

Annual Report

2013

CREOL

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



Contents

1. Faculty and Staff	2
1.1 Faculty	2
1.2 Research Staff	20
1.3 Administrative Staff	21
2. Academic Programs	23
2.1 Undergraduate Program	23
2.2 Graduate Programs	24
3. Research	35
3.1 Research Centers	35
3.2 Areas of Research	35
3.3 Laboratories & Facilities	37
3.4 Research Highlights	40
3.5 Publications and Presentations	45
3.6 Patents and Disclosures	61
3.7 Research Funding	64
3.8 Affiliated Research Centers	69
4. Partnership & Outreach	71
4.1 Industrial Partnership	71
4.2 Alumni Relations	76
4.3 Outreach and Public Service	77
4.4 International Partnership	78
5. CREOL Association of Optics Students	79
5.1 Officers	79
5.2 Educational Outreach	79
5.3 Professional Development	80
5.4 Seminars	81



Reception at CREOL for attendees of the 2013 OSA Frontiers of Optics (FIO), Laser Science (LS) Meeting.



Cover: Photo of an attosecond driving laser in the iFAST lab. See page 42.



Cover: An artistic rendition of an optical beam exerting attractive force on oil drops [by Andrii Pshenychnyi]. See page 44.



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



CREOL, The College of Optics and Photonics, is one of the world's foremost institutions for research and education in optics and photonics. It started in 1987 as the Center for Research in Electro-Optics and Lasers (CREOL) and became a College in 2004, the first such college in the US.

During the last 26 years, CREOL has graduated 244 PhD and 347 MS students. World-renowned for their scholarly contributions to fundamental and applied optics and photonics, the faculty have published 27 books and more than 2,000 journal papers with more than 27,000 citations.

The college has been an exciting place for students to have an outstanding educational experience and to engage in research in a broad spectrum of programs covering materials, devices, and systems

for applications including photonic technologies such as lasers; optical fibers; semiconductor and integrated photonic devices; nonlinear and quantum optics; and imaging, sensing and display. These technologies have applications in industry, communication and information technology, biology and medicine, energy and lighting, aerospace, and homeland security and defense. Advanced topics such as nanophotonics, attosecond optics, plasmonics, and biophotonics, are embraced as areas of strength and future growth. We are well positioned to take advantage of the revolution that is taking place in several fields enabled by optics and photonics. The College houses the Florida Photonics Center of Excellence (FPCE) and the Townes Laser Institute.

CREOL was initially founded to promote growth in optics and related fields here in central Florida and has maintained this tradition over the years. We provide the well-trained workforce that keeps the industry growing. The Florida Photonics Cluster is working to coordinate this industry's efforts and needs, and we also receive strong support from the Florida High Tech Corridor Council and Enterprise Florida. Since the founding of CREOL more than **170** industrial partners were affiliated with us and the faculty produced close to 250 patents, and spun off 23 photonics-based companies involving a wide variety of technologies. Five companies are incubated within the CREOL facilities.

Highlights of 2013 centered about the initiation of a new undergraduate program – *BS degree in Photonic Science and Engineering*. This is a joint program with the College of Engineering and Computer Science designed to fill the growing need for photonics engineers. The first class, *Introduction to Photonics*, was offered in Fall 2013, along with a companion laboratory.

Another key highlight is the appointment of Dr. Konstantin Vodopyanov, an expert in nonlinear optics and biophotonics applications from Stanford University, in January 2013, as the 21st Century World Class Scholar endowed Chair.

The faculty continue to receive prestigious awards and recognitions at the national and international level. This year, two CREOL faculty received honorary degrees. Martin Richardson was vested with a *Docteur Honoris Causa* of the University of Bordeaux in France, and George Stegeman received an honorary degree from INRS University in Canada. Also, the prolific spirit of innovations of our faculty continues to lead to many awards and honors. Michael Bass and Peter Delfyett were named Fellows of the National Academy of Inventors (NAI). Last year, Leonid Glebov, S.T. Wu, and M.J. Soileau were named Charter Fellows of NAI. Martin Richardson received the SPIE Harold E. Edgerton Award for his *significant contributions to the field of high-speed diagnostics of transient dense-plasmas*. I received the OSA C.E.K. Mees Medal for *for lifelong multidisciplinary contributions to statistical optics, quantum optics and image science*. Also, Kathleen Richardson received the Indian Ceramic Society I. D. Varshnei Award. Zenghu Chang became Fellow of OSA, bringing the number of OSA Fellows to 15. Sasan Fathpour received an ONR Young Investigator Award. At the university level, Demetrios Christodoulides was named Pegasus professor, the most prestigious honor given by UCF to a faculty member.

In AY 2012-2013, 123 graduate students were enrolled and 26 PhD degrees and 17 MS degrees were awarded. Our students receive national scholarships and honors. Graduate student Lane Martin was the winner of the OSA 2013 Emil Wolf Outstanding Student Paper

competition at the OSA annual meeting (FIO).

The research performed by the faculty, students, and scientists was disseminated nationally and internationally in 5 book chapters, 192 journal papers, 263 conference papers and presentations, and 34 invited lectures. This year, nine papers were published in Nature journals. Research and educational programs were funded by contracts and grants totaling approximately \$9M in 2013,

Our tradition of innovation has also continued. In 2013, the faculty were inventors or co-inventors of 19 issued patents. UCF has been ranked among the top 25 universities in the world for the number of patents awarded in 2012. The ranking, by the National Academy of Inventors (NAI) and the Intellectual

Property Owners Association (IPO), is based on data from the U.S. Patent and Trademark Office. UCF researchers received 72 patents and were ranked 21st on the list of 100. The rich IP portfolio in optics and photonics has contributed significantly to this ranking.

Our partnership with industry continues to be strong. Approximately \$2.2M are received from industry or from federal grants flow through industrial partners, a connection that gives our students experience and a leg up on industry positions after they graduate. Several companies donated equipment for the new undergraduate laboratories. The annual Industrial Affiliates Day events were attended by about 200 guests and the theme of the symposium was *Lasers in Action*. This year we offered four short courses with 200 attendees.

Last August Congressman John Mica held a Town Hall meeting at CREOL. The National Photonics Initiative and the role of the universities in advancing applications of the optics and photonics technology were discussed. Rep. Mica subsequently wrote an Op Ed in the Orlando Sentinel entitled "Let's be laser focused on photonics for the future." We are delighted!

This annual report provides an overview of the education, research, and partnership activities of the faculty, staff, and students in 2013. Key data are also compared to previous years to show progress and identify trends. Academic data are reported for the academic year AY2013 (Fall 2012, Spring 2013, Summer 2013). Fiscal data, grants, and patents are reported for the fiscal year FY2013 (July 2012–June 2013). Publications are reported for the 2013 calendar year. Selected research contributions that have received media attention in 2013 are highlighted. Information on more recent activities are reported regularly in the College's website *http://www.creol.ucf.edu/*. We hope you can find the information you need in this Annual Report or in the website.





1. Faculty and Staff 1.1 Faculty



Ayman F. Abouraddy Assistant Professor of Optics

PhD, Electrical Engineering, Boston University, 2003

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

http://multiOFD.ucf.edu

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 naopartide synthesis

Other Experience

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

Professional Activities

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

Honors and Awards

- □ Excellence in Reseach Award, CREOL, 2013
- Boston University President University Graduate Fellowship, 1997
- Ralph E. Powe Junior Faculty Enhancement Award



Rodrigo Amezcua Correa Research Assistant Professor of Optics

Ph.D. Optoelectronics, University of Southampton, 2009

r.amezcua@creol.ucf.edu http://www.creol.ucf.edu/ People/images/200x300Portrait/8719.jpg (407) 823-6853

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, CONACYT, Mexico, 2004 http://www. creol.ucf.edu/People/images/200x300Portrait/8719.jpg



Matthieu Baudelet

Research Assistant Professor of Optics

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

baudelet@creol.ucf.edu (407) 823-6910

Research

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

Other Experience

- Secondary joint appointment, National Center for Forensic Science
- Section chair for SciX, conference of the Federation of Analytical Chemistry and Spectroscopy Societies (FACSS)
- President-elect, North-American Society of Laser-Induced Breakdown Spectroscopy
- Member, editorial advisory board of Spectroscopy magazine
- □ Chair-elect, Society for Applied Spectroscopy Lester Strock Award

Honors and Awards

□ 2013 UCF Research Millionaire



Zenghu Chang

Distinguished Professor of Physics & Optics

Ph.D., Optics, Xi'an Institute of Optics & Precision Mechanics, 1988 Zenghu.chang@ucf.edu (407) 823-4442 http://fast.creol.ucf.edu/

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
- D Professor, Department of Physics, Kansas State Univ, 2006-09
- □ Associate Prof. Dept. of Physics, Kansas State Univ, 2001-06
- $\hfill\square$ Assistant Research Scientist, University of Michigan, 1999-01

Professional Activities

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

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



Demetrios Christodoulides

Pegasus Professor of Optics

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 Program Chair, CLEO/QELS, 2012
- □ Committee Chair, CLEO/QELS-QELS5, 2011
- □ Committee Chair, CLEO/IQEC-IQEC5, 2010
- □ Committee Chair, CLEO/IQEC-IQE5, 2009

Honors and Awards

- □ UCF Pegasus Professor Award
- □ OSA's R. W. Wood Prize, 2011
- □ Fellow, Optical Society of America
- □ Fellow, American Physical Society
- □ Provost Research Enhancement Position (PREP) award



Peter J. Delfyett

Trustee Chair and Pegasus Professor of Optics, EE & Physics Ph.D., Electrical Engineering, City University of New York, 1988

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

http://up.creol.ucf.edu/

Research

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

Other Experience

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

Professional Activities

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

Honors and Awards

□ NSF Presidential Early Career Award for Scientists & Engineers

- □ Fellow, OSA, IEEE, APS
- □ APS Edward Bouchet Award
- UCF Pegasus Professor Award



Dennis Deppe

FPCE Endowed-Chair Professor of Optics

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
- □ IEEE Fellow, 2000; OSA Fellow, 2000
- OSA Nicholas Holonyak Award
- □ NSF Presidential Young Investigator Award, 1991
- □ ONR Young Investigator Award, 1991



Aristide Dogariu

Professor of Optics

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

adogariu@creol.ucf.edu (407) 823-6839 http://random.creol.ucf.edu/

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

- □ Fellow of American Physical Society
- □ Fellow of Optical Society of America
- □ Florida Photonics Center of Excellence (FPCE) Professorship





Sasan Fathpour

Assistant Professor of Optics & EE

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

fathpour@creol.ucf.edu (407) 823-6961 http://ipes.creol.ucf.edu/

Research

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

Other Experience

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

Professional Activities

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

Honors and Awards

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



Romain Gaume

Assistant Prof. of Optics & NanoScience Technology

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

gaume@creol.ucf.edu (407) 823-5683 http://opticalceramics.creol.ucf.edu

Research

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

Other Experience

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

Professional Activities

□ Member: SPIE, ACerS

Honors and Awards

Dissertation Thesis Award, 2002.



Leonid B. Glebov

Research Professor of Optics

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

lbglebov@creol.ucf.edu (407) 823-6983 http://ppl.creol.ucf.edu/

Research

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

Other Experience

Founder, Vice President and CTO of OptiGrate Corporation

Professional Activities

- □ Member, SPIE
- Member, Optical Society of America
- Member, American Ceramic Society
- Member, Directed Energy Professional Society

Honors and Awards

- $\hfill\square$ Dennis Gabor Award in Holography
- □ Fellow, OSA
- □ Fellow, American Ceramics Society
- □ Fellow, National Academy of Inventors (NAI)
- Florida Photonics Center of Excellence (FPCE) Professorship



David J. Hagan

Associate Dean of Academic Programs, Professor of Optics & Physics

Ph.D., Heriot Watt University, 1985

hagan@creol.ucf.edu (407) 823-6817 http://nlo.creol.ucf.edu/

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.
- Dependence of the provided and the provi

Professional Activities

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

- Fellow of OSA
- $\hfill\square$ Ranked by ISI as "Highly Cited Researcher"
- □ College of Optics & Photonics Excellence in Research Award (2010–11)



Aravinda Kar

Professor of Optics, MMAE, EECS & Physics

Ph.D., Nuclear Engineering, University of Illinois at Urbana, 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 lightemitters

Other Experience

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

Professional Activities

Member, Laser Institute of America
 Editorials Board Member

Honors and Awards

Fellow, Laser Institute of AmericaNumerous Patents



Mercedeh Khajavikhan

Assistant Professor of Optics

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

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

Research

Nanophotonics and silicon photonics, plasmonics and applied electromagnetics, laser physics, quantum optics, nano fabrication.

Other Experience

□ Post-Doctoral Researcher, University of California, 2009-11

Staff Researcher, University of California, 2012

Professional Activities

- $\hfill\square$ Member, Optical Society of America, SPIE
- Reviewer, Optics letters, Optics Express, Applied Physics letter, IEEE
 Photonics Technology Letter, Applied Optics, Optical Communication, Journal of Optical Society A and B

Honors and Awards

D Norton Fellowship, University of Minnesota, 2005



Pieter G. Kik

Associate Professor of Optics & Physics

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

kik@creol.ucf.edu (407) 823-4622 http://kik.creol.ucf.edu/

Research

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

Other Experience

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

Professional Activities

- □ Editor, Optics Communications
- Member, Materials Research Society

Member, IEEE, SPIE

- Honors and Awards
- 2007 NSF CAREER Award



Stephen Kuebler

Associate Professor of Chemistry & Optics

D.Phil, Chemistry, University of Oxford, 1998

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

http://npm.creol.ucf.edu/

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 of MRS, OSA, SPIE, and ACS
- Chair, Orlando Section of the American Chemical Society
- Marshall Scholarship Selection Committee, Atlanta Region
 Honors and Awards
- □ NSF CAREER Award, January 2008
- □ Teaching Incentive Program Award, UCF, May 2009
- □ Excellence in Undergraduate Teaching Award, College of Sciences, UCF, March 2008
- Marshall Scholar, Association of Commonwealth Universities, UK, 1991
- □ NSF Graduate Fellowship, 1993
- □ Barry Goldwater Fellowship for physical sciences, 1989



Guifang Li

Professor of Optics, Physics & EECS

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

li@creol.ucf.edu (407) 823-6811 http://ofc.optics.ucf.edu

Research

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

Other Experience

- Nonlinear surface polaritons
- Phase conjugation
- □ Nonlinear dynamics

Professional Activities

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

Honors and Awards

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



Patrick L. LiKamWa

Associate Professor of Optics & ECE

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

patrick@creol.ucf.edu (407) 823-6816 http://mgw.creol.ucf.edu/patrick/likamwa.html

Research

Optoelectronics, integrated optics devices with gain using resonant XXX, 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

□ Co-founder, Optium Inc.

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

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

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

Research

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

Other Experience

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

Professional Activities

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

Honors and Awards

- □ Fellow, Optical Society of America
- □ Senior Member, IEEE
- UCF Graduate Teaching Award



Kathleen A. Richardson

Professor of Optics

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

- Member of the Board of Directors Society of Photo-Optical Instrumentation Engineers (SPIE)
- Associate Editor, International Journal of Applied Glass Science
- Advisory Board member, Virginia Tech's Materials Science and Engineering Dept.
- Coordinatings Technical Council, International Commission on Glass
- Image: Member of the Board of Trustees, Alfred University
- President-elect, American Ceramic Society

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



Martin C. Richardson

FPCE Trustee Chair; Northrop Grumman Prof. of X-ray Photonics; Pegasus Prof. of Optics, Physics & ECE; Director, Townes Laser Institute Ph.D., Physics; London, University, 1967

mcr@creol.ucf.edu (407) 823-6819 http://lpl.creol.ucf.edu/

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
- □ Senior Member, IEEE
- Schardin Medal



Bahaa E. A. Saleh

Dean & Director, Professor of Optics

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

besaleh@creol.ucf.edu (407) 882-3326 http://besaleh.creol.ucf.edu

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
- $\hfill\square$ 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

- $\hfill\square$ OSA Distinguished Service Award, 2009
- OSA Esther Hoffman Beller Medal, 1999
- Kuwait Prize, 2006
- □ SPIE BACUS Prize, 2004
- Fellow: IEEE, OSA, SPIE
- Fellow: Guggenheim Foundation



Winston V. Schoenfeld

Associate Professor of Optics

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

winston@creol.ucf.edu (407) 823-6898 http://npdg.creol.ucf.edu

Research

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

Other Experience

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

Professional Activities

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

Honors and Awards

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



Axel Schülzgen

Professor of Optics

Ph.D., Physics, Humboldt University, 1992

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

Research

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

Other Experience

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

Professional Activities

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

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



Lawrence Shah

Research Assistant Professor of Optics

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

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

Research

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

Other Experience

- Post doc, Lawrence Livermore National Laboratory, 2001-02
- □ Application Development and Laser Development Research Scientists, IMRA America Inc, 2002-08
- □ Senior Research Scientists, Laser Plasma Laboratory, 2008-12

Professional Activities

- □ Member, SPIE
- Member, OSA
- Member, DEPS
- Ultrafast sub-committee member for CLEO, 2006-08

Eric W. Van Stryland

Pegasus Professor of Optics, Past Dean

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

ewvs@creol.ucf.edu (407) 823-6835 http://nlo.creol.ucf.edu/

Research

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

Other Experience

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

Professional Activities

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

Honors and Awards

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



M.J. Soileau

Vice Pres., Research & Commercialization and Professor of Optics, 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; Laserinduced damage to optical materials, nonlinear refraction nonlinear absorption; Sensor protection

Other Experience

- Physicist, Naval Weapons Center Physics Div., China Lake, 1973-80
- Professor of Physics, North Texas State University, 1980-87
- Director, School of Optics/CREOL, 1987-99
- Chair of the Board, Orlando Science Center, 2002
- □ Technology-Based Economic Development; Technology Transfer
- □ Board of Directors, BEAM, Inc.; Board of Directors, Aquafiber Professional Activities
- □ Member, SPIE, OSA, IEEE, LEOS, LIA, ASEE; President, SPIE, 1997
- International Advisory Committee on Coherent and Nonlinear Optics, 2001
- □ Co-Chair, OSA/SPIE Joint Task Force, 1998-99
- Honors and Awards
- □ Director's Award, SPIE, 1999
- □ Fellow, OSA, IEEE, SPIE, AAAS; Senior Member, LIA
- Fellow, National Academy of Inventors (NAI)
- □ Outstanding Engineer Award, State of Florida, 1994
- □ Gold Medal of SPIE
- □ Esther Hoffman Beller Award of OSA
- □ Distinguished Service Appreciation Medal, presented by the Institute of Photonic Sciences, Barcelona, Spain



Konstantin L. Vodopyanov

21st Century Scholar Professor of Optics

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

vodopyanov@creol.ucf.edu (407) 823-6818 http:/mir.creol.ucf.edu

Research

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

Other Experience

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

Professional Activities

- □ General Chair, Inst. Symp. On Photodetection and Imaging (ISPDI),
- Beijing, China, 2013
- Photonics West, LA106 Conference Chair (2010-now)
- CLEO General Chair, 2010
- □ CLEO Program Chair, 2008
- □ Co-author, Solid-Steate Mid-Infrared Laser Sources, Springer, 2003

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



Shin-Tson Wu

Pegasus Professor of Optics

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

swu@creol.ucf.edu (407) 823-4763 http://lcd.creol.ucf.edu

Research

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

Other Experience

□ Senior Scientist, Hughes Research Labs

Professional Activities

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

Honors and Awards

- 2013 National Academy of Inventors
- 2011 SID Slottow-Owaki Prize
- □ 2010 OSA Joseph Fraunhofer Award
- 2008 SPIE G.G. Stokes Award
- 2008 SID Jan Rajchman Prize
- □ Fellow: IEEE, OSA, SID and SPIE
- UCF Pegasus Professor Award

Boris Y. Zeldovich

Professor of Optics & Physics

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

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

Research

Physical optics and propagation, wave propagation in multimode optical waveguides and irregularly, inhomogeneous media, beam clean-up and combining via nonlinear-optical processes, nonlinear optics, including liquid crystals.

