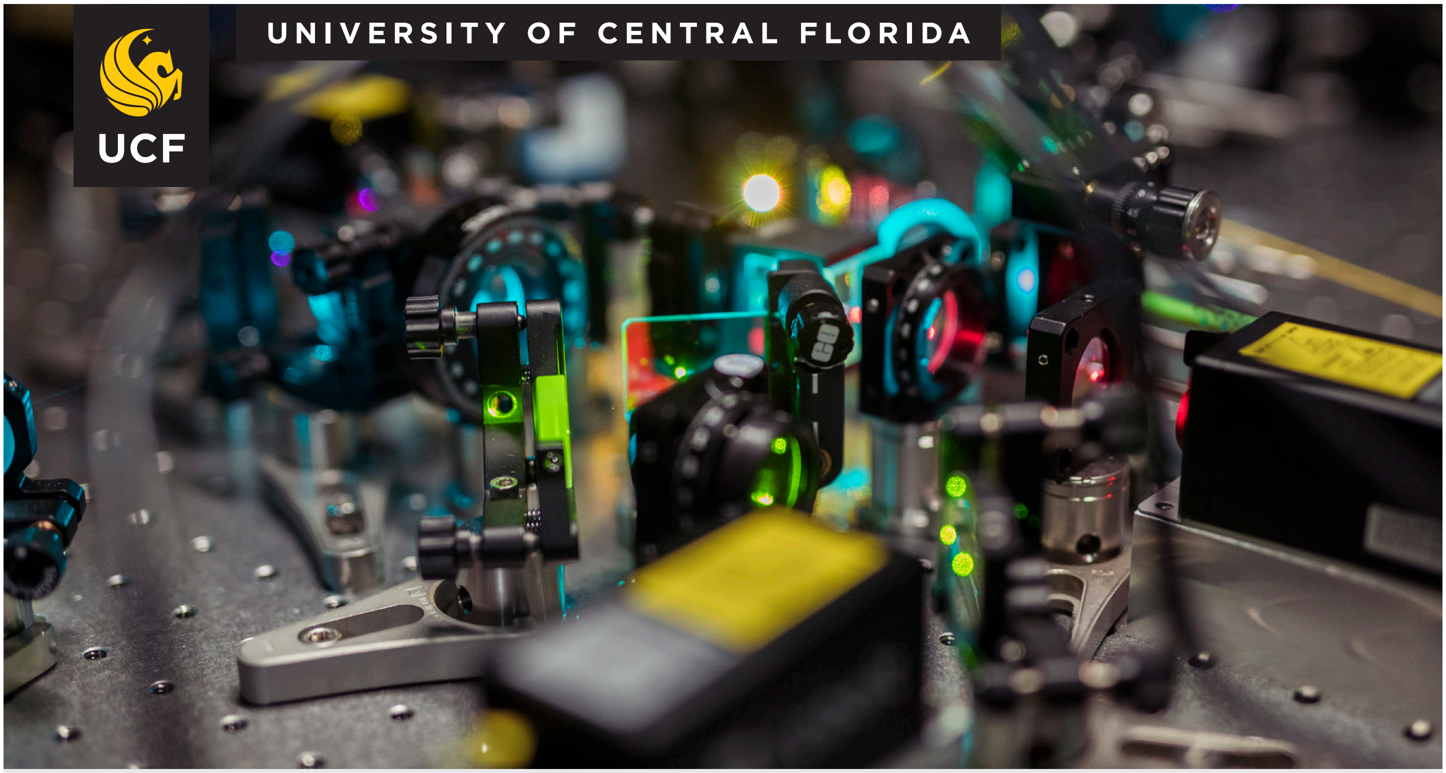

INDUSTRIAL AFFILIATES SYMPOSIUM 2021
CREOL, The College of Optics and Photonics

April 15-16, 2021

Symposium will be held virtually over 2 days

For More Information Visit:

tinyurl.com/CREOL-IAS

CREOL, The College of Optics and Photonics

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CREOL, The College of Optics and Photonics

Thursday, April 15th Agenda

THURSDAY, April 15, 2021: 1:00PM – 5:00PM EST

VIRTUALLY VIA ZOOM HTTPS://TINYURL.COM/XCMZN9H8 (Zoom Passcode is IAS2021)

1:00PM **Welcome**, David Hagan, Interim Dean, CREOL

1:05PM **Basic Research at the DoD: Advancing the Endless Frontier,** Bindu Nair, Director of Basic Research, Department of Defense

1:35PM **Welcome to UCF!**, Michael Johnson, Interim Provost and Vice President for Academic Affairs

1:45PM **Overview of CREOL**, David Hagan, Interim Dean, CREOL

2:15PM **Towards Space-Time Optics and Photonics**, Ayman Abouraddy, Professor, CREOL

2:35PM **Student of The Year Talk, Chip-Scale Optical To RF Link Via Harmonic Injection Locking**, Ricardo Bustos-Ramirez

2:50PM **OSA,** Tom Hausken, Executive Director

VIRTUALLY VIA THE REMO PLATFORM

https://live.remo.co/e/creol-industrial-affiliates-symp-1 (Remo Passcode is IAS2021)

3:00PM Senior Design Showcase, Poster Session & Lab Tours

4:30PM **Distinguished Alumni Awards** presented by Jason Eichenholz, Alum & CTO of Luminar Technologies

- 2020-Brian Lawrence
- 2021-Carl Kutsche

4:45PM Join us for a virtual Social Mixer featuring CREOL faculty and Alumni!

Friday, April 16th Agenda

FRIDAY, April 16, 2021: 9:30AM – 12:30PM EST

VIRTUALLY VIA ZOOM (Zoom Passcode is IAS2021)

Short Courses

9:30AM-11:00AM

- **Yehuda Braiman**-Semiconductor Diode Laser Arrays: Principles of Design, Array Beam Combining, And Applications.

  Zoom Link: https://ucf.zoom.us/j/95169276229?from=addon

- **Matthieu Baudelet**-Practical Spectroscopy for Medicine, Industry And Defense

  Zoom Link: https://ucf.zoom.us/j/93453387633?from=addon

11:00AM-12:30PM

- **James N. Hilfiker**- Thin Film Characterization with Spectroscopic Ellipsometry

  Zoom Link: https://ucf.zoom.us/j/92121807428?from=addon

- **ST Wu**- Mini-LED, OLED Or Micro-LED Display: Who Wins?

