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Program updates and changes may be found on the Conference Program Update Sheet distributed in the attendee registration bags, and check the Conference App for regular updates.

OSA and APS/DLS thank the following sponsors for their generous support of this meeting:

GoFoton THORLABS

Conference Schedule-at-a-Glance

Note: Dates and times are subject to change. Check the conference app for regular updates. All times reflect EDT.

	Sunday 15 September	Monday 16 September	Tuesday 17 September	Wednesday 18 September	Thursday 19 September
GENERAL					
Registration	07:00–17:00	07:00–17:00	07:30–18:00	07:30–17:30	07:30–11:00
Coffee Breaks	10:00–10:30 15:30–16:00	10:00–10:30 15:30–16:00	10:00–10:30 13:30–14:00	10:00–10:30 13:30–14:00	10:00–10:30
PROGRAMMING					
Technical Sessions	08:00–18:00	08:00–18:00	08:00–10:00 15:30–17:00	08:00–10:00 15:30–18:30	08:00–12:30
Visionary Speakers		09:15–10:00	09:15–10:00	09:15–10:00	09:15–10:00
LS Symposium on Undergraduate Research		12:00–18:00			
Postdeadline Paper Sessions			17:15–18:15		
SCIENCE & INDUSTRY SHOWCASE					
Science & Industry Showcase See page 12 for complete schedule of programs.			10:00–15:30	10:00–15:30	
Poster Sessions, including Dynamic E–Posters			10:00–12:00 13:30–15:30	10:00–12:00 13:30–15:30	
Plenary Sessions			12:00–12:40	12:00–12:40	
SPECIAL EVENTS					
Women of Light, a Special Program for Women in Optics *(OSA Headquarters)*	08:00–16:00				
OSA Career Lab Workshop: Advancing Mid-Managers Summit		08:00–18:00			
OSA Capitol Hill Meetings		09:00–16:00			
Career Development Programming		11:00–18:00	15:30–16:30		
Laser Science Symposium on Undergraduate Research		12:00–18:00			
Meet OSA's Journal Editors		15:00–16:00			
OSA Technical Group Events		12:30–14:00 18:00–19:00	12:40–13:45	14:15–15:30	
Awards Ceremony & Reception		18:30–21:00			
FIO Student Member Party		19:00–22:00			
DLS Annual Business Meeting			17:15–18:15		
OSA Annual Business Meeting			17:30–18:15		
FIO + LS Conference Reception			18:30–20:30		
Movie Night: Quantum Shorts Film Festival				19:30–20:30	
OSA Senior Member Reception				16:00–18:00	

Welcome to FiO

Welcome,

If you want to be updated on the most recent status of quantum computing or quantum communications, or if you want to know R&D trends in AR/VR or nanophotonics, the Frontiers in Optics + Laser Science APS/DLS (FiO + LS) offers something for you. We are pleased to welcome you to Washington, D.C. area, the home of The Optical Society and The American Physical Society - Division of Laser Science.

This year's conference experience continues to be thoughtfully revised — taking the best of the past and adding vital, innovative elements. The result is a conference with invaluable opportunities to learn from and meet with your peers and colleagues. On behalf of the FiO committee members, we would like to thank our colleagues from the Division of Laser Science (DLS) of the American Physical Society (APS) and OIDA for assisting in cultivating joint topics and sessions that will greatly enhance the experience of the attendees at FiO + LS 2019.

The world-class technical program features more than 120 invited speakers, 135 contributed talks and almost 500 poster presentations by celebrated members of the community describing some of the most exciting advances in their fields.

As technology advances at an ever-increasing pace, the potential applications for optics continue to grow and bring us closer to the edge of amazing discovery and stunning technology. Our plenary speakers, Donna Strickland from University of Waterloo will share her 2018 Noble Prize talk on generating high-intensity ultrashort optical pulses, and Ronald Hanson from Delft University of Technology will discuss the dawn of the quantum Internet. In addition, seven Visionary Speakers who have been paired with four themes will join to share their vision on the cutting-edge advances in the four dimensions: Autonomous Systems, Nanophotonics and Plasmonics, Quantum Technologies and Virtual Reality and Augmented Vision.

We believe you can also find so many outstanding research result presentations in all fields of optics and photonics – Fabrication, Design and Instrumentation; Optical Interactions; Quantum Electronics; Fiber Optics and Optical Communications Photonics; Photonic Integrated Devices for Computing, Sensing and Other Applications; Optics in Biology, Medicine, Vision, and Color; and Information Acquisition, Processing and Display.

While at FiO + LS, we encourage you to visit the Science & Industry Showcase – in which exhibiting companies are partnered with innovative demonstrations, networking events, educational programing sessions, poster presentations, e-posters and rapid-fire oral presentations. This year we have added the Plenary Sessions to the Showcase! Take the time to learn about new products, find technical and business solutions and gain the most up-to-date market perspective of your industry.

Again, we welcome you to FiO + LS 2019 and encourage you to enjoy the dynamic programming incorporated into the next few days ahead.

With best regards,
Christoph Harder and Byoungho Lee

Christoph Harder
FiO General Chair
Swissphotonics, Switzerland

Byoungho Lee
FiO General Chair
Seoul National University, South Korea

Welcome to Laser Science

Welcome,

The leadership of the Division of Laser Science (DLS) of the American Physical Society (APS) is pleased to welcome you to our 35th annual meeting, Laser Science (LS) 2019, in Washington, D.C. This year's program includes many of the areas at the forefront of laser science that are customarily found at the annual DLS meeting. We have collaborated with our colleagues at The Optical Society to coordinate schedules to encourage your intellectual wanderings between DLS and OSA sessions.

In addition to an outstanding technical program with more than 50 Laser Science presentations, there are many exciting special Visionary Speakers and events scheduled for the meeting this year. We would like to particularly call your attention to the Symposium on Undergraduate Research and the Laser Science Dissertation Award session, both on Monday, which showcase the work of some of our younger scientists. The Undergraduate Research Symposium will feature a special poster session.

The technical sessions for the Laser Science meeting are organized around several broad themes: Condensed Phase and Nanocrystal Spectroscopy; Plasmonics and Nanophotonics; Quantum Science; and the topics of the 2018 Nobel Prize in Physics.

We welcome you to the Laser Science 2019 Meeting and encourage you to take full advantage of this year's technical sessions, visionary and plenary talks, as well as the Science & Industry Showcase featuring leading suppliers to the laser science community, Rapid-fire Oral Presentations and Poster Sessions including e-posters.

Anne Myers Kelley
LS Chair
University of California, Merced, USA

Hailin Wang
LS Chair
University of Oregon, USA

General Information

Registration

Atrium (Lower Level)

Sunday, 15 September	07:00–17:00
Monday, 16 September	07:00–17:00
Tuesday, 17 September	07:30–18:00
Wednesday, 18 September	07:30–17:30
Thursday, 19 September	07:30–11:00

WiFi Access Instructions

To access the complimentary WiFi services during the FiO + LS Conference, please use the following login information.

SSID: Marriott Conference
Password: FIOLS2019

First Aid and Emergency Information

In the event of an emergency at the Washington Marriott Wardman Park, please contact hotel staff at the Front Desk. Please also notify the hotel's Front Desk of the emergency if you dial 911 on your own.

Lost and Found

For lost or found items please check first at the conference registration desk. Please put your name on all conference materials (including your Conference Program), as they will only be replaced for a fee.

Special Needs

If you have any special needs or require special accommodations to fully participate in this conference, please contact Conference Management at the registration desk. Staff will make every effort to accommodate reasonable requests we receive on-site.

Nursing Room

For Nursing Room information and access, please contact the FiO + LS Registration desk.

All Gender Restroom

An all gender restroom designation means this restroom is open and safe for people of all gender identities and expressions. The conference all gender restroom is clearly marked in the Washington rooms hallway on the lower level.

OSA Code of Conduct & Anti-Harassment Policy

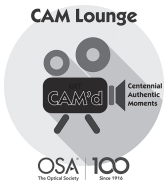
It is the policy of The Optical Society that all forms of bullying, discrimination, and harassment, sexual or otherwise, are prohibited in any OSA events or activities. Harassment consists of unwanted, unwelcomed and uninvited behavior that demeans, threatens or offends another. This policy applies to every individual at the event, whether attendee, speaker, exhibitor, award recipient, staff, contractor or other. For complete information visit osa.org/codeofconduct.

If you wish to report bullying, discrimination, or harassment you have witnessed or experienced, you may do so through the following methods:

- contact any OSA staff member
- use the online portal osa.org/IncidentReport
- or email CodeOfConduct@OSA.org

OSA CAM Lounge

Truman



We're Celebrating All Members (CAM) with quick interviews that highlight you! All OSA members are invited to stop by the CAM Lounge to be filmed talking about what inspired them to pursue their current work, and what excites them most about what they do. The collection of these short videos will be featured on OSA's website, social media, and at various conferences.

Monday, 16 September	08:00–17:00
Tuesday, 17 September	08:00–17:00
Wednesday, 18 September	08:00–17:00

APS Booth

Science & Industry Showcase, Booth 208

The American Physical Society (APS) is a non-profit membership organization working to advance and diffuse the knowledge of physics through its outstanding research journals, scientific meetings, education and diversity programs, outreach, advocacy, and international activities. APS represents over 54,000 members, including physicists in academia, national laboratories, and industry in the United States and throughout the world. Please stop by our booth to learn more about APS programs, services, and our new fully open access broad scope journal *Physical Review Research*.

The Optical Society (OSA) Booth

Atrium (Lower Level)

Founded in 1916, The Optical Society (OSA) is the leading professional association in optics and photonics, home to accomplished science, engineering and business leaders from all over the world. Through world-renowned publications, meetings and membership programs, OSA provides quality information and inspiring interactions that power achievements in the science of light. More than 22,000 OSA members, residing in 100 countries and spanning academia, government and industry, call OSA their professional home. Stop by to meet OSA staff, hear technical talks and learn more about how OSA can help you achieve your professional aspirations.

OSA Booth Programs

Monday, 16 September

10:00 - OSA Awards Selection Committee Meet & Greet

11:00 - Cristina Canavesi, *LighTopTech Corp., USA*

15:00 - Gennadi Saiko, *Oxilight Inc., Canada*

17:00 - Mercedes Gimeno-Segovia, *Psi Quantum, USA*

Tuesday, 17 September

16:00 - Anna Yaroslavsky, *University of Massachusetts Lowell, USA*

17:00 - Xiaoming Yu, CREOL, *University of Central Florida, USA*

Wednesday, 18 September

17:00 - Lingyan Shi, *Columbia University, USA*

Conference Materials

Access Technical Digest Papers

Full Technical Attendees have both EARLY and FREE continuous online access to the FiO + LS 2019 technical digest including Postdeadline papers. These summary papers of presented papers can be downloaded individually or by downloading daily.zip files (.zip files are available for 60 days.)

1. Visit the conference website at http://www.frontiersinoptics.com
2. Select the "Access Digest Papers" link on the right side of the web page
3. Log in using your email address and password used for registration. Access is limited to Full Technical Attendees only. If you need assistance with your login information, please use the "forgot password" utility or "Contact Help" link.

About OSA Publishing's Digital Library

Registrants and current subscribers can access all of the meeting papers, posters and postdeadline papers on OSA Publishing's Digital Library. The OSA Publishing's Digital Library is a cutting-edge repository that contains OSA Publishing's content, including 18 flagship, partnered and co-published peer reviewed journals and 1 magazine. With more than 370,000 articles including papers from over 700 conferences,

OSA Publishing's Digital Library is the largest peer-reviewed collection of optics and photonics.

Conference Program Update

Program changes will be communicated on the Conference Program Update Sheet. In addition, all updates will be made in the FiO + LS Conference App. Check daily for new information and/or reference the Conference App.

Poster Presentation PDFs

Authors presenting posters have the option to submit the PDF of their poster, which will be attached to their papers in OSA Publishing's Digital Library. If submitted, poster PDFs will be available about three weeks after the conference end date. While accessing the papers in OSA Publishing's Digital Library, look for the multimedia symbol.

Media

Badges for pre-registered reporters and credentialed media registering onsite can be found at the registration desk along with conference information.

Conference App

Manage your conference experience by downloading the Conference App to your smartphone or tablet.

Download the app in any of these three ways:

1. Visit www.frontiersinoptics.com/app
2. Search for 'OSA Events' in your preferred app store
3. Scan the QR code below

Schedule

Search for conference presentations by day, topic, speaker or program type. Plan your schedule by setting bookmarks on programs of interest. Technical attendees can access technical papers within session descriptions.

Science & Industry Showcase

Search for exhibitors or view the complete list. Bookmark exhibitors as a reminder to stop by their booth. Tap on the map icon within a description, to find their location on the show floor map.

Access Technical Digest Papers

Full technical registrants can navigate directly to the technical papers right from the Conference App.

Locate the session or talk in "Schedule" and click on the "Download PDF" link that appears in the description. IMPORTANT: You will need to log in with your registration email and password to access the technical papers. Access is limited to Full Conference attendees only.

Need assistance?

Contact our support team, available 24 hours a day Monday through Friday, and from 09:00 to 21:00 EDT on weekends, at +1.888.889.3069 option 1.

Join the Social Conversation at FiO + LS!

We will be tweeting about program highlights and the latest updates throughout the conference. Follow @OpticalSociety on Twitter and tweet about your conference experience using #FIO19 and be sure to mention @OpticalSociety in your tweets. Join the conversation!

Plenary Sessions

Tuesday, 17 September, 12:00–12:40
Science & Industry Showcase Theater

Donna Strickland
University of Waterloo, Canada

Generating High-intensity, Ultrashort Optical Pulses

With the invention of lasers, the intensity of a light wave was increased by orders of magnitude over what had been achieved with a light bulb or sunlight. This much higher intensity led to new phenomena being observed, such as violet light coming out when red light went into the material. After Gérard Mourou and Strickland developed chirped pulse amplification, also known as CPA, the intensity again increased by more than a factor of 1,000 and it once again made new types of interactions possible between light and matter. They developed a laser that could deliver short pulses of light that knocked the electrons off their atoms. This new understanding of laser-matter interactions led to the development of new machining techniques that are used in laser eye surgery or micromachining of glass used in cell phones.