Other Experience

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

Professional Activities

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

Honors and Awards

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

Emeritus Faculty



Larry C. Andrews

Emeritus Professor of Mathematics & Optics

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

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

Research

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

Other Experience

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

Professional Activities

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

Honors and Awards

□ Fellow, SPIE



Michael Bass

Emeritus Professor of Optics, Physics & ECE

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

bass@creol.ucf.edu (407) 823-6977 http://bass.optics.ucf.edu/

Research

Display technologies; all-optical 2– and 3-dimensional displays, upconversion 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
- $\hfill\square$ Associate Editor, 100th Anniversary of OSA commemorative books

- □ Fellow, Optical Society of America (OSA)
- □ Fellow, IEEE



Ronald L. Phillips

Emeritus Professor of EECS & Optics

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
- $\hfill\square$ Florida Space Business Roundtable Explorer Award for education
- □ Fellow, OSA, SPIE



William Silfvast

Emeritus Professor of Optics

Ph.D., Physics, University of Utah, 1965

silfvast@creol.ucf.edu (407) 823-6855 http://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
- □ Board of Directors, OSA. 1986-00
- Program Committee Member, LEOS, 1994-00
 Author, Textbook: "Laser Fundamentals," Cambridge University Press

Honors and Awards

- □ Fellow, Optical Society of America, American Physical Society, IEEE
- Guggenheim Fellow, Stanford University
- Distinguished Member Technical Staff, ATT-Bell Labs, 1983
- NATO Postdoctoral Fellow
- $\hfill\square$ Researcher of the Year, University of Central Florida, 2000



George I. Stegeman

Emeritus Professor of Optics, Physics & EECS

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

george@creol.ucf.edu (407) 629-2944

Research

Discrete optics, linear and nonlinear, solitons

Other Experience

Distinguished Professor, University of Toronto

Professional Activities

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

Honors and Awards

- Cobb Family Chair, UCF
- $\hfill\square$ Fellow, Optical Society of America
- $\hfill\square$ Fellow, American Physical Society
- Hertzberg Medal for Achievement in Physics
- □ R. W. Wood Prize for the Optical Society of America (2003)
- Bluto Award of the Polish Photonics Society, 2011
- Doctor Honoris Causa, Instituto Nacional de Astorfisica, Optica y Electronica (INAEO), 2011

Visiting Faculty



Angela Guzman

Visiting Research Associate Professor

Dr.SC., Ludwig Maximilian University

Quantum Optics angela.guzman@creol.ucf.edu



MALVIN C. TEICH

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

Adjunct Faculty



KEITH KASUNIC Adjunct Professor, Instructor

kkasuni@creol.ucf.edu

Joint Faculty



KEVIN D. BELFIELD

Department Chair & Prof. of Chemistry and Optics

Ph.D., Syracuse University

Multiphoton Absorbing Materials

Belfield@ucf.edu



Louis Chow Professor and Univ. Chair in Mechanical Engineering Ph.D., University of California, Berkeley Heat Transfer Issues in Electro-Optics Louis.chow@ucf.edu



FLORENCIO E. HERNANDEZ

Assoc. Prof. of Chemistry & Optics D.Sc., Universidad Central de Venezuela & Université Fracnhe-comté **Optical Materials**

Florencio.hernandez@ucf.edu



MICHAEL LEUENBERGER Assoc. Prof. of Physics and Optics Ph.D., University of Basel Quantum Information Michael.leuenberger@ucf.edu



ALFONS SCHULTE Professor of Physics and Optics Dr. rer. Nat, Technical University of Munich Near-IR Raman Spectroscopy Alfons.schulte@ucf.edu



MICHAEL SIGMAN Associate Professor of Chemistry and Optics Ph.D., Florida State University Explosives, Chemistry & Forensics Michael.sigman@ucf.edu



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







david.kaup@ucf.edu



Professor of Physics and Optics Ph.D., Cornell University Defects in Semiconductors Robert.peale@ucf.edu







CYNTHIA YOUNG



Ph.D., University of Washington

Laser Propagation in Random Media

Cynthia.young@ucf.edu

DAVID KAUP

Provost Distinguished Research Prof. of Math and Optics

Courtesy Faculty



Glenn D. Boreman Professor and Chair Univ. North Carolina

Ph.D., Optical Sciences, University of Arizona, 1984

gboreman@uncc.edu

BRUCE H. CHAI



President, Crystal Photonics Ph.D., Yale University

chai@crystalphotonics.com



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



KURT BUSCH

Prof. of Physics, Univ. Karlsruhe

Ph.D., University of Karlsruhe

kurt@tfp.uni-karlsruhe.de



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

Ph.D., CREOL, University of Central Florida

jason@open-photonics.com



HANS P. JENSSEN AC Materials Ph.D., MIT h.jenssen@ac-materials.com



ERIC G. JOHNSON Professor of Physics & Optical Science University of North Carolina Charlotte Ph.D., University of Alabama



VASSILIOS KOVANIS AFRL, Sensors Directorate Ph.D., University of New Mexico

Semiconductor lasers, nonlinear optics



JANNICK ROLLAND Brian J. Thompson Prof. of Optical Engineering, Prof. of

egjohnso@uncc.edu

Biomedical Engineering, University of Rochester Ph.D., University of Arizona

Optical Diagnostics & Applications rolland@optics.rochester.edu



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

Optical Coherence

ewlupus@pas.rochester.edu



KENNETH SCHEPLER AFRL, Sensors Directorate PhD, University of Michigan





Faculty Awards and Honors

COSA The Optical Society	 1997 Max Born Award 1999 Nicholas Holonyak Award 1999 Esther Hoffman Beller Award 2008 Esther Hoffman Beller Award 2008 Distinguished Service Award 2010 Joseph Fraunhofer/Robert M. Burley Prize 2003 R. W. Wood Prize 2011 R. W. Wood Prize 2012 R. W. Wood Prize 2013 C.E.K. Mees Medal 	Boris Zeldovich Dennis Deppe Bahaa Saleh M.J. Soileau Bahaa Saleh Shin-Tson Wu George Stegeman Demetrios Christodoulides Eric Van Stryland Bahaa Saleh
SPIE	1995 Kingslake Medal and Prize 2004 Bacus Award 2008 Dennis Gabor Award 2008 G. G. Stokes Award 2008 Gold Medal Award 2013 Harold E. Edgerton Award	Glenn Boreman Bahaa Saleh Leonid Glebov Shin-Tson Wu M.J. Soileau Martin Richardson
	2003 Engineering Achievement	Dennis Deppe
SOCIETY FOR INFORMATION DISPLAY	2008 Jan Rajchman Prize 2011 Slottow–Owaki Prize	Shin-Tson Wu Shin-Tson Wu
APS	2011 Edward A. Bouchet Award	Peter Delfyett
	NSF Presidential Early Career Award (PECASE)(199' NSF Presidential Young Investigator Award (1991) NSF CAREER Award (2012) NSF CAREER Award (2007) NSF CAREER Award (2008) NSF CAREER Award (1996)	7) Peter Delfyett Dennis Deppe Sasan Fathpour Pieter Kik Stephen Kuebler Guifang Li
CONTRACTOR OF THE OWNER	ONR Young Investigator Award (1991) ONR Young Investigator Award (1995) ONR Young Investigator Award (2013)	Dennis Deppe Guifang Li Sasan Fathpour
ORALU CALENDER ASSOCIATED LANCEMENTES	Ralph E. Powe Junior Faculty Award (2009)	Ayman Abouraddy
John Simon Guggenheim Memorial Foundation	Guggenheim Fellow (1984)	Bahaa Saleh
The American Ceramic Society	ACS Outstanding Educator Award (2009)	Kathleen Richardson

International Awards and Honors

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

Fellows of Professional Societies and Academies

OSA The Optical Society	Michael Bass Glenn Boreman Zenghu Chang Demetrios Christodoulides Peter Delfyett Dennis Deppe Aristide Dogariu Leonid Glebov	David Hagan Guifang Li Jim Moharam James Pearson Kathleen Richardson Martin Richardson Bahaa Saleh William Silfast	M.J. Soileau George Stegeman Eric Van Stryland Konstantin Vodopyanov Shin-Tson Wu Boris Zeldovich
SPIE	Glenn Boreman Leonid Glebov 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	James Pearson Martin Richardson Bahaa Saleh William Silfvast	M.J. Soileau Eric Van Stryland Shin-Tson Wu
APS	Zenghu Chang Aristide Dogariu Demetrios Christodoulides	Peter Delfyett Eric Van Stryland Konstantin Vodopyanov	
Laser Institute of America Laser Applications and Safety	Aravinda Kar Michael Bass		
SOCIETY FOR INFORMATION DISPLA	Shin-Tson Wu		
The American Ceramic Society www.ceramics.org	Leonid Glebov Kathleen Richardson		
SNAI	Michael Bass Peter Delfyett Leonid Glebov	M.J. Soileau Shin-Tson Wu	

NATIONAL ACADEMY OF INVENTORS

Presidents, Directors and Officers of Professional Societies

OSA The Optical Society	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)
SPIE	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)
* photonics	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)
National Society of Black Physicists	Peter Delfyett	President (2008–2011)
The American Ceramic Society www.ceramics.org	Kathleen Richardson Kathleen Richardson	Board of Directors Member (2008-2015) President-elect (2014–)
National Institute of Ceramic Engineers (NICE)	Kathleen Richardson	President (2008–2009)

Journal Editors & Associate Editors

Editors

Journal of the Optical Society of America B (1984–1987) Applied Optics (2000–2005) Applied Optics/Optical Technology (1998–2003) Applied Optics/Optical Technology (2004–2010) IEEE Journal of Selected Topics in Quantum Electronics (2001–2006) IEEE/LEOS Newsletter (1995–2000) Optics Communications (2011–2012) Optical Materials Express (2010–present) Journal of the Optical Society of America A (1991–1997) Advances in Optics & Photonics (2008–2013) IEEE/OSA Journal of Display Technology (2004–2008) Michael Bass Glenn Boreman Aristide Dogariu Peter Delfyett Peter Delfyett Pieter Kik David Hagan Bahaa Saleh Bahaa Saleh Shin-Tson Wu

Associate/Topical Editors

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

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





David Hagan is the current Editor-in-Chief of Optical Materials Express

Authors & Editors of Books

Michael Bass,

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



Walter Koechner and Michael Bass,

Solid-State Lasers: A Graduate Text, Springer (2003).



Michael Bass, Casimer DeCusatis, Jay Enoch and Vasudevan Lakshminarayanan, Guifang Li, Carolyn MacDonald, Virenda Mahajan, and Eric Van Stryland,



Handbook of Optics, 3rd ed., McGraw-Hill (2009).

Vol. I: Geometrical and Physical Optics, Polarized Light, Components and Instruments.
Vol. II: Design, Fabrication and Testing, Sources and Detectors, Radiometry and Photometry.
Vol. III: Vision and Vision Optics.
Vol. IV: Optical Properties of Materials, Nonlinear Optics, and Quantum Optics.
Vol. V: Atmospheric Optics, Modulators, Fiber Optics, X-Ray and Neutron Optics.

Glenn D. Boreman,

Basic Electro Optics for Electrical Engineers (SPIE Tutorial Texts in Optical Engineering Vol. TT31), SPIE (1998).



Glenn D. Boreman,

Modulation Transfer Function in Optical and Electro Optical Systems, SPIE Tutorial Texts in Optical Engineering Vol. TT52 (2001).



Zenghu Chang, Fundamentals of Attosecond Optics, CRC Press (2011).





William T. Silfvast,

Laser Fundamentals, Cambridge University Press, 2nd ed. (2008).



Gregory J. Exarhos, Arthur H. Guenther, Mark R. Kozlowski, Keith L. Lewis and **M. J. Soileau**,

Laser-Induced Damage in Optical Materials, SPIE (1997).



Arthur H. Guenther, Mark R. Kozlowski, **M. J. Soileau** and Gregory J. Exarhos (Eds.)

Laser-Induced Damage in Optical Materials, SPIE (1999).

Frederic A. Hopf and George I. Stegeman,

Applied Classical Electrodynamics, Vol. 1: Linear Optics, Wiley (1985).



George I. Stegeman and Frederic A. Hopf,

Applied Classical Electrodynamics, Vol. 2: Nonlinear Optics", Wiley (1986).



.

Carlo G. Someda and George I. Stegeman,

Anisotropic and Nonlinear Optical Waveguides, Elsevier (1992).

George I. Stegeman and Robert Stegeman,

Nonlinear Optics, Phenomena, Materials and Devices, Wiley, (2012).



Robert Crane, Monte Khoshnevisan, Keith Lewis, Eric Van Stryland, Eds., Materials for Optical Limiting: Vol. 374 (MRS Proceedings), (1995). Image: Strice	
Materials for Optical Limiting: Number of Stripping Proceedings (1995). Vol. 374 (MRS Proceedings), (1995). Materials proceedings), (1995). Konstantin L. Vodopyanov (ed.), Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications XII, Proceedings of SPIE, Vol. 8604 (2013) Image: Conversion of Conversion: Materials, Devices, and Applications XII, Proceedings of SPIE, Vol. 8604 (2013) Image: Conversion of Conversion of Conversion: Materials of Liquid Crystal Devices, Wiley (2006). Image: Conversion of Conver	
Vol. 374 (MRS Proceedings), (1995). Support of Proceedings Series Konstantin L. Vodopyanov (ed.), Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications XII, Proceedings of SPIE, Vol. 8604 (2013) Image: Conversion of Conv	
Konstantin L. Vodopyanov (ed.), Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications XII, Proceedings of SPIE, Vol. 8604 (2013) Shin-Tson Wu and Deng-Ke Yang, Fundamentals of Liquid Crystal Devices, Wiley (2006). Iam-Choon Khoo and Shin-Tson Wu, Optics and Nonlinear Optics of Liquid Crystals, Wiley (1993). Shin-Tson Wu and Deng-Ke Yang, Fundamentals of Liquid Crystal Devices, Wiley (2006). Iam-Choon Khoo and Shin-Tson Wu, Optics and Nonlinear Optics of Liquid Crystals, Wiley (1993). Shin-Tson Wu and Deng-Ke Yang, Reflective Liquid Crystal Displays, Wiley (2001). Hongwen Ren and Shin-Tson Wu, Introduction to Adaptive Lenses, Wiley, (2012)	
Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications XII, Proceedings of SPIE, Vol. 8604 (2013) Shin-Tson Wu and Deng-Ke Yang, Fundamentals of Liquid Crystal Devices, Wiley (2006). Iam-Choon Khoo and Shin-Tson Wu, Optics and Nonlinear Optics of Liquid Crystals, Wiley (1993). Shin-Tson Wu and Deng-Ke Yang, Reflective Liquid Crystal Displays, Wiley (2001). Hongwen Ren and Shin-Tson Wu, Introduction to Adaptive Lenses, Wiley, (2012)	14.101
Shin-Tson Wu and Deng-Ke Yang, Fundamentals of Liquid Crystal Devices, Wiley (2006). Iam-Choon Khoo and Shin-Tson Wu, Optics and Nonlinear Optics of Liquid Crystals, Wiley (1993). Shin-Tson Wu and Deng-Ke Yang, Reflective Liquid Crystal Displays, Wiley (2001). Hongwen Ren and Shin-Tson Wu, Introduction to Adaptive Lenses, Wiley, (2012)	
Fundamentals of Liquid Crystal Devices, Wiley (2006). Articless Iam-Choon Khoo and Shin-Tson Wu, Optics and Nonlinear Optics of Liquid Crystals, Wiley (1993). Image: Constant of C	П
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Optics and Nonlinear Optics of Liquid Crystals, Wiley (1993). Image: Crystals, Shin-Tson Wu and Deng-Ke Yang, Reflective Liquid Crystal Displays, Wiley (2001). Hongwen Ren and Shin-Tson Wu, Introduction to Adaptive Lenses, Wiley, (2012) Image: Crystal Displays, Science Science S	Ĩ
Shin-Tson Wu and Deng-Ke Yang, Reflective Liquid Crystal Displays, Wiley (2001). Hongwen Ren and Shin-Tson Wu, Introduction to Adaptive Lenses, Wiley, (2012)	
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Hongwen Ren and Shin-Tson Wu, Introduction to Adaptive Lenses, Wiley, (2012)	
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1991	
David Armitage, Ian Underwood and	
Shin-Tson Wu, Introduction to Microdisplays, Wiley (2006).	

Jiun-Haw Lee, David N. Liu and Shin-Tson Wu,

Introduction to Flat Panel Displays, Wiley (2009).



Boris Ya. Zeldovich, Alexander V. Mamaev and Vladimir V. Shkunov,

Speckle-Wave Interactions in Application to Holography and Nonlinear Optics, CRC Press, (1995).



Faculty Awards & Honors (2013)

National/International

Michael Bass Zenghu Chang Sasan Fathpour Peter Delfyett Kathleen Richardson Martin Richardson Martin Richardson

Bahaa Saleh George Stegeman National Academy of Inventors Award OSA Fellow ONR Young Investigator Award National Academy of Inventors Award I. D. Varshnei Award SPIE Harold E. Edgerton Award Honorary doctorate, University of Bordeaux, France OSA C.E.K. Mees Medal Honorary doctorate, NRS University, Canada



University

Pegasus Professor

Faculty Excellence in Mentoring Doctoral Students Teaching Incentive Program Award (College Level) Research Incentive Award (College Level) Excellence in Graduate Teaching Award (college level) Excellence in Research Award (college level) Demetrios Christodoulides Peter Delfyett Sasan Fathpour Peter Delfyett Sasan Fathpour Ayman Abouraddy





NRS University in Canada awarded an honorary doctorate to professor emeritus George Stegeman on May 25, 2013.



Professor Martin Richardson was vested with an honorary degree (Docteur Honoris Causa) of the University of Bordeaux, France, on December 5, 2013.

1.2 Research Staff

Senior Research Scientists

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

Research Scientists

Ying Chen (Prof. Bass' group) Andrey Krywonos (Prof. Harvey's group) Shivappa Gadag (Prof. Kar's group) Qi Hong (Prof. Wu's group) Igor Ciapurin (Prof. Glebov's group) Larissa Glebova (Prof. Glebov's group) Payam Rabiei (Prof. Fathpour's group) Huiyong Liu (Prof. Schoenfeld's group) David Musgraves (Prof. K. Richardson's group) Andreas Vaupel (Prof. M. Richardson's group) Sergiy Mokhov (Prof. Glebov's group) Jennifer Reed (Prof. Hagan/Van Stryland group)

Post-doctoral Research Associate

Samuel Paul David (Prof. Gaume's group) Magali Durand (Prof. M. Richardson's group) Nicholas Barbiere (Prof. M. Richardson's group) Viktor Smolski (Prof. Vodopyanov's group)

Research Associate

Helene Mingareev (Prof. Glebov's group)

Visiting Research Scientists

Hongyun Chen (Prof. Wu 's group) Ashraf Elsharif (Prof. M. Richardson's group) Olga V. Przhonska (Prof. Hagan/Van Stryland group) Matthias Heinrich (Prof. Christodoulides's group) Irina Popkova (Prof. Glebov's group) Fedor Kompan (Prof. Glebov's group) Julio Cesar Hernandez Herrejon (Prof. Christodoulides' group) Juangying Zhao (Prof. Christodoulides' group) Nils Gehlich (Prof. M. Richardson's group) Yan Liu (Prof. Li's group) Guiju Zhang (Prof. Abouraddy's group) Miao Hu (Prof. Abouraddy's group) Armando Perez Leija (Prof. Christodoulides's group)

Lab Technicians

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

Senior Electrical Engineer

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

Special Assistants



DR. JAMES PEARSON

jpearson@creol.ucf.edu (407) 823-6858



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

Sergey Sukhov (Prof. Dogariu's group) Vadim Smirnov (Prof. Glebov's group) Homaira Parchamy Araghy (Prof. M. Richardson's group) Hong Shu (Prof. Bass' group) Karima Chamma (Prof. Glebov/K. Richardson group) Christine Spiegelberg (Prof. Glebov's group) Giorgio Turri (Prof. Glebov's group) Yeong-Ren Lin (Prof. Chow's group) Su Xu (Prof. Wu's group) Guowei Zhao (Prof. Deppe's group) Jose Enrique Antonio Lopez (Prof. Amezcua/Schülzgen group)

Ashwani Kaul (Prof. Kar's group) Majid Masnavi (Prof. M. Richardson's group) Shi Chen (Prof. Gaume's group)

Jose Antonio Lopez (Prof. Amezcua/Schülzgen group) Yi-Fen Lan (Prof. Wu's group) Hector Moya Cessa (Prof. Christodoulides's group) Felix Jose Salazar Bloise (Prof. Dogariu's group) Amarendra Sarma (Prof. Christodoulides' group) Xunsi Wang (Prof. Abouraddy's group) Hongxia Zhang (Prof. Wu's group) Bo-Sture Skagerstam (Prof. Saleh's group) Seung Kwan Kim (Prof. Schülzgen's group) Chaoming Li (Prof. Chang's group) Ju Cai (Prof. Li's group) Xuechang Ren (Prof. Wu's group)

DR. C. MARTIN STICKLEY

Special Assistant to the Vice President, Research and Commercialization

stickley@creol.ucf.edu (407) 628-2514

1.3 Administrative Staff



Anne Marie Beary Receptionist Anne.Beary@ucf.edu



Monica Hagan Office Assistant Monica.Hagan@creol.ucf.edu



MARIA LOPES Travel Coordinator mlopes@creol.ucf.edu



Amy PERRY Coordinator, Administrative Services aperry@creol.ucf.edu



Fez Shah Office Assistant FezShah@creol.ucf.edu



GAIL DRABCZUK Coordinator, Administrative Services gaild@creol.ucf.edu

MICHAEL HEEKE

Office Assistant

Mike.heeke@creol.ucf.edu

Міке МсКее

Associate Director,

Academic Support Services

mmckee@creol.ucf.edu

MATTHEW PETRONE

Purchasing Office Manager

mpetrone@creol.ucf.edu

MARK C. WAGENHAUSER

Associate Director/Business

Manager

markw@creol.ucf.edu



DEON FRANK Computer Support dfrank@creol.ucf.edu



OLIVIA KAIN Student Assistant oliviakain@knights.ucf.edu



Tavis McLelland Fiscal Assistant tavis@creol.ucf.edu



JAMES Ross Assistant in Development Engineering jross@creol.ucf.edu



DENISE WHITESIDE Assistant to the Dean denise@creol.ucf.edu



RACHEL FRANZETTA Senior Admissions Specialist rfranzet@creol.ucf.edu



ADRIAN KOSTIC Computer Support akostic@creol.ucf.edu



VICKY ORTIZ Research Programs Coordinator vsortiz@creol.ucf.edu



KELLY Ross Office Assistant kaross@creol.ucf.edu



RICHARD ZOTTI Engineer rzotti@creol.ucf.edu



Organization Chart





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2. Academic Programs

Until this year, the College has offered only graduate degrees in optics and photonics at the MS and PhD levels. It has also contributed to the undergraduate teaching mission of the university by teaching optics and photonics courses for undergraduates in other programs. This year, a new BS degree in Photonic Science and Engineering has been launched.

2.1 Undergraduate Program

On March 21, 2013, the UCF Board of Trustees voted to formally establish the Bachelor of Science in Photonic Science and Engineering (PSE). This degree is offered as a joint program between the College of Engineering and Computer Science (CECS) and the College of Optics and Photonics (COP), making it the only B.S. in the state of Florida in this area and only one of a few in the nation.

The program is designed to fill the growing need for photonics engineers. Florida is home to about 270 photonics-based companies with an annual need of 270 photonics engineers. Nationally, there is a need to fill 1600 open positions. On a recent sampling of job postings, annual salaries begin at \$50,000 to \$70,000. Students who complete the program will be prepared for immediate employment or can pursue an advanced degree in optics and photonics.

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

An undergraduate curriculum committee comprised of faculty and administrative staff within the college meets on a bi-weekly basis to evaluate coursework and plan for eventual ABET accreditation. Accreditation is not awarded until after the first cohort of students graduate in 2015. A second joint committee with CECS meets twice a year to ensure successful collaboration and program progress.

The program began with its first course, OSE 3052: Introduction to Photonics and its complementary lab course, OSE 3052L. Dr. Sasan Fathpour was the instructor for OSE 3052, and Dr. Mercedeh Khajavikhan was the instructor for OSE 3052L. A dedicated lab space was established in CREOL to permanently host all the laboratory courses for the program. COP has received donations and discounts for the equipment and supplies from companies such as Edmund Optics, Newport, and Tektronix.

Seventeen students enrolled in OSE 3052, thirteen of which formally declared as majors in PSE. Most students were either already enrolled at UCF or were transfer students from local colleges (Seminole State, Valencia State) who were planning on majoring in electrical engineering but changed their major to PSE after learning about the program.

A recruitment plan is in place to work closely with local state colleges and high schools. Presentations about PSE have been made in the Introduction to Engineering courses offered at UCF and at the local state colleges. In the fall of 2013, a presentations for approximately 1000 students have been conducted. COP is also promoting the program at Wekiva High School, which has a photonics magnet program with nearly 100 students. Three of its recent graduates have already enrolled at UCF and declared as a photonics major. In addition, promotional materials and presentations have been made available for teachers to raise awareness of the program. Posters were distributed to about 100 middle and high schools in the Central Florida region. On Oct. 9, 2013, an additional 80 teachers who attended an Educators Night at the OSA sponsored Frontiers in Optics learned about the program. In October 2013, COP was present at the Florida Association of Science Teachers and Science Supervisors annual conference, allowing information to be presented to a representative of every county in the state of Florida.

Restrictive Electives	9
OSE 4421 Biophotonics	3
OSE 4240 Optics & Photonics Design	3
OSE 4720 Visual Optics	3
OSE 5312 Light Matter Interaction	3
OSE/EEL/PHY Approved Course	3
or Math/Eng/Sci (max 6)	6
Photonics Major and Capstone	31
OSE 3052 Fundamentals of Optics & Photonics	3
OSE 3052L Fundamentals of Optics & Photonics Lab	1
OSE 3053 EM Waves for Photonics	3
OSE 4520 Laser Engineering	3
OSE 4520L Laser Engineering Lab	1
OSE 4410 Optoelectronics	3
OSE 4410L Optoelectronics Lab	1
OSE 4830 Imaging & Display	3
OSE 4830L Imaging & Display Lab	1
OSE 4470 Fiber Optic Communications	3
OSE 4470L Fiber Optic Communications Lab	1
OSE 4930 Frontiers in Photonics	2
OSE 4914 Senior Design I	3
OSE 4915 Senior Design II	3

A growing list serve is used to regularly communicate with teachers in the Central Florida region.

