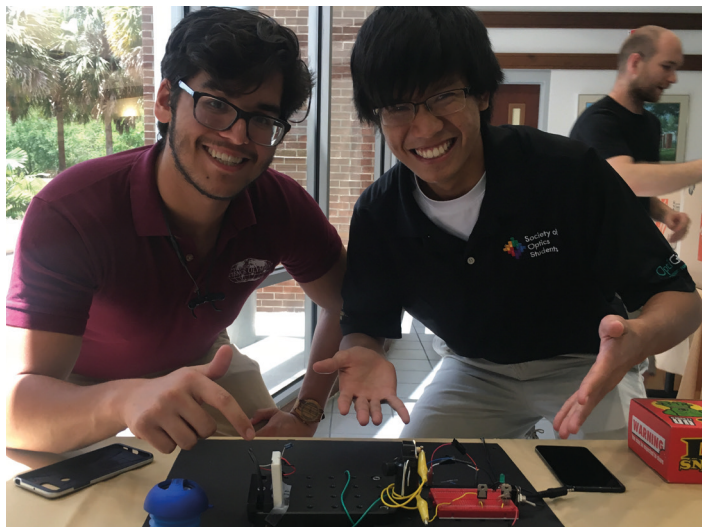
CREOL student Aaron Coville, Charles Volz, and Zheyuan Zhu (left to right) volunteered as judges for 2018 Seminole County Science Fair.

### Florida Science Olympiad

The College of Optics and Photonics sponsored the Florida Science Olympiad State Tournament. Middle and high school students compete in 23 science and engineering events and vie for honors to attend the national tournament. UCF hosted 84 schools around the state of Florida, with nearly 2000 spectators and participants in attendance. March 24.

### Optics Day

CREOL opened its doors to the public for the annual Optics Day, a fun-filled event of lab tours, optics demos, and talks from CREOL faculty members and students. Introductory talk presented by Dr. Saleh followed by lab tours of the Fiber Optics Lab, Liquid Crystal Displays Lab and Optical Nanoscopy Lab. The lobby hosted various



Austin Singh (I) and Duc-Quy Nguyen demonstrate Free-Space Optical Communication at Optics Day in April.

demonstrations contributed by IEEE Photonics Society and CREOL students. Dr. Delfyett presented a lecture on lasers, and a Q&A session on optics career paths by Mike McKee. In addition to the 50 on-site attendees from local high schools, community colleges and other UCF undergraduate programs, this year's optics day was livestreamed into classrooms across the state, reaching more than 240 students as part of a fascinating, interactive, and educational experience. April 13.

### Optics Sponsorship at Science Olympiad National Tournament, Fort Collins, Colorado

CREOL, SPIE, and OSA sponsored the Optics events at the Science Olympiad National Tournament hosted at the Colorado State University, Fort Collins, CO. This was an effort to spread the word about optics and photonics as a career. Two high school and two middle school students received \$1000 each for their top honors in the event. May 20.

### Camp Connect II CREOL Session

The Center for Initiatives in STEM welcomed 28 high school students to the UCF main campus for Camp Connect II. The purpose of the camp is to immerse students from underrepresented communities into a deeper level of understanding and application



Campers attempt to create a hologram using a red laser and legos.

of the various engineering and computer science disciplines. Camp Connect II is designed to be an extension from Camp Connect I, thus reinforcing concepts previously learned as well as introducing more in-depth concepts. For a third year, the college showed their support by developing and hosting a two-hour session, led by undergraduate student C.J. Volz.