About the Speaker: Donna Strickland is one of the recipients of the Nobel Prize in Physics 2018 for co-inventing Chirped Pulse Amplification with Gérard Mourou, her PhD supervisor at the time of the discovery. She earned her PhD in optics from the University of Rochester and her BEng from McMaster University. She was a research associate at the National Research Council Canada, a physicist at Lawrence Livermore National Laboratory and a member of technical staff at Princeton University. In 1997, she joined the University of Waterloo, where her ultrafast laser group develops high-intensity laser systems for nonlinear optics investigations. She is a recipient of a Sloan Research Fellowship, a Premier's Research Excellence Award and a Cottrell Scholar Award. She served as the president of The Optical Society (OSA) in 2013 and is an OSA Fellow.

Wednesday, 18 September, 12:00–12:40
Science & Industry Showcase Theater

Ronald Hanson
QuTech, Delft University of Technology, Netherlands

The Dawn of a Quantum Internet

Entanglement is arguably the most counterintuitive yet potentially most powerful element in quantum theory. Future quantum networks may harness the unique features of entanglement in exciting applications by connecting multi-qubit nodes through photonic channels. Today we are at the brink of realizing the first multi-node quantum networks. This talk discusses the concepts, current status and prospects of quantum internet research.

About the Speaker: Ronald Hanson is the Antoni van Leeuwenhoek Professor at Delft University of Technology and Scientific Director of the QuTech institute. He is known for his pioneering work on generating, testing and harnessing quantum entanglement between distant solid-state quantum bits, for instance in quantum teleportation and performing the first loophole-free Bell test.

Visionary Speakers

Monday, 16 September, 09:15–10:00
Washington 4

Jeremy J. Baumberg, FRS, *University of Cambridge, UK*

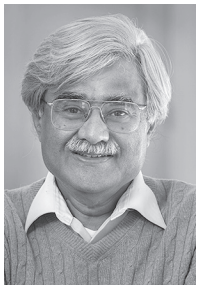
Extreme NanoPhotonics: Light on the Atom-scale

Coupling between coinage metal 'plasmonic' nano-components generates strongly red-shifted optical resonances combined with intense local light amplification on the nanoscale. Baumberg will show how we now create ultralow volume plasmonic cavities trapping light to the atom scale <1nm3, and are routinely able to watch individual molecules and bonds vibrating [1]. Using DNA origami we couple 1-4 dye molecules together optomechanically, and produce strong-light matter coupling that changes their quantum emission properties. We also watch redox chemistry in real time, watching single electrons shuttle in and out of single molecules, as well as 2D materials confined in the same gap. Prospective applications range from (bio)molecular sensing to fundamental science. Baumberg particularly focuses on applications to nanomachinery actuation by light.

[1] *Extreme nanophotonics from ultrathin metallic gaps,* JJ Baumberg et al., Nature Materials (2019); DOI: 10.1038/s41563-019-0290-y

About the Speaker: Jeremy Baumberg leads the NanoPhotonics Centre at the University of Cambridge and directs the Cambridge Nano Centre for Doctoral Training, a key UK site for PhD students in interdisciplinary Nano research. Strong experience with Hitachi, IBM, his own spin-offs Mesophotonics and Base4, give him a unique position to combine academic insight with industry application. His awards include the IoP Faraday gold Medal (2017), Royal Society Rumford Medal (2014), IoP Young Medal (2013), Royal Society Mullard Prize (2005) and the IoP Charles Vernon Boys Medal (2000). He is a Fellow of the Royal Society. His recent popular science book "The Secret Life of Science: How Science Really Works and Why it Matters" is published by PUP.

Tuesday, 17 September, 09:15–10:00
Washington 4



Mohan M. Trivedi, *University of California San Diego, USA*

Autonomous Vehicles: Vision, Illusion and Realization

Autonomous vehicles are no longer restricted to science fiction or to specialized research laboratories. They are rapidly becoming available on public roads for a range of mobility modes, including taxis, freight trucks, delivery robots and personal vehicles. We will discuss how we have arrived at this exciting point in time and what issues require deeper, critical examinations and careful resolution to assure safe, reliable and robust operation of these highly complex systems.

About the Speaker: Mohan Trivedi is a Distinguished Professor of Engineering and founding director of the Computer Vision and Robotics Research Laboratory, as well as the Laboratory for Intelligent and Safe Automobiles (LISA) at the University of California San Diego. These labs have played significant roles in the development of human-centered safe autonomous driving, advanced driver assistance systems, vision systems for intelligent transportation, homeland security, assistive technologies and human-robot interaction fields. Trivedi has received the IEEE Intelligent Transportation Systems (ITS) Society's Outstanding Researcher Award and LEAD Institution Award as well as the Meritorious Service and Pioneer Award (Technical Activities) of the IEEE Computer Society. He is a Fellow of IEEE, SPIE and IAPR. He frequently participates on panels dealing with technological, strategic, privacy and ethical issues surrounding research areas he is involved in. Trivedi serves very regularly as a consultant to industry and government agencies in the USA and abroad.

Tuesday, 17 September, 09:15–10:00
Washington 5

Jelena Vuckovic, *Stanford University, USA*

Optimized (Quantum) Photonics

Combining state of the art optimization and machine learning techniques with high speed electromagnetic solvers offers a new approach to "inverse" design and implement classical and quantum photonic circuits with superior properties, including robustness to errors in fabrication and temperature, compact footprints, novel functionalities, and high efficiencies.

About the Speaker: Jelena Vuckovic (PhD, Caltech, 2002) is a Professor of Electrical Engineering and by courtesy of Applied Physics at Stanford, where she leads the Nanoscale and Quantum Photonics Lab. She is also the director of the Q-FARM: the Stanford-SLAC Quantum Initiative. Vuckovic has won numerous prizes including the Humboldt Prize, the Hans Fischer Senior Fellowship, the DARPA Young Faculty Award, the Presidential Early Career Award for Scientists and Engineers and the Office of Naval Research Young Investigator Award. She is a Fellow of the American Physical Society (APS), OSA, and the Institute of Electronics and Electrical Engineers (IEEE).

Wednesday, 18 September, 09:15–10:00
Washington 5

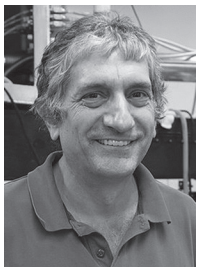
Steven Cundiff, *University of Michigan, USA*

Multdimensional Coherent Spectroscopy of Semiconductor Nanostructures

Multdimensional coherent spectroscopy has become an important tool for studying condensed phase systems and nanocrystals by combining the best features of time and frequency domain techniques. It provides deep insight by removing the effects of inhomogeneous broadening and revealing coupling between states, including many-body effects. Recent advances have demonstrated high spatial resolution, providing a path towards coherent microspectroscopy.

About the Speaker: Steve Cundiff received a BA in Physics from Rutgers University in 1985 and his PhD in Applied Physics from the University of Michigan in 1992. He spent two years at the University of Marburg, Germany, as a post-doctoral Alexander von Humboldt Fellow and then two-and-a-half years at Bell Laboratories in Holmdel, New Jersey. In 1997 he joined JILA, a joint institute between the University of Colorado and the National Institute of Standards and Technology (NIST) in Boulder, Colorado. From 2004 to 2009 he served as Chief of the NIST Quantum Physics Division. In 2015 he joined the faculty at the University of Michigan. He is a Fellow of OSA, the American Physical Society (APS), and the Institute of Electronics and Electrical Engineers (IEEE).

Wednesday, 18 September, 09:15–10:00
Washington 4



John Martinis, *Google and University of California Santa Barbara, USA*

Quantum Supremacy: Checking a Quantum Computer With a Classical Supercomputer

As microelectronics technology nears the end of exponential growth over time, known as Moore's law, there is a renewed interest in new computing paradigms such as quantum computing. A key step in the roadmap to build a scientifically or commercially useful quantum computer will be to demonstrate its exponentially growing computing power. Martinis will explain how a 7 by 7 array of superconducting xmon qubits with nearest-neighbor coupling, and with programmable single- and two-qubit gate with errors of about 0.2%, can execute a modest depth quantum computation that fully entangles the 49 qubits. Sampling of the resulting output can be checked against a classical simulation to demonstrate proper operation of the quantum computer and compare its system error rate with predictions. With a computation space of 2^49 = 5 x 10^14 states, the quantum computation can only be checked using the biggest supercomputers. Martinis will show experimental data towards this demonstration from a 9 qubit adjustable-coupler "gmon" device, which implements the basic sampling algorithm of quantum supremacy for a computational (Hilbert) space of about 500. We have been testing the quantum supremacy chip.

About the Speaker: John Martinis attended the University of California Berkeley from 1976 to 1987. His PhD thesis was a pioneering demonstration of quantum-bit states in superconductors. After postdoctoral research at CEA in France, he joined NIST Boulder where he developed electron counting devices and x-ray microcalorimeters. In 2004 he moved to the University of California Santa Barbara where he continued work on quantum computation. In 2014 he was awarded the London Prize for low-temperature physics research. In 2014 he joined the Google quantum-AI team and heads the hardware effort to build a useful quantum computer.

Thursday, 19 September, 09:15–10:00
Washington 4

Bernard Kress, *Microsoft Corp., USA*

There Is No Moore's Law in Optics: So How Come AR/VR/MR HMD Optics Still Succeed at Shrinking Over Time?

Improving wearable and visual comfort are key to delivering next generation MR experiences. At the same time, sensory immersion needs also to be improved (display, audio, touch, gestures…). It is clear there is no Moore's Law in optics, the law of étendue pleasing itself as the optical designer's worst nightmare. However, optical technological building blocks continue to be improved and reinvented, restocking constantly the optical designer's toolbox, and allowing weight and size to be improved without impacting visual comfort.

About the Speaker: Bernard Kress has been involved in the field of holography, diffractives and micro-optics for the past two decades. Surfing on the successive technology booms, he applied his knowledge at designing systems for optical computing, optical telecom, optical sensors, laser material processing and more recently for AR/VR/MR HMDs. He wrote a few books and book chapters along the way and enjoys teaching short courses on such topics. He joined Google [X] labs in 2010 to work on the Google Glass project as the Principal Optical Architect, and moved to Microsoft in 2015 to continue on the HoloLens project as the Partner Optical Architect. He is an SPIE Fellow since 2012 and member of the SPIE Board of Directors since 2016.

Thursday, 19 September, 09:15–10:00
Washington 5

Toshiki Tajima, *University of California Irvine, USA*

Laser Wakefields in Plasma, Nanostructures and Blackhole Vicinities

Laser wakefield acceleration has been enabled by the CPA laser and has been considered for high energy accelerators, cancer therapy and so on. The recent laser developments further expand its horizon to X-ray wakefields in nanostructures. Meanwhile, we find that Mother Nature had wakefieds emitted from blackhole jets.

About the Speaker: Toshiki Tajima (with John Dawson) suggested in 1979 the concept and theory of the formation of a wakefield behind an ultra-short intense laser pulse and its subsequent acceleration of particles to high energies. This concept spurred the creation of the field now referred to as Advanced Accelerator Research as well as High Field Science. He was among the first in a team that demonstrated wakefield acceleration experimentally. Its applications include the compact generation of high-energy electrons, ions and X-rays on ultrafast time scales and cancer therapy. He also discovered wakefields drive astrophysical acceleration.

Science & Industry Showcase

Tuesday, 17 September, 10:00–15:30
Wednesday, 18 September, 10:00–15:30

The FiO + LS Science & Industry Showcase hosts exhibiting companies partnered with innovative demonstrations, networking events, poster presentations, e-posters and Rapid-Fire Oral Presentations. Learn about new products, find technical and business solutions, and gain the most up-to-date market perspective of your industry. Don't miss this opportunity to visit companies representing a broad range of the best products and applications in the optics and photonics industry. There is no charge to attend the Showcase—it is open to all registered attendees!

Poster Sessions & E-Posters *E-Poster*

Tuesday, 17 September, 10:00–12:00, 13:30–15:30
Wednesday, 18 September, 10:00–12:00, 13:30–15:30

Attend the Poster Sessions and view more than 500 posters scheduled for presentation. Poster presentations communicate new research findings in an intimate setting that encourages lively and detailed discussion between presenters and attendees.

A select number of presentations will be offered as e-posters—which supplements the author's introduction, motivation, results and conclusions with digital capabilities that aid deeper discussion. Look for the symbol to see who will be presenting e-posters.

Rapid-Fire Oral Presentations *RAPID*

Held in the Theater during the poster session, a select number of poster presenters offer Rapid-fire Oral Presentations, which consist of a brief oral presentation accompanied by slides. This format enables poster presenters to preview key results from their research in brief, three-minute segments. In the session's second hour, presenters are available for more in-depth discussions adjacent to their accompanying posters. View the poster sessions in the abstracts for the symbol indicates Rapid-fire Oral Presentations.

Science & Industry Showcase Theater

Tuesday, 17 September	
10:05–11:05	Rapid-Fire Oral Presentations 1
11:05–11:45	Reaching for the Brightest Light: High Intensity Ultrafast Lasers
12:00–12:40	Plenary Presentation: Donna Strickland
13:00–14:00	Rapid-Fire Oral Presentations 2
14:00–14:45	Frontiers in Funding
14:50–15:20	Congressional Fellowship Q&A
Wednesday, 18 September	
10:05–11:05	Rapid-Fire Oral Presentations 3
11:05–11:45	The U.S. Quantum Leap: The National Quantum Initiative
12:00–12:40	Plenary Presentation: Ronald Hanson
13:00–14:00	Rapid-Fire Oral Presentations 4
14:00–14:40	Social Impact of AR/VR
14:45–15:30	Autonomous Platforms: Safety Challenges and Opportunities

Reaching for the Brightest Light: High Intensity Ultrafast Lasers

Since the release of a December 2017 U.S. National Academy of Sciences report on high intensity ultrafast lasers, the U.S. community has been organizing to identify science and technology opportunities for new potential capabilities. In March 2019 more than one hundred experts from around the world gathered at OSA for a workshop to begin articulating a U.S. strategy in the global context. Learn from workshop Technology Co-Chair Jon Zuegel from the Laboratory for Laser Energetics in Rochester, New York, USA about the meeting's conclusions and the path forward for the community.

Frontiers in Funding

This program, featuring representatives from funding agencies, will provide attendees with the opportunity to hear about the latest in science funding with a focus on the conference themes. Throughout the exhibit attendees will be able to further explore and discuss opportunities at agency alley on the show floor.

Congressional Fellowship Q&A: How Scientists and Engineers can Contribute to Public Policy

Hear from PhD scientists and engineers who spent one year working for a member of the U.S. Congress through the Congressional Fellowship program. They will discuss their Congressional Fellowship experience, what they learned about the influence that scientists and engineers can have on public policy, and why it is important for the technical community to be involved.