COP is sponsoring the Florida Science Olympiad event in Optics as a way to increase awareness of the program and has impact to over 120 schools throughout Florida. UCF is the annual host of the Florida Science Olympiad and is instrumental in hosting the 2014 Science Olympiad National Tournament.



Students in the new Undergraduate Photonics Laboratory.

As of the end of 2013, 36 students were accepted as a major (having fulfilled basic entrance requirements that include the successful completion of Calculus I, II, Physics I, and Chemistry) or are declared as pending in the major. This is far greater than originally expected

for the first year. Two students are already engaged in undergraduate research within the college and several companies have posted internships which are available for our students in the summer of 2014. A blog that is used to communicate postings and other activities is maintained at https://sharepoint.creol.ucf.edu/BS/creolblog/default. aspx.

The college has formed a "Get to Know Photonics" seminar series which is open to the public and held monthly. The inaugural presentation was conducted by Dr. Bahaa Saleh and entitled "What is the Laser?" The second at the end presentation entitled "Smartphone Displays: How Do They Work?" was presented by Dr. S.T. Wu and included a lab tour. These are designed to promote the program and keep the current students engaged, particularly for those who have not begun optics courses within the major. Several of our students have already joined the CAOS and OSA student groups. Advising, recruiting, and orientations are conducted by Mike McKee, associate director for the undergraduate program. He has worked with major recruitment and retention units across the university including Undergraduate Admissions, First Year Advising, and the Sophomore and Second Year Center.

Scholarship funds established in support of student in the BS-PSE program:

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

2.2 Graduate Programs

The college has maintained a strong focus on graduate education via its MS and PhD programs. In addition to over 40 graduate course that are actively taught, active involvement in research programs is a significant contribution to the education of all PhD students and many MS students. Our goal is that our graduate students should be well prepared for their future careers. As a result, our graduates and highly educated and well prepared for the modern-day workforce and consequently are highly sought after in both the private sector and in top universities and research centers.

On average, about two-thirds of PhD students take their first job in industry, while other continue their careers in either academia or government laboratories. MS graduates either enter the workforce upon graduating or else continue on to study for a PhD. Recent data show that of the students who plan to continue on to a PhD, all have been successful at gaining full funding for their PhD studies. 70% of these students remained at UCF for their PhD while the remaining 30% of these went to doctoral programs at other schools. Of the students who do not plan on continuing their studies, the vast majority (80%) take jobs in industry, while the remaining 20% mostly find employment in government labs.

Course and Program Development

In order to keep the curriculum up-to-date and that our graduates are well prepared for their future careers, the college regularly updates and improves the MS and PhD curricula. In recent years, significant changes to the PhD core were implemented to emphasize lasers and to provide an introduction to quantum mechanics for all students. In the 2011-12 academic year, the MS core was also redesigned to require students to take a more well-defined set of courses. After the many changes in the curriculum in the past few years, 2012-2013 was relatively quiet, with no new changes to the curriculum. A new course in *Photonic Crystals* was taught by Prof. Debashis Chanda. Also, the *Optical Systems Design* course was offered in summer 2013. This course had not been taught for several years, since Prof. Harvey retired, and the offering of this course was made possible by recruiting PhD alumnus, George Curatu to teach the course. To meet the heavy demand for the *Laser Engineering Laboratory*, it was offered consecutively in the summer A and B sessions.

Graduate Recruitment and Enrollment

Enrollment in the PhD program has dropped slightly in AY 2012-2013 at 91, while the MS enrollment continues to experience a growing trend, with 32 students. A total of 27 new students (14 Ph.D. and 13 MS) enrolled in Fall 2013. The reduction in new PhD students was mainly due to reduced availability of federal research funds that limit the number of PhD students the faculty can bring into their research groups. The reduction was offset by an increase in the matriculation of new MS students compared to previous years. The increase in MS enrollment may be due to increased marketing of this program.





New Matriculants for Fall 2012 - Summer 2013												
			Male	Female		FT	РТ		CREOL Fellow	UCF Award*	UCF Trustee	UCF Dean
	US		5	1		6	0		5	1	1	3
PND	Intl		7	1		8	0		6	0	0	0
	US		3	1	-	2	2	-	0	0	0	0
IVIS	Intl		9	0		9	0		0	0	0	0
Total Nev	v Students		27									

Total New Students

* Northrop Grumman, Schwartz, Suchoski, and Frances Townes graduate scholarships

The GRE Exam was changed over the last two years, so it is difficult to compare the scores of entering students with previous years. The percentile scores were similar to 2011-2012, which were higher than in previous years. Overall, we received 431 pre-applications and 242 full applications to the graduate programs, which is an increase over previous years. The pre-application is a preselecting tool run through our own web site that allows us to make contact with applicants early and to help advice international students as to whether to apply officially, which is an expensive undertaking for many international students.

			Fall 201	.2 Mean (GRE Sco	ores	S	pring 2	013 Mean	GRE So	ores		
		Quantitative	%	Verbal	%	Analytic Writing	%	Quantitative	%	Verbal	%	Analytic Writing	%
חאח	US	163	87%	158	77%	4	60%	152	52%	152	53%	3	11%
PhD	Intl	165	91%	150	49%	3	15%	161	87%	155	69%	3	11%
MC	US	158	78%	152	56%	4	56%	154	60%	158	77%	3.5	30%
IVIS	Intl	159	79%	150	48%	3	26%	-	-	-	-	-	-
Mea	an	161.25		152.5		3.7		155.6		155		3.2	

Degrees Granted

As shown in the chart below,[†] there was an increase in the number of PhD degrees granted in the past year. This does not appear to be related to any particular trend. Overall, we have a continuing trend of students achieving PhD candidacy status sooner in the program than has been historically the case. This may be related to a new advising database that the college has implemented to monitor student progress. This is also resulting in students passing their proposal examinations sooner. The number of MS degrees granted in academic year 2012-2013 (17) is roughly similar to previous years. This number tends to fluctuate on a year-to-year basis.





[†]Data on enrollment and awarded degrees are taken from UCF's official reports, which consider Summer 12, Fall 12 and Spring 13 as the Academic year 2012-13.

Ph.D. Dissertations

Degrees granted in academic year 2013 (Fall 2012 - Summer 2013)

Student	Program	Advisor	Dissertation Title
Zakariya Abdullah	Electrical Engineering	Patrick LiKamWa	Monolithically Integrated Broadly Tunable Light Emitters Based on Selectively Intermixed Quantum Wells.
Neng Bai	Optics	Guifang Li	Mode-Division Multiplexed Transmission in Few-mode Fibers
Seyed Esmaeil Banaei	Electrical Engineering	Ayman Abouraddy	Polymer Optical Fibers For Luminescent Solar Concentration
John Broky	Optics	Aristide Dogariu	Inverse Problems in Multiple Light Scattering
Ryan Casey Boutwell	Optics	Winston Schoenfeld	The Impact of Growth Conditions on Cubic ZnMgO Ultraviolet Sensors
Hui-Chuan Cheng	Optics	Shin-Tson Wu	Vertical Field Switching Blue Phase Liquid Crystals for Field Sequential Color Displays
Josue Davilla-Rodriguez	Optics	Peter Delfyett	External Cavity Mode-locked Semiconductor Lasers for the Generation of Ultra-low Noise Multi-gigahertz Frequency Combs and Applications in Multi-heterodyne Detection of Arbitrary Optical Waveforms
Apurva Jain	Optics	Leonid Glebov	Applications of Volume Holographic Elements in High Power Fiber Lasers
Pankaj Kadwani	Optics	Martin Richardson	Pulsed Tm-Fiber Laser for Mid-IR Generation
Saeed Khan	Electrical Engineering	Sasan Fathpour	Silicon Photonic Devices for Optical Delay Lines and Mid-Infrared Applications
Thomas Kohlgraf-Owens	Optics	Aristide Dogariu	Random Transformations of Optical Fields and Applications
Dana Kohlgraf-Owens	Optics	Aristide Dogariu	Optically Induced Forces in Scattering Probe Miscroscopy
Yan Li	Optics	Shin-Tson Wu	High-Efficiency Blue Phase Liquid Crystal Displays
Yuan Liu	Optics	Martin Richardson	Development of Laser Spectroscopy for Elemental and Molecular Analysis
Davorin Peceli	Optics	David Hagan/ Eric VanStryland	Absorptive and Refractive Optical Nonlinearities on Organic Molecues and Semiconductors
Mark Ramme	Electrical Engineering	Martin Richardson	Ultrafast Laser Material Processing for Photonic Applications
Jonathan Rosch	Optics	Winston Schoenfeld	An Investigation of the Relationship between Visual Effects and Object Identification Using Eye-tracking
Robert Andrew Sims	Optics	Martin Richardson	Development of Thulium Fiber Lasers for High Average Power and High Peak Power Operation
Andreas Vaupel	Optics	Martin Richardson	High Energy, High Average Power, Picosecond Laser Systems to Drive Few-Cycle OPCPA
Matthew Weed	Optics	Winston Schoenfeld	Wavelength Scale Resonant Structures for Integrated Photonic Applications
Ming Wei	Optics	Winston Schoenfeld	Growth and Characterization of ZnO Based Semiconductor Materials and Devices
Matthew Weidman	Optics	Martin Richardson	Laser Filamentation Interaction with Materials for Spectroscopic Applications
Charles Williams	Optics	Peter Delfyett	Injection Locking of Semiconductor Mode-Locked Lasers for Long Term Stability of Widely Tunable Frequency Combs
Christina Willis-Ott	Optics	Martin Richardson	Yitterbium-Dopped Fiber-Seeded Thin-Disk Master Oscillator Power Amplifier Laser System
Su Xu	Optics	Shin-Tson Wu	Optical Fluid-based Photonic and Display Devices
Jin Yan	Optics	Shin-Tson Wu	Optically Isotropic Liquid Crystals for Display and Photonic Applications

Student Scholarships and Awards

National Scholarships, Grants, and Awards (2013)

Scholarships

Brian Anderson, Directed Energy Professional Society, (DEPS) Scholarship

Neng Bai, SPIE Scholarship in Optics and Photonics Yuan "Esther" Chen, IEEE Orlando Section Graduate Student Scholarship

Yuan "Esther" Chen, SPIE Scholarship

Kumel Kagalwala, SPIE Optics and Photonics Education Scholarship

Yifan Liu, IEEE Outstanding Graduate Engineering Student Yifan Liu, IEEE Orlando Section Scholarship

Soroush Shabahang, SPIE Optics and Photonics Education Scholarship

Guangming Tao, SPIE Optics and Photonics Education Scholarship

Ming Wei, AVS and FSM Symposium, grand prize Ming Wei, AVS National Student Award Finalist, 2013

Best Papers or Posters

Yuan "Esther" Chen, SID Distinguished Student Paper Award Joshua Kaufman, MRS Fall Meeting, Best Poster Award

Lane Martin, OSA 2013 Emil Wolf Outstanding Student Paper Competition, National Winner

Jie Sun, SID Distinguished Poster Paper Award

Guangming Tao, OSA 2013 Emil Wolf Outstanding Student Paper Competition, Finalist

Guangming Tao, ACS Society 2013 conference, First Place Poster Prize

Daming Xu, SID Distinguished Student Paper Award

Travel Grants (2013)

Kumel Kagalwala, NSF Support at the IEEE Summer Topicals Conference 2013

Matthew Reichert, APS grant for FIO Registration

Benn Gleason, APOMA Student travel grant to attend SPIE - Optifab

Erick Koontz, APOMA Student travel grant to attend SPIE - Optifab

Guangming Tao, travel grant, 74^{th} conference on glass problems

Himmansu Pattanaik, Incubic/Milton Chang student travel grant

Himmansu Pattanaik, APS-DLS student travel grant

Yuan "Esther" Chen, SID travel grant

Daming Xu, SID travel grant

Jie Sun, SID travel grant

Jin Yan, SID travel grant

Yifan Liu, SID travel grant

Zhenyue Luo, SID travel grant

Ming Wei, Graduate travel scholarship

UCF Fellowships and Awards (AY 2012-2013)

Graduate Research Excellence Fellowship

Marcus Bagnell Yuan Chen Trenton Ensley Kumel Kagalwala Xiaohang Lin Chatdanai Lumdee Jichi Ma Mohammad-Ali Miri Dan Ott Matthew Reichert Soroush Shabahang Ben Webb Cen Xia Qi Zhang Graduate Research Forum I

Graduate Research Forum Poster Award

Dat Nguyen, Ming Wei

College of Optics & Photonics Awards (2013)

Neng Bai, College of Optics & Photonics Student Of The Year Award

Kyle Douglass, finalist, 2013 Student Of The Year Award Joshua Kaufman, finalist, 2013 Student Of The Year Award Andrew Sims, finalist, 2013 Student Of The Year Award Yan Cheng, 2013 Best Poster Award



2013 Student-of-The-Year Award winner Neng Bai.

Courses Taught

Coro Gradua	te Courses		Instructors	
		Fall 2012	Spring 2013	Summer 2013
OSE 5203	Geometrical optics and imaging systems	Moharam	Moharam	
OSE 5312	Light matter interaction	Van Stryland	Kik	
OSE 6111	Optical wave propagation	Moharam		
OSE 6115	Interference, diffraction and coherence	Dogariu	Abouraddy	
OSE 6432	Guided waves and optoelectronics		LiKamWa	
OSE 6525	Laser engineering	Delfyett	Schülzgen	
Other OSE g	raduate courses			
OSE 5041	Introduction to wave optics	Wu		
OSE 5313	Materials for optical systems	Gaume		
OSE 5414	Fundamentals of optelectronics	LiKamWa		
OSE 6120	Theoretical foundations of optics	Zeldovich		
OSE 6211	Fourier optics		Dogariu	
OSE 6125	Computational photonics		Moharam	
OSE 6234L	Applied optics laboratory		Khajavikhan	
OSE 6265	Optical systems design			Curatu
OSE 6319	Optical waves and materials			Zeldovich
OSE 6334	Nonlinear optics		Van Stryland	
OSE 6349	Applied quantum mechanics for optics	Abouraddy		
OSE 6445	High speed photonics		Delfyett	
OSE 6455C	Photonics laboratory	Li		
OSE 6526C	Laser engineering laboratory			Richardson
OSE 6615L	Optoelectronic device fabrication laboratory	Schoenfeld		
OSE 6650	Optical properties of nanostructured materials	Kik		
OSE 6820	Flat panel displays			Wu
OSE 6938	Special topics: Fiber lasers	Schülzgen		
OSE 6938	Special topics: Integrated photonic devices		Fathpour	
OSE 6938	Special topics: Photonic crystals			Chanda
Other Cours	es			
IDS 6416	<i>St: History of physical science, cultural connections and other issues</i>		Bass	
EEL 4440	Optical engineering	Fathpour		
EMA 5610	Lasaer materials processing	Kar		

Instructional Laboratories

OSE 6234C Applied Optics Laboratory

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



OSE 6455C Photonics Laboratory

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

OSE 6526C Laser Engineering Laboratory

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



OSE 6615L Optoelectronic Device Fabrication Laboratory

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





Colloquia and Seminars

1/15/2013	Percy F. Shadwell, Jr Carnegie-Mellon Robotics Institute	Career growth and Self management (IEEE Student Chapter Seminar Series)
1/31/2013	Wood-Hi Cheng National Sun Yat-Sen University, Taiwan	The Art and Science of Packaging High-Coupling Photonics Device and Modules. (IEEE Student Chapter Seminar Series)
2/01/2013	Jens Limpert Friedrich Schiller University, Jena, Germany	High-Performance Fiber-Laser Systems.
2/01/2013	Florian Jansen Friedrich Schiller University, Jena, Germany	Very Large Mode Area Fiber Designs.
2/01/2013	Cesar Jauregui / Hans-Jürgen Friedrich Schiller University, Jena, Germany	Mode Instabilities.
2/01/2013	Jan Rothhardt Friedrich Schiller University, Jena, Germany	High Average Power Fiber Laser System for Attosecond Science.
2/25/2013-	FSEC	Solar Day
3/01/2013	Peter Delfyett	Lasers - the Light Fantastic, Science and Applications from Pointers to DVDs. (CAOS Student Organization, CREOL celebrates UCF@50, Optics Week)
2/28/2013	Stephanos Venakides Duke University	Transmission Anomalies in Dielectric and Metallic Photonic Crystals.
3/05/2013	Ken Schepler AFRL	Ceramic Transition-Metal Mid-IR Lasers.
3/14/2013	Guillaume Bal Columbia University	Hybrid Inverse Problems and Optical Tomography.
3/14/2013	Andrew Ellis Aston University, England	Ultra High Capacity Optical Transmission Systems. (IEEE Student Chapter Seminar Series)
3/18/2013	Peter Kuchment Texas A&M University	What are the hybrid (coupled physics) imaging techniques and what is good about them?
4/09/2013	Sergey Shusterman Soreq NRC Yavne, Israel	MOVPE Droplets Heteroepitaxial Growth Model.
4/11/2013	Michael J. Levene Yale University	Getting Deeper with Multiphoton Microscopy: How Simple Optical Approaches Can Have a Profound Impact.
4/18/2013	Frank Wise Cornell University	Dissipative Solitons and Similaritons: New Nonlinear Waves Enable High- Performance Fiber Lasers.
4/22/2013	Weiyao Zou President & CEO, ZyConn	High Resolution Retinal Imaging with Dual Deformable Mirror AOSLO Imager.
5/17/2013	Gisele Bennett Georgia Tech	Superresolution imaging systems" & "Electro-Optical System Laboratory (EOSL) at Georgia Tech.
5/31/2013	Atsushi Shishido	Photoresponsive Liquid-Crystalline Polymers.
6/07/2013	Tokyo Institute of Technology Thierry Cardinal	Silver containing phosphate glasses for multi-scale structured optical materials.
6/18/2013	Jiun-Haw Lee	Small-molecule Planar Heterojunction Organic Solar Cell
	National Taiwan University	
7/16/2013	Oleg V. Yaroshchuk National Academy of Sciences of Ukraine (NASU),	Alternative methods of liquid crystal alignment and their potential for liquid crystal devices. (SID Student Chapter Seminar Series)
8/08/2013	Vitaly Gruzdev University of Missouri	Effects of laser-field enhancement in laser-induced damage.

9/23/2013	Bahaa Saleh CREOL – The College of Optics and Photonics	What is a LASER?" (Undergraduate Introduction to Photonics Seminar Series)
10/04/2013	Zhiyi Wei Institute of Physics, Chinese Academy of Sciences	Development on high-contrast PW Ti:sapphire laser system.
10/08/2013	Bahram Jalali UCLA	Cells as Bits: Biomedical Diagnostics Inspired by Wideband Data Multiplexing Techniques.
10/11/2013	Laszlo Veisz Max Planck Institute for Quantum Optics	Quasi-single-cycle multi-Terawatt Laser Development and it's Applications.
10/11/2013	Min Gu Swinburne University of Technology	Green Photonics for information technology, clean energy and life science. (Joint Student Chapter Seminar)
10/11/2013	David D. Sampson University of Western Australia, Perth	Photonics enables a microscope in a needle for imaging deep in tissue. (IEEE Student Chapter Seminar)
10/29/2013	Shin-Tson Wu CREOL – The College of Optics and Photonics	Get To Know Photonics - Smartphone Displays: How do they work? (Undergraduate Introduction to Photonics Seminar Series)
11/01/2013	Jacob Khurgin Johns Hopkins University	Plasmonics: dealing with loss. Distinguished Seminar Series
11/08/2013	Bryan M. Barnes NIST	Optical Methods for 3-D Nanostructure Metrology.
11/08/2013	Franky So University of Florida	Organic Electronics: A solution to our energy challenges? (IEEE Student Chapter Seminar)
11/15/2013	Ross Hodder Scientific Lasers	High Power Supercontinuum Fiber Lasers; Current Technology and Future Roadmap.
12/10/2013	Simon Poole Finisar, Australia	Confessions of a Serial Entrepreneur: 30 Years of Photonic Start-ups in Academia and Industry. (IEEE Student Chapter Seminar)
12/10/2013	Jiun-Haw Lee I-Chun Cheng Yuh-Renn Wu National Taiwan University	"Research in Photonics" National Taiwan University. (Joint Student Chapter Seminar)

The Townes Winter Symposium

The Townes Winter Symposium 2013 was organized by the Townes Laser Institute and the Atlantis-MILMI Program on March 11–15, 2013 and was held in Orlando at CREOL, The College of Optics and Photonics.

This was a meeting of leading experts in the fields of Lasers, Photonics and Material Science. Borne of existing research collaborations between University of Central Florida, University of Bordeaux, the Friedrich-Schiller University of Jena and Clemson University, the Symposium showcased the research and educational programs of the participating universities, and the cutting edge research conducted in our laboratories and was a forum for discussions on the mechanisms through which exciting development are pushed to the marketplace.