  Zoom Link: https://ucf.zoom.us/j/98553113509?from=addon

FRIDAY, April 16, 2021: 1:00PM – 4:00PM EST

VIRTUALLY VIA ZOOM https://tinyurl.com/n3xansb2 (Zoom Passcode is IAS2021)

1:00PM **Welcome,** David Hagan, Interim Dean, CREOL

1:10PM **Polyoculus: Low-Cost Telescope Arrays for Satellite Communication, LIDAR, And Astrophysics**, Stephen Eikenberry, Professor, University of Florida

1:30PM **Student Talks:**

- **Miniature Planar Telescopes for Laser Beam Steering?**, Ziqian He
- **Artefact-Free Fluorescence Imaging via an Annular Fiber Bundle**, Benjamin Croop

2:00PM **SPIE,** Kent Rochford, Executive Director

2:10PM **Industrial Affiliate Spotlights**

- II-VI Aerospace & Defense
- OptiGrate
- Facebook Reality Labs
- MKS Instruments

2:50PM **LIA**, Nathaniel Quick, Executive Director

3:00PM **High Power Lasers – Past, Present and Future**, Richard Bagnell, Former DARPA, Directed Energy

3:30PM **High Power Laser Development and Applications – A New Center For Directed Energy**

Martin Richardson, Professor, CREOL

3:50PM **Closing Remarks**, David Hagan, Interim Dean, CREOL

THURSDAY, April 15, 2021: 1:45PM

Basic Research at the DoD: Advancing the Endless Frontier
BINDU NAIR, Director of Basic Research, Department of Defense

Abstract: The Basic Research Office (BRO) sets scientific priorities aimed toward ensuring DoD is a leader in scientific discovery and identifying new paths for investigation. The office is responsible for oversight and management of DoD's $2.5B basic research investment in high risk, high pay-off research and manages programs including the Vannevar Bush Faculty Fellowship, MURI, Minerva, and pilot programs such as the Newton Award. In this presentation, I will discuss the BRO approach to basic research, which includes the use-inspired questions on fundamental processes, but also curiosity-driven, 'blue sky' science. After presenting the BRO framework for supporting basic research, I will discuss intriguing developments and future directions for funding at BRO, with a focus on research in optics and photonics.

Biography: Dr. Bindu Nair is the Director for Basic Research within the Office of the Secretary of Defense (OSD). In this role, she is responsible for oversight and coordination of the Department's $2.5 billion investment in basic science. She previously served as the Deputy Director of OSD's Human Performance, Training and Biosystems Directorate. Prior to OSD, Dr. Nair worked for the Department of the Army with oversight responsibilities over the science and technology program in power and energy. She has worked in the DoD laboratory system at Natick Soldier Research, Development and Engineering Center as well as in private industry at Foster Miller. Her research expertise is in the field of Material Science and Engineering including nanomaterials, polymers, and organic electronic materials. She has published primarily in membrane and materials development fields and holds patents in fuel cell technologies. Dr. Nair holds a B.Sc. from the University of Florida and a Ph.D. from the Massachusetts Institute of Technology in Materials Science and Engineering.

THURSDAY, April 15, 2021: 2:15PM

Towards Space-Time Optics and Photonics
AYMAN ABOURADDY, Professor, CREOL

Abstract: Exercising control over the spatial degrees of freedom of the optical field has continued to yield breakthroughs over the past few decades, ranging from the discovery of Bessel beams and beams endowed with orbital angular momentum, to optical tweezers and traps, and the manipulation of the field in multimode optical fibers. Separately, put in parallel with these efforts, ultrafast pulse shaping has revolutionized our control over the temporal degree of freedom of the optical field. The spatial and temporal realms in optics have led for the most part independent lives with few examples of creative intersections. In this talk I show that precise, joint sculpting of the spatial and temporal degrees of freedom of optical fields – rather than modulating each separately – yields a new class of pulsed beams that I call 'space-time' (ST) wave packets. Surprising and useful optical behavior are exhibited by ST wave packets when freely propagating or when interacting with photonic devices, leading to a new frontier for the study of structured light. I will share our recent experimental and theoretical results from this rapidly emerging topic and sketch potential applications that could benefit from ST wave packets.

Biography: Ayman F. Abouraddy received the B.S. and M.S. degrees from Alexandria University, Alexandria, Egypt, in 1994 and 1997, respectively, and the Ph.D. degree from Boston University, Boston, MA, in 2003, all in electrical engineering. In 2003 he joined the Massachusetts Institute of Technology (MIT) as a postdoctoral fellow, and then became a Research Scientist at the Research Laboratory of

Electronics in 2005. He is the coauthor of more than 120 journal publications, 240 conference presentations, and 70 invited talks; he holds seven patents, and has three patents pending, and is a fellow of the OSA. He joined CREOL, The College of Optics & Photonics, at the University of Central Florida as an assistant professor in September 2008 and was promoted to full professor in August 2017. Hi recent research interests are in the area of structured light, particularly in the emerging field of space-time optics and photonics, in addition to quantum optics and quantum information processing.

Website: https://creol.ucf.edu/person/ayman-abouraddy/

THURSDAY, April 15, 2021: 2:35PM

Chip-Scale Optical to RF Link Via Harmonic Injection Locking
RICARDO BUSTOS RAMIREZ, Student of the Year

Abstract: Due to their highly stable timing characteristics, optical frequency combs have become instrumental in applications ranging from spectroscopy to ultra-wideband optical interconnects, high-speed signal processing, and exoplanet search. Furthermore, optical frequency combs serve as the main gear to create the most precise time-keeping tools to date, optical atomic clocks. In the past few years, there has been a necessity for frequency combs to become more compact, robust to environmental disturbances, and extremely energy efficient. To that end, photonic integration shows a clear pathway to bring optical frequency combs to satellites, airships, drones, cars, and even smartphones. Therefore, the development of chip-scale optical frequency combs has become a topic of high interest in the optics community. In this talk, I will present the work that paves the way to achieve a compact frequency comb by linking together Kerr microresonator soliton combs and semiconductor mode-locked lasers via optical frequency division. First, I will focus on the development of harmonic injection locking, a technique that can optically divide EOM-based frequency combs with repetition rates in the 300 GHz range down to 10 GHz using a chip-scale semiconductor mode-locked laser. By using harmonic injection locking, the high timing-stability from the EOM-comb is transferred to the mode-locked laser and we measure a fractional frequency stability of 10-12 at 1 second (10 mHz in 10 GHz). Furthermore, I will talk about recent experiments where we have replaced the EOM-based comb with a 300 GHz Kerr microresonator soliton comb and the early results of linking such comb to a chip-scale semiconductor mode-locked laser.

Biography: Ricardo is currently a PhD candidate in Prof. Peter Delyett's Ultrafast Photonics Group. He received the B.S. degree in electrical engineering from ITESO, Guadalajara, Mexico, in 2013, and the M.S. degree in optics and photonics with CREOL in 2018. His research interests focus on chip-scale frequency comb sources and injection locking schemes for applications in communications and metrology. Ricardo has authored and co-authored 25 journal articles and conference proceedings articles and is also a co-inventor in two granted US patents. Ricardo is a student member of OSA and IEEE since 2017 and was granted the CONACyT Scholarship (2015-2020) and the CREOL Dean's Dissertation Completion Fellowship (Spring 2021).