The U.S. Quantum Leap: The National Quantum Initiative

In December 2018 the U.S. embarked on a formal National Quantum Initiative. What has changed since then? Find out from University of Maryland quantum physicist and IonQ co-founder Christopher Monroe at this session.

Social Impact of AR/VR

Speaker: Thad Starner, *Georgia Institute of Technology, USA*

This talk, given by one of the longest continuous users of augmented reality, will explore the social implications of augmented reality, virtual reality and related technologies.

Autonomous Platforms: Safety Challenges and Opportunities

As autonomous platforms start to move to higher levels of autonomy, there are multiple barriers to full acceptance, and many of them involve the optics and photonics community. This panel will explore several of these challenges and how the community can contribute to a safe and more rapid acceptance. Some of the issues involve laser eye-safety and obstacle recognition, both of which are due to multiple sensors on vehicles, and are being explored by many LiDAR-based companies developing these technologies. Other opportunities to be discussed will include the roles of industry in setting standards for sensors on autonomous platforms. Many of these standards for local and global implementation of electronics on autonomous platforms are set by the Society for Automotive Engineers International (SAE) and International Electrotechnical Commission (IEC) standards, and these will be highlighted by this esteemed panel.

Moderator: Anthony Cooke, *Luminar, USA*

Panelists:

S. William Gouse, *Society for Automotive Engineers International, USA*

Erwin K. Lau, *Exponent, USA*

Networking Area Programing

Tuesday, 17 September	
10:00–12:00	Wiki Needs Women in Optics: Wikipedia Edit-a-thon
12:40–13:45	Nonlinear Optics Technical Group Panel Discussion — Transitioning into a Career in Optics
14:00–15:30	Meet the APS Physical Review Journal Editors Reception
Wednesday, 18 September	
10:00–11:00	Fiber Optic Explosions
12:45–14:15	OIDA / OSAF Professional Development & Networking Lunch and Learn
14:15–15:30	OSA Holography and Diffractive Optics Technical Group Networking Session

Wiki Needs Women in Optics: Wikipedia Edit-a-thon

What's an Edit-a-thon? It's a community organized event focused on editing, updating, and adding articles on Wikipedia. At FiO we will focus on ensuring the Women of Optics get the pages they deserve.

Fast Facts: Only 18% of the 1.6 million biographies in the English Wikipedia are about women. The figure is lower for people tagged as scientists – 16% of almost 150,000 articles.

You will learn how to create and edit pages and will then have an opportunity to work together to research and write the biographies. Bring your laptop, enthusiasm and passion for honor the women of our field. Instructions, potential honorees and on-site guidance will be provided. No previous experience is needed!

Nonlinear Optics Technical Group Panel Discussion — Transitioning into a Career in Optics

Members are invited to OSA's Nonlinear Optics Technical Group event for a special panel discussion. Our feature presenters from academia, industry, and the government will give their perspectives on how their skills are useful in the workplace. Please contact TGactivites@osa.org to RSVP, but all are welcome to join.

Hosted by: OSA Nonlinear Optics Technical Group

Meet the APS Physical Review Journal Editors Reception

The editors of the Physical Review journals invite you to join them for conversation and light refreshments. The editors will be available to answer questions, hear your ideas and discuss any comments about the journals.

Fiber Optic Explosions

The Stanford Optical Society developed fiber optic explosions as a craftable outreach demo to teach students about total internal reflection. It combines plastic optical fibers with a color changing LED into a colorful bouquet that can be worn and shared with friends. An OSA Special Programs Grant funded the first batch of explosions, which were assembled with students at large science expos and smaller elementary school science nights throughout the San Francisco Bay Area. Join us for a discussion about the design and impact of this engaging demo and take one home to share with your community.

OIDA / OSAF Professional Development & Networking Lunch and Learn

This program will provide a unique opportunity for students and early career professionals, who are close to finishing or who have recently finished their doctorate degree, to interact with key industry and academic leaders in the community. Students interested in all career paths – from those seeking an academic position, to those wishing to start a technology business, to those interested government/public service, to those looking to translate their bench work skills to product development – are encouraged to attend. Students will have an opportunity to discuss their ongoing research and career plans with the attending leaders, who will share their professional journey and provide useful tips to those who attend. Advanced registration and acceptance is required.

Hosted by: OSA Foundation; OSA Industry Development Associates

Sponsored by: GoFoton

OSA Holography and Diffractive Optics Technical Group Networking Session

As an attendee, you will be asked to indicate your position on the question 'must AR headsets reproduce accommodation?' when you enter the networking area, which will help kick-off your conversations with fellow attendees. The session will be a great opportunity to connect with your fellow attendees who share an interest in this field, learn more about this technical group, and provide your input on future technical group activities. Please contact TGactivities@osa.org to let us know you will be joining us for this event.

Host by: OSA Holography and Diffractive Optics Technical Group

Exhibit Buyers' Guide
(as of 19 August 2019)

Attendees should visit the Conference App to access exhibiting companies' detailed information.

American Institute of Physics www.physicstoday.org	Booth 205
American Physical Society (APS) www.aps.org	Booth 208
asphericon, Inc. www.asphericon.com	Tabletop 408
Dark Field Technologies www.darkfield.com	Booth 206
Energetiq Technology Inc. www.energetiq.com	Tabletop 401
Hamamatsu Corporation www.hamamatsu.com	Booth 113
Inrad Optics, Inc www.inradoptics.com	Booth 217
Liquid Instruments www.liquidinstruments.com	Booth 117
Luminate www.nextcorps.org	Booth 103
M Squared Lasers Ltd. www.m2lasers.com	Booth 216
Menlo Systems Inc. www.menlosystems.com	Booth 218
National Academies of Sciences, Engineering and Medicine www.nap.edu	Agency Alley
Newport Corporation www.newport.com	Booth 316
NKT Photonics www.nktphotonics.com	Booth 212
The Optical Society (OSA) www.osa.org	Atrium
Optimax Systems, Inc. www.optimaxsi.com	Booth 303
OptoSigma Corporation www.optosigma.com	Booth 305
OSA Member Zone www.osa.org	Booth 209
PHASICS Corp. www.phasics.fr	Tabletop 402
Photonics Media/Laurin Publishing www.photonics.com	Booth 107
Santec USA Corporation www.santec.com	Booth 203
SPIE: The Intl Society for Optics and Photonics www.spie.org	Tabletop 404
Synopsys, Inc. www.synopsys.com	Tabletop 400
Thorlabs www.thorlabs.com	Booth 202
Toptica Photonics, Inc. www.toptica.com	Booth 105
Vescent Photonics, Inc. www.vescent.com	Booth 109
VIAVI Solutions www.viavisolutions.com/en-us/osp	Tabletop 409
WORKinOPTICS www.workinoptics.com	Tabletop 403
Zurich Instruments USA, Inc. www.zhinst.com	Booth 210

OSA Member Zone

Science & Industry Showcase, Booth 209

Tuesday, 17 September	10:00–15:30
Wednesday, 18 September	10:00–15:30

Through its world-renowned publications, meetings and membership programs, OSA provides quality information and inspiring interactions that power achievements in the science of light. More than 22,000 members, residing in over 100 countries and spanning academic, government and industry, call OSA their professional home.

All attendees are invited to stop by the OSA Member Zone to meet OSA staff, learn more about our publications, conferences and meetings, and find out about membership for individuals and companies. **Not a member? Definitely stop by and learn more about OSA! All conference attendees who join or renew as an Individual 1-year member will receive 50% off the cost of annual dues.**

Staff and/or volunteer members from the following six divisions will be in the OSA Member Zone to answer your questions, help you increase your engagement or discuss suggestions you have for future programs:

OSA Industry Development Associates (OIDA) helps corporations optimize product development resources and reduce time to market by giving professionals access to quality information, quality interactions and premium opportunities for collaboration.

OSA Advocacy works to promote optics and photonics to governments around the world. OSA offers its members many advocacy opportunities to advance science and technology policy. Getting involved is easy. Stop by to learn about opportunities such as the OSA Congressional Science Policy Fellowships and the global optics and photonics advocacy program or to write to your members of U.S. Congress, and more.

OSA Foundation provides training, mentoring, recognitions, scholarships, and travel support programs as directed by our donors. We currently support more than 30 scholarships, grants, prizes, professional development trainings, and schools benefitting students and early-career professionals. Stop by to learn more about our Career Calibrator and other new programs to support your career.

OSA Meetings convenes more than 40 events throughout the world annually to provide you with opportunities to advance your scientific ambitions, expand your professional network, and influence the future of optics and photonics worldwide. Learn more about the 2020-2021 schedule and discuss how you can participate in your favorite meetings.

OSA Publishing (OSAP) provides the largest collection of peer-reviewed optics and photonics content in the world and hosts more than 370,000 articles from 19 publications, as well as conference papers from more than 700 meetings.

OSA Technical Groups offer members the chance to connect with colleagues in their area of expertise through innovative events and focused networking opportunities. Both in-person and online events are planned throughout the year. Have an idea for your technical group? Bring it to the Zone! Looking to engage with a technical group while at FiO? Browse the special events on the conference app for a list of technical group events or visit www.osa.org/TGevents.

OSA Member Zone Programs

Tuesday, 17

Publishing in OSA's Journals: Tips for Authors
11:00–14:45

Learn tips for authors from OSA Publishing Staff and Editors.

Meet Donna Strickland!
13:15–13:45

Take a break and chat with the winner of the 2018 Nobel Prize in Physics. *No photos will be allowed at this event.*

Grab It While it's Cold!
14:00–15:00

Grab your favorite ice cream treat, mingle with colleagues, and learn more about what OSA has planned for the upcoming year.

Wednesday, 18 September

Prodiving Constructive Peer Reviews: Tips for Reviewers
10:00–11:00

Learn tips and tools for reviewers from OSA Publishing Staff and Editors.

Jelena Trbovic, Zurich Instruments, Switzerland
13:00–13:30

If You've Got the Time, We've Got the Beer
14:00–15:00

Had enough coffee? Swing by the OSA Member Zone for a cold beer and snacks. Chat with colleagues, make plans for the evening, and discuss how you can get more involved with OSA programs.

Special Events

WiSTEE Connect (Women in Science, Technology, Engineering and Entrepreneurship)

Sunday, 15 September, 08:00–16:00
OSA Headquarters

WiSTEE Connect (Women in Science, Technology, Engineering and Entrepreneurship) is collaborating with the OSA Foundation to organize the 4th International Symposium, "Global Women of Light" (GWL). This GWL symposium will focus on Career Strategies and Intersecting Science and Entrepreneurship. Advanced registration is required - wisteeconnect.org.

LGBTQ Meetup – Friends of Dorothy

Sunday, 15 September, 16:00–18:30
Mayahuel Cocina Mexicana (2609 24th Street, NW)

OSA invites you to *Friends of Dorothy,* our LGTBQ+ networking event during FiO. OSA welcomes anyone who is interest to come join us – we'll buy the first round (and some snacks).

OSA Career Lab Workshop: Advancing Mid-Managers Summit

Monday, 16 September, 08:00–18:00
Wilson C

The Summit is a very focused and unique professional development experience. In this small group setting, mid-level professionals will have the opportunity to enhance and develop the leadership skills, relationships, and effectiveness that distinguish them in their professions and will enable them to make more meaningful contributions to the teams and organizations they serve. Participants will have the opportunity to learn from CEOs, mentors and guest speakers. Participants engage in-group discussions, problem-solving and other activities to enhance management skills. Topics will include managing from the middle, navigating organizational politics and cultures, strategic planning, as well career planning and participants will leave with strategies and skills to make an impact when they return to their organization.

The Advancing Mid-Managers Summit is designed for individuals with at least five years of experience as a full-time professional and looking to move into a Vice President or Chief Executive Officer position in the next 3-5 years. Students are ineligible to attend. Eligible participants are middle managers and/or are judged to have high potential in their organization. Participants will also commit to and engage in post Summit work over the course of 6 months. This program is complimentary for OSA/APS Members, and $200 for Nonmember. Advanced Registration is required.

Hosted by: OSA CareerLab

OSA Capitol Hill Meetings

Monday, 16 September, 09:00-16:00
U.S. Capitol Hill, Washington D.C.

As the U.S. Congress determines spending levels in the FY2020 funding legislation, it is important for members of U.S. Congress to hear directly from their constituents. To facilitate those interactions, OSA will be holding U.S. Capitol Hill meetings to advocate for R&D funding as well as other relevant topics. Prior RSVP required to participate. If you RSVP'd and have questions, please contact bdillingham@osa.org.

Building Your Personal Brand

Monday, 16 September, 11:00-12:00
Wilson AB

When living in a world with countless online communication forums, building a strong personal brand is essential. A strong brand can expand your professional network and your career opportunities. This program will provide tips to clearly communicate your educational and professional highlights, what you currently do, why you do it and what is next for you professionally.

Laser Science Symposium on Undergraduate Research

Monday, 16 September, 12:00–18:00
Hoover

Organizers: Samir Bali, *Miami University of Ohio, USA*, and Harold Metcalf, *Stony Brook University, USA*

The Symposium on Undergraduate Research has been a feature of the annual meeting of the Division of Laser Science of the American Physical Society (APS-DLS) for sixteen years, and has showcased the research of more than 500 students during that time. Students' presentations often describe their work during the previous summer. The NSF has played a vital role by providing the research opportunities for many of the students through its REU programs, as well as by direct support of the event. The symposium has been generously supported by the DLS, OSA, NSF, SPS, and Univ. MD (JQI), along with corporate sponsors Thorlabs, Photonics Industries, East Coast Optical Technologies, and Bristol Instruments.

OSA Therapeutic Laser Applications Technical Group Birds of a Feather Lunch

Monday, 16 September, 12:30 – 14:00
Wilson AB

Join the OSA Therapeutic Laser Applications Technical Group for a guided networking session. In addition to learning more about this technical group, you will have a chance to connect with your fellow attendees who share an interest in the same topics as you, such as lasers as elastography, surgical tools, tissue imaging, spectroscopic tools and methods, and light-tissue interactions. Please

contact TGactivites@osa.org to let us know you will be joining us for this event.