During the session, students focused on imaging, a relatively basic and old area of optics and photonics. Students were engaged in presentations discussing various light concepts, demonstrations that allowed students to understand how scientists know which elements and compounds constitute the sun, and activities such as using lenses and images at the front of the room to measure the refractive index of glass. Additionally, graduate student Zheyuan Zhu led the students through a challenging activity on making a holographic image using a red laser, Legos, and holographic glass. June 25-29



## **SPIE/OPTIKS Workshop**

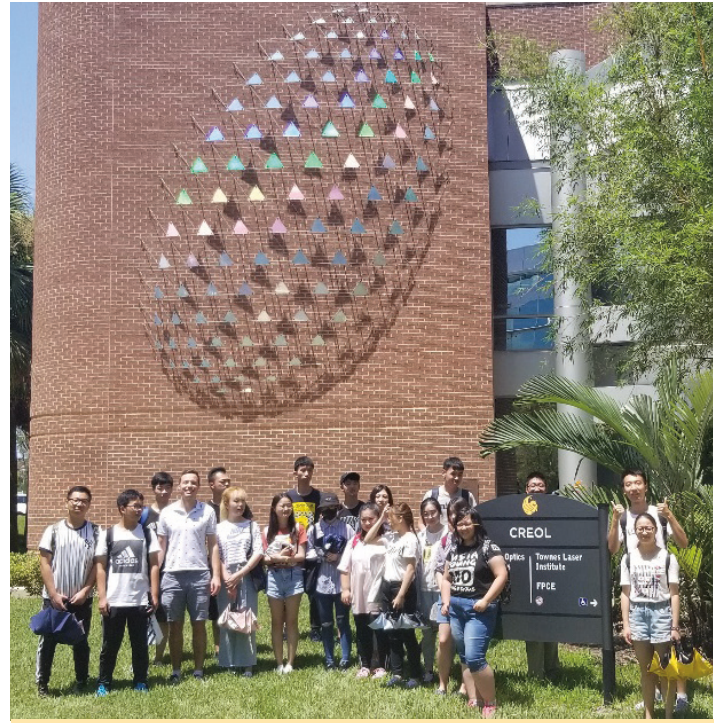
The OPTIKS workshop (Outreach for Professionals who Teach in Informal environments and K-12 Schools) attracted industry professionals with the goal to learn how to effectively present activities in optics and photonics that will maximize engagement and training skills. August 20.

## **SPIE/COP Outreach Workshop**

Mike McKee presented a workshop at SPIE San Diego on the basics of light. Graduate students and local elementary teachers attended this 4-hour workshop and learned about the electromagnetic spectrum, lenses and mirrors, and how light travels. Participants were given a light kit from SPIE and a book of lesson plans from CREOL. August 21.

## **STEM Days**

Society of Optics Students gave 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 discovered the answer to the question: How do we know what the sun is made from? March 30 and October 26.



Students from Seijoh University in Japan visited CREOL in August.

# **STUDENT PROFESSIONAL DEVELOPMENT**

## **Professional Development Workshop**

This workshop was about how to adult, network and get the job you want. Tips on networking, time management/organization and interviewing skills were discussed, before the participants split into small activities on each topic. Resume critiques were conducted at the end of the workshop. Sponsored by SOS. January 23.

## **BRIDG/IMEC Industry Tour**

BRIDG is the world's first industry-led smart sensor consortium. They are a non-profit organization created to support research and commercialization for industry and academic customers. Their primary focus is the development of advanced smart sensor technologies in their state-of-the-art cleanroom facilities. BRIDG is currently home to IMEC Florida, which is included in the tour. IMEC is a global leader in nanotechnology research and development. Sponsored by SPIE Student Chapter. February 23.

## **LabVIEW Workshops**

WiLO hosted its first of a series of LabVIEW workshops. The first session was instructed by Mohammad Hokmabadi, CREOL Postdoctoral Researcher, and provided an introduction to LabVIEW followed by some examples to help with research work. The second session was instructed by CREOL graduate student Fedor Kompan. This workshop demonstrated the use of LabVIEW in real experimental scenarios. Topics including the basics of using LabVIEW for data acquisition, processing and visualization, along with hands-on demonstrations. Handout of the workshop material were provided. March 8 and October 26.