Guest Speakers

Prof. Philippe Balcou, University of Bordeaux 1, France
Dr. Matthieu Baudelet, University of Central Florida/CREOL/TLI
Prof. Jean-Louis Bobet, University of Bordeaux 1, France
Prof. Bruno Bousquet, University of Bordeaux 1, France
Prof. Lionel Canioni, University of Bordeaux 1, France
Prof. Zenghu Chang, University of Central Florida/Physics/TLI
Dr. Sylvain Danto, Clemson University
Prof. Peter Delfyett, University of Bordeaux 1, France
Dr. Jason Eichenholz, Open Photonics, USA
Alexandre Fong, Gooch & Housego, USA
Prof. Alexander Heisterkamp, Friedrich-Schiller Universitat, Germany
Prof. Stephen Kuebler, University of Central Florida/Chemistry

Prof. Falk Lederer, Friedrich-Schiller Universitat, Germany
Prof. Jens Limpert, Friedrich-Schiller Universitat, Germany
Dr. Ilya Mingareev, University of Central Florida/CREOL/TLI
Prof. Stefan Nolte, Friedrich-Schiller Universitat, Germany
Prof. Martin Richardson, University of Central Florida/CREOL/TLI
Prof. Vincent Rodriguez, University of Bordeaux 1, France
Prof. Bahaa Saleh, University of Central Florida/CREOL
Giorgio Santarelli, University of Bordeaux 1, France
Dr. Lawrence Shah, University of Central Florida/CREOL/TLI
Prof. Axel Schülzgen, University of Central Florida/CREOL/TLI
Prof. Andreas Tunnermann, Fraunhofer IOF, Germany
Prof. Eric Van Stryland, University of Central Florida/CREOL/TLI

Students

MS Students (AY 2012-2013)

Alvarez Perez, Oseas, (Optics) Anderson, Scott, (Optics, part time) Bodnar, Nathan, (Optics), Advisor: M. Richardson Bourgade, Thomas, (Optics, MILMI), Advisor: Glebov Butler, Corey, (Optics, MILMI), Advisor: M. Richardson Butrimas, Steven, (Optics, part time) Chatterton, Amanda, (Optics), Advisor: Bass Creekmore, Amy, (Optics, part time) Farrell, Matthew, (Optics, part time) Gaida, Christian, (Optics, MILMI), Advisor: M. Richardson Gebhardt, Martin, (Optics, MILMI), Advisor: M. Richardson Georgiev, Nikolay, (Optics, part time) Grafer, Elliott, (Optics) Hardin, James, (Optics, part time) Huang, Bin, (Optics) Kazemi Jahromi, Ali, (Optics, GRA), Advisor: Gaume Kennedy, Christopher, (Optics), Advisor: Bass Knebl, Andreas, (Optics, MILMI), Advisor: M. Richardson Lantigua, Christopher, (Optics, GRA), Advisor: Glebov Levy, Melissa, (Optics, part time)

Ph.D. Students (AY 2012-2013)

Aleahmad, Parinaz, (Optics, GRA), Advisor: Christodoulides Anderson, Brian, (Optics, GRA), Advisor: Glebov Anderson, James, (Optics, GRA), Advisor: Vodopyanov Ardey, Abhijeet, (Physics, GRA), Advisor: Delfyett Bagnell, Kristina, (Optics, GRA), Advisor: Delfyett Bagnell, Marcus, (Optics, GRA), Advisor: Delfyett Bai, Neng, (Optics, GRA), Advisor: Li Banaei, Esmaeil 'Hooman', (EE, GRA), Advisor: Abouraddy Barbieri, Nicholas, (Physics, GRA), Advisor: M. Richardson Bhooplapur, Sharad, (Optics, GRA), Advisor: Delfyett Boutwell, Ryan, (Optics, GRA), Advisor: Schoenfeld Bradford, Joshua, (Optics, GRA), Advisor: M. Richardson Broky, John, (Optics, GRA), Advisor: Dogariu Chantharasupawong, Panit, (Optics, GRA), Advisor: Thomas Chen, Yuan, (Optics, GRA), Advisor: Wu Cheng, Yang, (Physics, GRA), Advisor: Chang Chiles, Jeffrey, (Optics, GRA), Advisor: Fathpour Chini, Michael, (Physics, GRA), Advisor: Chang Constant, Colin, (Optics, GRA), Advisor: Dogariu Cunningham, Eric, (Optics, GRA), Advisor: Chang Darchangel, Jeffrey, (Optics, GRA), Advisor: Schoenfeld Davila-Rodriguez, Josue, (Optics, GRA), Advisor: Delfyett Davis, Kristopher, (Optics, GRA), Advisor: Schoenfeld Digaum, Jennefir, (Optics, GRA), Advisor: Kuebler Douglass, Kyle, (Optics, GRA), Advisor: Dogariu Ensley, Trenton, (Optics, GRA), Advisor: Hagan/VanStryland Fardad, Shima, (Optics, GRA), Advisor: Christodoulides Ferdinandus, Manuel, (Optics, GRA), Advisors: Hagan/VanStryland Gleason, Benjamin, (Mat. Sci, GRA), Advisor: K. Richardson Grabill, Chris, (Chemistry, GRA), Advisor: Kuebler He, Sihui, (Optics, GRA), Advisor: Wu Hofmann, Peter, (Optics, Visiting/ U. Arizona), Advisor: Schülzgen Huang, Bin, (Optics, GRA), Advisor: Li Jang, Yuseong, (Optics, GRA), Advisor: M. Richardson Jeon, Cheonha, (Optics, GRA), Advisor: M. Richardson Jollivet, Clemence, (Optics, GRA), Advisor: Schülzgen Kadwani, Pankaj, (Optics, GRA), Advisor: M. Richardson Kagalwala, Kumel, (Optics, GRA), Advisor: Saleh Kaim, Sergiy, (Physics, GRA), Advisor: Zeldovich Kajorndejnukul, Veerachart, (Optics, GRA), Advisor: Dogariu Karnemaat, Ryan, (Optics, GRA) Kaufman, Joshua, (Optics, GRA), Advisor: Abouraddy Khan, Saeed, (EE, GRA), Advisor: Fathpour Klee, Anthony, (Optics, GRA), Advisor: Delfyett Kohlgraf-Owens, Dana, (Optics, GRA), Advisor: Dogariu Kondakci, Hasan, (Optics, GRA), Advisor: Saleh Leblanc, Richard, (Optics, GRA)

Lin, Yu-wei, (Optics, GRA), Advisor: Kik Lui, Eric, (Optics), Advisor: Chanda Matz, Gregor, (Optics, MILMI), Advisor: Li Modak, Sushrut, (Optics), Advisor: Chanda Mueller, Michael, (Optics, MILMI), Advisor: M. Richardson Münnich, Matthias, (Optics, MILMI), Advisor: Hagan/VanStryland Patil, Aniket, (Optics) Popoola, Atiloluwa, (Optics) Relina, Victoriya, (Optics), Advisor: Wu Schick, Ryan, (Optics, part time) Schneider, Larry, (Optics) Shamieh, Frederick, (Optics, part time) Shappard, Todd, (Optics, part time) Sincore, Alex, (Optics, MILMI), Advisor: M. Richardson Tan, Felix, (Optics), Advisor: Abouraddy Temple, Sarah, (Optics, part time) Tiess, Tobias, (Optics, MILMI) Turnbull, Brendan, (Optics), Advisor: Hagan/VanStryland Villinger, Massimo Maximilian, (Optics, part time)

Li, Jie, (Optics, GRA), Advisor: Chang Li, Mingxin, (Optics, GRA), Advisor: Deppe Lim, Khan, (Optics, GRA), Advisor: M. Richardson Lim, Geunsik, (Mat's Sci), Advisor: Kar Liu, Yifan, (Optics, GRA), Advisor: Wu Liu, Xiaohang, (Optics, GRA), Advisor: Deppe Liu, Yuan, (Optics, GRA), Advisor: M. Richardson Lumdee, Chatdanai, (Optics, GRA), Advisor: Kik Luo, Zhenyue, (Optics, GRA), Advisor: Wu Ma, Jichi, (Optics, GRA), Advisor: Fathpour Martin, Lane, (Optics, GRA), Advisor: Saleh McKee, Erik, (Optics, GRA), Advisor: M. Richardson Mills, Matthew, (Optics, GRA), Advisor: Christodoulides Miri, Mohammad, (Optics, GRA), Advisor: Christodoulides Nguyen, Dat, (Physics, GRA), Advisor: Delfyett Novak, Spenser, (Mat's Sci, GRA, Visiting/ Clemson U.), Advisor: K. Richardson Ogutman, Nizamettin, (Optics, GRA), Advisor: Dogariu Ott, Daniel, (Optics, GRA), Advisor: Glebov Ozcan, Ali, (Chemistry, GRA), Advisor: Kuebler Pattanaik, Himansu, (Optics, GRA), Advisors: Hagan/VanStryland Peceli, Davorin, (Optics, GRA), Advisor: Hagan/VanStryland Peng, Fenglin, (Optics, GRA), Advisor: Wu Ramme, Mark, (EE, GRA), Advisor: M. Richardson Reichert, Matthew, (Optics, GRA), Advisor: Hagan/VanStryland Sanjabi Eznaveh, Zeinab 'Zahoorah', (Physics, GRA), Advisor: Amezcua Sarailou, Edris, (Optics, GRA), Advisor: Delfyett Segall, Marc, (Optics, GRA), Advisor: Glebov Shabahang, Soroush, (Optics, GRA), Advisor: Abouraddy Shoulders, Taylor, (Mat's Sci, GRA), Advisor: Gaume Sims, Robert, (Optics, GRA), Advisor: M. Richardson Sincore, Alex, (Optics, GRA), Advisor: K. Richardson Sisken, Laura, (Optics, GRA), Advisor: K. Richardson Sun, Jie, (Optics, GRA), Advisor: Wu Szilagyi, John, (EE, GRA), Advisor: M. Richardson Tao, Guangming, (Optics, GRA), Advisor: Abouraddy Toroghi, Seyfollah, (Optics, GRA), Advisor: Kik Van Newkirk, Amy, (Optics, GRA), Advisor: Schülzgen Vaupel, Andreas, (Optics, GRA), Advisor: M. Richardson Vazquez-Guardado, Abraham, (Optics, GRA), Advisor: Chanda Wang, Tiansi, (Optics, GRA), Advisor: Kar Wang, Yang, (Optics, GRA), Advisor: Chang Webb, Benjamin, (Optics, GRA), Advisor: M. Richardson Weed, Matthew, (Optics, GRA), Advisor: Schoenfeld Wei, Ming, (Optics, GRA), Advisor: Schoenfeld Williams, Charles, (Optics, GRA), Advisor: Delfyett

Williams, Henry, (Chemistry, GRA), Advisor: Kuebler
Willis-Ott, Christina, (Optics, GRA), Advisor: M. Richardson
Wu, Yi, (Optics, GRA), Advisor: Chang
Xia, Cen, (Optics, GRA), Advisor: Li
Xu, Daming, (Optics, GRA), Advisor: Wu
Yan, Jin, (Optics, GRA), Advisor: Wu
Yang, Xu, (Optics, GRA), Advisor: Deppe

Zakariya, Abdullah, (EE, GRA), Advisor: LiKamWa Zhang, Yu, (Optics, GRA), Advisor: Deppe Zhang, Qi, (Optics, GRA), Advisor: Chang Zhao, Jian, (Optics, GRA), Advisor: Zhao, Peng, (Optics, GRA), Advisor: Hagan/VanStryland Zhu, Ruidong, (Optics, GRA), Advisor: Wu



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



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

International Collaboration

The Atlantis- MILMI Program

The Atlantis-MILMI Program is a Masters Degree program, offering dual Masters degrees in the interdisciplinary field of Lasers, Photonics and Material Science by a consortium of four institutions, the Physics

and Chemistry departments of the University of Bordeaux, France; the Friedrich Schiller University in Jena, Germany; CREOL, the College of Optics & Photonics of the University of Central Florida; and the School of Material Science & Engineering, Clemson University in South Carolina. Twelve scholarships are offered each year to allow students in this dual Masters degree program to take courses and perform research

for up to 12 months at institutions across the Atlantic. Six different choices of Dual Masters are offered under the Atlantis-MILMI Program and unique opportunies to work with different professors are available.

Resulting from a long history of scientific collaboration between these institutions, this advanced degree program creates individualized education and training in optics, lasers, photonics, optical materials and the interaction of light with matter, drawing on their unique expertise, research programs, and educational curricula. CREOL, The College of Optics & Photonics at UCF, provides comprehensive education and research training in optics, photonics and lasers. Friedrich Schiller University is renowned for its expertise in advanced lasers and laser material processing. The University of Bordeaux will introduce non-linear science and the optical properties of materials. A foundation in chemistry and physics is complemented by dedicated programs in organic and inorganic materials science and engineering at Clemson University.



Each semester, the students attend existing selected technical courses taught in English at all four institutions. The latest technology in teleconferencing and "podcasting" solutions is used to accompany the

mobility of students. First class training facilities will be offered to participants along with strong tutorship. Special (existing) intensive language classes in the national languages of the consortium (German, French and English) are made available to participants along with particular courses that will foster mutual integration of the scientific community. The students are also involved in research activities and exposed to research seminars

and courses. Faculty exchanges also support a summer school each year in Europe or the US. To encourage entrepreneurship experience, every effort is made to match each student's program to a technical project having scientifically and technologically maturity in his home university.

MILMI Students AY 2012-2013

Thomas Bourgade Corey Butler Martin Gebhardt Andreas Knebl Gregor Matz Matthias Munnich Michael Mueller

Post-Graduation Employment



Yan Li PhD Optics, 2012 Advisor: Shin-Tson Wu Senior Optics Engineer, Magic Leap, Inc.



Jonathan Rosch PhD Optics, 2012 Advisor: Winston Schoenfeld Senior Packaging Engineer, Intel Corporation



Matthew Weidman PhD Optics, 2012 Advisor: Martin Richardson Post Doc, Max-Planck Institute of Quantum Optics, Germany



Apurva Jain PhD Optics, 2012 Advisor: Leonid Glebov Optical Program Engineer, Avo Photonics



Thomas Kohlgraf-Owens PhD Optics, 2012 Advisor: Aristide Dogariu Optical Research Scientist, Kord Technologies



John Broky PhD Optics, 2013 Advisor: Aristide Dogariu RET Engineer, Intel Corporation



Casey Boutwell PhD Optics, 2013 Advisor: Winston Schoenfeld Licensing Associate, North Carolina State University



Pankaj Kadwani PhD Optics, 2013 Advisor: Martin Richardson Research Scientist, IPG Photonics



Dana Kohlgraf-Owens PhD Optics, 2013 Advisor: Aristide Dogariu Engineering Consultant, Kord Technologies



Yuan Liu PhD Optics, 2013 Advisor: Martin Richardson Laser Optics Engineer, ESI



Davorin Peceli PhD Optics, 2013 Advisors: David Hagan and Eric Van Stryland Senior Laser System Researcher, ELI Beamlines



Robert Sims PhD Optics, 2013 Advisor: Martin Richardson Senior Research Scientist in Solid State Lasers, Lockheed Martin Coherent Technologies



Charles Williams PhD Optics 2013 Advisor: Peter Delfyett Senior member of the Technical Staff, FAZTechnology



Neng Bai PhD Optics, 2013 Advisor: Guifang Li Senior Hardware Development Engineer, Optical System Architecture



Matthew Weed PhD Optics, 2013 Advisor: Winston Schoenfeld Technical Analyst, Open Photonics



Ming Wei PhD Optics 2013 Advisor: Winston Schoenfeld Manufacturing Process Development Engineering Staff, JDSU



Christina Willis PhD Optics, 2013 Advisor: Martin Richardson Optics and Laser Scientist Vision Engineering Solutions



Jin Yan PhD Optics, 2013 Advisor: Shin-Tson Wu Senior Optical Engineer, Apple.
Research

3. Research

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

3.1 Research Centers

Florida Photonics Center of Excellence (FPCE)

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

Townes Laser Institute

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

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

Established in 2013 under the direction of Prof. Zenghu Chang, iFAST presently has 6 research groups dedicated to research, education and outreach of attosecond physics and optics. The mission is to provide unique opportunities for faculty, scientists and students from College of Science and CREOL to closely collaborate in attosecond science research, create and disseminate new knowledge in attosecond physics by conducting, presenting, and publishing cutting-edge fundamental and applied research and develop next generation attosecond lasers for technology transfer and creating jobs in the State of Florida and the nation. An \$8 million DARPA PULSE is awarded to Chang and his collaborators at University of California Berkeley and University of Ottawa to develop high energy attosecond light sources.

3.2 Areas of Research

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



Lasers

Science & Technology

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

Applications

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



Laser and Plasma Laboratory

Optical Fibers

Science & Technology

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

Applications

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





Fiber Drawing Towers

Semiconductor & Integrated Photonics

Science & Technology

- \square Eptiaxial Growth
- □ LEDs & Laser Diodes
- □ Quantum Dots & Nanostructures
- □ Optoelectronics
- □ Oxide Semiconductors
- D Photovoltaics
- □ Integrated Optics
- Deriodic 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



Nanophotonics Fabrication Facility

Nonlinear and Quantum Optics

Science & Technology

- D Nonlinear Guided Waves & Fibers
- Nonlinear Optical Materials
- Nonlinear Optics & Spectroscopy
- D Nonlinear Opticsr in Periodic Structures
- □ Photosensitive Glasses
- $\hfill\square$ Quantum Optics
- \square Solitons

Applications

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



Femto-second Nonlinear Optics Laboratory

Imaging, Sensing and Display

Science & Technology

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

Applications

- □ Laser Protectors
- Quantum Communication & Information



3.3 Laboratories & Facilities

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

Shared Facilities

Nanophotonics Systems Fabrication Facilities. A 3,000 ft² multi-user facility containing Class 100 and Class 1000 cleanrooms and a Leica 5000+ e-beam lithography instrument capable of 10-nm resolution. These facilities are used for fabrication and study of nanostructured materials and nanophotonic integrated circuits. The Laboratory is designed and operated as a multi-user facility, with availability to companies and other outside users. Rm 180.

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

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

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

Zygo Facility. Rm 211B. Shared facility administered by Martin Richardson.

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



Photolithographic and device packaging equipment in the Optoelectronic Fabrication Cleanroom

Faculty Labs

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

Fiber Optics Lab. Research in fiber fabrication technology, nanostructured fibers, nonlinear fiber materials, fiber lasers, and fiber sensing applications. Axel Schülzgen, Rodrigo Amezcua.

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

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

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

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

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

Laser System Development Lab. Developing new solid-state lasers, external cavity semiconductor lasers and amplifiers, seeding lasers, laser-induced damage, far infrared semiconductor lasers, high-

average-power solid state lasers, semiconductor and solid state volume Bragg lasers, high power laser beam combining, ultra-high-intensity femtosecond lasers, new solid state lasers and materials development (crystals & glasses). Michael Bass, Martin Richardson, Peter Delfyett, Leonid Glebov.

Liquid Crystal Display Lab. Investigating 1) advanced liquid crystal display materials, display devices, and device modeling, 2) electronic laser beam steering and adaptive optics using fast-response spatial light modulators, 3) adaptive liquid crystal and liquid lenses for forveated imaging and zoom lens, and 4) bio-inspired tunable optical filters using cholesteric liquid crystals. Shin-Tson Wu.

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

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

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

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

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

Nonlinear Waves Lab. Research in nonlinear optics, spatial and

spatio-temporal solitons, discrete solitons in photonic lattices, and curved beams. Demetrios Christodoulides.

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

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

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

Optical Ceramics Lab. conducting research on the 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.

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

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

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

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

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



Graduate student Sharad Bhooplapur, center, in the Ultrafast Opticsl Signal Processing Laboratory.



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



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



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

3.4 Research Highlights



Professor Ayman Abouraddy (left) and his graduate students Joshua Kaufman, Soroush Shabahang and Guangming Tao discovered a method for breaking molten fiber into spherical droplets.

Nanospheres fabricated by optical fiber drawing

When thinking of an optical fiber, one usually imagines the thin strands of glass that extend for thousands of kilometers around the globe forming the backbone for optical communications networks and the internet. A wide range of other devices, from fiber lasers to sensors, also benefit from extending optical functionalities along the length of a fiber. In terms of the form factor, there could be nothing more remote from an extended fiber than a nanoparticle. Such nanoparticles are typically produced via chemical synthesis, and a new route must be established for each new material.

In 2012, Prof. Abouraddy's group reported in the journal Nature the first observation of a fluid instability within a fiber formed of multiple materials. The same physical mechanism that make faucets drip is thermally induced inside a fiber - and if the core and cladding materials are chosen appropriately, the continuous cylindrical core can be made to break up into a necklace of spheres held stationary and isolated from each other within the cladding matrix. Surprisingly, this fluid instability operates at both the macroscopic and microscopic scales, leading to the controllable fabrication of uniformly sized glass spheres that are big enough to be visible to the naked eye, down to 20-nm particles the size of a single virus.

The past year witnessed two new breakthroughs based on the original observation.

First, Abouraddy's group at CREOL in collaboration with Prof. Ratna Chakrabarti's group at UCF's Burnett School of Biomedical

Sciences, College of Medicine, confirmed that this particle fabrication process is independent of chemistry by utilizing

a wide range of polymers – even the polymer ABS (acrylonitrile butadiene styrene) used in making LEGOs[®] was drawn into a fiber that yielded particles upon thermal treatment! By using *biocompatible* polymers, microparticles were produced and then employed in biosensing experiments. Furthermore, a hollow fiber was used to create polymeric micro-capsules filled with a biological cargo (collagen was used here) that was later released. These results were published in the *Proceedings of the National Academy* of Science, the first paper from CREOL published in this prestigious journal. The partnership between the two colleges is UCF's latest step in fostering collaborative research projects that will have improved chances for federal funding. The joint UCF project is called RIBOP – Research Initiative In Biophotonics – and was initiated after both colleges and the UCF Office of Research and Commercialization each contributed \$15,000 to identify biological applications for photonics and lasers.

A second breakthrough was achieved in collaboration with Prof. Yoel Fink's group at MIT in which the reach of this in-fiber fluid instability process is extended to new temperature regimes and types of materials. Specifically, a silica-cladded silicon-core fiber is continuously fed into a flame defining an axial thermal gradient to continuously form spheres whose size is controlled by the feed speed to <500 nm. Moreover, a fiber with dual cores (p-type and n-type silicon) is drawn and processed into spheres. The separation between the two cores was chosen to induce spatially coherent breakup in the two cores leading to the joining of the spheres into bispherical silicon 'p-n molecules'. Indeed, measurements reveal a rectifying I-V curve consistent with the formation of a p-n junction. A paper entitled "Silicon-in-silica spheres via axial thermal gradient in-fiber capillary

instabilities" was published in *Nature Communications* describing these results.

Prof. Abouraddy's

group is currently extending the capabilities of this process further by endowing the nanoparticles produced with optical and magnetic functionalities, in addition to adopting the use of biodegradable polymers. In collaboration with Prof. Chakrabarti's group, the first experiments on selective drug delivery to cancer cells are currently underway.



Experiments on selective drug

delivery to cancer cells are

currently underway

Starting from a centimeter-scale macroscopic preform (Left: here containing a large number of identical 'cores'), a fiber is thermally drawn containing the intact cores (Middle: the cores are revealed at the fiber tip by dissolving the cladding), and an infiber fluid instability converts all the cores into nanospheres (Right).

Laser pulses: Shorter, faster, and stronger

The quest for the shortest attosecond L laser pulse has been underway since the first demonstration of such light sources in 2001. Single attosecond pulses with a record duration of 80 as were previously generated in 2008. Further reduction of the pulse width requires a broader spectrum with correct phase. The extreme ultraviolet (XUV) continuum produced by the Double Optical Gating (DOG) developed by Professor Zenghu Chang's group covers much broader spectra than the previous scheme. They demonstrated that the XUV light could be tailored to obtain the spectrum with the desirable phase. In addition, they solved the characterization problem by improving a scheme named PROOF (Phase Retrieval by Omega Oscillation Filtering) previously developed in his group. A 67 attosecond XUV pulse, the

new shortest light pulse world record, was generated and fully characterized by PROOF in 2012.

Understanding and controlling the dynamic evolution of electrons in matter is among the most fundamental goals of attosecond science. Chang's group developed an advanced attosecond transient absorption setup at UCF, with which they obtained ground-breaking results in observing excited electronic state dynamics of atoms with sub-optical cycle time resolution. They have been

able to show that the concepts of dynamic Stark shift and ponderomotive energy shifts, which are intrinsically cycle averaged quantities used routinely in the literature for decades, have to be extended to include subcycle structure on the time scale of the near infrared dressing field.

They uncovered absorption structures corresponding to laser-induced "virtual" intermediate states in the two-color two-photon and three-photon absorption process. These previously unobserved absorption structures are modulated on half-cycle (~1.3 fs) and quarter-cycle (~0.6 fs) timescales, resulting from quantum interference. The results were published in Physical Review Letters and Scientific Reports in 2013.

Dr. Chang led a research team that received a \$6.9 million grant from the U.S. Defense Advanced Research Projects Agency to make those pulses 1000 times stronger.



The Institute for the Frontier of Attosecond Science and Technology (*i*FAST) Laboratory

The team is comprised of researchers from the University of Ottawa (Professor Paul Corkum) and the University of California,

> Berkelev (Professors Steve Leon and Dan Neumark) to help the federal agency better understand the interaction of electrons in solids and, ultimately, create ultrafast sensors and detectors. There is also a strong interest in investigating whether attosecond pulses of laser light can be applied to building electronic devices with much greater speeds. The new attosecond light source to be built will be strong enough to both excite and probe electron dynamics, which is considered to be the Holy Grail of attosecond science.

0 0

Zenghu Chang

The first stage of the project will focus in building a new femtosecond laser capable of producing higher energy, pulses to drive the process of attosecond pulse generation. The laser will be housed in a 2400 square-foot space comparable to four standard labs in UCF's Physical Science buildingand still, the laser beam will have to be "folded" multiple times to achieve the power the DARPA project is seeking. Such a facility will help the U.S. compete more effectively with European countries that have thus far dominated the landscape for attosecond laser research infrastructure.