Hosted by: OSA Therapeutic Laser Applications Technical Group

40 Top Jobs For STEM PhDs. Which Is Right For You?

Monday, 16 September, 14:15–15:15
Wilson AB

Speaker: Isaiah Hankel, *Cheeky Scientist, USA*

In this seminar, you will gain a thorough understanding of your career options as a STEM PhD regardless of the country you want to work in. Understanding which industry positions are on the rise in STEM will help you see what's available to you outside of a traditional postdoc or professorship. This understanding will also help you make an intelligent decision on which positions you would enjoy and which you may not enjoy. Perhaps you are a better fit for a Project Manager or Business Development Manager position over an R&D Scientist or R&D Engineer position. Perhaps you are a better fit for a Competitive Intelligence Analyst, Quantitative Analyst, Medical Communication Specialist, Healthcare Information Technology Specialist, or User Experience Analyst. When choosing the next step in your career, you must consider not only the title and salary you want to have, but the professional lifestyle you want to live out. This session will help you choose accordingly.

Meet OSA's Journal Editors

Monday, 16 September, 15:00–16:00
Exhibit Hall B South (via the Washington rooms hallway)

Join OSA Publishing's Journal Editors for conversation and refreshments. The Editors welcome your questions, concerns and ideas for any of OSA's Journals. Topics that can be covered include best practices when submitting a manuscript, elements of a useful manuscript review, criteria editors look for in submitted manuscripts, and the process to propose a Feature Issue topic for publication in an OSA Journal. All are welcome to attend.

Power Negotiating Your Salary Offer - How PhDs Get Paid What They Are Worth

Monday, 16 September, 15:30–16:30
Wilson AB

Speaker: Isaiah Hankel, *Cheeky Scientist, USA*

What are your salary expectations? If you are not sure how to answer this question, you will want to come to this seminar. In this seminar, you will learn how to avoid not being paid what you are worth as a PhD. Most PhDs still fail to negotiate their salary contracts, even though companies expect them to negotiate. However, while companies expect you to negotiate, they will still apply negotiation strategies against you to drive down the cost of your salary contract. Here, we will cover which strategies companies will apply against you and how to combat these strategies. We will show you how companies start negotiations very early in the job search process, even at the resume stage, and how to prepare for it so that you can leverage your PhD to increase your starting salary by 15-20%.

The Rules of Engagement: Navigating Important Business Relationships

Monday, 16 September, 16:45–18:00
Wilson AB

Speaker: Mary Crane, *USA*

Important business relationships are often formed and cemented in social settings. Yet, many professionals feel uncomfortable in these environments. Working a crowded room and managing the more formal dining setting—these and other business entertainment opportunities challenge many professionals, junior and more senior alike. This program is specifically designed to help your professionals feel competent and comfortable in any business-social setting. Participants will learn ten specific rules for working a reception and ten more rules for managing a business lunch or dinner. We will also cover rules for electronic communications and personal presentation.

OIDA Networking Happy Hour

16 September, 17:00–18:00

Join us for drinks and light hors d'oeuvres at the OIDA happy hour at FiO. Don't miss this exclusive member event to connect with your colleagues before the exhibition opens! This event requires pre-registration. Please email: OIDA@osa.org to RSVP and for more information.

OSA Fiber Optics Technology Technical Group Rapid-fire Presentation & Networking Event

Monday, 16 September, 18:00–19:00
Washington 1

Join the OSA Fiber Optics Technology Technical Group for a networking event that will highlight the research being done in this topic area by students and early career professionals. The event will be an opportunity to hear rapid-fire presentations of the work they will present during Frontier in Optics while networking with your colleagues over refreshments. At the end of the session, attendees will vote for the top fiber optics presentation. Please contact TGactivites@osa.org to RSVP.

Hosted by: OSA Fiber Optics Technology Technical Group

Explore DC - FIO OSA Student Member Walking tour of the Monuments

Monday, 16 September, 18:30

Meet at the World War II Memorial at 1750 Independence Ave SW, and join fellow OSA student members on a walking tour of DC! After the tour head over to the Student Party just a short walk from the monuments for more networking and social time. Wear comfortable shoes!

FiO Student Member Party

Monday, 16 September, 19:00–22:00
The Brighton (949 Wharf St., SW, Washington, DC)

All OSA student members attending FiO are invited to head down to the Wharf and explore the city while networking with your peers. Food and fun will be provided!

Be a Part of the Solution: Ally & Bystander Training

Tuesday, 17 September, 15:30–16:30
Wilson AB

OSA is committed to providing an environment that is conducive to the free and robust exchange of scientific ideas. This requires that all participants be treated with equal consideration and respect. With this in mind, OSA is offering this session to help provide members with the skills needed to make this a reality throughout our community. The program will examine different ways to successfully respond to harassment, bullying or other unwanted behavior.

DLS Annual Business Meeting

Tuesday, 17 September, 17:15–18:15
Washington 5

All members and interested parties are invited to attend the annual business meeting of the APS Division of Laser Science (DLS). The DLS officers will report on the activities of the past year and on plans for the future. Questions will be taken from the floor. This is an opportunity to help define the operations of the DLS and the Laser Science Conference. In addition, the winner of the Carl E. Anderson Dissertation Award will be announced.

OSA Annual Business Meeting

Tuesday, 17 September, 17:30–18:15
Wilson C

Learn more about OSA and join the OSA Board of Directors for the Society's annual business meeting. An update on the Society's activities will be presented and the results of the Board of Directors election will be announced.

FiO + LS Conference Reception

Tuesday, 17 September, 18:30–20:30
Thurgood Marshall Ballroom

Dance the night away and enjoy tasty treats with your fellow conference attendees from around the world. The reception is sure to be a high point in a memorable conference week.

Sponsored by: THORLABS

OSA Senior Member Reception

Wednesday, 18 September, 16:00-18:00
Stone's Throw Restaurant (Lobby Level)

Join us for a reception with OSA Senior Members, and for future OSA Senior Members to learn about this distinction, it's benefits, application process and deadline while networking with colleagues from around the world. *This program is complimentary for OSA Members and there is limited space.*

Hosted by: OSA Senior Member

Movie Night: Quantum Shorts Film Festival

Wednesday, 18 September, 19:30–20:30
Wilson AB

Quantum physics has long provided inspiration for artists, writers, film-makers and philosophers. Join us for a very special screening of four films from the 2018 Quantum Shorts Film Festival which challenges writers and filmmakers to produce quantum-inspired creations. The evening will be hosted by Araceli Venegas-Gomez from QURECA, UK.

Over 170 submissions were judged as part of the 2018 festival. Our viewing will include the top-three films and one from the top ten.

Slide! (First Prize)
If the World Spinned Backwards (Runner Up)
Legio VIII Quantae (People's Choice Prize)
Heads or Tails (Top Ten)

Quantum Shorts is an initiative of the Centre for Quantum Technologies (CQT) that has run every year since 2012, alternating between calls for short films and flash fiction (shorts.quantumlah.org). The festival is also supported by media partners Scientific American and Nature, and scientific and screening partners around the world'. The Centre brings together physicists, computer scientists and engineers to do basic research on quantum physics and to build devices based on quantum phenomena.

Awards, Honors and Special Recognitions

FiO + LS Awards Ceremony & Reception

Monday, 16 September, 18:30–21:00
Carnegie Institution of Science, 1530 P St. NW

Join us for an evening of celebration as we recognize the achievements of award and honor recipients from OSA, the OSA Foundation, and APS Division of Laser Science. This is a great opportunity to connect with the OSA Board of Directors, honorees and colleagues.

Schedule for the Evening
Program: 18:30–19:30
Reception: 19:30–21:00
Note: This is a ticketed event. A limited number of tickets can be purchased for US$75 on-site at the conference registration desk.

The following awards, honors and recognitions will be presented during this event:

2019 OSA Awards and Honors

Frederic Ives Medal/Jarus W. Quinn Prize

Eli Yablonovitch, *University of California Berkeley, USA*

The Ives Medal/Quinn Prize recognizes overall distinction in optics and is OSA's highest award. It was endowed by OSA charter member Herbert Ives, in honor of his father, photography pioneer Frederic Ives. A subsequent endowment in honor of long-time OSA Executive Director Jarus Quinn funds the prize.

OSA honors Yablonovitch for diverse and deep contributions to optical science including photonic crystals, strained semiconductor lasers, and new record-breaking solar cell physics.

Yablonovitch is the Director of the NSF Center for Energy Efficient Electronics Science (E3S), a multi-university center headquartered at UC Berkeley. He received a Ph.D. in applied physics from Harvard University. His career has included work at Bell Telephone Laboratories, Harvard, Exxon, and the University of California. He also founded and co-founded several companies.

Regarded as a father of the photonic bandgap concept, Yablonovitch is a pioneer in the field of optoelectronics and photonic bandgap research. He has received many awards and honors including OSA's R.W. Wood Prize and Adolph Lomb Medal. He is an OSA Fellow, American Physical Society Fellow, and a member of the National Academy of Engineering, the National Academy of Sciences, the National Academy of Inventors, the American Academy of Arts & Sciences and a Foreign Member of the Royal Society of London.

OSA Honorary Member

The most distinguished of all OSA Member categories, Honorary Membership is awarded for unique, seminal contributions to the field of optics, and is confirmed by the Awards Council and OSA Board of Directors.

Joseph W. Goodman, *Stanford University, USA*

Goodman is honored for fundamental contributions in the fields of Fourier Optics and Optical Information Processing through his research, teaching and classic textbooks.

Goodman received an A.B. Degree in Engineering and Applied Physics from Harvard University, and M.S. and Ph.D. degrees in Electrical Engineering from Stanford University. His fields of research included holography, optical information processing, digital image processing, statistical problems in optics, optical switching, and speckle phenomena. He joined the faculty of Stanford University's Department of Electrical Engineering in 1967 and served as Department Chair and Senior Associate Dean of Engineering until his retirement in 2000. He is the author of the Introduction to Fourier Optics, Statistical Optics, Speckle Phenomena in Optics, and co-author of Fourier Transforms: An Introduction for Engineers.

A leader in the optics community, among many roles he has served as President of OSA and the ICO. He is a Fellow of OSA, IEEE, SPIE, and the American Academy of Arts and Sciences; a member of the National Academy of Engineering; and the recipient of many prestigious awards including OSA's Ives Medal/Quinn Prize, Born Award, Hoffman Beller Medal and Leith Award.

Max Born Award

Govind P. Agrawal, *University of Rochester, USA*

The Born Award is presented to a person who has made outstanding contributions to physical optics, theoretical or experimental. Agrawal is recognized for sustained distinguished contributions to physical optics through innovative research on lasers, fiber-optical communications and nonlinear optics.

Paul F. Forman Team Engineering Excellence Award

Headwall Photonics, Inc., Special Projects Team, USA

The Forman Team Award recognizes technical achievements in optical engineering.The Headwall Photonics Team is recognized for the successful development of a compact, rugged, and lightweight imaging spectrometer, optimized for cost-effective airborne retrieval of chlorophyll fluorescence emission signatures monitoring plant health in near-real-time at simultaneously high spectral and spatial resolutions.

Joseph Fraunhofer Award/Robert M. Burley Prize

Juergen Czarske, *TU Dresden, Germany*

The Fraunhofer Award/Burley Prize recognizes significant research accomplishments in the field of optical engineering. Czarske is honored for seminal contributions to the field of digital interferometric and holographic sensors and their commercial applications.

Robert E. Hopkins Leadership Award

Allister I. Ferguson, *University of Strathclyde, UK*

The Hopkins Award recognizes an individual or group who has had a significant impact on the global optics and photonics community or on society as a whole stemming from non-research oriented activities. The award seeks to recognize achievements that would not be eligible for a traditional OSA award or medal. Ferguson is recognized for extraordinary leadership creating major international optics and photonics research centers and programs that support the global optics and photonics community

William F. Meggers Award

Michael D. Morse, *University of Utah, USA*

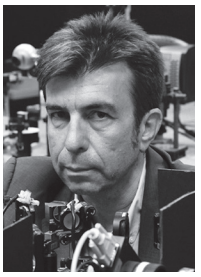
The Meggers Award recognizes outstanding work in spectroscopy. Morse is recognized for pioneering systematic studies of small transition-metal-containing molecules, including precise measurements of bond energies by the discovery and exploitation of sharp predissociation thresholds in highly congested electronic spectra.

David Richardson Medal

Fred Leonberger, *EOvation Advisors LLC, USA*

The Richardson Medal recognizes significant contributions to optical engineering, primarily in the commercial and industrial sector. It is presented to Leonberger for innovative development, technical leadership and commercialization of guided wave photonic components, especially integrated optical modulators, that have had major applications in fiber optic communications, CATV, and sensing.

Edgar D. Tillyer Award



Pablo Artal, *Universidad de Murcia, Spain*

The Tillyer Award recognizes distinguished work in the field of vision. Artal is honored for the pioneering use of optics and photonics technologies to unravel the human visual system and improve eye diagnostics and correction.

OSA Treasurer's Award

Winner to be announced on-site

The Treasurer's Award recognizes an OSA employee who contributes significantly to organizational excellence, promotes and enacts innovative solutions and/or exemplifies inspirational leadership.

R. W. Wood Prize

Jian-Wei Pan, *University of Science and Technology of China, China*

The Wood Prize recognizes an outstanding discovery, scientific or technical achievement, or invention in the field of optics. It is presented to Pan for pioneering experimental research at the frontier of quantum foundations and optical implementations of quantum information, including quantum nonlocality, quantum key distribution, quantum teleportation, and optical quantum computing.

OSA Fellows

This year marks the 60th anniversary of the first class of OSA Fellows. 98 OSA Fellow Members were elected in 2019. The recipients listed below are being recognized at FiO. View a full list at osa.org/2019Fellows.

Geoffrey K. Aguirre, *University of Pennsylvania, USA*
For fundamental and technically sophisticated non-invasive measurements of retinal and cortical visual processing in healthy humans, and translation of the understanding gained from these measurements to the characterization and treatment of blinding disease.

Hui Deng, *University of Michigan, Ann Arbor, USA*
For pioneering contributions to fundamental physics and applications of matter-light coupled systems including polariton condensation, polariton lasers, atomic quantum memories and site-controlled gallium nitride quantum dots.

Enrique J. Galvez, *Colgate University, USA*
For outstanding research in classical and quantum optics, in particular on the topic of complex light; and for developing educational optics laboratories and involving undergraduates in research

Hong Hua, *University of Arizona, USA*
For development of innovative 3D display technologies, complex visualization systems, and novel image acquisition systems.