THURSDAY, April 15, 2021: 2:50PM

OSA- Industry Update
TOM HAUSKEN, Senior Industry Advisor

Biography: With over 40 years in optoelectronics, Dr. Hausken focuses on industry content at OSA—The Optical Society. This includes OIDA (OSA Industry Development Associates, a trade association within OSA), where he also held a position earlier in his career. For 13 years until 2012, Dr. Hausken led market research and strategy consulting for lasers, image sensors, and a range of other photonic products at Strategies Unlimited. He was also a telecom policy analyst at the U.S. Congressional Office of Technology Assessment and held R&D and production positions at Alcatel and Texas Instruments in photonics and electronics. He has a PhD from the University of California at Santa Barbara, in optoelectronics.

Senior Design Projects

SD1 **Project title:** Color Acquisition Device (CAD)

Project description: We present a novel device for determining the reflectance or transmittance of different objects at three different discrete wavelengths and reporting them to the user with a wireless Bluetooth LCD screen. Using a 100m long polarization-maintaining silica fiber as a single-pass stimulated Raman scattering source when pumped by 1kW peak-power, 5ns wide, 1064nmn wavelength laser pulses at a repetition rate of 20kHz, two wavelengths at 1120nm and 1178nm are generated (when polarization is not aligned to fast or slow fiber axes). These generated wavelengths and the pump acquire distinct temporal shapes whose linear combination makes up the exiting gaussian pulses that, with proper signal analysis and software tuning, are used to analyze and extract the spectral content of the target that is reported to the user; all is done without the need of additional laser cavities, diffractive optics, and by using a single high-speed detector.

Students: Cesar Lopez-Zelaya, Noah Richter

Advisors: C. Kyle Renshaw, Guifang Li

Sponsor: Air Force Research Laboratory (AFRL)

SD2 **Project title:** Standard Small Satellite Research Platform for Life Sciences

Project description: A dissolved oxygen sensor and salinity sensor are designed and integrated into a system alongside a camera to characterize the health of an aquatic ecosystem and report the resulting data long distances via wireless transmission.

Students: John Semmen, Brandon Triplett

Advisor: David Hagan

SD3 **Project title:** The Smart Window

Project description: The Smart Window aims to solve problems with inaccurate weather predictions using its set of onboard sensors. The Smart Window also supports meaningful engagement with users of a wide range of technical ability, because of its integration of new and exciting technologies like PDLC films, transparent displays, and assistive technology like proximity sensors, easy to read GUI and accompanying mobile application.

Students: Jake Pivnik, Pablo Calzada, James Brunner (EE), Shaneal Findley (CS)

Advisor: Shin-Tson Wu

SD4 **Project title:** Optical Harp

Project description: A laser style harp with MIDI functionality

Students: Matthew Kalinowski, Mohamed Jabbar, Kyle Kaple, Christian Chang

Advisors: Patrick LiKamWa, Kyu Young Han, Zhishan Guo

THURSDAY, April 15, 2021: 3:00PM – 4:30PM EST

Lab Tours

L1 **Title:** Lightguide Based AR Displays
Group: Liquid Crystal Displays
PI: Dr. Shin-Tson Wu
Presenter: Kelly Yin
Description: We demonstrate a lightguide Augmented Reality (AR) display based on reflective polarization volume grating (PVG). In this lab tour, we will first give an introduction to the background and then dive into the principle of PVG. In addition, we will show the fabrication process and the samples of the PVG. Finial, a short video about our AR demo will be present.

L2 **Title:** HDR Head-up Display
Group: Liquid Crystal Displays
PI: Dr. Shin-Tson Wu
Presenter: Winnie Zou
Description: We demonstrate a full-color high dynamic range head-up display (HUD) based on a polarization selective optical combiner, which is a three-layer cholesteric liquid crystal (CLC) film. Our demo shows that the dark state of the new HUD is lowered by 3x and bright state is boosted by 2.5x. By applying antireflection coating to the optical components and optimizing the degree of polarization, our simulation results indicate that the dynamic range can be improved by ~50x.

L3 **Title:** High Energy Mid-IR Laser for Attosecond Physics
Group: IFAST
PI: Dr. Zenghu Chang
Presenter: Jialin Li
Description: IFAST Group has been working on generating bright attosecond sources in soft X-ray range. In this recently established lab, we are building up a novel mid-infrared source (4.1 μm) via OPA and Multi-Stage CPA with the intention of generating KeV high-flux isolated attosecond pulses.

L4 **Title:** Femtosecond Nonlinear Optics
Group: Nonlinear Optics
PI(s): Dr. Eric Van Stryland, Dr. David Hagan, and Dr. M.J. Soileau
Presenter: Nicholas Cox
Description: The Nonlinear Optics Group conducts 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. The group has invented several new techniques for characterizing the nonlinear optical properties of materials, e.g., Z-scan, white-light continuum Z-scan, and nonlinear Beam Deflection and has pioneered advances in the understanding of the nonlinear interactions.

L5 **Title:** Living on the Oxygen K-edge; Attosecond Physics
Group: IFAST
PI: Dr. Zenghu Chang
Presenters: Quynh Le and Chase Geiger

Description: The FAST group uses attosecond laser pulses to observe vibrational, rotational, and electronic transitions in atoms and molecules on attosecond, femtosecond, and picosecond timescales. We will discuss recent laser system improvements and potential new experimental applications, such as for studying electron transport in organic photovoltaic solar cells and chemical sensors.

L6 **Title:** Few-Cycle Pulses Generation and Interaction with Optical Materials
Group: Ultrafast Laser Processing
PI: Dr. Xiaoming Yu
Presenter: Dr. Yingjie "Leo" Chai
Description: Compression of ultrashort laser pulses from 170 fs down to 10 fs is achieved in a custom-built multi-plate continuum (MPC) system. These few-cycle pulses, measured by frequency-resolved optical gating (FROG), are used in the study of laser-induced damage and the formation of ripples in ZnSe and silicon.

L7 **Title:** Generation of Femtosecond Laser Bursts In A Folded Michelson Interferometer
Group: Ultrafast Laser Processing
PI: Dr. Xiaoming Yu
Presenter: Boyang Zhou
Description: Sixteen replicas of an ultrashort laser pulse are produced in a 4-fold Michelson interferometer. We will examine the setup, explain how to control the timing and envelope of each "burst", and showcase experimentally measured bursts that can be used in laser materials processing and the generation of THz radiation.

L8 **Title:** Multiphoton Lithography with Spatial Beam Shaping
Group: Ultrafast Laser Processing
PI: Dr. Xiaoming Yu
Presenter: He Cheng
Description: We have built a multiphoton lithography system to fabricate micron-sized structures additively through two-photon polymerization. The system consists of a femtosecond laser source, a spatial light modulator, a 4-f optical relay, motion control, and an in-situ camera. Spiral-shaped structures are fabricated using the superpositions of high-order Bessel modes.

L9 **Title:** Broadband High-Resolution Molecular Spectroscopy in A Mid-IR Range
Group: Mid-Infrared Combs
PI: Dr. Konstantin L. Vodopyanov
Presenter: Dmitrii Konnov
Description: Mid-infrared spectroscopy offers unparalleled sensitivity for the detection of trace gases, solids, and liquids, based on the existence of strongest tell-tale vibrational bands in the 3-12 μm band. Our dual-comb spectroscopy system is moving-parts-free and provides fast data acquisition combined with superior spectral resolution and broadband spectral coverage, simultaneous detection of tens trace molecular species in a gas mixture, including isotopologues, with part-per-billion sensitivity.