Chang has a joint appointment in the College of Optics and Photonics and the Department of Physics, and is also the the Director of the UCF new Institute for the Frontier of Attosecond Science and Technology (*i*FAST), which has researchers from the Department of Physics and CREOL. *i*FAST has the potential to create major breakthroughs in our understanding of the role of ultrafast electron dynamics.

Chang was elected as a Fellow of the Optical Society of America in 2013. He is also a Fellow of American Physical Society.



Breaking Newton's third law of motion

Newton's third law states that the action-reaction forces involved in an elemental two-body interaction must be equal and opposite. Combined with the second law of motion, this implies that two classical bodies are expected to accelerate either towards or away from each other, but never in the same direction. This is true as long as the masses of the two particles involved are positive, which is of course the case in mechanics. However, this situation completely changes if hypothetically one of the masses is negative. In fact, in this regime, an intriguing scenario arises whenever the two masses are equal and opposite; under these conditions, two interacting bodies will indefinitely accelerate in the same direction while keeping a constant distance among themselves Interestingly, this possibility was first speculated within the context of "diametric drive" that could itself provide a possible mechanism for space propulsion. Of course, in the absence of negative mass particles, no such acceleration behavior that breaks the action-reaction symmetry has ever been reported.

In a recent study (Nature Physics, 9, 780 (2013)), the group of Prof. Christodoulides in collaboration Prof. Ulf Peschel's team from the University of Erlangen-Nuernberg in Germany, have demonstrated this effect using optical pulses in a figure-8, fiber-optic platform (Fig. 1b). This periodic arrangement ultimately leads to two photonic bands. Given that the effective photon "mass" in these two bands is equal and opposite, one could then anticipate optical diametric drive acceleration effects to take place. To excite such a selfaccelerating bound state, two pulses (having opposite masses), were launched in close proximity to each other. The interaction force between these wavepackets was provided by means of Kerr nonlinearity. The formation of such a mass/anti-mass self-accelerating state is shown below. In all cases, this combined entity perpetually accelerates towards the direction of the negative-mass component until relativistic saturation effects from the band edges come into play.



Setup of two time-multiplexed fiber loops. Sequences of light pulses circulating in both loops, obey the same dynamics as in a periodic lattice



Observation of optical diametric drive acceleration...

The underlying concept presented is quite general and can be directly apply to many other physical settings. Given that the effective mass is a generic concept in physics, diametric drive effects can inspire new approaches in controlling particle interactions in crystal lattices. The demonstrated reversal of actionreaction symmetry could also enable new possibilities for frequency generation and pulse steering applications, as in advanced laser systems or during supercontinuum processes in photonic crystal fibers.

Along similar lines, optics may serve as a powerful test bed for another physical phenomenon, the so-called supersymmetry (SUSY). This concept was originally conceived in the context of quantum field theory as a means to treat bosons and fermions on an equal mathematical footing. As recently indicated (PRL 110, 233902 (2013)), transferring SUSY notions to photonic settings turns out to open a number of interesting possibilities. These include for example, global phase matching of an arbitrary number of guided modes that would enable the direct manipulation of individual modes in heavily-multimoded systems. Furthermore, supersymmetry can endow two apparently dissimilar structures with identical scattering characteristics and thereby render them indistinguishable to an external observer.



Global phase-matching in supersymmetric multimode waveguides.



Two bodies of positive mass accelerate towards each other in the presence of attractive forces. In contrast, two particles with equal and opposite in sign masses tend to self-accelerate when subject to the same force.



Demetrios Christodoulides was named UCF Pegasus Professor this year. His research has produced a number of breakthroughs for which he has received international recognition including the prestigious OSA R.W. Wood Prize. His work also has attracted international media coverage from the Sunday Times-London to MSNBC.

In essence, SUSY provides a novel approach to transformation optics, where it allows structures with high refractive index contrast, and even metallic inclusions, to be replaced without loss in functionality. Finally, the unique phase-matching capabilities of supersymmetric optical structures allow coupled arrangements of SUSY partner waveguides to exhibit highly efficient mode conversion, and enables them as scalable, versatile building blocks fully integrated mode division multiplexing schemes.

Mode conversion in a SUSY ladder. Light injected into the ground mode of the fundamental layer remains trapped (left). When a superposition of modes is excited, its constituents are transferred to the subsequent layers and thereby converted to their respective node-free ground modes (center, right).



New paradigms for light-matter interaction

Light induces mechanical action in different ways. When energy is exchanged, both light and material properties may be altered leading to a variety of movement or propulsion mechanisms, such as phototaxis or photophoresis. Light also carries linear and angular momenta that can be transferred directly to matter. This permits controlling microscopic systems with extreme precision.

When light interacts with more complex media, new manifestations optically-induced of forces occur. Professor Aristide Dogariu and research scientist Sergey Sukhov have recently shown that gradientless light fields can, counterintuitively, exert pulling forces in complex multiphase systems. These forces arise naturally when the properties of the electromagnetic fields can be carefully

controlled. Remarkably, this happens in purely passive dielectric environments and without resorting to complicated illumination beams or the use of exotic materials (Nature Photonics 7, 24, 2013).

What's more, the electromagnetic momentum nonequilibrium can be practically amplified when light Light is used to learn how

amplified when light Light is used to learn propagates from one biological cells move medium into another with

higher refractive index. As a result of linear momentum conservation at interfaces, a new type of mechanical action is generated at the interface between homogeneous domains. This phenomenon leads to negative forces which point against the main flow of light and can act on arbitrarily large objects causing very large displacements, as demonstrated by research in Professor Dogariu's group (Nature Photonics 7, 787, 2013).

This discovery should not only drive the development of microscopic theories of

electromagnetic forces in soft bodies but it may also have significant technological applications. The new way to generate optically-induced action is easy to scale, simple to implement and robust, and it can open fresh avenues optomechanics, in optofluidics, or micromanipulation. instance, For one could imagine these types of forces driving microflows without

moving parts or other additional mechanical or chemical preparations. In conjuncture with other external fields (thermal, chemical, etc.), the optically controlled dynamics could assist in establishing a range of steady-state nonequilibrium situations in complex fluids.

Based on such electromagneticallyinduced surface forces one can develop new

tools to explore fundamental interfacial phenomena in biology and colloidal science. For example, complex fluid-fluid interfaces



The wavefront of incoming radiation can be controlled to induce "negative" forces acting on complex objects.



Due to negative forces, surface-bound droplets move opposite to the directio of illumination. After Nature Photonics 7, 787 (2013).

are common to many living systems, environment, chemically engineered products, etc. These structures are created when active molecules or particles collect at interfaces; they couple strongly to hydrodynamic forces and have nonlinear rheological properties. The flexibility of applying spatially distributed stresses could lead not only to novel interfacial microrheology techniques but also to new means for macroscopic manipulation of such structures described by complex constitutive relations.

There are more distinctive consequences of strong light-matter interaction. For instance, the interplay between Brownian motion and optical forces generates unusual mechanical properties and provides unique insights into out-of-equilibrium phenomena. Professor Dogariu's group was the first to demonstrate that light interacting with colloids can serve as a model for a different type of matter (Nature Photonics 6, 834, 2012). The unique properties of such "active matter" are derived from the additional energy imparted to system's constituents and, as a result, the medium is out of the equilibrium and displays unusual collective behaviors. Biological systems are certainly archetypical examples of active matter that span many length scales from the transformation of cytoskeletal filaments at subcellular levels to swarming of bacteria to complex motion in animal groups. This artificial all-optically controlled "active matter" enables unique studies and brings new insights into the fundamental properties of complex biological systems. In addition, the colloidal active matter may also open avenues for creating synthetic materials that could mimic properties of living matter.





Professor Sasan Fathpour and members of his research team (Research Scientist Dr. P. Rabiei, and graduate students J. Ma, S. Khan and J. Chiles) have developed a new way of integrating photonic devices that can potentially revolutionize integrated optics for applications in telecommunications as well as nonlinear and quantum optic devices on chips.

Despite decades of research, there appears to be no ideal photonic material that can play the unifying role that silicon has been dominantly playing for decades in microelectronics. For example, some photonic materials (like compound semiconductors) are good for laser light generation, while some (like lithium niobate) are good for electro-optics (an effect useful for switches and modulators). Silicon is a good passive optical material to move light around a chip and there are ways to make modulators on it but the performance of the devices is not great because the material is not electro-optic.

The problem with current lithium niobate devices is that they are bulky and expensive. If thin films of lithium niobate are developed and the geometrical cross-section of devices on the films can be reduced to submicron dimensions, the field of integrated photonics can move toward a more unifying platform. In addition, if such miniaturized photonic devices

are made on silicon wafers that already The advantage of the novel platform is beyond

house electronic circuits, ultrafast photonics and electronics can be seamlessly merged. Such a hybrid platform can pave the path toward using optics to transmit data between microprocessors, graphic and memory chips of future personal computers, game consoles, laptops and tablets.

Fathpour and his team's breakthrough results make such a hybrid versatile platform closer to reality. For the first time, they have managed to bond thin films (less than half a micrometer thick) of lithium niobate to silicon wafers. The films themselves may have applications other than photonics (microelectromechanical systems, microwave filters for cell phones and piezoelectric transducers, to name a few). For now, the CREOL researchers are more focused on demonstrating basic integrated photonic devices such as low-loss microring resonators

and high-performance optical modulators. They have managed to demonstrate electrooptic modulators whose driving voltage is several times less than the best commercial devices. This has possible become because the dimensions of the devices are less than a micrometer in

width and height, compared to tens of microns in conventional devices. Having smaller devices means less voltage to attain the required radio-frequency electric field for the electro-optic effect, and less real estate on thin films means less consumption of expensive lithium niobate wafers.

Unlike conventional lithium niobate waveguides that can be hardly bent, the UCF researchers have demonstrated optical rings with diameters less than a third of a millimeter for the first time on the material. All of these will allow integrating several miniaturized modulators and other photonic devices on a single chip for advanced communication formats such as quadrature phase shift keying (QPSK).

telecommunication applications. optical Lithium niobate is one of the best known nonlinear optical materials but, with the lack of small and efficient waveguides, nonlinear photonic chips that can manipulate the wavelength of light and quantum optics chips that allow quantum-mechanical interaction of light and matter have been hard to achieve. It is expected that these nonlinear and quantum optical chips can become a reality in the near future. Fathpour's group plans to start working on building such chips in addition to pursuing their research on advanced photonic devices for optical telecommunication applications. The work is funded under the Office of Naval Research Young Investigator Program and was published in Optics Express last October.

Next-generation platform for

Sasan Fathpour was among 16 researchers nationwide receiving Young Investigator



Awards from the Office of Naval Research in 2013. He was recognized for showing "exceptional promise for doing creative research" early in his tenure track, according to the Navy. Fathpour was awarded a three-year, \$680,000 grant to study novel nonlinear integrated

devices on silicon. In 2012, he received the National Science Foundation CAREER award (another prestigious award for junior faculty) to conduct research on mid-infrared silicon photonics.

His research at CREOL has been highlighted by Nature Photonics, Optics and Photonics News, Laser Focus World, photonics.com and other trade magazines and professional websites. He is the co-editor of a book entitled "Silicon Photonics for Telecommunications and Biomedicine" published by CRC Press in 2012.



Detailed waveguide cross-section, dimensions, and materials for an integrated-optic ring-resonator and a Mach-Zehnder modulator (shown in the upper inset) implemented in the new platform.

3.5 Publications and Presentations

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

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H. Lin, L. Li, Y. Zou, S. Danto, J. D. Musgraves, K. **Richardson** and J. Hu, "*High-Q mid-infrared chalcogenide glass-on-silicon resonators for spectroscopic chemical sensing*," CLEO, San Francisco, CA, June (2013).

H. Lin, L. Li, Y. Zou, S. Danto, K. **Richardson**, J. D. Musgraves, and J. Hu, "*Mid-IR chalcogenide glass on-chip photonics*," American Ceramic Society PacRim/GOMD Meeting, San Diego CA, June 4–7 (2013).

V. Singh, T. Zens, J. Hu, P.T. Lin, J. Wang, J. D. Musgraves, K. **Richardson**, J. Hensley, L. C. Kimerling, and A. Agarwal, *"Monolithically integrated evanescently coupled photodetector for infrared glass-on-silicon sensing platform,"* American Ceramic Society PacRim/GOMD Meeting, San Diego, CA, June 4–7 (2013). V. Singh, J. Giammarco, A. Paola Soliani, P.T. Lin, J. Hu, J. D. Musgraves, I. Luzinov, K. **Richardson**, J. Hensley, L. C. Kimerling, and A. Agarwal, "*Polymer-coated microdisk resonators for infrared chemical sensing*," American Ceramic Society PacRim/GOMD Meeting, San Diego CA, June 4–7 (2013).

K. **Richardson**, "Engineering chalcogenide glass materials for optical sensor applications," 15th I.D. Varshnei Memorial Award Lecture, 76th Annual Indian Ceramic Society meeting, Ahmedabad, India (2013). *Invited*

K. **Richardson**, J.D. Musgraves, P.F. Wachtel, S. Novak, S. Danto, A. Agarwal, V. Singh, P-T Lin, L.C. Kimerling, J. Hu, Z. Yi, H. Lin, J. Giammarco, A.P. Soliani, I. Luzinov, and J. Hensley, "*Engineering materials for mid-infrared optical sensor applications*," First International Congress on Progress in Ultrafast Laser Processing of Materials, Cargèse, Corsica (2013). *Invited*

K. **Richardson**, J. D. Musgraves, P. Wachtel, S. Novak, S. Danto, J. Giammarco, A.P. Soliani, I. Luzinov, A. Agarwal, V. Singh, P.T. Lin, L.C. Kimerling, J. Hu, Z. Yi, H. Lin, L. Li and J. Hensley, "Advanced chalcogenide glasses for next generation photonic applications," International Congress on Glass, Prague (2013). *Invited*

E.G. Johnson, Y. Li, I.R. Srimathi, R.H. Woodward, M.K. Poutous, A.J. Pung, M. **Richardson**, L. **Shah**, R. Shori, and R. Magnusson, *"Resonant optical devices for IR lasers,"* paper 8599-53, SPIE Photonics West, (2013).

Y. Liu, B. Bousquet, M. **Richardson**, and M. **Baudelet**, "*Thomson scattering from aluminum laser plasmas in air*," OSA-FIO, Orlando, FL, October 10 (2013).

Y. Liu, B. Bousquet, M. **Richardson**, and M. **Baudelet**, "*Thomson* scattering from aluminum laser plasmas in air," CLEO, San Jose, CA, June 13 (2013).

M. Durand, A. Jarnac, A. Houard, Y. Liu, B. Prade, M. Richardson, and A. Mysyrowicz, "*Self-cleaning properties of a filament conjugate mirror*," paper QTh5B.8, CLEO, San Jose, CA (2013). Postdeadline

M. Richardson, M. Ramme, A. Royon, T. Cardinal and L. Canioni, *"Femtosecond generation of nano-fibers,"* Cargese International School on Ultrafast laser Modification of Materials, Cargèse, France, April 15–19 (2013).

I. Mingareev, T. Bonhoff, A. F. El-Sherif, and M. **Richardson**, *"Femtosecond laser post-processing of metal parts produced by laser additive manufacturing,"* Cargese International School on Ultrafast laser Modification of Materials, Cargèse, Corsica, France (2013).

M. Ramme, A. Housman, I. Mingareev, and M. **Richardson**, *"Femtosecond single-pulse absorption in semiconductors with varying dopant concentration,"* Cargese International School on Ultrafast laser Modification of Materials, Cargèse, Corsica, France (2013).

M. **Richardson**, M. Ramme, A. Royon, T. Cardinal, and L. Canioni, *"Femtosecond generation of nano-fibers,"* Cargèse International School on Ultrafast laser Modification of Materials, Cargèse, Corsica, France April, 15–19 (2013).

M. **Richardson**, *"Filamentation of Laser Light in Air,"* South East Section, APS, 80th Annual Meeting, Bowling Green, KY, Nov. 17 (2013).

M. Richardson, N. Barbieri, M. Durand, M. Baudelet, E. Johnson, Z. Hosseinimakarem, N. Litchinitzer, Z. Kudyshev and R. Hammond, "*Meta-optics transforms laser filamentation studies*," OSA Incubator Workshop Structured Light in Structured Media, Washington DC, Nov. 17 (2013).

M. **Richardson**, R. Bernath, M. Weidmann, N. Barbieri, K. Lim, M. Durand and M. **Baudelet**, "*Remote plasmas produced by laser filaments*," ICONO/LAT Conference, Moscow, Russia, June 18–22 (2013).

M. Richardson, R. Bernath, M. Weidmann, N. Barbieri, K. Lim, M. Durand and M. Baudelet, "*Remote plasmas produced by laser filaments*," ICON/LAT, Moscow, Russia, June 16–22 (2013).

M. Masnavi, J. Szilagyi, H. Parchamy, and M. Richardson, "Laserbased plasma sources at 6.6 and 60 nm," CLEO, San Jose, CA, paper JW1D.2 (2013).

J. A. Bernstein, A. Bravato, B. Ealy, M. Ricklick, J. S. Kapat, I. Mingareev, M. **Richardson**, W. Meiners, and I. Kelbassa, *"Fabrication and Analysis of Porous Superalloys for Turbine Components Using Laser Additive Manufacturing,"* Proc. of 49th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, San Jose, CA (2013).

Y. Liu, C. Jeon, M. **Richardson**, and M. **Baudelet**, "*Analyse quantitative par spectroscopie de plasma induit par laser (LIBS): de l'analyse spectrale a l'analyse de traces*," Spectr'Atom 2013; Mont-Tremblant, QC, Canada, June 27 (2013).

C. J. Frederickson, C. Frederickson, D. Rusak, C. Jeon, M. **Richardson** and M. **Baudelet**, "*Determination of elemental nutritional status in man by LIBS interrogation of in situ tissues*," NASLIBS, Milwaukee, WI, September 29 (2013).

Y. Liu, B. Bousquet, M. **Richardson**, and M. **Baudelet**, "*Thomson scattering from aluminum laser plasmas in air*," NASLIBS, Milwaukee, WI, September 29 (2013).

M. Richardson, and R. Gaume, "*Transparent ceramics- A game-changer for lasers*," PARSHURAM B GANPULE MEMORIAL AWARD LECTURE, 76th Annual Session of Indian Ceramic Society, International Conference on New Era in Glass & Ceramics (NEGC), Ahmedabad, India, January 18–19 (2013).

M. **Richardson**, M. **Baudelet**, M. Sigman, and A. Miziolek, "*Laser stand-off sensing technologies*," Indo-US Workshop on Spectroscopy: Application to National Security, Banaras Hindu University, Varanasi, India, January 18–20 (2013).

M. **Richardson**, et al., "*Recent studies of air filamentation*," Workshop on "Fundamentals and Applications of Laser Filaments" Institute for Molecular Science (IMS), Okazaki, Japan, April 4–6 (2013).

B. E. A. **Saleh**, "*Image science in the optics & photonics curriculum*," 12th International conference on Education and Training in Optics and Photonics (ETOP), Porto, Portugal (2013).

M. Wei, R. C. Boutwell, and W. V. **Schoenfeld**, "*Homoepitaxial growth of high quality ZnO thin films*," Young Leads' Session, FL-AVS Symposium, Orlando, FL (2013).

K.O. Davis, K. Jiang, C. Demberger, H. Zunft, D. Habermann, and W.V. **Schoenfeld**, "*Microstructural properties of TiO2 anti-reflection coatings deposited via in-line APCVD*," 39th IEEE Photovoltaic Specialists Conference (2013).

M. Wei, R. C. Boutwell, and W. V. **Schoenfeld**, "*Impact of Growth Conditions on ZnO Homoepitaxial Films on ZnO Substrates by Plasma-assisted Molecular Beam Epitaxy*," SPIE Photonics West (2013).

K.O. Davis, K. Jiang, C. Demberger, H. Zunft, D. Habermann, and W. V. Schoenfeld, "*Multi-functional APCVD oxide films*," SCEC-IMAPS Symposium (2013). *Invited*

K.O. Davis, K. Jiang, C. Demberger, H. Zunft, D. Habermann, and W. V. Schoenfeld, "*Multi-functional APCVD oxide films for c-Si solar cells*," Florida AVS Symposium, Orlando, FL (2013). *Invited*

K.O. Davis, K. Jiang, C. Demberger, H. Zunft, D. Habermann, and W.V. Schoenfeld, "*Multi-functional APCVD oxide films for c-Si solar cells*," 2nd Annual c-Si PVMC Workshop, Intersolar North America (2013). *Invited*

C. Jollivet, J. Guer, P. Hofmann, A. Mafi, and A. Schülzgen, "*All-fiber mode-field adapter for low coupling losses between step-index and large-mode area fibers*," paper: JTh2A.02Advanced Solid-State Lasers (ASSL), Paris, France (2013).

C. Jollivet, K. Wei, B. Samson, and A. Schülzgen, "Low-loss, singlemode propagation in large-mode-area leakage channel fiber from 1 to 2 um," paper CM31.4, CLEO, San Jose, CA (2013).

A. Van Newkirk, P. Hofmann, C. Voigtländer, S. Nolte, N. Peyghambarian, and A. **Schülzgen**, "*Monolithic phosphate glass fiber lasers with gratings inscribed by fs-laser pulses*," paper: LTh4F.4, OSA-FIO/LS, Orlando, FL (2013).

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G. Freihofer, M. Lowen. E. Durnberg, D. Fugon, A. Jones, E. Ergin, A. Schülzgen, S. Raghavan, and H. Tat, "*Prediction of piezospectroscopic properties with fundamental nanoparticle load transfer theory*," Society for the Advancement of Material and Process Engineering (SAMPE), Nanomaterials IV, Baltimore, MD (2013).

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L. Shah, K. L. Vodopyanov, P. Schunemann, J Bradford, A. Sincore, and M. Richardson, "*CW Tm:fiber lasers for THz generation*," International Symposium on Photoelectronic Detection and Imaging, Beijing, China, June (2013).

P. Kadwani, M. Gebhardt, C. Gaida, L. Shah, and M. Richardson, "A high peak power, nanosecond tm:fiber MOPA system for mid-IR OPO pumping," paper JW2A.29 CLEO-QELS (2013).

C. Gaida, M. Gebhardt, P. Kadwani, L. Leick, J. Broeng, L. Shah, and M. Richardson, "Amplification of ns-pulses beyond 1 MW-peak power in Tm3+-doped photonic crystal fiber rod," paper CW1M.2 CLEO: Science and Innovations (2013).

A. Vaupel, N. Bodnar, B. Webb, L. **Shah**, E. Cormier and M. **Richardson**, *"Energy-scaling of DPSS Picosecond Amplifiers for OPCPA Pumping*," paper CM1N.2, CLEO-QELS, San Jose, CA (2013).

M. Gebhardt, C. Gaida, P. Kadwani, A. Sincore, N. Gerlich, L. Shah, and M. Richardson, "Nanosecond Tm:fiber MOPA system for high peak power mid-IR generation in a ZGP OPO," paper MW3B.2,OSA Advanced Solid-State Lasers Congress, Mid-Infrared Coherent Sources, (2013).