Yoonchan Jeong, *Seoul National University, South Korea*
For pioneering contributions to optical fiber lasers through the demonstration of the world's first kilowatt single-mode optical fiber laser and the identification of the stochastic photon dynamics in a quasi-mode-locked optical fiber laser.

Kenny Weir, *Imperial College London, UK*
For outstanding vision and accomplishment in optics education, influence on the optics community as an academic manager, and achievements as an experimentalist.

2019 APS/Division of Laser Science Awards and Honors

Arthur L. Schawlow Prize in Laser Science

Steven T. Cundiff, *University of Michigan, USA*

For pioneering contributions to the field of ultrafast laser spectroscopy, including optical multidimensional coherent spectroscopy applied electronic excitation in solids and atomic vapors, and the development and application of femtosecond frequency comb technology.

Steve Cundiff received a B.A. in Physics from Rutgers University in 1985 and his Ph.D. in Applied Physics from the University of Michigan in 1992. He spent two years at the University of Marburg, Germany, as a post-doctoral Alexander von Humboldt Fellow and then two-and-a-half years at Bell Laboratories in Holmdel, New Jersey. In 1997, he joined JILA, a joint institute between the University of Colorado and the National Institute of Standards and Technology (NIST) in Boulder, Colorado. From 2004 to 2009 he served as Chief of the NIST Quantum Physics Division. In 2015, he joined the faculty at the University of Michigan. He is a Fellow of OSA, the American Physical Society (APS), and the Institute of Electronics and Electrical Engineers (IEEE).

Carl E. Anderson Division of Laser Science Dissertation Award

The Carl E. Anderson Award for Outstanding Doctoral Dissertation in Laser Science was established in 2013 by the American Physical Society (APS) Division of Laser Science (DLS). Its purpose is to recognize doctoral research in the Laser Science area and to encourage effective written and oral presentation of research results. The award consists of $1,000USD and a certificate citing the contribution made by the recipient. The finalists will present their work at a special session of the Laser Science conference on Monday morning. The winner will be announced at the DLS business meeting late Tuesday afternoon.

The following presentations will be given during this special session on Monday at 08:00 in Washington 5.

Edoardo Baldini, *École Polytechnique Fédérale de Lausanne, France*
Nonequilibrium Dynamics of Collective Excitations in Strongly Interacting and Correlated Quantum Systems

Chitraleema Chakraborty, *University of Rochester, USA*
Flatland Nanophotonics: A Study of Quantum-Confined Excitons in 2D Materials

Chong Chen, *University of Colorado at Boulder, USA*
Attosecond Light Pulses and Attosecond Electron Dynamics Probed using Angle-Resolved Photoelectron Spectroscopy

Chen-Ting Liao, *JILA at University of Colorado Boulder, USA*
Exploring Ultrafast Quantum Dynamics of Electrons by Attosecond Transient Absorption

APS DLS Fellows

Noureddine Melikechi, *University of Massachusetts Lowell, USA*
For pioneering research leading to advancements in the use of lasers for diagnosing cancers, studying the geochemistry of Mars and for outstanding leadership in developing model programs and infrastructure to attract and engage diverse students into optical physics.

Willie J. Padilla, *Duke University, USA*
For co-discovery of negative refractive index, the development of dynamic metamaterials and devices, and the development and understanding of metamaterial and metasurface absorbers in the microwave, terahertz and infrared ranges of the electromagnetic spectrum.

Stephen C. Rand, *University of Michigan, USA*
For outstanding contributions to precision optical spectroscopy, laser physics, and the exploration of ultrafast magneto-electric interactions at the molecular level.

Nikolay Zheludev, *University of Southampton, UK*
For seminal contributions and international leadership in nanophotonics and metamaterials.

2019 OSA Foundation Fellowship, Scholarships and Special Recognitions

The OSA Foundation (OSAF) serves as the philanthropic are of OSA. Our vision is a thriving, robust and collaborative optics and photonics community that inspires and empowers the next generation of leaders in the field. Our mission is to inspire promising individuals to pursue careers in optics and photonics that lead to ongoing support and an enduring passion for the community.

Our donor directed and supported programs provide training, mentoring, recognition, scholarships and travel support programs. We support more than 30 scholarships, grants, prizes, professional development trainings, and summer schools benefitting students and early-career professionals.

Paul Anthony Bonenfant Memorial Scholarship

Established in 2011 in memory of Paul Anthony Bonenfant, this scholarship enables students enrolled in engineering and/or physical science programs to attend semester-abroad programs offered through their accredited college or university. The goal of the scholarship is to provide international experience to students as they prepare for professional lives that promote global engagement and collaboration.

Travis Sawyer, *University of Arizona, USA*

Milton and Rosalind Chang Pivoting Fellowship

Established in 2018, the Milton and Rosalind Chang Pivoting Fellowship provides unrestricted fellowships to talented young optical scientists and engineers who believe their expertise can be utilized to improve society beyond the bench. The program is intended to encourage people of exceptional talent to pursue their newfound passion. Each year, one OSA member is presented a "no strings" stipend of $50,000USD. This fellowship is an investment in a person's commitment to advancing science through non-traditional career paths (e.g. public policy, government, and journalism). The Fellowship is given in support of the individual not a project.

Araceli Venegas-Gómez, *University of Strathclyde, UK*

Thomas F. Deutsch Fellowship in Biomedical Optics

Established in 2017 and presented by the OSA Foundation and The Wellman Center for Photomedicine (WCP) at the Massachusetts General Hospital, the Thomas F. Deutsch Fellowship honors the extraordinary contributions Dr. Deutsch made to the field of Biomedical Optics. This one-year multidisciplinary Fellowship specifically fosters interactions between researchers from diverse fields of science and medicine and will support post-doctoral investigators pursuing training in either basic or clinical research.

Vincente Parot, *Harvard University, USA*

Diversity & Inclusion Advocacy Recognition

Established in 2018 to acknowledge the outstanding dedication and accomplishments of OSA members, companies or organizations that demonstrate efforts to foster greater appreciation, advancement and celebration of diversity and inclusivity. This can be achieved through community service, professional development, hiring practices or programming that enhance opportunities for the understanding and inclusion of people of diverse cultures, backgrounds and experiences.

Jay Mathews, *University of Dayton, USA*

National Institute of Standards & Technology, *USA*

The following award and recognition recipients were recognized elsewhere during FiO or during other conferences this year:

2019 OSA Awards and Medals

Esther Hoffman Beller Medal

Rick Trebino, *Georgia Institute of Technology, USA*
The Beller Medal recognizes outstanding contributions to education in optical science and engineering. Trebino is recognized for pioneering educational optics practices, including the only textbook on ultrashort-pulse measurement, innovative short courses, and the creation of high-quality graduate and undergraduate optics lectures that are shared freely with students and instructors worldwide.

Michael S. Feld Biophotonics Award

Valery Tuchin, *Saratov State University, Russia*
The Feld Biophotonics Award recognizes individuals for their innovative and influential contributions to the field of biophotonics, regardless of their career stage. Tuchin is recognized for pioneering research in biophotonics, particularly in the field of tissue optics and tissue optical clearing, and for promoting biophotonics by educating future researchers through seminal monographs and reviews.

Nick Holonyak Jr. Award

Fumio Koyama, *Tokyo Institute of Technology, Japan*
The Holonyak Award recognizes contributions to optics based on semiconductor-based devices and optical materials, including basic science and technological applications. Koyama is recognized for seminal contributions to VCSEL photonics and integration.

Edwin H. Land Medal

Nabeel Agha Riza, *University College Cork (UCC), Ireland*
The Land Medal, co-sponsored by OSA and the Society for Imaging Science and Technology, recognizes pioneering work empowered by scientific research to create inventions, technologies, and products. Riza is honored for the invention and commercialization of pioneering macro- and micro-scale imaging techniques across RF and optical wavelengths, and the education and mentoring of distinguished scientists and engineers.

Emmett N. Leith Medal

Wolfgang Osten, *Universität Stuttgart, Germany*
The Leith Medal recognizes seminal contributions to the field of optical information processing. It is presented to Osten for extending the limits of optical metrology by integrating digital image processing with modern optical measurement techniques.

Ellis R. Lippincott Award

Ji-Xin Cheng, *Boston University, USA*
The Lippincott Award, co-sponsored with the Coblentz Society and the Society for Applied Spectroscopy, recognizes contributions to vibrational spectroscopy. Cheng is honored for outstanding contributions in inventing and developing a broad spectrum of vibrational spectroscopic imaging technologies with ground-breaking discoveries and clinical applications.

Adolph Lomb Medal

Laura Na Liu, *University of Heidelberg, Germany*
The Lomb Medal recognizes noteworthy contributions made to optics at an early career stage. Liu is recognized for seminal contributions to nano-optics, three-dimensional optical metamaterials, as well as interdisciplinary scientific work regarding the development of DNA nanotechnology-based dynamic plasmonics.

C. E. K. Mees Medal

Bahram Javidi, *University of Connecticut, USA*
The Mees Medal recognizes an original use of optics across multiple fields. It is presented to Javidi for pioneering multidisciplinary contributions to information-optics with diverse applications in bio-photonics, 3D imaging and displays, photon-counting imaging and cyber-physical security.

Kevin P. Thompson Optical Design Innovator Award

Kyle Henry Fuerschbach, *Sandia National Laboratories, USA*
The Thompson Award recognizes contributions to lens design, optical engineering, or metrology at an early career stage. It is presented to Fuerschbach for ground breaking work utilizing nodal aberration theory to design, manufacture, and test a fully functional first-ever free form imaging telescope in a fully rotationally nonsymmetric configuration, demonstrating revolutionary freeform surfaces in optical imaging systems.

Charles Hard Townes Award

Alexander Gaeta, *Columbia University, USA*
The Townes Award recognizes contributions to quantum electronics. Gaeta is recognized for seminal contributions to chip-based nonlinear photonics, nonlinear optics in photonic crystal fibers, and nonlinear propagation of ultrashort laser pulses.

John Tyndall Award

Kim Roberts, *Ciena, Canada*
The Tyndall Award, co-sponsored with the IEEE/Photonics Society, recognizes contributions to fiber optic technology. Roberts is honored for pioneering contributions to the development of practical coherent communication systems.

Herbert Walther Award

Peter Knight, *Kavli Royal Society International Centre, UK*
The Walther Award, co-sponsored with Deutsche Physikalische Gesellschaft (DPG), recognizes distinguished contributions in quantum optics and atomic physics as well as leadership in the international scientific community. Knight is recognized for remarkable and varied contributions to quantum optics and quantum information science, ranging from foundations to applications.

2019 OSA Foundation FiO Grants, Prizes and Scholarships

Jean Bennett Memorial Student Travel Grant

Established in 2008, in memory of Jean M. Bennett, a highly decorated research physicist recognized for her contributions to the studies of optical surfaces and served as OSA's first female president, this $1,000USD grant is awarded to a student presenting their work at FiO. This competition is administered by the OSA Foundation and is made possible through the generous support of Nanoptek Corporation, the Pennsylvania State University Department of Physics and individual contributors.

Peter Schnauber, *TU Berlin, Germany*

Robert S. Hilbert Memorial Student Travel Grant

Established in 2009 by Optical Research Associates (ORA), now the Optical Solutions Group at Synopsys, as a memorial to ORA's former President and Chief Executive Officer Robert S. Hilbert, this $1,100USD grant recognizes the research excellence of students in the areas of optical engineering, lens design and illumination design.

Shun Fujii, *Keio University, Japan*

Philippe Guay, *Université Laval, Canada*

Xinyang Su, *Beijing Jiaotong University, China*

Boris P. Stoicheff Memorial Scholarship

Established in 2011 by the OSAF and the Canadian Association of Physicists Educational Trust Fund (CAPETF), this program pays tribute to Boris P. Stoicheff, an internationally renowned laser spectroscopist who also served as Presi- dent of OSA (1976) and CAP (1983-84).This $3,000USD scholarship is awarded annually to a graduate student who has demonstrated both research excellence and significant service to the optics or physics community. Past student recipients for this program can be found online at osa.org/stoicheff.

An Pan, *Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China*

Emil Wolf Outstanding Student Paper Competition

This competition recognizes the innovation, research excellence and presentation abilities of students presenting their work during FiO and honors Emil Wolf for his many contributions to science and The Optical Society. One winner is selected from each of the seven FiO subcommittees. Winners receive a complimentary OSA three-year student membership, an award stipend of $300USD and an award certificate. Past student recipients for this program can be found online at osa.org/wolf.

Congratulations to our finalists competing at FiO:

Scott Will, *University of Rochester, USA*

Cecilia Zaza, *CIBION-CONICET, Facultad de Ciencias Excatas y Naturales, UBA, Argentina*

Chenglong You, *Louisiana State University, USA*

Harsh K. Gandhi, *IIT Jodhpur, India*

Tristan A. Wilkinson, *West Virginia University, USA*

Yun Zhao, *Columbia University, USA*

Sally I. Elhenawy, *Massachusetts Institute of Technology, USA*

Sanjaya Lohani, *Tulane University, USA*

Alexander Lochbaum, *ETH Zurich, Switzerland*

Nils T. Otterstrom, *Yale University, USA*

Justin Patel, *Purdue University, USA*

Phuc Nguyen, *University of Michigan, USA*

Elia Alejandra Zegarra Valverde, *Leibniz Institute of Photonic Technology, Germany*

Adedayo Muideen Sanni, *Wayne State University, USA*

Chan Kyaw, *Howard University, USA*

Jiamin Li, *Tianjin University, China*

Incubic/Milton Chang Travel Grant

Funded by an endowment from Milton and Rosalind Chang, this program provides 10 grants of $500USD each to enable students who present papers to travel to Frontiers in Optics. Grants are awarded to the presenter and usually the first author of the paper. Past student recipients for this program can be found online at osa.org/incubic.

Congratulations to our 2019 Grant Recipients:

Scott Will, *University of Rochester, USA*

Tristan A. Wilkinson, *West Virginia University, USA*

Yun Zhao, *Columbia University, USA*

Justin Randall Rippy, *University of Houston, Baylor College of Medicine, USA*

An Pan, *Xi'an Institute of Optics and Precision Mechanics, China*

Jiamin Li, *Tianjin University, China*

Adedayo Muideen Sanni, *Wayne State University, USA*

Nils T. Otterstrom, *Yale University, USA*

Swagato Sarkar, *Indian Institute of Technology, Delhi, India*

Sanjaya Lohani, *Tulane University, USA*

OSA Senior Members

OSA Senior Membership provides established individuals with the opportunity to request a designation that recognizes their experience and professional accomplishments or service within the optics and photonics field. This designation is a separate category from Emeritus Status and is intended for active Members earlier in their careers making it more accessible than the Fellow Program.