L10 **Title**: Nonlinear Material Characterization for Mid-Infrared Generation
Group: Mid-Infrared Combs
PI: Dr. Konstantin L. Vodopyanov
Presenter: Taiki Kawamori
Description: The Mid-Infrared Combs Research Group develops groundbreaking techniques for producing mid-infrared laser sources and explores its diverse applications. The areas of research embrace generation of ultra-broadband frequency combs and high-power coherent source in the mid-infrared, and Fourier-domain mid-Infrared spectroscopy including dual-comb spectroscopy, ultrasensitive molecular detection, and spectroscopic study of dynamic processes. In this tour, the study of nonlinear optical properties in novel crystals for mid-infrared generation will be presented.

L11 **Title:** Super-Resolution Fluorescence Microscopy
Group: Optical Nanoscopy
PI: Dr. Kyu Young Han
Presenter: Chun Hung "Crystal" Weng
Description: The optical nanoscopy group focuses their research on the development and applications of novel optical tools to study essential problems in biology. Particularly, we are interested in fluorescence imaging techniques including two-photon excitation fluorescence microscopy via ultrafast semiconductor laser, single-shot volumetric image, light-sheet fluorescence microscopy, Nanobody-based SiMPull assay, etc. These techniques have enabled us to investigate subcellular structures as well as the interactions and dynamics of biomolecules in living-cells and tissues non-invasively.

L12 **Title:** Microstructured Optical Fiber and Devices
Group: Microstructured Fibers and Devices
PI: Dr. Rodrigo Amezcua Correa
Presenter: Juan Carlos Alvarado Zacarias
Description: Optical fibers are present in many different applications, ranging from telecommunications, fiber lasers for medical/industrial applications and sensing, to name a few. In this Lab tour we will showcase our fiber fabrication facilities for specialty fibers, along with the fabrication of photonic lantern devices for space division multiplexing technologies. We will also present different setups for the characterization and study of different fibers and fiber devices.

Student Poster Presentations

P1 **Title:** An Optical Parametric Amplifier For Seeding Femtosecond Fe:Znse Lasers At 4.1 µm
Author list: Z. Alphonse Marra (presenter), Jialin Li, David Smerina, Fangjie Zhou, Yi Wu, Zenghu Chang
Abstract: Mid-infrared pulses with 200 nJ energy and 200 nm bandwidth were generated at 4.1 µm and 60 kHz repetition rate. The highly-stable $LiGaS_2$-based Optical Parametric Amplifier was pumped by a turn-key, commercially-available Yb:KGW laser.

P2 **Title**: Liquid Crystal Flat Optics for Augmented Reality
Author list: Jianghao Xiong (presenter), Tao Zhan, Kun Yin and Shin-Tson Wu
Abstract: Lately a new type of reflective liquid crystal optical elements has found pervasive applications in augmented reality displays. These optical elements exhibit unique properties like compact form factor, large diffraction angle, high diffraction efficiency and polarization selectivity. By applying them in augmented reality displays, we are able to solve various challenges in brand new ways, like enlargement of field of view and pupil steering to expand eye box.

P3 **Title** : Optical Beam Transformation Using Holographic Phase Masks
Author list: Nafiseh Mohammadian (presenter), Oussama Mhibik, Marc Segall, Leonid Glebov, Ivan Divliansky
Abstract: Spatial light modulators produce beams with a desired phase pattern, which directly affects the beam's power spatial distribution. We demonstrate an approach for creating holographic phase masks, which are permanently recorded in a photosensitive glass and do not require electric power in order to operate. The essence of the approach is that by means of holographic recording, an arbitrary phase pattern is encoded into a transmitting volume Bragg grating. Upon Bragg reconstruction, the phase pattern is reconstructed in the diffracted beam. These spatial light modulators are tunable and could be achromatic in broad spectral range.

P4 **Title:** Optimization of Laser Processing Parameters Through Automated Data Acquisition and Artificial Neural Networks
Author list: Cameron Vo(presenter), Boyang Zhou, Xiaoming Yu
Abstract: Finding the optimal parameters in a laser processing application can be time-consuming given the large parameter space and various sources of error. This problem is exacerbated by day-to-day variation in laser beam characteristics and a large variety of materials that need to be processed. The ideal laser processing system should be "smart", meaning that it can sense changes in the environment, make proper adjustment, and predict parameters for new materials. As a step towards this goal, we propose a method to efficiently extract the areas of a large number of laser-induced damages in-situ using an automated data acquisition system that controls laser parameters, movement of a motorized stage, image capturing/processing, and feature extraction. A large number of data points are collected automatically within an hour and reduction in time can be achieved by further hardware and software optimization. The damage areas are extracted and compared with direct measurements. Features such as ripples and sub-surface cracks are analyzed and fed into artificial neural networks (ANNs) for classification and prediction. With the capability of collecting a large amount of data in a short period of time, this system can be used to train sophisticated ANNs for complicated tasks such as quality control and failure prediction.

P5 **Title**: Generation And Amplification Of High Power Ultrafast Mid-Infrared Pulses Through ZGP
Author list: Fangjie Zhou (presenter), Yi Wu, Yanchun Yin, Krishna Murari, Zenghu Chang
Abstract: We present the generation of femtosecond pulses centered at 3 and 8 μm through a ZnGeP2-based Optical Parametric Chirped Pulse Amplifier. The output can be used for a two-color high harmonic generation scheme.

P6 **Title**: Sampling Laser Waveforms Using Tunneling in Solids
Author list: Yangyang Liu, Shima Gholam-Mirzae, John Beetar (presenter), Jonathan Nesper, Ahmed Yousif, Nrisimha Murty Madugula, & Michael Chini
Abstract: Characterizing the time-dependent electric field waveform of few-cycle laser pulses is a requirement for applications to attosecond science and other field-resolved spectroscopies. Recently, characterization techniques based on strong-field excitation have shown success in characterizing few-cycle pulses and waveforms ranging from the ultraviolet to mid-infrared. Unlike perturbative nonlinear optical techniques, these characterization methods do not rely on phase matching or retrieval algorithms, and they have been demonstrated to accurately characterize broad bandwidth pulses and sub-optical cycle field transients. Here, we extend one such technique, known as TIPTOE (tunneling ionization with a perturbation for time-domain observation of an electric field), to solid-state media. We show that tunneling and multiphoton excitation in a dielectric solid can provide an ultrafast temporal gate, as well as a simple detection scheme, for waveform characterization. The solid-state TIPTOE allows for full measurement of the electric field waveform from sources with relatively low pulse energies in comparison to the gas-phase TIPTOE. Furthermore, we experimentally demonstrate that the solid-state platform allows for single-shot, on-chip measurement of optical waveforms.