L. Sisken, J. Bradford, P. Wachtel, B. Gleason, D. Musgraves, L. Shah, M. Richardson, and K. Richardson, "Distribution of photothermal heating and effects in chalcogenide glass," paper FTh4E.1, OSA-FIO, (2013).

A. Sincore, R. A. Sims, C. Gaida, P. Kadwani, M. Gebhardt, L. Shah, and M. Richardson, FM3A.3 "Scaling bottlenecks in Thulium-doped fiber lasers," OSA-FIO, Orlando, FL (2013).

J.D. Bradford, C.C.C. Willis, S. Danto, L. Shah, J.D. Musgraves, K. Richardson, and M. Richardson, "Shack-Hartmann thermal lensing characterization of mid-IR materials," paper FTh1F.5, OSA-FIO, Orlando, FL (2013).

N. Bodnar, A. Vaupel, B. Webb, L. Shah, and M. Richardson, "DPSS

Picosecond Energy Scaling for OPCPA Pumping," paper LW51.1, OSA-FIO/LS, Orlando, FL (2013).

B. Webb, J. Bradford, K. Lim, A. Vaupel, N. Bodnar, L. Shah, and M. Richardson, "Optimization of Multi-pass Amplifiers in TW-Class Ti:Sapphire Chirped Pulse Amplification Systems," OSA-FIO/LS, Orlando, FL (2013).

B. Webb, J. Bradford, K. Lim, L. Shah, M. Richardson, "Optimization of multi-pass amplifiers in TW-class Ti:sapphire chirped pulse amplification systems," paper FM3A.3, Laser Science, Orlando, FL (2013).

R. A. Sims, P. Kadwani, L. Shah, and M. Richardson, "*Chirped pulse amplification in Tm doped fiber using a chirped Bragg grating*," Paper 8601-97, SPIE Photonics West, (2013).

C. Gaida, M. Gedhardt, P. Kadwani, L. Leick, J. Broeng, L. Shah, and M. Richardson, "*Peak power scaling in Tm doped fiber laser to MW-level*," Paper 8601-107, SPIE Photonics West (2013).

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L. **Shah**, R.A. Sims, P. Kadwani, C. Gaida, M. Gebhardt, J. Bradford, A. Sincore, C. Willis, and M. **Richardson**, "2 µm fiber lasers," International Symposium on Photoelectronic Detection and Imaging, Conference 1: High power lasers and applications (2013).

L. Shah, K. L. Vodopyanov, P. Schunemann, J Bradford, A. Sincore, and M. Richardson, "*CW Tm:fiber lasers for THz generation*," International Symposium on Photoelectronic Detection and Imaging, Beijing, China (2013).

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H. Hu, T. R. Ensley, M. Seidel, M. Ferdinandus, M. Reichert, O. Przhonska, E. W. Van Stryland, and D. J. Hagan, "Dispersion of the electronic third-order nonlinearity of symmetric molecules," CLEO-QELS, San Jose, CA, QM4E.1 (2013).

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E. W. Van Stryland, "The making of a new discipline: Optics and Photonics, CREOL@25," LIA International Laser Safety Conference, Orlando, Fl, Feb. 18-21 (2013). Plenary

E. W. Van Stryland, "*The making of a new discipline: Optics and Photonics, CREOL@25*," LIA - International Laser Safety Conference, Orlando, Fl, Feb. 18–21 (2013). Plenary

K. Ingold, A. Marandi, C. W. Rudy, V. Pervak, R. Byer, and K. L. **Vodopyanov**, "500-MHz Mid-IR Frequency Comb Source Based on a Compact Subharmonic OPO," CLEO, San Jose (2013).

K.F. Lee, J. Jiang, C. Mohr, J. Bethge, N. Leindecker, K. L. Vodopyanov, P. G. Schunemann, M. E. Fermann and I. Hartl, *"Carrier envelope offset frequency of mid-infrared doubly-resonant GaAs optical parametric oscillators,"* Ultrafast Optics Conference (UFO), Davos, Switzerland (2013).

K. Lee, J. Jiang, C. Mohr, J. Bethge, N. Leindecker, K. L. Vodopyanov, P. G. Schunemann, M. E. Fermann, and I. Hartl, *"Carrier envelope offset of nondegenerate, doubly-resonant, midinfrared GaAs optical parametric oscillators,"* CLEO, San Jose, June (2013).

S. Wolf, C. R. Phillips, A. Marandi, K. L. Vodopyanov, M. Fejer, and

R. Byer, "Dynamical behavior of an ultrafast OPO near degeneracy," CLEO, San Jose (2013).

K. F. Lee, N. Granzow, M. A. Schmidt, W. Chang, L. Wang, Q. Coulombier, J. Troles, P. Toupin, N. Leindecker, K. L. **Vodopyanov**, P. G. Schunemann, L. Wondraczek, I. Hartl, M. E. Fermann and P. St.J. Russell, "*Mid-IR Frequency Combs From Coherent Supercontinuum Generation in Chalcogenide Nano-Spike Waveguides*," CLEO, San Jose (2013). Post deadline paper.

M. W. Haakestad, N. C. Leindecker, A. Marandi, K. L. **Vodopyanov**, and T. P. Lamour, "*Intracavity molecular spectroscopy in the mid-IR using ultrabroadband optical parametric oscillator*," SPIE Photonics West, San Francisco (2013).

V. Pervak, M. K. Trubetskov, M. von Pechmann, I. B. Angelov, O. Razskazovskaya, E. Fedulova, K. L. **Vodopyanov**, and F. Krausz, *"Measurements of the group delay dispersion with resonance scanning interferometer,"* The 10th CLEO-PR, Kyoto, Japan (2013).

K. F. Lee, C. Mohr, N. Leindecker, K. L. Vodopyanov, P. G. Schunemann, I. Hartl, and M. E. Fermann, "*Mid-IR frequency comb with sub-hertz residual linewidth from a doubly-resonant OPGaAs OPO*," CLEO-PR, Kyoto, Japan (2013).

K. L. Vodopyanov, "Producing octave-wide combs and few-cycle pulses in the mid-IR: frequency divide-and-conquer approach," CLEO-PR, Kyoto, Japan, June 30-July 4 (2013). Invited

C.W. Rudy, A. Marandi, K. L. **Vodopyanov**, and R. L. Byer, "Octavespanning supercontinuum generation in tapered chalcogenide fiber from 1.1 to 3.5 microns," Ultrafast Optics Conference (UFO), Davos, Switzerland (2013). **Invited**

M.W. Haakestad, T. P. Lamour, N. C. Leindecker, A. Marandi, and K. L. **Vodopyanov**, "*Intracavity molecular spectroscopy in the mid-IR using ultra-broadband optical parametric oscillator*," Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications XII, Konstantin L. Vodopyanov, Editors, Proc. of SPIE Vol. 86040T (2013).

A. Marandi, C. W. Rudy, K. L. **Vodopyanov**, and R. L. Byer, *"Cascaded generation of octave-spanning 2–5 \mum frequency combs via subharmonic-supercontinuum process,"* SPIE Photonics West, San Francisco, CA (2013). **Invited**

K. L. **Vodopyanov**, "*Frequency divide-and-conquer approach to producing octave-wide combs and few-cycle pulses in the mid-IR*," Ultrafast Optics Conference (UFO), Davos, Switzerland (2013). **Invited**

K. Lee, N. Granzow, M. Schmidt, W. Chang, L. Wang, Q. Coulombier, J. Troles, P. Toupin, N. Leindecker, K. L. **Vodopyanov**, P. G. Schunemann, L. Wondraczek, I. Hartl, M. E. Fermann; and P. St.J. Russell, "*Mid-IR frequency combs from coherent supercontinuum generation in chalcogenide nano-spike waveguides*," OSA-FIO/LS, Orlando, Florida (2013).

K. L. Vodopyanov, "Producing octave-wide combs and few-cycle pulses in the mid-infrared: frequency divide-and-conquer approach," OSA-FIO/LS, Orlando, Florida, October 6-10 (2013). Invited

K. L. **Vodopyanov**, "*Producing octave-wide combs and few-cycle pulses in the mid-infrared: frequency divide-and-conquer approach*," International Symposium on Photoelectronic Detection and Imaging (ISPDI), Beijing, China June 25-27 (2013). **Plenary**

K. L. **Vodopyanov**, *"High power and spectral purity continuous-wave photonic THz source tunable from* 1 *to* 4.5 *THz for nonlinear molecular spectroscopy*," International Symposium on Photoelectronic Detection and Imaging (ISPDI), Beijing, China (2013).

K. L. **Vodopyanov**, "*Producing octave-wide combs and few-cycle pulses in the mid-infrared: frequency divide and-conquer approach*," US-UK Workshop in Mid-IR to THz Technology and Applications,

Edinburgh, UK (2013). Invited

K. L. Vodopyanov, "Resonantly-enhanced photonic generation of monochromatic 0.5-5 THz radiation using periodically-inverted GaAs," Terahertz Workshop, Cargèse, Corsica, France, March 25–27 (2013). Invited

D. Xu, L. Rao, C. D. Tu and S. T. **Wu**, "*A nematic LCD with submillisecond gray-to-gray response time*," SID Symposium 2013, Vancouver, Canada (2013). Distinguished Student Paper.

Y. Liu, H. Zhang, R. Zhu, D. Xu, S. T. **Wu**, Y. F. Lan, C. Y. Tsai, J. K. Lu, N. Sugiura, and Y. C. Lin, *"Enhancing the contrast ratio of blue phase LCDs,"* SID Symposium 2013, Vancouver, Canada (2013).

S. He, W. Liang, C. Tanner, J. Fang, and S.T. **Wu**, "*Liquid crystal based biosensors for bile acid detection*," Proc. SPIE, vol. 86420, 86420P (2013).

J. Sun, Y. Chen, and S.T. **Wu**, "Submillisecond-response IR spatial light modulators with polymer network liquid crystal," Proc. SPIE, vol. 86420, 864207 (2013).

S. T. **Wu**, "*Is blue-phase LCD ready for prime time*?," (Plenary Talk) Symposium on Liquid Crystal Photonics, Chengdu, China, April 19–24 (2013). **Plenary**

S. T. **Wu**, "Submillisecond-response and scattering-free polymer network liquid crystals," ACS Annual Meeting, New Orleans, April 7–9 (2013). *Invited*

S. T. **Wu**, "*The dawn of blue-phase LCD*," Conference on Liquid Crystals, Mikolajki, Poland, Sept. 16–20 (2013). **Plenary**

S. T. **Wu**, *"Blue-phase liquid crystal displays,"* SPIE Photonics West, San Francisco, CA, Feb. 5 (2013). **Keynote**

M. Segall, I. B. Divliansky, D. Ott, J. Lumeau, S. Mokhov, B. **Zeldovich**, and L. B. **Glebov**, *"Beam shaping by volume phase structures in photo-thermo-refractive glass*," Paper 8843-5, SPIE Optics + Photonics Conference, 25–29 August, San Diego, CA (2013).

S. Mokhov, V. Smirnov, E. Rotari, J. Lumeau, B. **Zeldovich**, and L. B. **Glebov**, "*Deterioration of beam quality factor of laser pulses due to angular dispersion of optical elements*," Paper 8603-03, SPIE Photonics West, San Francisco, CA (2013).

B. Anderson, S. Kaim, G. Venus, I. Majid, J. Lumeau, V. Smirnov, B. **Zeldovich**, and L. B. **Glebov**, "*Forced air cooling of volume bragg gratings*," SPIE Photonics West, San Francisco, CA (2013).

B. Anderson, S. Kaim, G. Venus, J. Lumeau, V. Smirnov, B. Zeldovich, and L. B. Glebov, *"Forced Air Cooling of Volume Bragg Gratings for Spectral Beam Combination*," Fiber Lasers X: Technology, Systems, and Applications, edited by Sami T. Hendow, Proc. SPIE 8601, 86013D 1–9 (2013).

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Konstantin L. **Vodopyanov** (ed.), "Nonlinear Frequency Generation and Conversion: Materials, Devices, and Applications XII," Proceedings of SPIE, Volume 8604 (2013).

Invited Lectures and Tutorials

A. F. Abouraddy, "Multi-Material fibers: Prospects for photonics, energy, and biotechnology," Division of Materials Science & Engineering, Boston University, Feb. 22 (2013).

A. F. **Abouraddy**, "*Multimaterial Fibers: Prospects for Photonics, Energy, and Biotechnology*," University of Southern Florida, Physics Department Colloquium, Tampa Bay, FL, Sept. 6 (2013).

Z. Chang, "*Broadband high flux isolated attosecond pulses*," State Key Laboratory of Transient Optics and Photonics, Xi'an Institute of Optics & Precision Mechanics, Xi'an, China (2013).

Y. Wu, E. Cunningham, H. Zang, J. Li, M. Chini, X. Wang, Y. Wang, K. Zhao, and Z. **Chang**, "*Generation of high-flux attosecond extreme ultra-violet continuum with a 20TW laser*," The International OSA Network of Students (IONS®) conference, Ottawa, Canada (2013).

Z. Chang, "*Latest progress on attosecond optics research*," The Distinguished Alumni Lecture Series, Xi'an Institute of Optics & Precision Mechanics, Xi'an, China (2013).

Z. Chang, "Observing sub-cycle oscillations in virtual states with attosecond transient absorption," ATTOFEL Winter school, Bormio, Italy Jan.27– Feb.2 (2013).

Z. Chang, "Probing electron dynamics with attosecond transient absorption," Wayne State University, January 9 (2013).

P. J. **Delfyett**, "*Ultrafast photonics – applications in high speed signal processing, computing and communications*," University of South Florida, Department of Chemical Engineering & Biomedical Engineering (2013).

P. J. **Delfyett**, "*Ultrafast photonics – applications in high speed signal processing, computing and communications*," SRI, St. Petersburg, Florida, (2013). *Invited*

P. J. **Delfyett**, "*Ultrafast photonics – applications in high speed signal processing, computing and communications*," Univ. Calif. Berkeley, Dept of EECS (2013).

P. J. **Delfyett**, "*Central Florida Institute Commencement Speech*," August 16th (2013).

P. J. **Delfyett**, "*UCF Commencement Speech 50th Anniversary* – *Graduation Ceremony of the College of Engineering and Computer Science, and The College of Arts and Humanities (2013)*," Graduation Ceremony of the College of Engineering and Computer Science, and The College of Arts and Humanities (2013).

P. J. **Delfyett**, "*Lasers – the light fantastic – Science and appliations from pointers to DVDs*," UCF Optics Week, UCF 50th Anniversary (2013).

A. **Dogariu**, "*Mechanical action in complex electromagnetic fields*," Complex Nanophotonics Science Camp, Windsor, UK (2013). Keynote lecture

A. **Dogariu**, "*Optical action in complex fields*," SOILM13, Max Planck Complex Systems, Dresden (2013).

M. Richardson, "The Townes Institute – Today and Tomorrow," Briefing to the Air Force Office of Research (AFOSR), Arlington VA,



March 21 (2013).

M. **Richardson**, "*Une vie avec des lasers*," Presentation made to the University of Bordeaux 1, on the award of the Docteur Honoris Causa, University of Bordeaux1, Talence, France, Dec. 6 (2013).

B. E. A. **Saleh**, "*The future of optics & photonics*," National Institute of Laser Enhanced Sciences (NILES), Cairo University, Cairo, Egypt, January 2 (2013).

B. E. A. **Saleh**, "*Classical and Quantum Digital Optics*," NCT Photonics Symposium, Hsinchu, Taiwan, March 25, 2013.

B. E. A. Saleh, "Entanglement and coherence in classical optics, Physics Symposium, Oklahoma State University, April 18, 2013.

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S. T. **Wu**, "*Next-Generation LCDs for mobile displays*," AU Optronics, Hsinchu, Taiwan (2013).

S.T. **Wu**, "*Next-generation liquid crystal displays*," CREOL Industrial Affiliates Day Symposium, March 8 (2013).

S. T. **Wu**, "*My 30-year career with liquid crystals*," (Plenary talk) Honorary professorship ceremony at Nanjing University, April 28 (2013).



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Lawrence **Shah**, Tobias Bonhoff, Pankaj Kadwani, Ilya Mingareev, Mark Ramme, Martin **Richardson**, "Tm:fiber laser apparatus, materials processing method, and application," Provisional Patent 61/7764,277 filed February 13 (2013).

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Guifang Li, Neng Bai, Cen Xia, "Systems and Methods for Optical Transmission Using Supermodes," Utility Patent 13/587,129 filed August 13 (2012).

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Shin-Tson **Wu**, Yifan Li, "Liquid Crystal Display Panel," Utility Patent 13/556,184 filed July 23 (2012).

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Martin **Richardson**, Matthew Weidman, "High power laser filament mirror."

Winston **Schoenfeld**, Ryan Boutwell, Ming Wei, "High response deep ultraviolet photodetectors based on wurtzite MgZnO with homo-nucleation layer."

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Lawrence **Shah**, Martin **Richardson**, Konstantin **Vodopyanov**, "Non-mechanical, wavelength tunable optical parametric amplifier/ difference frequency generation."

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Shin-Tson Wu, Yifan Liu, "Liquid crystal display."

Shin-Tson Wu, "Polarization preserving light guide plate."

Shin-Tson **Wu**, Yifan Lu, "Polarizer design for high contrast blue phase liquid crystal display."

Shin-Tson Wu, Yifan Lu, Su Xu, "Switchable polymeric lens array."



Professor S.T. Wu, charter member of the National Academy of Inventors.



3.7 Research Funding

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

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



Research Funding (FY 2013)

Recipient	Source	Title of Award	Begin	End	Awarded 2013	Cumulative Funding
Abouraddy, A.	Massachusetts Institute of Technology	CMSE IRG 3 - Multimaterial, Multifunction Nano- structured Fibers	2/1/2012	1/31/2014	\$55,000	\$110,000
Amezcua Correa, R.	Incom, Inc.	Silica Photonic Bandgap Fiber Accelerators	10/24/2012	1/4/2013	\$12,045	\$12,045
Amezcua Correa, R. Schülzgen, A.	No Needles Venipuncture	Iles Femtosecond Lasers for cture Tissue Ablation		11/12/2012	\$10,250	\$10,250
Amezcua Correa,R. Schülzgen, A., Glebov, L., Shah L., Richardson, M.	US Army Research Office	JS Army Research Fiber Laser Light Engines - A Diffice New Platform to Collectively Address Power-limiting Constraints		8/19/2015	\$372,500	\$554,655
Bass, M.	Element Six LTD	Element Six LTD 10.6 Micron Laser Calorimetry		3/31/2013	\$2,640	\$2,640
Bass, M.	Element Six LTD	10.6 Micron Laser Calorimetry	7/6/2012	9/5/2012	\$1,000	\$1,000
Bass, M.	Powerlase Photonics, Ltd	Design of a KW class, Pulsed, ~1mm, 10kHz, Diode Pumped Slab Solid State Laser System	3/19/2012	5/5/2013	\$94,213	\$139,164
Bass, M.	Element Six LTD	Six LTD Polycrystalline Analysis Laser Calorimetry		8/15/2013	\$9,368	\$9,368
Bass, M.	Element Six LTD	Single Crystal Analysis Laser Calorimetry	5/1/2013	12/31/2013	\$5,632	\$28,448
Bass, M., Glebov, L.	Honeywell Federal Manufacturing & Technologies, LLC	Volume Bragg Grating (VBG) Beam Combiner	4/30/2013	9/30/2013	\$150,000	\$150,000
Baudelet, M.	National Institute of Justice (NIJ)	Level of confidence in elemental analysis by LIBS	1/1/2013	12/31/2015	\$399,532	\$399,532

Chang, Z.	US Army Research Office	High flux isolated attosecond XUV source	9/10/2012	1/9/2014	\$88,286	\$180,175
Chang, Z.	US Army RDECOM Acquisition Center	High flux isolated attosecond XUV source	9/10/2012	1/9/2014	\$2,940	\$6,000
Christodoulides, D.	University of Arizona	Mathematical Modeling and Experimental Validation of Ultrafast Nonlinear Light- Matter Couping Associated with Filamentation in Transparent Media	9/30/2010	11/29/2013	\$77,380	\$283,013
Christodoulides, D.	United States- Israel Binational Science Foundation	Sub-wavelength Linear and Non-Linear Optics	10/1/2011	9/30/2013	\$16,500	\$37,177
Delfyett, P.	Raydiance, Inc.	Amplitude and Phase Tailoring Phase 2	2/1/2011	3/18/2013	\$75,000	\$225,000
Delfyett, P.	Northrop Grumman Corporation	RF - Novel Low Noise Mode- locked Lasers for Advanced Components for Electronic Warfare	1/1/2013	4/15/2016	\$40,000	\$40,000
Delfyett, P.	Harris Corporation	Tunable Ultralow Noise RF Signal Generation using a Frequency Stabilized Laser and High Finesse Etalon Based Optoelectronic Oscillator	7/17/2012	4/30/2013	\$100,000	\$100,000
Deppe, D.	sdPhotonics, LLC	Expatixial Growth for Facet Passivation of High Power Diode Lasers	10/29/2012	7/31/2013	\$23,736	\$23,736
Deppe, D.	sdPhotonics, LLC	High-Power Semiconductor Laser in the 3.0- to 3.5-um Spectral Range	8/15/2012	6/14/2013	\$24,000	\$24,000
Deppe, D.	DOD/Army/Army Research Office	WDM Nanoscale Laser Diodes for Si Photonic Interconnects	2/1/2012	1/31/2014	\$120,000	\$241,838
Deppe, D., Freisem, S.	National Science Foundation (NSF)	Research into the P-N Juntion Thermophotonic Effect	9/15/2010	8/31/2014	\$141,695	\$420,000
Dogariu, A.	KaMin LLC	Light Scattering Properties of Load Pigment Layers	7/15/2010	12/14/2012	\$46,302	\$123,472
Dogariu, A.	US Air Force Office of Scientific Research (AFOSR)	Sensing Random Electromagnetic Fields and Applications	5/1/2010	4/30/2015	\$148,988	\$613,126
Dogariu, A.	Malvern Instruments Ltd	LCDLS Technology Development and Tests	7/1/2013	6/30/2014	\$72,899	\$72,899
Dogariu, A., Abouraddy, A.	Sherwin Williams Company	Composite Optical Scatter	2/18/2013	2/17/2014	\$120,535	\$120,535
Fathpour, S.	Office of Naval Research	Hybrid Second-Order Nonlinear Photonic Devices on Silicon	5/20/2013	5/19/2016	\$158,000	\$158,000
Gaume, R.	University of California/ Lawrence Berkeley National Laboratory (LBNL)	BaBrI:Eu2+ and other Ba- based bright scintillators as transparent ceramics: a multi-institutional approach	4/16/2013	9/30/2015	\$21,675	\$85,000
Gaume, R.	Duke University	High-throughpout computational and experimental search of novel phonon mediated covalent metal superconductors and thermoelectric materials	10/1/2011	9/30/2013	\$63,750	\$200,000
Gaume, R.	Government of Israel: Ministry of Defense	Transparent Ceramics for Nonlinear Optics	4/30/2013	4/30/2016	\$98,986	\$98,986