To qualify for Senior Membership, individuals should have at least 10 years of cumulative professional experience (since completion of first degree) in optics and/or optics related field and be an active OSA Member with a minimum of five years of cumulative professional membership.

Firooz Aflatouni, University of Pennsylvania, USA
Vyas Akondi, Stanford University, USA
Félicie Albert, Lawrence Livermore National Laboratory, USA
Antonio Ambrosio, Harvard University, USA
Sanguan Anantathanasarn, Furukawa FITEL (Thailand) Co., Ltd., Thailand
Torben Andersen, Lockheed Martin Space, USA
Juan Ania-Castanon, Instituto De Optica 'Daza De Valdes', Spain
Samuel Arba-Mosquera, SCHWIND eye-tech-solutions, Germany
Gonzalo Arce, University of Delaware, USA
Henry Arguello, Universidad Industrial de Santander, Colombia
Amit Ashok, University of Arizona, USA
Shaghik Atakaramians, University of New South Wales, Australia
Yasuhiro Awatsuji, Kyoto Institute of Technology, Japan
Kate Bechtel, Triple Ring Technologies, USA
Anna Bezryadina, California State University Northridge, USA
Jayant Bhawalkar, AVAVA, Inc., USA
Mohammad Bolorizadeh, Yazd University, Iran
Bryan Bolt, Nanometrics Inc., USA
Ekaterina Borisova, Bulgarian Academy of Sciences, Bulgaria
Santasri Bose-Pillai, Air Force Institute of Technology, USA
Audrey Bowden, Vanderbilt University, USA
Francesca Bragheri, Istituto di Fotonica e Nanotecnologie, Italy
Camille-Sophie Bres, Ecole Polytechnique Federale de Lausanne, Switzerland
Joseph Buck, Lockheed Martin, USA
Lynda Busse, US Naval Research Laboratory, USA
James Butler, USA
Ryan Camacho, Brigham Young University, USA
Donald Carlin, Carlin Consulting LLC, USA
Alvaro Casas-Bedoya, University of Sydney, Australia
Arup Chakraborty, Indian Institute of Technology, Gandhinagar, India
Chi Chiu Chan, Shenzhen Technology University, Hong Kong
Hsi-Chao Chen, National Yunlin University of Science and Technology, Taiwan
Minghan Chen, Johnson & Johnson Vison Care, USA
Xiaogang Chen, University of Illinois at Urbana-Champaign, USA
Wei Cheng, University of Michigan, USA
Zhenzhou Cheng, The University of Tokyo, Japan
Rim Cherif, Université de Carthage, Tunisia
Naven Chetty, University of KwaZulu-Natal Westville, South Africa
Young-Wan Choi, SpaceOptics, USA
Amol Choudhary, University of Sydney, India
Michal Cifra, Institute of Photonics and Electronics, Czech Republic
Giovanni Cirmi, Deutsches Elektronen Synchrotron, Germany
Nelson Claytor, Fresnel Technologies Inc., USA
Golshan Coleiny, LEDVANCE, USA
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Marc Currie, US Naval Research Laboratory, USA
Arash Darafsheh, Washington University School of Medicine, USA
Bijoy Krishna Das, Indian Institute of Technology, Madras, India
Domenico de Ceglia, University of Padova, Italy
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Parag Deotare, University of Michigan, USA
John Dexheimer, LightWave Advisors, Inc., USA
Anirban Dhar, CSIR-Central Glass & Ceramic Research Institute, India
Jiangbing Du, Shanghai Jiao Tong University, China
Ramy El-Ganainy, Michigan Technological University, USA
Hossein Emami, Islamic Azad University, Iran
Julian Moises Estudillo Ayala, Unversidad De Guanajuato, Mexico
Felix Fanjul-Velez, University of Cantabria, Spain
Muhammad Faryad, Lahore University of Management Sciences, Pakistan
Eyal Feigenbaum, Lawrence Livermore National Laboratory, USA
ZeXin Feng, Beijing Institute of Technology, China
Mark Feuer, College of Staten Island, USA

Dror Fixler, Bar-Ilan University, Isreal
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Stephen Foulger, Clemson University, USA
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Paulina Kuo, National Institute of Standards & Technology, USA
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Benjamin Lee, IBM TJ Watson Research Center, USA
Ho Wai Lee, Baylor University, USA
Ray-Kuang Lee, National Tsing Hua University, Taiwan
Daan Lenstra, Technical University of Eindhoven, Netherlands
Kristjan Leosson, Innovation Center Iceland, Iceland
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Qian Li, Peking University Shenzhen Graduate School, China
Tongcang Li, Purdue University, USA
Pao Lin, Texas A&M University, USA
Psang Dain Lin, National Cheng Kung University, Taiwan
Hanli Liu, University of Texas at Arlington, USA
Carlos Lopez-Mariscal, Underwater Photonics, Mexico
Igor Lyubchanskii, National Academy of Sciences of Ukraine, Ukraine
Roberto Machorro, Unversidad Nacional Autonoma de Mexico, Mexico
Mehul Malik, Heriot-Watt University, Edinburgh, UK
Boris Malomed, Tel-Aviv University, Isreal
Murukeshan Matham, Nanyang Technological University, Singapore
Nirmal Mazumder, Manipal Academy of Higher Education, India
David McGloin, University of Technology, Sydney, Australia
Steve McGrew, Incandescent Arts, USA
Euan McLeod, University of Arizona, USA
Patrice Mégret, Universite de Mons, Belgium
William Meyer, USRA at NASA GRC, USA
Daniel Milanese, Politecnico di Torino, Italy
Mohammad-Ali Miri, Queens College of CUNY, USA
Vasyl Molebny, Tracey Technologies Corporation, Ukraine
Inkyu Moon, DGIST, South Korea
Oleg Morozov, Kazan National Research Tech University, Russia
Sushil Mujumdar, Tata Institute of Fundamental Research, India
Otto Muskens, University of Southampton, UK
Rajesh Nair, Indian Institute of Technology Ropar, India
Izabela Naydenova, Technological University Dublin, Ireland
Sha Shiong Ng, Universiti Sains Malaysia, Malaysia
Salman Noach, Jerusalem College of Technology, Isreal
Sang-Hyun Oh, University of Minnesota, Twin Cities, USA
Bulend Ortac, Bilkent Universitesi, Turkey
Thomas O'Sullivan, University of Notre Dame, USA
Jacopo Parravicini, Università di Milano Bicocca, Italy
Rajendran Parthiban, Monash University, Malaysia
Nikolai Petrov, ITMO University, Russia
Christopher Phillips, ETH Zurich, Switzerland
Dario Polli, Politecnico di Milano, Italy
Alexey Popov, University of Oulu, Finland
Guy Potvin, Defence R&D Canada, Canada
Sangeetha R.G., Vellore Institute of Technology, Chennai, India
Yair Rivenson, University of California Los Angeles, USA
Karsten Rottwitt, Danmarks Tekniske Universitet, Denmark
Yasser Sabry, Ain Shams University, Egypt
Basel Salahieh, Intel Corporation, USA
Ildar Salakhutdinov, California State Polytechnic University, USA
Goutam Samanta, Physical Research Laboratory, India
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Michelle Sander, Boston University, USA
Takashi Sato, Toshiba Memory Corporation, Japan
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Jason Schmidt, MZA Associates Corporation, USA
Marcelo Segatto, UFES, Brazil
Natan Shaked, Tel-Aviv University, Isreal
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Yagya Sharma, OSI Systems, USA
Yaochun Shen, University of Liverpool, UK
Wei-Chuan Shih, University of Houston, USA
Mark Siemens, University of Denver, USA

Edvin Skaljo, BH Telecom / University of Sarajevo, Bosnia and Herzegovina
Linda Smith, Ceres Technology Advisors, Inc., USA
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Sachin Srivastava, Indian Institute of Technology, Roorkee, India
Dong Sun, Peking University, China
Jie Sun, Intel Corporation, USA
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Azeemuddin Syed, International Institute of Information Technology, India
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Joseph Talghader, University of Minnesota Twin Cities, USA
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Manish Tiwari, Manipal University Jaipur, India
Fatima Toor, University of Iowa, USA
Marko Topic, Univerza v Ljubljani, Slovenia
Jurgen Van Erps, Vrije Universiteit Brussel, Belgium
Esteban Vera, P. Universidad Catolica de Valparaiso, Chile
Maria Antonietta Vincenti, DII - University of Brescia, Italy
Reinhard Voelkel, SUSS MicroOptics SA, Switzerland
Hideaki Wakabayashi, Okayama Prefectural University, Japan
David Walker, University of Huddersfield, UK
Bo Wang, Tsinghua University, China
Frank (Fengqiu) Wang, Nanjing University, China
Hsiang-Chen Wang, National Chung Cheng University, Taiwan
Wei Wang, Heriot-Watt University, UK
Bruce Warner, LLNL, USA
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Thomas Weiss, University of Stuttgart, Germany
Thomas White, Australian National University, Australia
Jonathan Wierer, Jr., Lehigh University, USA
Ling-An Wu, Institute of Physics, Chinese Academy of Sciences, China
Limin Xiao, Fudan University, China
Xiaochuan Xu, Omega Optics, Inc., USA
Phaneendra Yalavarthy, Indian Institute of Science, India
Dongmin Yang, Apple, USA
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Winnie Ye, Carleton University, Canada
Jeremy Yeak, University of New Mexico, USA
Ping Yu, University of Missouri, USA
Guanghui Yuan, Nanyang Technological University, Singapore
Avi Zadok, Bar-Ilan University, Isreal
Yuebing Zheng, University of Texas at Austin, USA
Tao Zhu, Chongqing University, China

FiO + LS Committees

Thanks to the technical program committee members! Your time and efforts are appreciated!

Frontiers in Optics General Chairs

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Byoungho Lee, *Seoul National University, Korea*

Laser Science Chairs

Anne Myers Kelley, *University of California Merced, USA*
Hailin Wang, *University of Oregon, USA*

FiO Theme Coordinators

Nanophotonics and Plasmonics

Ortwin Hess, *Imperial College London, UK*

Quantum Technologies

Nils Hempler, *M Squared Lasers Ltd., UK*

Virtual Reality and Augmented Vision

Douglas Lanman, *Facebook Reality Labs, USA*

FiO Program Committees

FiO 1: Fabrication, Design and Instrumentation

Yunlong Sheng, *Universite Laval, Canada*, **Subcommittee Chair**
Julie Bentley, *University of Rochester, USA*
Liangcai Cao, *Tsinghua University, China*
Chau-Jern Cheng, *National Taiwan Normal University, Taiwan*
Yoshio Hayasaki, *Utsunomiya University, Japan*
Stephen Kuebler, *University of Central Florida, USA*
Pascal Picart, *Le Mans Université, France*
Jamie Ramsey, *RPO (Rochester Precision Optics), USA*
Simon Thibault, *Universite Laval, Canada*

FiO 2: Optical Interactions

Takashige Omatsu, *Chiba University, Japan,* **Subcommittee Chair**
Yoshihiko Arita, *University of St. Andrews, UK*
Etienne Brasselet, CNRS *Université De Bordeaux, France*
Judith Dawes, *Macquarie University, Australia*
Andrew Forbes, *University of Witwatersrand, South Africa*
Natalia Litchinitser, *Duke University, USA*
Carlos Lopez-Mariscal, *Underwater Photonics, Mexico*
Sile Nic Chormaic, *Okinawa Inst. of Science & Technology, Japan*
Ruben Ramos-Garcia, *Inst. National Astrofisica Optica Electronica, Mexico*
Fabian Rotermund, *KAIST, South Korea*

FiO 3: Quantum Electronics

Marcelo Davanco, *NIST, USA*, **Subcommittee Chair**
Sam Carter, *US Naval Research Lab, USA*
Hui Deng, *University of Michigan, USA*
Sophia Economou, *Virginia Tech, USA*
Elizabeth Goldschmidt, *US Army Research Laboratory, USA*
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Armando Rastelli, *Johannes Kepler Universität Linz, Germany*
Luca Sapienza, *University of Southampton, UK*
Thilo Stöferle, *IBM Research Gmbh, Switzerland*
Jeff Thompson, *Princeton University, USA*

FiO 4A: Fiber Optics and Optical Communications Photonics

Gregory Raybon, *Nokia Bell Labs, USA,* **Subcommittee Chair**
Anjali Agarwal, *Vencore, USA*
Tymon Barwicz, *IBM TJ Watson Research Center, USA*
Mihaela Dinu, *LGS Innovations, USA*
Mina Esmaeelpour, *Stanford University, USA*
Takuro Fujii, *NTT Device Technology Laboratories, Japan*
Lyuba Kuznetsova, *San Diego State University, USA*
Anna Peacock, *University of Southampton, UK*
Karsten Rottwitt, *Danmarks Tekniske Universitet, Denmark*
Alexey Turukhin, *TE Subcom, USA*
Thomas Van Vaerenbergh, *Hewlett Packard Labs, USA*

FiO 4B: Photonic Integrated Devices for Computing, Sensing, and Other Applications

Amy Foster, *Johns Hopkins University, USA*, **Subcommittee Chair**
Imad Agha, *University of Dayton, USA*
Tingyi Gu, *University of Delaware, USA*
Zhaoran Huang, *Rensselaer Polytechnic Institute, USA*
Femius Koenderink, *AMOLF, Netherlands*
Bart Kuyken, Ghent University, *INTEC, Belgium*
Uriel Levy, *Hebrew University of Jerusalem, Israel*
Qiang Lin, *University of Rochester, USA*
Ke-Yao Wang, *Inphi Corporation, USA*
Xu Yi, *University of Virginia, USA*

FiO 5: Optics in Biology, Medicine, Vision, and Color

Felix Fanjul-Velez, *University of Cantabria, Spain,* **Subcommittee Chair**
Bernhard Baumann, *Medizinische Universität Wien, Austria*
David Busch, *University of Texas Southwestern Medical Center at Dallas, USA*
Alvaro Casas-Bedoya, *University of Sydney, Australia*
Szu-Yu Chen, *National Central University, Taiwan*
Alexandre Douplik, *Ryerson University, Canada*
Francisco Robles, *Georgia Institute of Technology, USA*
Wei Sun, *Thorlabs Inc., USA*
Ilya Turchin, *Institute of Applied Physics of the Russian Academy of Sciences, Russia*