P7 **Title:** Image Transport In Disordered Optical Fiber Endoscopes
Author list: Xiaowen Hu, Jian Zhao, Jose E. Antonio-Lopez, Rodrigo Amezcua Correa, and Axel Schülzgen
Abstract: We demonstrate the advantages of disordered optical fibers in endoscopic imaging applications with increased robustness and broadband incoherent illumination. By using deep learning neural networks, we achieve high fidelity full-color cell imaging and accurate image classification under large fiber deformations.

P8 **Title:** A Study On Phosphor Thermometry Thermal Gradient Sensitivities For Gas Turbine Environments
Author list: Johnathan Hernandez (presenter), Quentin Fouliard, Ranajay Ghosh, Seetha Raghavan
Abstract: Power-Generation Turbines are the main source of energy and power distribution in the world. These systems rely on 300 micron ceramic based coating to ensure the high pressure turbine blades are protected over multiple cycles. However, in-situ monitoring of these systems is limited to very few techniques such as thermocouples and IR methods. Monitoring of these surface and subsurface temperatures can help increase temperature restrictions and provide operators to valuable information to ensure efficiency operation. Phosphor thermometry is a unique method that utilizes the luminance intensity, decay, and decay shift to measure thermal loads in rare earth dopants. In this work Rare earth dopants that ingressed into thermal barrier coatings are tested in simulated turbine environment. To do this a novel heat sink system was devised to ensure high thermal gradients within the coating. This work and future work will utilize

Phosphor thermometry as technique to measure sensitivity limits with in coatings with different thickness and dopants. Passive cooling in high heat flux testing has demonstrated roughly 1°C per micron. It is expected in future testing a more extreme thermal gradient will be experienced. This sensitivity analysis will give PTS users a fundamental understanding of possible limitations and restrictions to this technique in high thermal gradient environments such as power generation turbines.

P9 **Title:** Intracavity Spatial Mode Conversion by Mean of Holographic Phase Masks
Author list: Lam Mach (presenter), Nafiseh Mohammadian, Oussama Mhibik, Leonid Glebov, and Ivan Divliansky
Abstract: Holographic phase masks – i.e., complex phase structures coupled with the transmissive volume Bragg grating, possess a high degree of tunability and achromatism. Here we demonstrate a linear, wavelength-tunable, continuous-wave Yb^{3+}:KYW laser capable of emitting customizable spatial modes by mean of holographic phase masks.

P10 **Title:** High-Sensitivity Experimental Setup for Measuring Optical Scattering In PTR Glass
Author list: Roberto Alvarez, Aleksandr Ryasnyanskiy, Pavel Shirshnev and Leonid Glebov
Abstract: One of the sources that introduce losses into holographic optical elements recorded in PTR glass is strong scattering produced by NaF nanocrystals that precipitate after UV exposure and thermal development. Previous investigations on the scattering properties of PTR glass were derived from optical attenuation spectra and no experimental tools for direct measurement of optical scattering were developed. Here, we present a high-sensitivity experimental setup for measuring scattering from a 1-mm probe beam at 405 nm. The system provides 2D image of the probe beam at 90° at this wavelength. A narrowband filter cuts off luminescence of the sample. A high-resolution CCD captures the image and values of scattering intensity is calculated with a specialized image processing software Image J. The system sensitivity is sufficient to detect the scattering level of highly homogeneous glasses including fused silica. Absolute values of scattering index in PTR glass are calculated by normalization to known scattering value in fused silica. This setup represents a fundamental tool for the exploration of structural transformations that take place during the holographic recording process.

P11 **Title**: Direct Modulation of Electrically Pumped Coupled Microring Lasers
Author list: Chi Xu (presenter), Mercedeh Khajavikhan, Patrick LiKamWa
Abstract: We demonstrate the use of gain-loss contrast between two coupled identical resonators, as a new degree of freedom to enhance the modulation frequency response of laser diodes. An electrically pumped microring laser system with a bending radius of 50 µm is developed on InAlGaAs/InP MQW p-i-n structure. The device lases in continuous-wave mode at room temperature with a threshold current of 27 mA. By tuning the ratio between injection current levels in the two coupled rings, our experimental results clearly show a bandwidth improvement of by up to 1.63 times the fundamental resonant frequency of the individual device. This matches well with our rate equation simulation model.

P12 **Title:** Pulse Width Dependence of The Effective Nonlinear Refractive Index In Air
Author list: Natalia Munera (presenter), Salimeh Tofighi, Eric W. Van Stryland, and David J. Hagan
Abstract: The existence of a transparency window in the Mid-IR has raised considerable interest in atmospheric propagation of short Mid-IR laser pulses. Propagation of high-power self-guided, diffraction-resistant laser filaments in the atmosphere has attracted attention in remote sensing and LIDAR [1]. It is therefore important to measure the nonlinear refraction governing high power

beam propagation in the atmosphere. We used the nonlinear refraction of air results from the polarization-sensitive, time-resolved Beam-Deflection technique, exciting in both the near and mid-IR and probing in the mid-IR [2]. As has been shown earlier, we assumed that the nuclear rotational nonlinear refraction is nearly dispersionless [3]. From these data, we find no dispersion of the bound-electronic nonlinear refractive index, $n_{2,el}(\lambda_p;\lambda_e)$, which allows us to model the pulsewidth dependence of the effective nonlinear refractive index, $n_{2,eff}$, i.e., as would be measured by a single beam. Interestingly, $n_{2,eff}$ is maximized for a pulsewidth of approximately 0.5 ps. The position of this maximum is nearly independent of pressure while its magnitude decreases with increasing pressure and temperature. From our measurements and modeling, we predict the nonlinear refraction in the atmosphere at different altitudes.

P13 **Title:** Tin-Gallium-Oxide Solar-Blind Photodetectors on Silicon (111) By MBE

Author list: Isa Hatipoglu, Daniel A. Hunter, Partha Mukhopadhyay, Martin Williams, Paul R. Edwards, Robert W. Martin, G. Naresh Kumar, and Winston Vaughan Schoenfeld

Abstract: Deep ultraviolet (DUV) frequencies of the Solar spectrum do not reach the Earth's surface thanks to the Ozone layer, leaving us with a background noise-free environment for wavelengths below ~280 nm. Detection of this solar-blind region is essential for many applications ranging from flame and missile detection, gas sensors, medical applications, non-line-of-sight communication, and space-to-space communication. AlGaN and MgZnO have been the choice of material for solar-blind photodetectors until Gallium Oxide came into play. Gallium oxide is a natural choice due to its bandgap of 4.8-4.9 eV (cut-off wavelength ~255nm), high breakdown voltage, and radiation hardness. However, there are several issues to be addressed to achieve the foremost device parameters: 1) Coverage of the entire solar-blind region, 2) higher responsivity, and 3) better transient response. Here we present heterogeneous integration of Tin-Gallium-Oxide UVC photodetectors on Silicon by molecular beam epitaxy (MBE). Direct correlation in structural and compositional and optical properties are studied by multimodal electron microscopy and spectroscopy techniques. The Sn composition is found to be x=2.2-2.6% by wavelength dispersive X-ray spectroscopy. There are clear peaks in cathodoluminescence intensity at 2.2 eV and 2.64 eV, a potential signature of intrinsic point defects. We suspect that these intragap states are the root of the ultrahigh photoconductive gain via hole trapping. Moreover, the Ga2O3 nucleation layer improves the surface quality and results in better device properties, including higher specific detectivity on the order of 1012 Jones compared to TGO growth directly on the Si substrate.