Glebov, L.	OptiGrate Corporation	Compact stretcher/ compressor for high power ultrafast laser based on volume chirped Bragg grating in PTR glass	5/1/2012	3/31/2014	\$60,000	\$100,000
Glebov, L.	Emory University	RF: High Power Diode Pumped Alkali Vapor Lasers and Analog Systems	8/15/2007	2/14/2013	\$69,227	\$697,655
Glebov, L.	OptiGrate Corporation	Self-Stabilized monolithic sold state single frequency laser	7/15/2012	6/15/2013	\$40,000	\$40,000
Glebov, L.	OptiGrate Corporation	Volume Bragg Gratings for Spectral and Coherent Beam Combining in MWIR Spectral Region - Phase 2	2/1/2013	1/31/2015	\$111,725	\$111,725
Glebov, L., Schülzgen, A., Zeldovich, B.	US Air Force Office of Scientific Research (AFOSR)	Volume Bragg Gratings - Research, Testing and High Power Applications	9/27/2010	12/26/2014	\$500,000	\$2,000,000
Glebova, L.	OptiGrate Corporation	Monolithic rare earth doped PTR glass laser	6/1/2011	5/31/2013	\$67,500	\$180,000
Kar, A.	Semiconductor Research Corporation	AO Deflector for Laser Beam Scanning in Material Processing	10/1/2011	9/30/2014	\$100,000	\$300,000
Kar, A., Vaidyanathan, R.	Lumen Medical, LLC	Laser Treatment of MP35N Wires for MRI Compatibility	9/1/2012	10/30/2016	\$275,400	\$510,000
Kuebler, S.	Academy of Applied Science	AAS-REAP Program 2013	1/22/2013	9/30/2013	\$780	\$2,600
Kuebler, S., Richardson, K.	Lockheed Martin Corporation	Chalcogenide Materials and Functional Optics	1/2/2013	11/27/2013	\$32,500	\$50,000
Richardson, K.	Lockheed Martin Corporation	IRAD - Improved thermal mechanical oxy- Chalcogenide (oxy-ChG) materials	4/12/2013	12/31/2013	\$70,020	\$70,020
Richardson, M.	Inertial Labs, Inc	Next Generation Laser Training Systems	11/1/2012	2/28/2014	\$440,920	\$440,920
Richardson, M.	University of Maryland/ Baltimore	Optical Turbulence Instrumentation	8/15/2012	8/14/2015	\$483,366	\$758,373
Richardson, M., Shah, L.	US Army Research Office	MULTI-KW 2 M EMISSION BY SPECTRALLY COMBINING MANY Tm FIBER LASERS Year 2	6/28/2011	12/12/2012	\$35,600	\$509,326
Richardson, M., Shah, L.	University of North Carolina at Charlotte	Novel GMRF devices for integration with Tm:fiber lasers	12/1/2010	9/30/2013	\$102,087	\$180,000
Richardson, M., Baudelet, M.	US Air Force Office of Scientific Research (AFOSR)	Fundamentals of Filament Interaction	10/15/2010	10/14/2015	\$484,936	\$1,464,854
Richardson, M., Baudelet, M.	DOD/Army/Army Research Office	Phase-Stabilized Terawatt High Energy Ultra-Short (PhaSTHEUS) Laser Facility	8/25/2012	8/24/2014	\$302,800	\$302,800
Richardson, M., Baudelet, M., Chang, Z.	DOD/Army/Army Research Office	Light Filamentation Science	8/1/2011	12/31/2013	\$1,206,250	\$3,020,833
Schoenfeld, W.	US Army Research Office	Deep-UV Emitters and Detectors Based on Lattice- Matched Cubic Oxide Semiconductors	7/1/2010	8/31/2014	\$80,000	\$340,000
Schoenfeld, W.	US Army Research Laboratory	Hybrid MgZnO/AlGaN Ultra- violet Lasers	3/3/2011	7/1/2013	\$10,433	\$158,433
Schoenfeld, W.	DOD/Army/Army Research Office	Polarization doping in p-ZnMgO (RESEARCH AREA 11.1-STIR)	10/1/2012	6/30/2013	\$50,000	\$50,000

Schoenfeld, W.	DOD/Army/Army Research Office	Research Initiative (RI) Proposal to Enhance Oxide MBE Growth through Facilitization of an Ozone Source and Oxygen Resistant Zn Effusion Cell	9/1/2012	8/31/2013	\$22,000	\$22,000
Hagan, D.	Research Corporation	Characterization	9/30/2010	8/31/2013	\$210,505	\$743,333
Van Stryland, E., Hagan, D.	Georgia Tech Research Corporation	Zeno Project for Georgia Tech	9/30/2009	5/1/2013	\$15,000	\$375,000
Van Stryland, E., Hagan, D., Abouraddy, A., Fathpour, S.	National Science Foundation (NSF)	MRI: Development of a Nonlinear Optical Spectrometer	9/1/2012	8/31/2014	\$445,029	\$494,477
Van Stryland, E., Hagan, D., Li Kam Wa, P.	National Science Foundation (NSF)	Extremely Nondegenerate (END) Photonic Devices	11/1/2012	10/31/2015	\$361,683	\$361,683
Vodopyanov, K.	Stanford University	Laser Sensor for In-Situ Detection of Chemical and Organic Biomarkers and Isotopes	1/1/2013	9/8/2014	\$199,872	\$199,872
Vodopyanov, K.	Stanford University	Novel Concept of Frequency- Combs Interferometric Spectroscopy in the Mid-IR for Significantly Enhanced Detection of Explosives	1/1/2013	9/30/2013	\$90,000	\$90,000
Vodopyanov, K.	PolarOnyx	Supercontinuum fiber laser for multi-spectral energy propagation	5/1/2013	12/14/2013	\$81,794	\$81,794
Wu, ST.	Shenzhen China Star Optoelectronics Technology Co. Ltd	Active Liquid Crystal Lens	1/1/2013	12/30/2013	\$155,000	\$155,000
Wu, ST.	US Air Force Office of Scientific Research (AFOSR)	Fast response and low voltage dual frequency liquid crystals	3/1/2009	11/30/2013	\$140,000	\$730,000
Wu, ST.	Office of Naval Research	Low-Absorption Liquid Crystals for Infrared Beam Steering	10/23/2012	1/22/2015	\$160,000	\$160,000
Wu, ST.	Raytheon Corporation	Polymer-Network Liquid Crystals	12/3/2012	6/30/2013	\$50,000	\$50,000
TOTAL					\$9,013,079	\$19,227,423

Continuing Projects

Recipient	Source	Title of Award	Begin	End
Abouraddy, A.	National Science Foundation	Mid-infrared, wide-bandwith, stable coherent optical sources generated by multi-material, nonlinear chalcogenide-glass	4/15/2010	3/31/2014
Abouraddy, A. Christodoulides, D	DOD/AF/Air Force Office of Scientific Research	Large-scale Fabrication of Macroscopic All- Polymer PT-Materials	4/15/2012	4/14/2014
Christodoulides, D.	National Science Foundation	IDR: Collaborative Research: Novel Photonic Materials and Devices based on Non-Hermitian Optics	9/1/2011	8/31/2014
Christodoulides, D.	Israel Ministry of Defense	Airy Wavepackets and wavefront Engineering for Beam Filamentation Studies	7/13/2011	8/31/2014
Dogariu, A.	Mayo Clinic	Intraoperative, Real-Time Monitoring of Coagulation with Laser Spectroscopy	8/15/2007	12/31/2013
Dogariu, A.	National Science Foundation	Optical Control of Cellular Biomechanics	7/1/2012	6/30/2015
Fathpour, S.	National Science Foundation	CAREER: Mid-Infrared Photonic Devices and Integrated Circuits on Silicon	2/1/2012	1/31/2017

Fathpour, S.	National Science Foundation	Silicon Photonic Devices for Optical Delay Line Integrated Circuits	9/1/2011	8/31/2014
Fathpour, S.	Office of Naval Research	Hybrid Second-Order Nonlinear Photonic Devices on Silicon	5/20/2013	5/19/2016
Hagan, D.	Israel Ministry of Defense	Development of new materials for strong, broadband nonlinear transmission (Year 3)	7/28/2009	11/1/2014
Kar, A.	Naval Undersea Warfare Center	Uncooled MWIR SIC Detector	4/12/2012	7/31/2013
Raghavan, S., Schülzgen, A.	National Science Foundation	GOALI: Developing Piezospectroscopic Sensing Systems in Adhesives and Coatings	10/1/2011	9/30/2014
Richardson, K.	US Dept of Commerce, NIST	Evaluation of IC Interconnect Failure of through Silicon Vias (TVSs)	4/1/2013	3/31/2014
Richardson, M.	KLA - Tencor Corporation	DUV Laser Plasma Studies	10/10/2011	6/30/2014
Richardson, M.	Trumpf Photonics, Inc	Seed Injected and Ceramic Thin Disc Laser Development	1/1/2011	6/30/2013
Richardson, M.	US Army Research Office	ARO High School Apprenticeships in Laser Development and Spectroscopy at the Townes Laser Institute	9/5/2009	9/4/2013
Richardson, M.	US Army Research Office	Engineered Laser Filaments in air for defense stand-off sensing and interaction applications	9/5/2009	9/4/2013
Richardson, M.	US Dept of Education	MILMI - International Masters in Laser Materials and Interactions	9/1/2008	8/31/2013
Richardson, M.	US Naval Suppy System Command	Localized High Power RF Generation at Large Distances Using Self-Channeled Laser Beams	9/14/2011	6/30/2014
Schoenfeld, W.	National Science Foundation	REU Site: Research Experience for Undergraduates in Optics and Lasers	3/1/2009	5/31/2013
Wu, ST.	AU Optronics Corporation	Advanced Liquid Crystal Displays	7/1/2010	6/30/2015
Wu, ST.	China Star Optoelectronics Tech.	Active Liquid Crystal Lens	1/1/2013	12/30/2013
Wu, ST.	ITRI Display Technology Center	Novel Display and Biosensor Devices	12/1/2011	12/31/2014
Wu, ST.	Kent Optronics, Inc	Electronically switchable IR beam splitter technology	1/7/2012	1/6/2014

Most funded faculty

Twenty one researchers in areas ranging from optics, medicine, psychology and education were recognized by UCF in 2013 in what has become a much-anticipated campus tradition – induction into the UCF Millionaires Club. Three CREOL faculty were inducted.



Matthieu Baudelet



Martin Richardson



Winston Schoenfeld

3.8 Affiliated Research Centers

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

Advanced Materials Processing and Analysis Center

The Advanced Materials Processing and Analysis Center (AMPAC) is an interdisciplinary research and education center for materials science and engineering, one of two major UCF research centers that comprise the Center of Advanced Materials and Nanotechnology. Our two university-wide multi-user facilities - the Materials Characterization Facility (MCF) and the Advanced Microfabrication Facility (AMF) are available to all researchers at UCF and from outside companies, government labs, and universities, enabling them to perform cuttingedge 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 a \$4M grant from the state of Florida when leaders recognized the potential of nanotechnology as its applications in medicine, materials, computing and electronics began entering the mainstream. Since that time, NSTC has consolidated UCF researchers across multiple disciplines and hired many more to better respond to nanoscience funding opportunities and to develop the technologies demanded by the industries of the future. In 2007 the NSTC officially opened a 20,000- square-foot renovated research facility in the Central Florida Research Park. A total of 19 faculty, 7 staff and more than hundred graduate students, postdocs, researchers at the center are creating tools to treat neurological diseases; materials that can advance solar and fuel cell technology; and longer batteries that can make ever-smaller electrical devices a reality. Current research areas include Green Energy, In Vitro Test Systems, Functional Nanomaterials, Computer/ Mathematical Simulations, Quantum Dynamics, Nano-Bio-Imaging, NanoElectronics & NanoPhysics, and Integrated Device Development.

Biomolecular Science Center



The Burnett School of Biomedical Sciences became an integral part of the UCF College of Medicine in 2007, 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. We vigorously pursue our mission, to build nationally recognized research programs and undergraduate and graduate programs in biomedical sciences. The School is well on its way of accomplishing its goal towards hiring faculty members to build vigorous research programs focused on cancer, cardiovascular diseases, neurological diseases and infectious diseases, the School has formed active partnerships with other units such as the College

of Optics and Photonics, the School of Electrical Engineering and Computer Science and the NanoScience Technology Center to build interdisciplinary research and education programs in the innovative applications of photonics and nanoscience to biomedical problems. The School recently updated its undergraduate curriculum to better prepare students for health professions and graduate studies in biomedical sciences. The School also provides pre-health advisement for UCF students to prepare them for entry into health professional schools. Our BS degree program in Biotechnology started Fall 2007 and graduated the first students in Spring 2009.

Florida Solar Energy Center

The Florida Solar Energy Center® (FSEC®) is the largest and most active state-supported energy research institute in the United States. Located on the Cocoa campus of UCF at Eastern Florida State College, FSEC has gained national and international respect for its programs on photovoltaics, solar thermal systems, energy-efficient buildings, advanced cooling



technologies, hydrogen and fuel cells, and the testing and certification of solar equipment. The Center conducts continuing education workshops for professionals, government and industry leaders around the world. Additionally, FSEC offers Science, Technology, Engineering and Mathematics (STEM)-focused opportunities to K-12 and college level-students, professional development for teachers, and renewable energy curriculum and activities to schools throughout Florida.

Florida Space Institute

Florida Space Institute is located at the space center, in Brevard County



in East Central Florida, so as to provide a focus on space for the research and education programs of its institutional members. Classrooms, faculty offices and laboratories are located at the Kennedy Space

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



The Institute for Simulation and Training 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 facculty member at CREOL.

Innovative Science & Technology Facility (ISTEF)

The ISTEF site is located at the Kennedy Space Center, Florida. It is a Navy SSC PAC facility operated by CSC. ISTEF was originally built in 1989 to support the Strategic Defense Initiative Organization's Innovative Sciences and Technology Office (SDIO/ISTEF). Today ISTEF 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, 1 km laser test range, a precision tracker (gimbal) with a coude mirror feed (for laser transmission), and several transportable trackers capable of supporting active (laser) or passive testing. Additionally, ISTEF maintains an assortment of telescopes, optics, and sensors to support data collection requirements. ISTEF is a tenant of the 45th Space Wing at Cape Canaveral Florida and has operating agreements that allow tasking Eastern Range assets as needed. It also has standardized range operations for laser testing against boosting rockets, satellites, and other targets. ISTEF has a close partnership with the CREL, The UCF College of Optics and Photonics, 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.





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)


4. Partnership and Outreach

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

4.1 Industrial Partnership

Since its early years, CREOL has benefitted from a strong partnership with industry and it endeavors to transfer the technology developed by the faculty, scientists, and students to industry, particularly Florida industry, and to assist in forming, recruiting, and retaining optics and optics-related industries in Florida. CREOL is an active partner with the Florida Photonics Cluster (FPC), which supports the growth and profitability of the photonics industry in Florida. This year, the FPC held its September meeting at CREOL, jointly with the Manufacturers Association of Central Florida, and the guests toured the CREOL facilities. On March 1, 2013, the College hosted an *Optics and Economic Development Day* for the Metro Orlando Economic Development Commission. M. J. Soileau gave a talk on the "Role of University Research in Economic Development" and Bahaa Saleh reviewed the National Academies recent report "Optics and Photonics: Essential Technologies for our Nation" and shared with the attendees copies of the brochure "UCF Strength in Optics and Photonics."

The Industrial Affiliates Program

The College has established a large industrial affiliates program (with current membership of **63** companies, sustained over many years).

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

their business. Other benefits include:

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

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

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

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

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

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



2013 Industrial Affiliates Members

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Cobb Family Foundation Northrop Grumman Corporation Nufern

Memoriam Members

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

Medallion Members

Lasersec Systems Corp.* Northrop Grumman Laser

Senior Members

LightPath Technologies Lockheed Martin Newport Corporation Ocean Optics Ophir-Spiricon Optimax Systems Radiant Zemax, LLC

Affiliate Members

JENOPTIK Optical Systems Inc. Kaufman & Robinson, LLC Laser Institute of America Lee Laser NKT Photonics Ocean Optics Optigrate Corp. OIDA Photonics Online Photonics Spectra Plasmonics Inc.* Princeton Instruments QPC Lasers/Laser Operations LLC Optical Research Associates Paul G. Suchoski, Jr

> Tektronix Thorlabs TRUMPF, Inc. V & N Zygo Corporation

Ray Williamson Consulting R-Soft Design Group Resonetics, LLC SCD.USA LLC* Sterile Enviroment Tech. (SET3)* Sciperio, Inc. SPIE StellarNet, Inc. Teledyne ODI The Optical Society Tower Optical Corporation TwinStar Optics, Coatings & Crystals Vytran LLC Yokogawa Corporation of America

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

Breault Research

FLIR

Aerotech Inc. AFL* Analog Modules Applied Image Inc.* Applicote Associates, LLC Block Engineering, LLC* eVision, LLC Fike Corporation* Florida Turbine Tech. Inc. Gentec-EO, Inc. Gooch & Housego, LLC Harris Corporation HORIBA Jobin Yvon Inrad Optics

* New members

Industrial Affiliates Day

The CREOL Industrial Affiliates Day brings in optics companies from around the country to learn about the ongoing research, recruit students, and identify new partnering opportunities. The 2013 event, held on March 8, 2013, drew over 200 attendees including industrial affiliates, guests from industry and academia, representatives from photonics professional societies, faculty and students, and 25 exhibitors. The theme of the technical symposium was "Light in Action". Four technical sessions covered advances in laser manufacturing, optogenetics, displays, and lithography. Four distinguihed speakers from the US and Europe and four UCF faculty speakers participated (see program details on the next page).

In addition to these technical talks, a session on photonic entrepreneauship featured Milton Chang, managing director of Incubic Management LLC, former president of Newport and New Focus, and author of *Toward Entrepreneurship*. A panel discussion on the "future challenges for photonics in manufacturing" was moderated by Jim Pearson, who was one of CREOL's initial Industrial Affiliates when he was at United Technologies, and later worked in the CREOL administration. The panelists were: Peter Baker (LIA), Jay Kumler (Jenoptik) and Jochen Deile (Trumpf), and Stephen Anderson (SPIE). The symposium was followed by tours of the CREOL facilities and viewing of student posters featuring research of 32 graduate students (see poster titles on page 74). The Best Poster Award went to graduate student Yan Cheng for his poster entitled "*attosecond transient absorption experiments on atoms and molecules*", and the Student of the Year Award went to Neng Bai. This year, four short courses were offered (see list on the next page). on Thursday, March 9. The following Saturday, the attendees were invited to the traditional annual event: The Spring Thing, hosted by Dr. M. J. Soileau, Founding Director of CREOL and now the Vice-President for Research and Commercialization at UCF. The festivities included great fellowship and great Cajun cuisine.

2013 Industrial Affiliates Day Program

Symposium: Light in Action

Friday, 8 March, Morning Session –UCF Student Union

8:00	Continental Breakfast, Registration & Exhibits	;		UCF Student Union	
8:30	Welcoming Remarks		MJ Soileau	UCF Vice President for Research	
8:50	Welcome and overview of CREOL		Bahaa Saleh	Dean & Director, CREOL, UCF	
	Мо	ornin	g Sessions		
Session I.	Manufacturing				
9:15	Advances in optical diagnostics for laser processing		Jyoti Mazumder	University of Michigan	
9:45	Fabrication of metamaterials		Debashis Chanda	CREOL, UCF	
10:05	Break & Exhibits			UCF Student Union	
Session II.	Optogenetics				
10:25	Reshaping the optical dimension in optogenetics		Alipasha Vaziri	University of Vienna	
10:55	Optical action at mesoscales		Aristide Dogariu	CREOL, UCF	
Session III	. Displays				
11:15	Holographic 3-D displays		Nasser Peyghambarian	University of Arizona	
11:45	Next-generation LCD displays		STWu	CREOL, UCF	
12:05	Lunch Served & Exhibits			UCF Student Union	
	Afte	rnoo	n Sessions		
Session IV	. Lithography				
1:00	Nanoscale lithography using visible light	Joh	n Fourkas	University of Maryland	
1:30	Fabrication of volume bragg reflectors	Leo	on Glebov	CREOL, UCF	
Session V.	Photonics Entrepreneurship				
1:50	"Making entrepreneurship work"	Mil	ton Chang	Incubic Management, LLC	
2:20	Discussion, questions & answers Mi		ton Chang		
2:40	Panel discussion on "Future challenges for photonics in manufacturing"	Jim	Pearson - moderator	Stephen Anderson (SPIE), Peter Baker (LIA), Jay Kumler (Jenoptik), Jochen Deile (Trumpf)	
3:20	Break & Walk to CREOL Building				
Session V	Session VI. Poster Session, Tours, Exhibits, and Awards				
Poster Sessi	ons: Lab Tours: Exhibits:		CREOL ro	ooms 102 & 103: Tours start	

Poster Sessions; Lab Tours; Exhibits;
(contiguous).CREOL Graduate StudentsC
fitPoster award presentation; receptionBahaa SalehC

CREOL rooms 102 & 103; Tours start from lobby; exhibits in lobby CREOL, UCF



Panelists (left to right): Peter Baker (LIA), Jay Kumler (Jenoptik) and Jochen Deile (Trumpf).



Milton Chang (right) with Peter Baker.

		Short Courses	Thursday ,7 March, Short Courses–UCF CREOL
Lasers in Manufacturing	Instructor:	Aravinda Kar, UCF	1:00-2:30 PM
Plasmonic & Metamaterials	Instructor:	Pieter Kik, UCF	1:00-2:30 PM
Biomedical Imaging	Instructor:	Bahaa Saleh, UCF	2:45-4:15 PM
Organic & Polymeric Optical Materials	Instructor:	Stephen Kuebler, UCF	2:45–4:15 PM

Student Posters

Spencer Novak, Luminescent quantum dots in solution-derived chalcogenide glass films. **Saeed Khan**, Silicon-on-nitride waveguides for mid- and near-infrared integrated photonics.

Abraham Vazquez-Guardado, Optical Nanostructures for Enhanced Light-Matter Interactions and Energy Harvesting. Yuan Chen, Advanced Fringe-Field Switching Using a Negative Anisotropy Liquid Crystal.

C. Jollivet, Advanced Characterization of Novel Fiber Designs for High Power Fiber Laser Applications.

Amy Van Newkirk, Fiber Bragg Gratings as In-Situ Calibration of Piezospectroscopic Stress-Mapping.

Christopher N. Grabill, Direct Laser Writing using a Chalcogenide Glass. G. Guery, Elaboration and optimization of tellurite glasses and glass-ceramics for optical fiber amplification applications.

W. Taylor Shoulders, Europium Doped Barium Bromide Iodide Scintillator Ceramics for Gama Ray Detection.

Brian Anderson, Path to Multi Kilowatt Spectral Beam Combining by Air Cooling Volume Bragg Gratings.

Marc SeGall, The effect of aberrated recording beams on reflecting Bragg gratings. Guangming Tao, Three Extrusion Strategies as Routes Towards Robust Infrared Multimaterial Fibers.

Nathan Bodnar, Power-scaling of an OPCPA

System Based on DPSS Pump Technology. **Xiaohang Liu**, Possibility for Breaking the Unity Efficiency Barrier: Semiconductor Laser Optically Pumped by an Integrated Light Emitting Diode.

Seyfollah Toroghi, Plasmon resonances in multi-material nanoparticle trimers for extreme field enhancement.

Erik McKee, Molecular studies of filamentation in Carbon Dioxide. **Khan Lim**, Broadband THz detection in the counter-propagating configuration using THz-enhanced plasma fluorescence.