FiO 6: Information Acquisition, Processing and Display

Ting-Chung Poon, *Virginia Tech, USA,* **Subcommittee Chair**
Partha Banerjee, *University of Dayton, USA*
Nobuyuki Hashimoto, *Citizen Watch Co., Ltd, Japan*
Taegeun Kim, *Sejong University, South Korea*
Jung-Ping Liu, *Feng Chia University, Taiwan*
Daniel Smalley, *Brigham Young University, USA*
Elena Stoykova, *Bulgarian Academy of Sciences, Bulgaria*
Hiroshi Yoshikawa, *Nihon University, Japan*

Laser Science Program Committees

2018 Nobel Prize in Physics Topics

Mark Raizen, *University of Texas-Austin, USA*

Condensed Phase and Nanocrystal Spectroscopy

Munira Khalil, *University of Washington, USA*

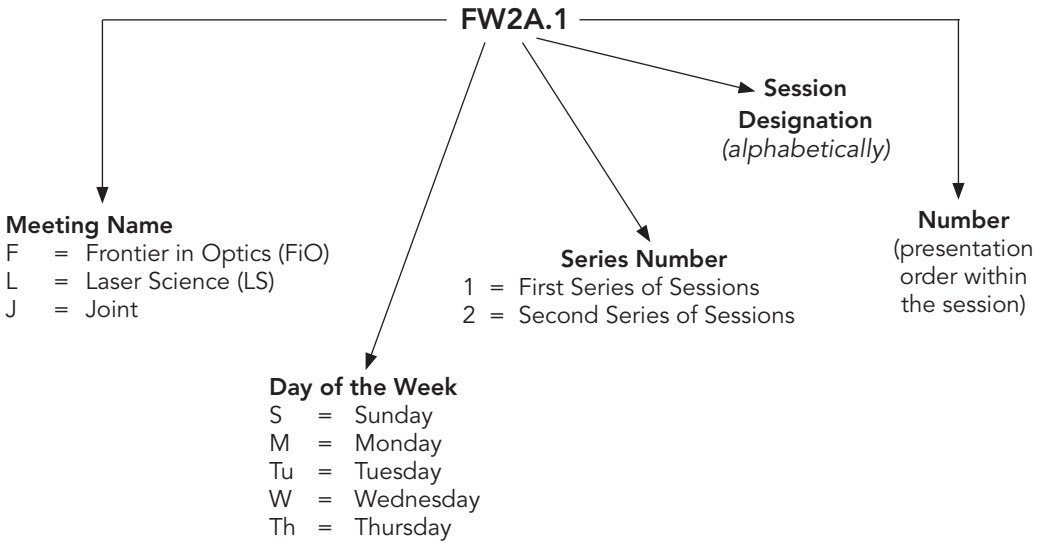
Plasmonics and Nanophotonics

Gary Wiederrecht, *Argonne National Lab., USA*

Quantum Science

Prem Kumar, *Northwestern University, USA*

Explanation of Session Codes



The first letter of the code designates the meeting (For instance, F = Frontiers in Optics, L = Laser Science). The second element denotes the day of the week The third element indicates the session series in that day (for instance, 1 would denote the first parallel sessions in that day). Each day begins with the letter A in the fourth element and continues alphabetically through a series of parallel sessions. The lettering then restarts with each new series. The number on the end of the code (separated from the session code with a period) signals the position of the talk within the session (first, second, third, etc.). For example, a presentation coded FW2A.1 indicates that this paper is part of the FiO and is being presented on Wednesday (W) in the second series of sessions (2), and is the first parallel session (A) in that series and the first paper (1) presented in that session.

Agenda of Sessions — Sunday, 15 September

	Theme: Quantum Technologies
07:00–17:00	**Registration,** *Atrium (Lower Level)*
08:00–10:00	**FS1A • Quantum Sensing for Industry and Fundamental Physics I,** *Washington 4*
08:00–16:00	**Women of Light, a Special Program for Women in Optics hosted by WiSTEE CONNECT,** *OSA Headquarters (Separate Registration Required)*
10:00–10:30	**Coffee Break,** *Washington Rooms Foyer*
10:30–12:30	**FS2A • Quantum Sensing for Industry and Fundamental Physics II,** *Washington 4*
12:30–13:30	**Lunch Break on Your Own**
13:30–15:30	**FS3A • Quantum Sensing for Industry and Fundamental Physics III,** *Washington 4*
15:30–16:00	**Coffee Break,** *Washington Rooms Foyer*
16:00–18:00	**FS4A • Quantum Computing With Atoms and Photons I,** *Washington 4*
16:00–18:30	**LGBTQ Meetup – Friends of Dorothy,** *Mayahuel Cocina Mexicana (2609 24th Street, NW)*

Key to Shading

Quantum Technologies

Agenda of Sessions — Monday, 16 September

	Washington 1	Washington 2	Washington 3	Washington 4	Washington 5	Washington 6
	Theme: Autonomous Systems	Theme: Nanophotonics and Plasmonics	FiO	FiO / LS	LS / FiO	FiO
07:00–17:00	**Registration,** *Atrium (Lower Level)*					
08:00–08:45	**FM1A • Autonomous Systems: Market Overviews**	**FM1B • Fundamentals and Visions in Nanophotonics and Plasmonics**	**FM1C • Optical Telescope and Microscope Instruments**	**FM1D • Photonic Quantum Computing and Simulation**	**LM1E • LS Dissertation Award Presentations**	**FM1F • Optical Interaction with Matters**
08:00–18:00	**OSA Career Lab Workshop: Advancing Mid-Managers Summit,** *Wilson C (Separate Registration Required)*					
09:00–16:00	**OSA Capitol Hill Meetings**					
09:15–10:00				**FM2A • Visionary - Jeremy J. Baumberg**		
10:00–10:30	**Coffee Break,** *Washington Rooms Foyer*					
10:30–12:30	**FM3A • LiDAR Sensors and Systems**	**FM3B • Quantum and Active Nanophotonics**	**FM3C • Light Propagation and Transport in System**	**FM3D • Quantum Photonics**	**LM3E • Plasmonics and Nanophotonics I**	**FM3F • Spectral and Endoscopic Diagnosis on Cells and Tissues**
11:00–12:00	**Building Your Personal Brand,** *Wilson AB*					
12:00–18:00	**Laser Science Symposium on Undergraduate Research,** *Hoover*					
12:30–14:00	**OSA Therapeutic Laser Applications Technical Group Birds of a Feather Lunch,** *Wilson AB*					
12:30–14:00	**Lunch Break on Your Own**					
14:00–15:30	**FM4A • Autonomous Unmanned Vehicles**	**FM4B • Topological and Nonlinear Nanophotonics**	**FM4C • Metasurface, Graphene and Liquid Crystal Lenses and Low Coherence Laser**	**LM4D • Quantum Science I**	**FM4E • Optomechanical, PT-Symmetric and Nonlinear Photonic Systems**	**FM4F • Structured Materials**
14:15–15:15	**40 Top Jobs For STEM PhDs. Which Is Right For You?,** *Wilson AB*					
15:00–16:00	**Meet OSA's Journal Editors,** *Exhibit Hall B South (via the Washington rooms hallway)*					
15:30–16:00	**Coffee Break,** *Washington Rooms Foyer*					
15:30–16:30	**Power Negotiating Your Salary Offer - How PhDs Get Paid What They Are Worth,** *Wilson AB*					
16:00–18:00	**FM5A • Panel On Connectivity and Cyber-Security for Autonomous Systems**	**FM5B • Active Nanoplasmonics and Metamaterials**	**FM5C • Nano-Materials, Structure and Physics**	**LM5D • Quantum Science II**	**FM5E • Quantum Emitters** (ends 17:30)	**FM5F • Optical and Acoustic Label-Free Imaging on Biological Tissues**
16:45–18:00	**The Rules of Engagement: Navigating Important Business Relationships,** *Wilson AB*					
17:00–18:00	**OIDA Networking Happy Hour**					
18:00–19:00	**OSA Fiber Optics Technology Technical Group Rapid-Fire Presentation & Networking Event,** *Washington 1*					
18:30–21:00	**FiO + LS Awards Ceremony & Reception,** *Carnegie Institution of Science (Separate Registration Required)*					
18:30–19:00	**Explore DC - OSA Student Member Walking Tour of the Monuments,** *World War II Memorial*					
19:00–22:00	**FIO Student Member Party,** *The Brighton 949 Wharf St. SW*					

Key to Shading

Quantum Technologies

Agenda of Sessions — Tuesday, 17 September

	Washington 1	Washington 2	Washington 3	Washington 4	Washington 5	Washington 6
	Themes: Virtual Reality and Augmented Vision	**Theme: Nanophotonics and Plasmonics / FiO**	**FiO**	**LS / Theme: Quantum Technologies**	**FiO / LS**	**FiO**
07:30–18:00	**Registration,** *Atrium (Lower Level)*					
08:00–09:00		**FTu1B • Nonlinear Nano- and Biophotonics**	**FTu1C • Optical Interconnects**	**LTu1D • Quantum Science III**	**FTu1E • Quantum Photonics & Information Security**	**FTu1F • Molecular Contrast and Detection on Cells and Tissues**
09:15–10:00				**FTu2A • Visionary - Mohan M. Trivedi**	**LTu2B • Visionary - Jelena Vucko**	
10:00–15:30	**Science & Industry Showcase,** *Lower Level* **JTu3A • Poster Session I,** 10:00–12:00 **Coffee Break,** 10:00–10:30 **Lunch,** 12:45–13:30 **JTu4A • Poster Session II,** 13:30–15:30 **Coffee Break,** 14:30–15:00					
10:00–15:30	**Theater** **Rapid-Fire Oral Presentations 1** 10:05–11:05 **Reaching for the Brightest Light: High Intensity Ultrafast Lasers** 11:05–11:45 **Plenary Presentation: Donna Strickland** 12:00–12:40 **Rapid-Fire Oral Presentations 2** 13:00–14:00 **Frontiers in Funding** 14:00–14:45 **Congressional Fellowship Q&A** 14:50–15:20			**Networking Area** **Wiki Needs Women in Optics: Wikipedia Edit-a-thon** 10:00–12:00 **Nonlinear Optics Technical Group Panel Discussion - Transitioning into a Career in Optics** 12:40–13:45 **Meet the Physical Review Journal Editors Reception** 14:00–15:30		
15:30–17:00	**FTu5A • Optical Challenges of the Past, Present, and Future**	**FTu5B • Data Centers, Free Space and Microwave Photonics**	**FTu5C • Heterogeneous Integration**	**FTu5D • Quantum Computing With Atoms and Photons II**	**LTu5E • Plasmonics and Nanophotonics II** (starts 16:00)	**FTu5F • Excitons and Photons**
15:30–16:30	**Be a Part of the Solution: Ally & Bystander Training,** *Wilson AB*					
17:15–18:15	**Postdeadline Presentations**				**DLS Business Meeting**	
17:30–18:15	**OSA Annual Business Meeting,** *Wilson C*					
18:30–20:30	**FIO + LS Conference Reception,** *Thurgood Marshall Ballroom Room, Mezzanine Level*					

Key to Shading

Quantum Technologies

Agenda of Sessions — Wednesday, 18 September

	Washington 1	Washington 2	Washington 3	Washington 4	Washington 5	Washington 6
	Theme: Virtual Reality and Augmented Vision	FiO	FiO	Theme: Quantum Technologies	LS	FiO
07:30–17:30	**Registration,** *Atrium (Lower Level)*					
08:00–09:00	**FW1A • Applications of AR/VR**	**FW1B • Fiber Lasers and Lasers on Silicon**	**FW1C • Optical Signal Processing**	**FW1D • Quantum Computing With Atoms and Photons III**	**LW1E • Plasmonics and Nanophotonics III**	**FW1F • Novel Materials and Optical Fields**
09:15–10:00				**FW2A • Visionary - John Martinis**	**LW2B • Visionary - Steven Cundiff**	
10:00–15:30	**Science & Industry Showcase,** *Lower Level* **JW3A • Poster Session I,** 10:00–12:00 **Coffee Break,** 10:00–10:30 **Lunch,** 12:45–13:30 **JW4A • Poster Session II,** 13:30–15:30 **Coffee Break,** 14:30–15:00					
10:00–15:30	**Theater** **Rapid-Fire Oral Presentations 3** 10:05–11:05 **The U.S. Quantum Leap: The National Quantum Initiative** 11:05–11:45 **Plenary Presentation: Ronald Hanson** 12:00–12:40 **Rapid-Fire Oral Presentations 4** 13:00–14:00 **Social Impact of AR/VR** 14:00–14:40 **Autonomous Platforms: Safety Challenges and Opportunities** 14:45–15:30			**Networking Area** **Fiber Optic Explosions** 10:00–11:00 **OIDA / OSAF Professional Development & Networking Lunch and Learn** 12:45–14:15 **OSA Holography and Diffractive Optics Technical Group Networking Session** 14:15–15:30		
15:30–17:00	**FW5A • State of the Art in VR Optics**	**FW5B • Emerging Optical Fiber Technology**	**FW5C • Silicon Waveguides & Resonators**		**LW5E • Condensed Phase and Nanocrystal Spectroscopy I**	**FW5F • Structured Light**
16:00–18:00	**OSA Senior Member Reception,** *Stone's Throw Restaurant and Bar*					
17:15–18:45	**FW6A • State of the Art in AR Optics**	**FW6B • Optical Manipulations**	**FW6C • Integrated Frequency Combs**	**FW6D • Quantum Communications and the Future Quantum Internet I**	**LW6E • Condensed Phase and Nanocrystal Spectroscopy II**	**FW6F • 3D and Light -Field Optics**
19:30–20:30	**Movie Night: Quantum Shorts Film Festival,** *Wilson AB*					

Key to Shading

Quantum Technologies

Agenda of Sessions — Thursday, 19 September

	Washington 1	Washington 2	Washington 3	Washington 4	Washington 5	Washington 6
	Theme: Virtual Reality and Augmented Vision	FiO	FiO	Theme: Quantum Technologies	LS	FiO
07:30–11:00	**Registration,** *Atrium (Lower Level)*					
08:00–09:00	**FTh1A • Capturing and Recreating Photorealistic Experiences**	**FTh1B • High Field Light Matter Interaction**	**FTh1C • Plasmonics & Metamaterials**	**FTh1D • Quantum Computing with Atoms and Photons IV**	**LTh1E • Nobel Prize Symposium I**	**FTh1F • Computer-Generated Holography and Digital Holography**
09:15–10:00				**FTh2A • Visionary - Bernard Kress**	**LTh2A • Visionary - Toshiki Tajima**	
10:00–10:30	**Coffee Break,** *Washington Rooms Foyer*					
10:30–12:30	**FTh3A • Innovation Showcase**	**FTh3B • Waveguides & Structured Materials**	**FTh3C • Nonlinear Integrated Photonics**	**FTh3D • Quantum Communications and the Future Quantum Internet II**	**LTh3E • Nobel Prize Symposium II**	**FTh3F • Information Acquisition and Processing**

Key to Shading

Quantum Technologies

Washington 4

Theme: Quantum Technologies

08:00–10:00
FS1A • Quantum Sensing for Industry and Fundamental Physics I
Presider: To be Announced

FS1A.1 • 08:00 Invited
Frontiers in Optical Atomic Clocks: Challenges, New Platforms, and Entanglement, Adam Kaufman[1]; [1]*JILA, USA.* Optical atomic clocks provide unprecedented metrological precision and accuracy. I will describe challenges and new approaches being explored. Looking to the future, I will discuss efforts to incorporate quantum entanglement and the potential impact.