## **Mock Interviews with Northrop Grumman**

In this workshop, Society of Optics Students invited five Northrop Grumman interviewers to evaluate resumes and interviewing skills. After the mock interview, they provided feedback on the performance/resume of the attendees. March 20.

## **Luminar Industry Tour**

The SPIE Student Chapter hosted a tour of Luminar's research and manufacturing facilities in Research Park. Luminar is currently developing LIDAR technologies for the autonomous vehicle market. More than 20 students joined the tour to see the next-generation LIDAR product Luminar is developing. March 30.

## **Mock Interviews with Elbit Systems of America**

Elbit Systems of America came to conduct "mock" or practice interviews for CREOL students. This provides a great opportunity for both undergraduate and graduate students to practice their interviewing skills and to have their resume critiqued. Sponsored by SOS. April 16.

## **Informational meeting on graduate school at the University of Arizona**

This meeting was geared towards undergraduate students who are interested in going to graduate school in pursuit of a degree in optics. Prof. Rolf Binder from the University of Arizona gave a brief overview of research areas at the College of Optical Sciences, and discussed several aspects of graduate studies, including course and lab requirements, recommended course sequences, funding and fellowships, as well as exam requirements. Sponsored by SOS. April 18.

## **Optics & Photonics Demo Design Competition**

IEEE Photonics Society Student Chapter hosted a Demo Design Competition to encourage undergraduate and graduate students to design and build creative demonstrations that showcase some aspect of optics and photonics. In this competition, participants were sponsored to design and build their own demos of a particular optics concept. These demos were presented at CREOL's Optics Day and are placed in the CREOL lobby for future CREOL outreach programs and permanent display. April 19



## Newport Professional Development Panel

Society of Optics Students invited Newport's technical sales team in Lake Mary, FL to CREOL for a panel discussion on career opportunities in the field of optics and photonics. The speakers discussed their academic background and working experiences after graduation. The discussion lasted for 2 hours, and the Newport team answered career/recruiting-related questions from CREOL undergraduate and graduate students based. Sponsored by SOS. October 16.

## Graduate Student Panel

Society of Optics Students invited CREOL graduate students Rachel Sampson, Alex Sincore, Patrick Roumayah and Robert Grimming to present to their members on the life as a graduate student and the graduate school application process. The panelists discussed the average day of a graduate student, how to prepare to be accepted into the top graduate schools and provided insight on what a selection committee looks for in graduate student applications. November 14.

## Undergraduate Research Panel

Society of Optics Students invited undergraduate students Zachary Labossiere, Austin Singh, Nick Kosan and Teodor Malendevych to give a talk on the importance of participating in undergraduate research. The panelists discussed their research experiences and how to become involved in research both at UCF and at other research institutions. November 19.



Demonstration of coherence in the exhibit design contest sponsored by SPIE Student Chapter. Ryan Ellis and Zheyuan Zhu won second place in the contest.

## PROFESSIONAL SOCIETY TALK SERIES

### The Mid-Infrared as an Optical Playground, by Daniel Wasserman, University of Texas Austin

In this talk, Prof. Wasserman discussed recent work developing novel optoelectronic, all-dielectric, plasmonic and phononic devices and structures for mid-IR wavelength applications. He demonstrated that mid-IR provides a unique materials playground for the exploration, and implementation of a range of light-matter interactions. Sponsored by IEEE Student Chapter. February 9.

### Harnessing Light for a Better World by Marc Himel, Jenoptik

The first optical devices date back 2700 years while the laser was invented just 50 years ago. Advances in these technologies in the 20th century that are continuing (and perhaps accelerating) today have led to the development of products and systems that impact our lives on a daily basis. From vision enhancement to early disease diagnosis, from gaming interfaces to high speed communication networks, from renewable energy to enhanced security, from the cosmic scale to the molecular level, optical science and engineering is a fertile ground for the creative scientist and engineer. The talk provided an overview of how our world today is impacted by optics and lasers and how optics can assist with some of the greatest engineering challenges we face in the coming decades. Sponsored by SOS. February 13.