P14 **Title:** Non-Degenerate Two-Photon Absorption Spectroscopy of Bulk Silicon Using White-Light Continuum Probe

Author list: Sanaz Faryadras (presenter), Nick Cox, David J. Hagan, and Eric W. Van Stryland

Abstract: Extremely nondegenerate two-photon absorption (END-2PA) shows large enhancement over degenerate 2PA in direct and indirect gap semiconductors and can be utilized in applications such as sensitive mid-infrared detection and 3D infrared imaging. Due to its wide range of applications in integrated photonics, optical switching, and sensing, silicon is of special interest. Specially, 2PA across the indirect gap of silicon (1.12 eV) can be of importance because of its applications in telecommunication wavelengths (1300 and 1550 nm), when using with high optical irradiance. We perform pump-probe measurements of ND-2PA of bulk silicon across its indirect gap with a combination of several pump and probe wavelengths. Femtosecond pulses in the range 1700 nm<λ<2400 nm were used as the pump beam. Probe pulses in the range 1150 nm<λ<1500 nm were provided by filtering the white-light-continuum (WLC) generated in a YAG crystal. Enhancement of the 2PA coefficient is observed in our measurements for the more non-

degenerate wavelength combinations and its dispersion is compared with our recently developed theoretical model for the dominant transition in the band structure of silicon.

P15 **Title:** Laser-Aided Manufacturing and Micro-Processing of Materials
Author list: Tianyi Li(presenter), Gunjan Kulkarni and Christopher Kosan
Abstract: Depositing nanoparticles additively on rigid or flexible substrates as 2D films is of great importance when it comes to Photonics and Optoelectronics. The processes developed in our laboratories, Nano-Electrospray Laser Deposition (NELD) and Laser-Assisted Contact Printing, are presented.

In the NELD process, nanoparticle suspension is delivered to needle, through capillary tube, from the syringe pump at a specific flow rate and the substrate is fixed below the needle. Application of a very high electric field between needle and substrate creates a conical meniscus at needle tip, resulting in microdroplets. While the microdroplet falls towards the substrate, pulsed Nd:YAG laser, passing through an optical setup is focused on the substrate to evaporate liquid in the microdroplet and simultaneously sinter the nanoparticles onto the substrate. Furthermore, an analytical conduction model was developed to calculate temperature distribution within the droplet depending on its refractive index, reflectance, and absorption coefficient. As per the model, 20 wt% Ag nanoparticle microdroplet was predicted to explode mid-air and this was verified experimentally.

For Laser-Assisted Contact Printing, nanoparticle suspension is delivered to the needle through a capillary tube to draw a liquid line on the substrate fixed on an XYZ stage. CW CO_2 laser is passed through an optical setup and focused on the substrate to evaporate the liquid and simultaneously sinter the nanoparticles. Systematic selection of process parameters allows for numerous materials to be accepted into this apparatus and obtain the desired aspect ratio of the deposited film. Using this technique, we deposited Ag fingers on ITO-coated Si substrate and SiO_2 line on glass substrate. The experimental setup can also be used to laser-anneal Ag fingers deposited on solar cells through screen printing. An analytical model for laser-annealing of Ag fingers has been developed to understand the effects of laser power and substrate speed on the temperature distribution within the solar cell.

Implementation of the NELD process has yielded sub-wavelength features deposited on both rigid and flexible substrates while the contact printing method has been used to generate optically transparent thin films.

THURSDAY, April 15, 2021: 4:30PM

2020 Distinguished Alumni Awardee
BRIAN LAWRENCE

Biography: Dr. Brian Lawrence is the Senior Vice President and Chief Technology Officer of Hill-rom since 2010. Hill-rom (HRC) is a global medical technology leader with more than 10,000 employees worldwide and market capitalization of over $7B. Prior to joining Hill-rom, he served as chief technology officer for GE Healthcare's Life Support Solutions business and held other leadership and innovation positions in GE's Global Research Center. Before GE, Mr. Lawrence was president and CEO of Extend Optical Systems Corporation and senior vice president of Research and Development and chief technology officer for Molecular OptoElectronics Corporation. Dr. Lawrence received his undergraduate MIT and his Ph.D. from the Center for Research and Education in Optics and Lasers (CREOL) at the University of Central Florida in 1997 under the supervision of Professor George Stegeman.

2021 Distinguished Alumni Awardee
CARL KUTSCHE

Biography: Carl Kutsche, Chief Technologist for the Critical Infrastructure Security and Resilience Directorate, Idaho National Laboratory, Department of Energy; organizes capabilities solving communications, cyber security, energy grid, and critical infrastructure challenges across the Nation. He is also the technical lead for INL's National and Homeland Security Research and Development Program. Prior to joining INL, Dr. Kutsche served 25 years active duty with the US Air Force leading communications, intelligence, and counter-terrorism programs. Dr. Kutsche received his Doctorate in Electrical and Optical Engineering from the University of Central Florida in 1998, focusing on High-Speed Communications and Electro-Optic Systems.

SOCIAL MIXER TABLE HOSTS

Table #1 **Peter Delfyett**
University Trustee Chair, Pegasus Professor of Optics & Photonics, ECE & Physics; Director, Townes Laser Institute

Table #2 **Martin Richardson**
Founding Director of the Townes Laser Institute, Pegasus Professor, University Trustee Chair, Northrop Grumman Professor, Prof of Optics & Photonics, Physics and Electrical & Computer Engineering

Table #3 **Eric Van Stryland**
Emeritus Dean and Professor of Optics & Photonics

Table #4 **MJ Soileau**
University Distinguished Professor of Optics & Photonics, ECE & Physics

Table #5 **Amy Perry**
HR Manager

Table #6 **Shin-Tson Wu**
Pegasus Professor of Optics & Photonics

Table #7 **Mike McKee**
Associate Director, Academic Support Services. Undergraduate Advising

Table #8 **Alma Montelongo**, Graduate Admissions Coordinator
Rachel Franzetta, Graduate Admissions

Table #9 **Axel Schülzgen**
Professor of Optics & Photonics

Table #10 **Leon Glebov,** Research Professor of Optics & Photonics
Ivan Divliansky, Research Assistant Professor of Optics & Photonics

Table #11 **Women in Lasers and Optics (WILO)**
Jessica Pena, Graduate Student
Sanaz Faryadras, Graduate Student

Table #12 **Guifang Li**
Professor of Optics & Photonics, Physics, ECE

Short Courses

Friday, April 16, 2021: 9:30AM

Short course: **Semiconductor Diode Laser Arrays: Principles Of Design, Array Beam Combining, And Applications**
Presenter: **YEHUDA BRAIMAN, Professor, CREOL**

Abstract: Semiconductor diodes offer wide choice of advantages including wide-ranging availability wavelengths, small size, high electro-optical and wall-plug efficiency, and low cost. For many applications, however, single diodes do not emit enough power and this deficiency can be compensated by combining multiple diodes into arrays. In this short course we will:

- cover the basics of diode laser array design and structure.
- overview beam combining designs.
- briefly discuss analytical modeling of semiconductor diode lasers and diode laser arrays.
- present experimental results for array beam combining.
- address scalability challenges of array beam combining.
- overview applications of diode laser arrays.