Himansu S. Pattanaik, Sub-bandgap Energy Detection of Pulsed and CW Radiation using Extremely Nondegenerate Two-photon. Absorption in Wide-gap Semiconductors Yi Wu, Generation of High-Flux Attosecond XUV Continuum with a 10 TW Driving Laser.

Yuan Liu, Novel LIBS and Raman Sensor Fusion Strategies for Fluorescence Reduction. Manuel R. Ferdinandus, Time-resolved Measurement of Nonlinear Refraction Using Beam Deflection.

Cheonha Jeon, Fourier Transform Infrared Spectroscopy of Laser Induced Plasma. Yan Cheng, Attosecond Transient Absorption Experiments on Atoms and Molecules. Spencer Novak, Luminescent quantum dots in solution-derived chalcogenide glass films. Abdullah J. Zakariya, Wavelength Tunable Selectively Intermixed Quantum Well Fabry-Pérot Laser. **Daniel Ott**, Versatile phase stabilization technique for holographic recording of large aperture volume Bragg gratings.

Farnood K. Rezaie, Plasmonic Mid-IR spectrometer.

Jichi Ma, Submicron optical waveguides and microring resonators fabricated by selective oxidation of tantalum.

Benn Gleason, Compositional-tailoring of optical properties in IR transparent chalcogenide glasses for precision glass molding.

Payam Rabiei, High-Q Lithium Niobate Microring-Resonators on Silicon. Janardan Nath, Selective perfect absorption

and excitation of surface plasmon polariton in IR by suspended gratings.

Samuel Paul David, Femtosecond Dual-Arm Z-Scan On Ceramic And Single Crystals Of YAG.



Best Poster winner Yan Cheng.

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. Current clients are:

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

entertainment systems.

- □ Orlando Photonics Laboratory Corp. (Chang Ching Tsai) designs and develops custom diffractive optical elements (DOEs), including diffractive lenses, gratings, fibers, optical thin films and diffusors.
- Plasmonics, Inc. (David Shelton, www.plasmonics-inc.com) is developing tunable infrared metamaterials which are engineered composites with unique refractive-index characteristics. Metamaterials with tunable resonances have wide ranging potential for optical devices, modulators, and sensors.
- □ sdPhotonics LLC (Dennis Deppe, Sabine Freisem) is an emerging leader in the development of high power laser diode technologies that provide improved power, efficiency, brightness and reliability.



Industrial Projects

Recipient	Source	Title of Award	Begin	End	Awarded 2013	Cumulative Funding
Amezcua Correa, R.	Incom, Inc.	Silica photonic bandgap fiber accelerators	10/24/2012	1/4/2013	\$12,045	\$12,045
Amezcua Correa, R. Schülzgen, A.	No Needles Venipuncture	Femtosecond lasers for tissue ablation	10/8/2012	11/12/2012	\$10,250	\$10,250
Bass, M. Glebov, L	Honeywell Federal Manufacturing & Technologies, LLC	Volume bragg grating (VBG) beam combiner	4/30/2013	9/30/2013	\$150,000	\$150,000
Delfyett, P.	Raydiance, Inc.	Amplitude and phase tailoring Phase 2	2/1/2011	3/18/2013	\$75,000	\$225,000
Delfyett, P.	Northrop Grumman Corporation	RF - Novel low noise mode-locked lasers for advanced components for electronic warfare	1/1/2013	4/15/2016	\$40,000	\$40,000
Delfyett, P.	Harris Corporation	Tunable ultralow noise rf signal generation using a frequency stabilized laser and high finesse etalon based optoelectronic oscillator	7/17/2012	4/30/2013	\$100,000	\$100,000
Deppe, D.	sdPhotonics, LLC	Expatixial growth for facet passivation of high power diode lasers	10/29/2012	7/31/2013	\$23,736	\$23,736
Deppe, D.	sdPhotonics, LLC	High-power semiconductor laser in the 3.0- To 3.5-um spectral range	8/15/2012	6/14/2013	\$24,000	\$24,000
Dogariu, A.	KaMin LLC	Light scattering properties of load pigment layers	7/15/2010	12/14/2012	\$46,302	\$123,472
Dogariu, A., Abouraddy, A.	Sherwin Williams Company	Composite optical scatter	2/18/2013	2/17/2014	\$120,535	\$120,535
Glebov,L.	OptiGrate Corporation	Compact stretcher/compressor for high power ultrafast laser based on volume chirped Bragg grating in PTR glass	5/1/2012	3/31/2014	\$60,000	\$100,000
Glebov, L.	OptiGrate Corporation	Self-stabilized monolithic sold state single frequency laser	7/15/2012	6/15/2013	\$40,000	\$40,000
Glebov, L.	OptiGrate Corporation	Volume Bragg gratings for spectral and coherent beam combining in MWIR spectral region - Phase 2	2/1/2013	1/31/2015	\$111,725	\$111,725
Glebova, L.	OptiGrate Corporation	Monolithic rare earth doped PTR glass laser	6/1/2011	5/31/2013	\$67,500	\$180,000
Kar, A.	Semiconductor Research Corporation	AO deflector for laser beam scanning in material processing	10/1/2011	9/30/2014	\$100,000	\$300,000
Kar, A., Vaidyanathan, R.	Lumen Medical,	Laser treatment of MP35N wires for MRI compatibility	9/1/2012	10/30/2016	\$275,400	\$510,000
Kuebler, S. Richardson, K.	Lockheed Martin Corporation	Chalcogenide materials and functional optics	1/2/2013	11/27/2013	\$32,500	\$50,000
Richardson, K.	Lockheed Martin Corporation	IRAD - Improved thermal mechanical oxy-Chalcogenide (oxy-ChG) materials	4/12/2013	12/31/2013	\$70,020	\$70,020

Richardson, M.	Inertial Labs, Inc	Next generationlaser training Systems	11/1/2012	2/28/2014	\$440,920	\$440,920
Van Stryland, E., Hagan, D.	Georgia Tech Research Corporation	MURI: Nonlinear optical characterization	9/30/2010	8/31/2013	\$216,305	\$749,999
Van Stryland, E., Hagan, D.	Georgia Tech Research Corporation	Zeno project for georgia tech	9/30/2009	5/1/2013	\$15,000	\$375,000
Vodopyanov, K.	PolarOnyx	Supercontinuum fiber laser for multi-spectral energy propagation	5/1/2013	12/14/2013	\$81,794	\$81,794
Wu, ST.	Raytheon Corporation	Polymer-network liquid crystals	12/3/2012	6/30/2013	\$50,000	\$50,000



Industrial Affiliates members providing financial support for research projects

Visitors from Industry

Eric D. Park, Qpeak, Inc., January 9, 2013

Alexander W. Zschäbitz, Jean-Luc Nogues, Sabrina Matthias, **Asphercon and AgilTek**, January 31, 2013

Chris Voita, Jeffrey S. Pridmore, Steven R. Frey, Lockheed Martin, February 20, 2013

Richard Sneed, Newark Corp., Tom Marhr, Tektronix, April 22, 2013

Dan Dillery, Chris DePriest, Dennis Hammons, David Muh, Ron Jones, Northrop Grumman Corporation, May 15, 2013 Herb Gingold, Kevin Lewis, ELCOM and Fred Maxik, Lighting Sciences Group, May 24, 2013

Austin Smith, **National Instruments**, June 4, 2013, October 30, 2013 Jochen Diele, **Trumpf**, June 6, 2013

Haejin Lee, Youngcheol Kim, Gwantek Lim, Charlie Kim, **SAMSUNG** electronics, October 23, 2013

Chuck Reagan, **Ophir-Spiricon** LLC, November 13, 2013 Simon Poole, **Finisar**, Australia, December 10, 2013

4.2 Alumni Relations

CREOL maintains an ongoing relation with its alumni. The online CREOL Highlights Newsletter, which is produced several times a year, is distributed to all alumni, and alumni profiles and alumni news are posted on the CREOL website. Alumni are invited to the Industrial Affiliates Day and alumni renunions are held at various locations during key meetings of professional societies. In 2013, a reunion was hosted on February 4 during the SPIE Photonics West meeting in San Francisco (at Jillian's Metreon) with about 100 guests attending. At the CLEO meeting in San Jose, the alumni reunion was held on June 10 at the Gordon Biersch Brewery Restaurant.



Guifang Li (third from right with alumni at the CLEO reunion.

Alumnus Tiejun Xia Receives 2013 Professional Achievement Award

Tiejun (TJ) Xia (PhD, '94) received the UCF 2013 Professional Achievement Award for the College of Optics and Photonics. The award was presented at the UCF's Alumni Association's annual Black & Gold Gala on November 7, 2013.

Dr. Xia received his PhD from CREOL in 1994 and had a distinguished career in optical communication. In 2007, at Verizon Communication, he led a team that accomplished the fastest field test ever for live streaming video, in which live video traffic was carried in field at 100-Gb/s over over a distance of more than 500 km for the first time. Because of this accomplishment he received the "2008 Telecom Leaders Circle" award from Verizon. Since 2008 he has been a Distinguished Member of Technical Staff (DMTS) at Verizon Communication. Dr. Xia was recently elected as a Fellow of the Optical Society (OSA). When asked what advice he would give to an incoming graduate student, he said "In addition to obtaining good grades, do not forget to train yourself to be more innovative."



Tiejun (TJ) Xia (left) and Bahaa Saleh at the UCF Foundation Black & Gold Gala.

4.3 Outreach and Professional Service



Launched this spring by photonics organizations, the National Photonics

Initiative (NPI) is a collaborative alliance among industry, academia and government, seeking to raise awareness of photonics and drive US funding and investment in five key photonics-driven fields critical to US competitiveness and national security: advanced manufacturing, communications and information technology, defense and national security, energy, and health and medicine. This effort followed the publication of the National Academis Report "Optics and Photonics, Essential Technologies for Our Nation." A report entitled entitled "UCF Strength in Optics and Photonics" was produced by CREOL and the UCF Office of Research and Commercialization, and distributed widely.

Professors Winston Schoenfeld and Martin Richardson joined industrial and academic leaders in Washington, D.C. in February 2013 to help provide recommendations toward the development of the National Photonics Initiative. CREOL alumnus Matt D. Weed is a member of the NPI Advisory Committee. As part of this initiative, a Congressional Town Hall meeting was held on August 7, 2013 at CREOL with Rep. John L. Mica, faculty, students, and university leaders attending. Applications of photonics and the role of universities in this field were discussed. Rep. Mica subsequently wrote an Op Ed in the August 20, 2013 issue of the Orlando Sentinel entitled "Let's be laser-focused on photonics for the future." He wrote: "UCF is home to one of the most advanced and well-regarded



Peter Delfyett (left) explaining to Rep. Mica (right) some of his work on frequency-comb light and its applications in optical communication

schools in the country for research in the field of optics and photonics, which both enable technology and drive Florida's economy."



CREOL alumnus Matt Weed spoke at the Plenary Session of the OSA Frontiers in Optics meeting in October 2013 about the National Photonics Initiative.

A team from the the Metro Orlando Economic Development Commission (EDC) visited CREOL and toured its facilities on March 1, 2013. M.J. Soileau, UCF Vice President for Research and Commercialization gave a talk on the role of university research in economic development and Bahaa Saleh reviewed the report "Optics and Photonics, Essential Technologies for our Nation" and described UCF strength in this area.

OSA/LS Meeting

The Frontiers in Optics (FiO) meeting of the Optical Society's (OSA) was held together with the Laser Science (LS) meeting in Orlando in October 2013. David Hagan was FIO Program Chair, and Peter Delfyett was LS General Chair. A reception and open house was held at CREOL on October 9, 2013 for the attendees.



Eric Van Stryland, past Dean of the College and former President of OSA (right) during the FIO/LS meeting.

4.4 International Partnership

One of the principal goals of UCF is to rovide international focus to our academic and research programs. The College has established a number of educational and research partnerships with international institutions, including Universite Bordeaux 1, France; Friedrich-Schiller Universitat, Germany; Fraunhofer Institute for Laser Technology, Achen University, Germany; A.M. Prokhorov General Physics Institute of Russian Academy of Sciences, Russia; and Utsunomiya University, Japan. Many faculty members have established research collaborations with colleagues at international institutions.

International partnerships in education include the Atlantis-MILMI Program, which is a Masters Degree program in the interdisciplinary field of Lasers, Photonics and Material Science offered by a consortium of four institutions, including the University of Bordeaux, France and the Friedrich Schiller University in Jena, Germany (see page 33).

International visitors in 2013 include:

Wei Wei, Tingyun Wang, Fufei Pang, Na Chen, Sujuan Huang, Nanjing University and Shanghai University, China, January 29, 2013

Elli Angelopoulou, University of Erlangen-Nuremberg, Germany, February 12, 2013

Hilda M. Colón Plumey, José f. Méndez, Carlos Padín, Jonathan Friedman, Robert B. Kerr, Héctor Rivera, Universidad Metropolitana Ana G. Méndez University System, San Juan, PR, February 18, 2013

Young J. Kim, Do Young Noh, Gwangju Institute of Science and Technology (GIST), Korea, March 18, 2013 MBA Delegation from Spain, April 23, 2013

Sun-Ho Kim, President of Korean Photonics Technology Institute (KOPTI), Korea, May 9, 2013

Arnold Smeulders, University of Amsterdam, Netherlands, August 2, 2013

Jiun-Haw Lee, I-Chun Cheng & Yuh-Renn Wu, National Taiwan University, Taiwan, December 10, 2013



In March 22013, Bahaa Saleh, together with Thomas Koch, Dean of the University of Arizona College of Optical Sciencces (left), and Xi-Cheng Zhang, Director of the Institute of Optcs at the University of Rochester (right) visited several photonics educational and research centers in Taiwan.

Fraunhofer-Townes Partnership

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

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

Fraunhofer ILT's interdisciplinary research activities cover a wide range of areas such as the development of new laser beam sources and components, the use of modern laser measurement and testing technology and laser-supported manufacturing. This includes for example laser cutting, caving, drilling, welding and soldering as well as surface treatment, micro-processing and rapid-prototyping. Furthermore, ILT's research involves laser plant technology and versatile system technology including process control. Besides solving questions of laser technology, the institute develops highenergy sources for soft X-rays for use in semiconductor production and in X-ray microscopy.

The close contact to the Department of Laser Technology at the

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



Martin Richardson, Director of the Townes Laser Institute (left), UCF President John Hitt (Center) and Reinhart Poprawe, Director of the Fraunhofer Institute for Laser Technoloty (right), at the signing of the collaboration agreement between the Townes Laser Institute, UCF and the Fraunhofer Institute for Laser Technology, RWTH Aachen University (Germany).

5. CREOL Association of Optics Students

CAOS, the CREOL Association of Optics Students, is a student organization founded in 1999 to bring together the diverse population of graduate students of CREOL, The College of Optics and Photonics. CAOS facilitates communication and integration of the student chapters of four optics and photonics professional societies: OSA-The Optical Society, IEEE-Photonics Society, SPIE-The International Society for Optics and Photonics, and SID-The Society for Information Display.

5.1 Officers

Elected officers of CAOS and the professional societies' student sections in 2012-2013 are listed below:



President: Vice President: Treasurer: Secretary:

Colin Constant Amy Van Newkirk Kristina Bagnell Aniket Patil

|--|

President: Jie Sun Vice President: Zhenyue Luo Treasurer: Kumel Kagalwala Secretary: Yu-Wei Lin Web Master: Ruidong Zhu

President: Sharad Bhooplapur Vice President: Esmaeil-Hooman Banaei Treasurer: Benjamin Webb Secretary: Abhijeet Ardey



Treasurer:

Secretary:

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SPIE President: Vice President: Cen Xia

Chatdanai Lumdee Sihui He Brian Anderson



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CAOS

5.2 Educational Outreach

Optics Week – February 25 – March 1, 2013

This year's Optics Day was expanded to a whole week in celebration of UCF's 50th anniversary. Events were scheduled throughout the week and the public was invited to come learn about optics and see, first hand, what we do here at CREOL. The week was started with a spectacular laser light show from Pangolin, highlighting the advanced technology of laser imaging. This was followed the Solar Day dedicated to solar energy, featuring a solar powered car and sponsored by the Florida Solar Energy Center. On Day 3, Professor Peter Delfyett gave a lecture "lasers - The Light Fantastics: Applications from pointers to DVDs," and a KHET tournament was held. The week finished with an Open House, with the theme The Cycle of Innovation. This included lab tours and demonstrations along with a visit from Orlando Science Charter School.



Sharad Bhooplapur explains frequency combs to attendees of Optics Day 2013.

College Reach-Out Program – July 12, 2013

The College Reach-Out Program was created in 1983 as a statewide initiative designed to increase the number of low-income, educationally challenged students in grades 6 through 12 to pursue higher education. CROP has served more than 9, 000 students statewide and is sponsored by the Office of Student Outreach Programs, a division of Strategy, Marketing, Communications, and Admissions. CAOS assisted in promoting STEM education to CROP high school through demonstrations and lab tours. CREOL undergraduate program director, Mike McKee, also gave a demonstration filled presentation to the students as part of the day's activities.

Undergraduate "Get to Know Photonics" Seminars:

The first in the "Get to Know Photonics" series targeted at students in the new undergraduate program at CREOL. In this talk students were treated to a presentation by CREOL Dean Bahaa Saleh on September 23, 2013. The title of this presentation was, "What is a Laser?" The presentation was open to all, but was primarily attended by CREOL undergraduates pursuing a bachelor of sciences degree in optics.

On October 29, 2013, undergraduate students were treated to a presentation by CREOL Professor of Optics, S.T. Wu. Amazingly thin and increasingly complex, smartphone displays use technologies that are being developed at CREOL. Find out how they work and visit a lab to explore what could be the next advancement to show up on your cell phone. The title of this presentation was, "Smartphone Displays: How Do They Work?" The presentation was open to all, but was primarily attended by CREOL undergraduates pursuing a bachelor of sciences degree in optics.

Wheatley Elementary School Math Night - October 30, 2013

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



Laura Sisken and Joshua Beharry at Wheatley Elementary School's Math Night.

Lake Brantley High School Visit - November 21, 2013

CREOL hosted close to 50 high school physics students in November for a lecture and lab tours. Professor Pieter Kik started the visit with an exciting review of optics and the current research being done at CREOL. The students were then guided through the CREOL labs where they met with graduate researchers and got to see what working in optics

5.3 Professional Development

Student Professional Awareness Conference: January 15, 2013

Engineering Career Strategies with Butch Shadwell

The ultimate tutorial on how to have the best career possible in the fields of applied physical science and engineering. Specific information on interviewing, graduate school, winning the talent competition, and optimizing your income and standard of living. If you want to be able to take control of your professional future, you will want to attend this talk.

OSA Conferences: October 6-10, 2013

Frontiers in Optics 2013, Orlando, FL

This year OSA's annual Frontiers in Optics conference was held in Orlando less than 45 minutes away from CREOL. At the conference, many CREOL students gave technical presentations, listened to presentations concerning breakthrough research, and reported on the chapter's activities for the past academic year. Because the conference was held so close to CREOL, we were able to host visitors from FiO for tours of our college. This proved to be a great opportunity to meet students and researchers from other institutions interested in starting collaborative research projects.

Ocean Optics Tour: November 14, 2013

Tour and Discussion with Gary Manche

On November 14, 2013, IEEE Photonics society and SPIE student chapter arranged a tour to Ocean Optics, a world leading company in miniature spectrometers. Dr. Gary Manche from Ocean Optics gave is all about. The students were given the opportunity to learn about exciting developments in fiber optics, frequency combs, LCDs, and nanophotonics. The tours finished with a lunch among demonstrations of fascinating optical phenomena.



Dr. Kik teaches optics to high school students.

Liberty Middle School Visit – December 20, 2013

On Friday, December 20th, three CAOS members traveled to Mrs. Shoulders 8th grade science class at Liberty Middle School for 7 whole periods of optics demonstrations. Over 200 students participated over the course of the day. The students were led in a hands-on laboratory exercise in which they used cookie cutters to fabricate both converging and diverging lenses out of Jell-O. The students studied the basics of geometrical optics by passing lasers through their lens arrays. The exercise was followed by a short demonstration on optical communication

a talk about the operating principles of their products and the vision of ocean optics. During the company tour, CREOL students got a close look at the whole designing and manufacturing process of a spectrometer.



CREOL graduate students at Ocean Optics with Gary Manche.

Graduate Research Symposium: November 15, 2013

Optical Fibers with Felix Tan and Amy Van Newkirk

The first in a new series of talks sponsored by the student chapter of OSA at CREOL, graduate students here at CREOL presented on the research currently going on in their groups. The purpose of the new symposium is to internally educate our researchers, promote collaboration, and give students practice at presenting. This first talk focused on research groups working with optical fibers. Felix Tan presented on the research of Dr. Ayman Abouraddy's group using multimaterial optical fiber devices. Amy Van Newkirk represented Dr. Axel Schülzgen's group to discuss the many applications for fiber optics.

Graduate Research Symposium: December 12, 2013

Plasmonics with Sushrut Modak and Chatdanai 'Tua' Lumdee

The second in a new series of talks sponsored by the student chapter of OSA at CREOL, graduate students here at CREOL presented on the research currently going on in their groups. The purpose of the new symposium is to internally educate our researchers, promote collaboration, and give students practice at presenting. This talk focused on research groups working within the realm of plasmonics. Sushrut Modak presented on the research of Dr. Debashis Chanda's group working with nano-optics. Chatdanai 'Tua' Lumdee represented Dr. Pieter Kik's group to discuss nanophotonics and near-field optics.

5.4 Seminars

DATE	SPEAKER	TITLE & ORGANIZER
3/14/2013	Andrew Ellis, Aston University	"Ultra High Capacity Optical Transmission Systems". IEEE-PS
3/15/2013	Lianshan Yan, Southwest Jiaotong University	"Polarization in Fiber Optics", IEEE-PS
5/17/2013	Gisele Bennett, Georgia Tech	"Superresolution Imaging Systems" and "Electro-Optical System Laboratory (EOSL) at Georgia Tech Research Institute – an overview an applied research lab, SPIE
5/30/2013	Josephe A. Shaw, Montana State University	"Optics in Nature", SPIE
6/18/2013	Jiun-Haw Lee, National Taiwan University	"Small Molecule Planar Heterojunction Organic Solar Cell", SID
7/16/2013	Oleg V. Yaroshchuk, National Academy of Sciences, Ukraine	"Alternative Methods of Liquid Crystal Alignment and their Potential for Liquid Crystal Devices.", SID
10/11/2013	Min Gu, Swinburne University of Technology	"Green Photonics for Information Technology, Clean Energy, and Life Science", SID
10/11/2013	David D. Sampson, University of Western Australia	"Photonics Enables a Microscope in a Needle for Imaging Deep in Tissue", IEEE-PS
11/08/2013	Frank So, University of Florida	"Organic Electronics: a solution to our energy needs", IEEE-PS
12/10/2013	Simon Poole, Finisar University	"30 Years of Photonic Start-ups in Academia and Industry", IEEE-PS
12/10/2013	Jiun-Haw Lee, National Taiwan University	"Device Design for Display, Lighting, and Solar Cell", SID
12/10/2013	I-Chun Cheng, National Taiwan University	"Oxide Based Thin Film Electronics", SID
12/10/2013	Yuh-Renn Wu, National Taiwan University	"Device Modeling for Lighting, Solar Cell, and High Speed Transistor", SID





University of Central Florida CREOL – The College of Optics & Photonics P.O. Box 162700 , Orlando, FL 32816-2700 407-823-6800 creol.ucf.edu