### Optically Chopped PIR Sensor for Occupancy Detection by Ya Wang, The State University of New York, Stony Brook University

Passive infrared (PIR) sensors are the current choice for occupancy presence detection in buildings. The sensors are popularly used for controlling lighting, heating and cooling based on occupancy. A major problem is that these PIR sensors only detect individuals who are moving, which may provide false negative detections and inaccurate occupancy estimation, resulting in uncomfortable lighting/temperature swings, short lifetime of the equipment, and waste of energy. To address this issue, this talk presented

a new type of optically chopped PIR sensor, equipped with an electronic shutter and machine learning technologies that enable fast and accurate occupancy detection including individuals who are stationary. Sponsored by SID Student Chapter. February 14

### A guide to publish your work in peer-reviewed journals, by David Hagan and Ronald Driggers, CREOL/UCF

The SPIE student chapter hosted a workshop lead by Drs. Hagan and Driggers on how to write and publish research papers in peer reviewed journals. Sponsored by SPIE Student Chapter. February 15.

### Novel laser systems using digital wavefront shaping by Juergen Czariske, Technische Universität Dresden

This presentation covered recent advances in digital control of coherent light and novel adaptive laser systems for different application areas; mode conversion in multimode fiber transmission lines and its utility for physical layer security and space division multiplexing, lens-less endoscopy with multi-core fibers, adaptive focusing through a fiber for the stimulation of neurons by means of optogenetics, and the development of smart microscopes for the acquisition of structural and physiological information such as mechanical mapping of tissue by use of Brillouin scattering. April 2.

### Women in Optics & Photonics, by Elizabeth Rogan, Chief Executive Officer, OSA

From the political arena to Hollywood to the sciences, gender equity has become a predominant focus of thought leaders worldwide, but change has been incremental. Scientific societies have a responsibility to improve the participation of women in STEM fields like optics and photonics. The Optical Society along with its sister societies are making an impact by focusing on the participation of women in our programs and honors. Liz Rogan shared insights regarding OSA and its partners' initiatives. Sponsored by WiLO. April 19.

## **100 days in Antarctica by Sönke Wittek, Becker Marine Systems**

This talk shared experiences from the recent 4-month long stay at the German Neumayer Research station on the Antarctic shelf ice. While Mr. Wittek was supporting the efforts to prepare the station for the Antarctic winter, he was also exposed to ongoing research, wildlife and the daily whereabouts of human life below 70-degree latitude. Sponsored by SPIE Student Chapter. April 24.



SPIE seminar "100 days in Antarctica"

## **"Career Planning: An Academic Leader's Perspective", by Daniel M. Litynski, Western Michigan University**

Where will we be in five, ten or twenty years? What do we want to do (Vision), where do we want to go (Mission), and how do we get there (The Plan)? Will we be in industry, government, academia, or an entrepreneur (or perhaps be more than one)? Will we lead, follow, or make a difference to the technology development? What are decision makers looking for when they hire someone? Dr. Litynski shared his perspective and experience of over forty years as a leader in university and government organizations. He is responsible for hiring, managing, and evaluating hundreds of personnel and for budgets worth millions of dollars. Sponsored by SPIE Student Chapter. May 4.