Friday, April 16, 2021: 9:30AM

Short course: **Practical Spectroscopy For Medicine, Industry And Defense**
Presenter: **MATTHIEU BAUDELET, Associate Professor, Chemistry**

Abstract: This short course will introduce the participants to the **different types of spectroscopies** that are used for medical diagnostics, quality assurance as well as remote, stand-off and field sensing.

We will discuss why and how to **choose the appropriate techniques** to obtain the best information adapted to the needs of the industry, analysts, and field operators.

An overview of the **commercial availability** of the technologies will also be presented to the participants.

Friday, April 16, 2021: 11:00AM

Short course: **Thin Film Characterization with Spectroscopic Ellipsometry**
Presenter: **JAMES HILFIKER, J.A. Woollam**

Biography: James Hilfiker graduated from the University of Nebraska in 1995, where he studied under Professor John Woollam. He joined the **J.A. Woollam Company** upon graduation, where his research has focused on new applications of ellipsometry, including anisotropic materials, liquid crystal films, thin film photovoltaics, and Mueller matrix optical characterization. He has authored over 50 technical articles involving ellipsometry, including Encyclopedia articles, four book chapters and in 2016, James co-authored a book “Spectroscopic Ellipsometry: Practical Application to Thin Film Characterization” with Harland Tompkins.

Friday, April 16, 2021: 11:00AM

Short course: **Mini-LED, OLED Or Micro-LED Display: Who Wins?**
Presenter: **SHIN-TSON WU,** Professor, CREOL

Abstract: Display technologies have deeply affected our daily lives. Their applications cover from smartphones, pads, notebook computers, desktop monitors, TVs, data projectors, and emergent augmented reality and virtual reality. "Mini-LED, OLED, or Micro-LED: Who Wins?" is a hotly debated question. In this short course, I will explain the fundamental operation principles and compare the pros and cons of these three promising technologies in terms of dynamic range, ambient contrast ratio, color gamut, motion picture response time, form shape, power consumption, lifetime, and cost. Some CREOL students' pioneering contributions will also be highlighted.

Friday, April 16, 2021: 1:10PM

PolyOculus: Low-Cost Telescope Arrays for Satellite Communication, LIDAR, And Astrophysics
STEPHEN EIKENBERRY, Professor, University of Florida

Abstract: We have developed a method for producing large-area-equivalent telescopes by using photonic technology to link modules of multiple semi-autonomous, small, inexpensive, Commercial-Off-The-Shelf (COTS) telescopes. Crucially, this scalable design has construction costs which are ~10 times lower than equivalent traditional large-area telescopes. This innovative "PolyOculus" array approach represents a transformational technology for applications including optical ground stations for satellite communications, atmospheric LIDAR, and astrophysics. PolyOculus relies primarily on recent advances in low-cost, high-performance COTS equipment – telescopes, CCD cameras, and control computers – combined with a novel photonic-link architecture and a few key technological innovations to produce telescope collecting areas equivalent to standard telescopes with mirror diameters ranging from 0.9-m to 40-m and beyond for certain applications. I will review the current status of PolyOculus, and our plans for upcoming technology demonstrator units.

Friday, April 16, 2021: 1:30PM

Student Talk 1: Miniature Planar Telescopes for Laser Beam Steering
ZIQIAN HE, CREOL Doctoral Candidate

Abstract: Non-mechanical beam steering with lightweight, compact, high-efficiency, high-precision and large-angle is pivotal for light detection and ranging (LiDAR) of autonomous vehicles, eye-tracking for near-to-eye displays, microscopy, optical tweezers, and high-precision three-dimensional (3D) printing. However, even the most matured optical phased array can only provide quasi-continuous, efficient beam steering within a relatively small angle range. A telescope module with angle magnification function can be coupled to enlarge the steering range or precision. But obtaining a compact, low cost, lightweight, high quality telescope module with conventional optics remains challenging. Patterned liquid crystal-based planar optical elements offer great design freedom for manipulating the 2D phase profile of light. Owing to the advantages of high efficiency, thinness, low cost, easy processing, flexibility, and response to environmental stimuli, plethora of high-quality optical devices have been demonstrated. Here, a miniature planar telescope mediated by liquid crystal polymers is proposed to offer angle magnification independent of incident spatial location. Based on this guideline, planar optical elements are fabricated using a customized exposure method and assembled into planar telescopes with different magnification

factors. Within the incident field of view, over 80% optical efficiency is achieved. Such a miniature planar telescope shows the potential of cascaded liquid crystal planar optical elements for realizing functionalities that cannot be fulfilled by single optical elements, and enables lightweight, low loss, passive optical transmitters for widespread applications.

Biography: Ziqian is currently a Ph.D. candidate in Dr. Shin-Tson Wu's Liquid Crystal Photonics and Display Group. He received his B.S. degree in material physics from Nanjing University in 2016. His research interest includes liquid crystal photonics, mini/micro-LED displays, and near-eye displays. So far, he has coauthored 35 journal papers and 14 conference proceedings.

Student Talk 2: Artefact-Free Fluorescence Imaging Via an Annular Fiber Bundle
BENJAMIN CROOP, CREOL Doctoral Candidate

Abstract: Fluorescence microscopy is one of the most widely used research tools among biologists because it provides the ability to selectively label and visualize a target of interest, exceptional signal contrast, and the flexibility to analyze a wide variety of sample types. Additionally, the illumination and other imaging parameters can easily be modified to tailor the microscope to a certain sample type or analysis method. Total internal reflection fluorescence (TIRF) illumination is a popular approach for analyzing surface features using fluorescence microscopy, where a shallow evanescent field is generated at the sample interface, preventing unwanted background from features deeper in the sample. However, the most common method of generating TIRF illumination can cause imaging artefacts in 3D samples due to scattering and the required coherence of the light sources. In my talk, I will discuss how we designed a fiber bundle that eliminates the common artefacts observed with traditional TIRF imaging and overcomes limitations that prevent TIRF imaging with incoherent light sources. I will also discuss how this fiber bundle can be used for shadow-free widefield imaging of topographical samples, such as patterned semiconductor wafers.

Biography: Ben Croop is a fifth year PhD candidate in Dr. Han's research group. Prior to joining CREOL, Ben received his bachelor's degree in Materials Science & Engineering at the University of Michigan, and then received a master's degree in Materials Science & Engineering at the University of Washington. Currently, Ben's research within Dr. Han's group focuses on developing a fluorescence microscopy method to count the number of proteins interacting with one another from the intensity of the diffraction-limited spot in the microscope image. The method is universal and can be applied to any protein for which antibodies are available, but Ben aims to apply the technique to monitor a protein related to Parkinson's disease, which currently has no diagnostic test.

Friday, April 16, 2021: 2:00PM

SPIE Industry Update
KENT ROCHFORD, Executive Director, SPIE

Biography: Kent Rochford is the CEO of SPIE, the international society for optics and photonics (Bellingham, WA). Serving more than 264,000 constituents from approximately 166 countries, the not-for-profit society advances emerging technologies through interdisciplinary information exchange, continuing education, publications, and career and professional growth. Previously, Rochford was the Associate Director for Laboratory Programs at the National Institute of Standards and Technology (NIST), providing direction and operational guidance for NIST's scientific and technical laboratory programs with 2,800 staff and an $800 million budget. He served as Acting NIST Director in 2017. He previously headed up NIST-Boulder Labs and the Communication Technology Laboratory (CTL) in Colorado and served as chief of both the Quantum Electronics and Photonics and Optoelectronics Divisions at NIST, as well as acting director of the Electronics and Electrical Engineering Laboratory. Outside of NIST held management roles in an optical communications start-up and a multinational corporations R&D lab. Rochford holds a PhD in optical sciences from the University of Arizona, a BS in electrical engineering from Arizona State University, and an MBA from the University of Colorado.

Friday, April 16, 2021: 2:10PM

INDUSTRIAL AFFILIATES SPOTLIGHTS

- **SPOTLIGHT: II-VI AEROSPACE AND DEFENSE**
  Neal Stoker
- **SPOTLIGHT: FACEBOOK REALITY LABS**
  Barry Silverstein
- **SPOTLIGHT: OPTIGRATE**
  Alexei Glebov
- **SPOTLIGHT: MKS INSTRUMENTS, INC.**
  Marc Himel

Friday, April 16, 2021: 2:50PM

LIA Industry Update
NATHANIEL QUICK, Executive Director, LIA

Biography: Nathaniel R. Quick, PhD is a past president, past secretary, past board member and fellow of LIA. He was confirmed as the Executive Director of the Laser Institute of America October 22, 2017. He is the president and CTO of AppliCote Associates, LLC, Lake Mary, FL., specializing in advanced materials transformation using high pressure laser implantation. Focus is on licensing these technologies.

He currently holds 62 U.S. patents and has over 60 publications. Quick has a PhD from Cornell University in Materials Science and Engineering. He has served as Vice President Research and Development Fluid Dynamics Division, Pall/Memtec Corp; Technology Program Manager, Economic Conversion Kaiser Hill, LLC/ EG&G Rocky Flats; President of Applications Technology of Indiana Inc., Supervisor Technology Applications/Keypads, and Interconnect Technology/Resident Metallurgist; Vice President, Quality Control and Laboratory Operations Washburn Wire Products; and Materials Scientist, Eastman Kodak Research Division. Recognition includes Minority Engineers Outstanding Contributions Award, Cornell University, Outstanding Achievement Business/Professions Center for Leadership and Development, Indianapolis, Indiana, and EG&G Award of Excellence Rocky Flats (twice). He is a fellow of the African Scientific Institute, a past guest researcher at NIST and a past member of the Army Science Board. He is Chairman of the UCF Materials Science and Engineering Industrial Advisory Board and graduate faculty scholar. He is currently a member of ASM International and the Materials Research Society.

Friday, April 16, 2021: 3:00PM

High Power Lasers – Past, Present and Future.
RICHARD BAGNELL, Former DARPA, Directed Energy

Abstract: The Department of Defense has invested in high power laser development for 50+ years. The challenges encountered in fielding effective systems are complicated by varying engagement environmental conditions, target characteristics, timelines, and platform constraints. Early demonstrations requiring high power to produce a target effect were limited to the available high power sources (gas laser era), and highlighted the need to improve efficiency, ruggedness, pointing accuracy and stabilization, and support systems (power/cooling) technologies. As contributing technologies advanced, these advances put within reach systems which address these shortfalls and can be employed for highest priority needs (primarily self-defense), with side benefits including improved free-space communications, power beaming, and remote diagnostics. An overview of past and recent projects and demonstrations is presented, as well as next steps/new challenges anticipated.

Biography: Dr. Bagnell has led laser weapon system development efforts government and industry positions for 25 years. He chiefed planning, integration and execution for field and laboratory experiments to support the Airborne Laser and Advanced Tactical Laser programs and the Airborne Laser Advanced Technology Demonstration, including build-up of an experimental laser testbed at North Oscura Peak, White Sands Missile Range (WSMR), New Mexico. In 2008, he served as Directed Energy Specialist in the Office of the Secretary of Defense working Directed Energy strategy at the Pentagon after which he joined DARPA as the High Energy Liquid Laser Area Defense System (HELLADS) program manager in 2010. At DARPA, he completed laser development and acceptance of the 150 kW-class HELLADS laser and transitioned it for field tests at WSMR. He also led development of an airborne laser turret technology in DARPA's ABC program. ABC developed a laser turret that could provide in-flight capability of laser engagement in forward and aft pointing geometries at subsonic and transonic flight speeds. Since joining MZA Associates Corporation, he has led beam control development programs for airborne and ground based high energy laser systems to produce prototype demonstrations relevant to military missions.

Friday, April 16, 2021: 3:30PM

High Power Laser Development and Applications – A New Center For Directed Energy.
MARTIN RICHARDSON, Professor, CREOL

Abstract: Lasers have long been recognized for their capability to project energy from one location to another. As their power and efficiency have improved, this capacity to transport and concentrate energy is unleashing ground-breaking applications in many fields, from manufacturing to defense, from communications to space. These applications are spreading across many regions of the electromagnetic spectrum and can involve special materials and complex spatial structures and nonlinear optical and quantum processes. This talk reviews some of these developments at UCF and describes how they will contribute to a new university center for directed energy, systems, science and technology.

Biography: Martin Richardson is a well-known expert in high power and high intensity lasers and their applications. His career spans several decades, across several continents, with major commitments to several institutions. At UCF he directs the Laser Plasma Laboratory, is the director of the Center for Directed Energy, Systems, Science & Technology, C-DESST, is the Founding Director of the Townes Laser Institute, a University Trustee Chair, Pegasus Professor, Northrop Grumman Professor and Professor of

Optics, Physics and Electrical & Computer Engineering, He is a visiting Professor at Nanyang Technology University, Singapore, and has worked in several institutes in Canada, Germany, France, the UK, Japan, Qatar, and the former Soviet Union. He is a Fellow of NAI, AAAS, IEEE, OSA, APS, SPIE, JSPS and IoP. He has received several awards including the Schardin Medal, the Harold E. Edgerton Award, *Docteur Honoris Causa,* University of Bordeaux, the Fulbright-Tocqueville Distinguished Chair, and was a Jefferson Fellow of the National Academy of Sciences at the U.S. Dept. of State. He recently was made a fellow of the Directed Energy Professional Society.

Thank you for attending!

We hope to see you next year in person!