## **Distinguished Seminar: Photonic Integrated Devices and Systems: Technology for next Generation Telecom Networks by Ghanshyam Singh, Malaviya National Institute of Technology, Jaipur, India**

Telecommunications networks and systems are seeing extreme increase in network traffic which is growing at the tremendous rate of 30% per year. It is estimated that the energy and cost requirements will increase tenfold in coming ten years. In this seminar, Prof. Singh introduces the technological advancements in Photonic Integrated Circuits (PICs), which is a popular choice for components of next generation networks. Due to robustness, flexibility, reliability and performance of PICs, many commercial solutions are now available for a variety of applications. In coming years, it is expected that the field will continue to advance and communication networks may see a shift from electronic to all-optical/electro-optic network infrastructure. Sponsored by IEEE Student Chapter. May 29

## **"High average power pulsed multi-mode Raman fiber laser in graded index fiber", by Patrick Roumayah and "Generation and characterization of isolated attosecond pulse in the soft X-Ray regime", by Jie Li**

In this series of talks sponsored by the student chapter of OSA, CREOL graduate students presented on research they have been conducting. The purpose of the symposium is to internally educate our researchers, promote collaboration, and give students practice at presenting. Sponsored by OSA Student Chapter. May 31.

## **Applications of Interferometric and Non-interferometric Methods for 3D Imaging by Partha Banerjee, University of Dayton**

In this talk both interferometric and non-interferometric methods for 3D imaging were discussed, with particular emphasis on multi-wavelength digital holography and transport of intensity. Multi-wavelength digital holography is applied to reconstructions of various objects. Besides demonstration of very large and very small synthetic wavelengths, of particular recent interest is the 3D reconstruction of level 3 details in latent fingerprints. Other applications of multi-wavelength digital holography resulting from realization of very small and very large synthetic wavelengths were discussed. Applications of digital holographic tomography to 3D virtual reality was demonstrated. Also, it was shown how the transport of intensity equation, along with its coupled transport of phase equation can be used to obtain better estimates of imaged phase and 3D profiles. Sponsored by WiLO. June 28.

## **Lidar, an up and coming, multi-phenomenology, sensor by Paul McManamon, Exciting Technology LLC**

The main lidar components are a laser, a receiver, aperture, and processing system. Some interesting types of lidar are range only lidar, two dimensional lidar, 3D lidar, and laser vibrometer. The most popular current application of Lidar is the driverless car. Luminar, right in Orlando, is one of the contenders in that area. 3D mapping is another commercial application. It is expected that lidar will be useful in the exploration and extraction of fossil fuels. Lidar is a revolutionary sensor that is coming into its time. Sponsored by SPIE Student Chapter. June 29.

## **Polarization-sensitive scanning of the retina – from moving to no-moving part designs by Boris Gramatikov, Wilmer Eye Institute, John Hopkins University**

This talk was about utilizing the birefringent properties of the human fovea in the design of ophthalmologic diagnostic instrumentation. His laboratory is developing novel technologies for Retinal Birefringence Scanning (RBS) - a technique that uses the changes in the polarization state of light returning from the fundus, to detect the projection into space of the radial array of birefringent Henle fibers surrounding the fovea. This allows eye tracking and detection of central fixation using anatomical information directly from the fovea and without calibration, in contrast to other eye tracking methods that employ less accurate pupillary light reflex methods. In a binocular setting, RBS allows precise checking for eye alignment, which is important in testing/screening for amblyopia ("lazy eye"), a major health problem.

The talk focused on two major applications: a) a family of pediatric vision screeners, and b) a combined system where RBS technology is guiding the data acquisition and/or analysis in an Optical Coherence Tomography (OCT) system (in collaboration with Duke University). Both projects include design optimization using

computer model of polarization-sensitive systems, incorporating Mueller matrix modeling and Poincare sphere representation. Sponsored by SID Student Chapter. June 29

### **Coherence Theory as applied to Imaging Systems and Research Career Paths by Gisele Bennett, Georgia Institute of Technology**

Super resolution imaging is a term that has been used for various meanings and has been under debate by the algorithm and optics communities. Dr. Bennet reviewed the super resolution from a coherence imaging approach to exceeding the classical diffraction limit. Of course with most systems, to gain in one parameter usually means a compromise in some other feature. She showed that coherence analysis to an optical system provides insights that would otherwise not be obvious. Sponsored by WiLO. August 24.

### **What International Students Need to Know About the Changing U.S. Immigration Laws, by Scot Silzer, SilzerLaw Chartered, Orlando, FL**

Scot Silzer presented a talk on what international students need to know amid changing U.S. immigration policy, requirements and

regulations related to student visas, work visas and permanent residency. Sponsored by CAOS. October 22.

### **Industrial speaker session “Career in optical engineering” by James Chung, Northrop Grumman Electronic Systems**

IEEE Photonics Society invited CREOL alumnus James Chung to talk about career opportunities with a degree in optics/optical engineering. Mr. Chung demonstrated the application of optical and laser technologies in all the companies he worked with (LaserSight Technologies, CVI Laser Optics and Northrop Grumman Electronic System) since graduation from CREOL. Students attended a luncheon with Mr. Chung for further discussions. Sponsored by IEEE Student Chapter. October 29.

## **STUDENT ORGANIZATION SOCIALS AND MENTORING**

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### **IONS 2019 Election Event**

The International OSA® Network of Students, IONS®, is a series of annual conferences supported by OSA® and organized by OSA® student chapters. The goal of the conferences is to promote networking, and professional and technical development of students. CREOL will host IONS2019 March 11-13, 2019. The IONS2019 Election Event was organized to elect the conference committee. This event was open to all CREOL faculty, students, and staff. February 27.

### **SPIE Social Hour**

The SPIE Student Chapter, along with collaboration from other CREOL student chapters, hosted social hours throughout the year to bring students together. These include snacks, beverages, board/card/video games, and a relaxed atmosphere. These social hours are held to inform students of SPIE's activities and garner new members or volunteers for events. The CREOL/SPIE Social Hours are a long-standing favorite for the close-knit graduate student community at CREOL, with well over 40 attendees at each event. March 9.

### **Staff appreciation breakfast**

CAOS organized a staff appreciation breakfast for the CREOL staff to show gratitude for their wonderful support and outstanding help over the past year. The event was supported by the student chapters at CREOL and the college. March 26

### **CAOS Qualifier Social Hour**

In order to give new graduate students a chance to discuss study strategies with second year PhD students and form study groups, CAOS organized a Qualifier Social Hour. CAOS provided pizza and beverages and more than 30 students participated in this event. May 2.

### **WiLO and Qualifier Exam**

WiLO provided refreshments to the graduate students on the qualifier exam days. June 5, 6.

### **Women in Imaging Social Hour**

Women scientists and professionals in academia and industry attended this social hour. At the meeting, Dr. Giselle Bennett and Ms. Elizabeth Rogan discussed women's role in science and engineering, especially in imaging and optics, throughout the world. The goal is to establish good connections and communications with women scientists. June 26.

### **Demo Design Competition announcement and Social Hour**

Following the success of Demo Design Competition in April, IEEE Photonics Society announced the plan for the second Demo Design Competition for undergraduate and graduate students. To encourage more participation from CREOL students and answer questions they might have about the event, IEEE Photonics Society hosted a social hour during which participants enjoyed pizza and drinks, while playing with the demonstrations from previous Optics Days. October 18.

### **SOS/CAOS Halloween Celebration**

SOS and CAOS joined venture to celebrate Halloween in CREOL after classes ended on Oct. 30. The idea was conceived by SOS president Samuel Knight, in an attempt to bring the tradition of annual CREOL Halloween celebration back after nearly 4 years of absence. The event consisted of a costume contest, dessert contest, a carefully prepared Halloween-themed trivia and social hours open to both undergraduate and graduate students. October 30.

### **CREOL Fall Picnic**

The CREOL Fall Picnic is an annual event organized by CAOS for students, faculty, staff members, friends and family of CREOL. This year's picnic was held at UCF Arboretum, and included great food and diverse activities. November 3.







# CREOL, The College of Optics and Photonics

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