FS1A.2 • 08:30 Invited
Quantum Sensors for Gravimetry and Navigation, John Close[1]; [1]*Australian National Univ., Australia.* Abstract not available.

FS1A.3 • 09:00 Invited
Quantum Sensors with Matter Waves: From General Relativity to Gravimetry and Navigation, Philippe Bouyer[1]; [1]*Institut d'Optique - CNRS, France.* I will present some of the latest development in matter-wave interferometry with provides today the most promising precision inertial measurements for navigation, monitoring of gravity or for precise tests of general relativity.

FS1A.4 • 09:30 Invited
Unique Identification with Imperfect Quantum Materials, Robert Young[1,2]; [1]*Quantum Base, UK;* [2]*Quantum Technology Centre, Lancaster Univ., UK.* Unique identification is important for anticounterfeiting. Imperfections, locked into structures, can provide complex and robust fingerprints. We propose a simple method to read unique information from atomic defects in quantum materials.

08:00–16:00 Women of Light, a Special Program for Women in Optics hosted by WiSTEE CONNECT, *OSA Headquarters (Separate Registration Required)*

10:00–10:30 Coffee Break, *Washington Rooms Foyer*

10:30–12:30
FS2A • Quantum Sensing for Industry and Fundamental Physics II
Presider: To be Announced

FS2A.1 • 10:30 Invited
Quantum Sensors and Optical Technologies for Space Applications, Markus Krutzik[1]; [1]*Ferdinand Braun, Germany.* We will present recent work and visions on integrated atomic sensors with applications in frequency metrology, timing and gravimetry, including R&D for space.

FS2A.2 • 11:00 Invited
Quantum Navigation and Atomic Clocks, Brenton C. Young[1]; [1]*AOSense, Inc., USA.* AOSense has fielded prototype quantum sensors and atomic clocks in practical environments and is now productizing these innovative systems. In parallel, we have successfully commercialized compact, robust components supporting quantum technologies.

FS2A.3 • 11:30 Invited
Quantum sensors for gravimetry and intertial navigation, Joseph A. Thom[1]; [1]*M Squared, UK.* M Squared's atom interferometer systems for gravimetry and inertial navigation are presented, with focus on the engineering required for their use in non-laboratory settings. This is a critical step towards the commercialization of quantum sensors.

FS2A.4 • 12:00 Invited
Rydberg Atoms for Quantum Sensing of Electric and Magnetic Fields, David Anderson[1]; [1]*Rayleigh Optical Corp., USA.* Abstract not available.

12:30–13:30 Lunch Break on Your Own

Washington 4

Theme: Quantum Technologies

13:30–15:30
FS3A • Quantum Sensing for Industry and Fundamental Physics III
Presider: To be Announced

FS3A.1 • 13:30 Invited
Quantum Atomics from 30,000 Feet and from 3 Feet, Dana Anderson[1]; [1]*ColdQuanta Inc., USA.* The utility and performance of atom-based sensors will advance as techniques for manipulating the wavefunction of an atomic ensemble become increasingly sophisticated. Modulated optical lattices and atomtronics provide two different approaches to future high-performance sensors.

FS3A.2 • 14:00 Invited
Atomic Clocks and Quantum Sensors in Space – Opportunities and Challenges, Nan Yu[1]; [1]*Jet Propulsion Laboratory, Californina Inst. of Technology, USA.* This talk will discuss our atomic clock and quantum sensor technology developments and applications in space including Deep Space Atomic Clock (DSAC) and Cold Atom Laboratory (CAL) recently launched into space.

FS3A.3 • 14:30 Invited
Improving the Accuracy of Atom Gravity Sensors, Franck Pereira dos Santos[1], Romain Caldani[1], Romain Karcher[1], Kanxing Weng[1], Sébastien Merlet[1]; [1]*Paris Observatory, France.* I will show how the use of ultracold atom sources and innovative measurement methods improve the accuracy of cold atom gravity and gravity gradient sensors.

FS3A.4 • 15:00 Invited
Conceptualization, Design and Prospects of Atom-Interferometry Based Full Tensor Gravity Gradiometer, Anirban Mukherjee[1,2], Ana Rakonjac[1,3], Ravi Kumar[1]; [1]*Atomionics Pte. Ltd., Singapore;* [2]*Department of Physical Sciences, Indian Inst. of Science Education and Research Kolkata, India;* [3]*Department of Physics, Durham Univ., Joint Quantum Centre (JQC) Durham–Newcastle, UK.* The talk would present techniques to measure full tensor gravity gradient using atom-interferometry and propose a design for building a full tensor gravity gradiometer for geophysical exploration of natural resources and gravity-aided navigation.

15:30–16:00 Coffee Break, *Washington Rooms Foyer*

16:00–18:00
FS4A • Quantum Computing With Atoms and Photons I
Presider: Jonathan Olson; Zapata Computing Inc., USA

FS4A.1 • 16:00 Invited
Cloud Based Quantum Control, Michael J. Biercuk[1,2], Michael Hush[2], Harrison Ball[2]; [1]*Univ. of Sydney, Australia;* [2]*Q-CTRL, Australia.* We describe an experimentally validated quantum control toolset which leverages distributed processing to enable error-robust control optimization for complex multiqubit unitaries with order-of-magnitude advantages in time to solution.

FS4A.2 • 16:30 Invited
Research and Technology for Scalable Quantum Computing, Zachary Dutton[1]; [1]*Raytheon BBN Technologies, USA.* We are developing technologies to enable scalable quantum processing systems, including electronics hardware and firmware to control multiple qubits, low latency feedback for error correction, and protocols to characterize multi-qubit systems.

FS4A.3 • 17:00 Invited
Quantum Computing with Rydberg Atoms, Mark Saffman[1,2]; [1]*Univ. of Wisconsin-Madison, USA;* [2]*ColdQuanta, Inc., USA.* Neutral atoms are a leading approach for scalable quantum information processing. Rydberg states mediate strong interactions for fast gates and entanglement. I will present quantum experiments with a 2D array of more than 100 Cs atom qubits.

FS4A.4 • 17:30 Invited
Integrated Quantum Entropy Sources, Carlos Abellan[1]; [1]*Quside, Spain.* Random numbers are essential in cybersecurity and supercomputation. In this talk, we will review recent progress in the development of highly integrated quantum entropy sources for unpredictable random number generation using InP and SiPh platforms.

16:00–18:30 LGBTQ Meetup – Friends of Dorothy, *Mayahuel Cocina Mexicana (2609 24th Street, NW)*

Washington 1

Theme: Autonomous Systems

08:00–09:00
FM1A • Autonomous Systems: Market Overviews
Presider: To be Announced

FM1A.1 • 08:00 Invited
Title to be Announced, Alexis Debray[1]; [1]*Yole Developments, France.* Abstract not available.

FM1A.2 • 08:30 Invited
Introduction to Unmanned Vehicles, David Klein[1]; [1]*AUVSI, USA.* An unmanned vehicle is a mobile platform that functions without the presence of an onboard human operator. This presentation will provide an overview of the markets utilizing unmanned vehicles and demonstrate the tremendous impact from the integration of these technologies.

Washington 2

Theme: Nanophotonics and Plasmonics

08:00–09:00
FM1B • Fundamentals and Visions in Nanophotonics and Plasmonics
Presider: Ortwin Hess; Imperial College London, UK

FM1B.1 • 08:00 Invited
An Integrated Two-qubit Quantum Network Node, Mihir Bhaskar[1], Denis D. Sukachev[1], Christian Nguyen[1], Ralf Riedinger[1], David Levonian[1], Bart Machielse[1], Pavel Stroganov[1], Erik Knall[1], Marko Loncar[1], Mikhail Lukin[1]; [1]*Harvard Univ., USA.* We build a two-qubit quantum network node based on a ^{13}C nuclear spin and a silicon-vacancy center strongly coupled to a diamond nanophotonic cavity and efficiently interfaced with a tapered optical fiber.

FM1B.2 • 08:30 Invited
Collective Quantum Optical Effects in Organic Molecules via Nanophotonic Circuits, Vahid Sandoghdar[1]; [1]*Max-Planck-Inst. Physik des Lichts, Germany.* Recent experiments have shown that organic molecules act as solid-state quantum emitters. We shall discuss the efficiency of photon-molecule coupling and its implications for the coupling of many emitters via a photonic channel.

Washington 3

FiO

08:00–09:00
FM1C • Optical Telescope and Microscope Instruments
Presider: Liangcai Cao, Tsinghua University, China

FM1C.1 • 08:00
Understanding Polarization Aberrations in the LUVOIR Coronagraph Instrument, Scott Will[1], James R. Fienup[1]; [1]*Univ. of Rochester, USA.* We study the diffraction effects of polarization-dependent wavefront aberrations on the coronagraph instrument of the proposed LUVOIR space observatory, and the degree to which active wavefront control can compensate.

FM1C.2 • 08:15 Invited
Gabor Domain Optical Coherence Microscopy Imaging, from Cellular to Nano-Class, and Perspectives, Cristina Canavesi[1], Jannick Rolland[2,1]; [1]*LighTopTech Corp., USA;* [2]*The Inst. of Optics, Univ. of Rochester, USA.* Breaking the cellular resolution limit of optical coherence tomography, Gabor-domain optical coherence microscopy achieves an isotropic 2-micron resolution in 3D. Recent advances include nano-class thickness estimation and functional imaging.

FM1C.3 • 08:45
Experimental Variation of Magnification Calibration for Localization Microscopy, Craig Copeland[1], B. R. Ilic[1], Samuel Stavis[1]; [1]*Microsystems and Nanotechnology Division, NIST., USA.* We study the variation of a localization microscope from temporal and thermal factors, enabling elucidation of the discrepancy between transillumination brightfield and epi-illumination fluorescence of an aperture array for magnification calibration.

08:00–18:00 OSA Career Lab Workshop: Advancing Mid-Managers Summit, *Wilson C (Separate Registration Required)*

09:00–16:00 OSA Capitol Hill Meetings

10:00–10:30 Coffee Break, *Washington Rooms Foyer*

Washington 4

FiO

08:00–09:00
FM1D • Photonic Quantum Computing and Simulation

Presider: Elizabeth Goldschmidt; Army Research Lab / Joint Quantum Institute, USA

FM1D.1 • 08:00 Invited

Photonic Quantum Simulations, Anthony Laing[1]; [1]*Univ. of Bristol, UK.* Recent progress in integrated photonics heralds a versatile class of programmable quantum simulator. We report photonic simulations of molecular quantum dynamics, and results toward scaling this technology to challenge conventional computers.

FM1D.2 • 08:30 Invited

Photonic Quantum Computing, Mercedes Gimeno-Segovia[1]; [1]*Psiquantum Corp., USA.* In this talk, I will describe an architecture for fault-tolerant quantum computing based on linear optics, which can be implemented in silicon photonics opening the door to manufacturability at large scale.

09:15–10:00
FM2A • Visionary - Jeremy J. Baumberg

FM2A.1• 09:15 VISIONARY

Extreme NanoPhotonics: Light on the Atom-Scale, Jeremy J. Baumberg[1]; [1]*Univ. of Cambridge, UK.* Coupling between coinage metal 'plasmonic' nano-components generates strongly red-shifted optical resonances combined with intense local light amplification on the nanoscale. I will show how we now create ultralow volume plasmonic cavities trapping light to the atom scale <1nm3, and are routinely able to watch individual molecules and bonds vibrating [1]. Using DNA origami we couple 1-4 dye molecules together optomechanically, and produce strong-light matter coupling that changes their quantum emission properties. We also watch redox chemistry in real time, watching single electrons shuttle in and out of single molecules, as well as 2D materials confined in the same gap. Prospective applications range from (bio)molecular sensing to fundamental science. I particularly focus on applications to nanomachinery actuation by light.

Washington 5

LS

08:00–10:00
LM1E • LS Dissertation Award Presentations

Presider: Randy Bartels; Colorado State University, USA

LM1E.1 • 08:00 Invited

Shedding Light on Quantum Materials via Ultrafast Broadband Laser Spectroscopy, Fabrizio Carbone[1], Majed Chergui[1]; *École Polytechnique Fédérale de Lausanne, Switzerland.* We demonstrate a novel laser spectroscopy method to study the physics of quantum materials. This approach allows us to reveal the interplay among the collective modes that govern the exotic behavior of these solids.

LM1E.2 • 08:30 Invited

Flatland Nanophotonics: A Study of Quantum-Confined Excitons in 2D Materials, Chitraleema Chakraborty[1]; [1]*Univ. of Rochester, USA.* Solid-state quantum emitters are desirable for scalable quantum photonics. We study the photophysical properties of quantum-confined excitons in two-dimensional materials. Our efforts to controllably tune these quantum emitters and realize a spin-valley-photon interface are described.

LM1E.3 • 09:00 Invited

Direct Time-domain Observation of Attosecond Electron Dynamics in Solids using Attosecond Pulse Sequences, Cong Chen[1], Zhensheng Tao[1], Adra Carr[1], Tibor Szilvási[2], Mark Keller[3], Manos Mavrikakis[2], Henry C. Kapteyn[1], Margaret M. Murnane[1]; [1]*JILA, Univ. of Colorado, Boulder, USA;* [2]*Univ. of Wisconsin-Madison, USA;* [3]*NIST, USA.* We use attosecond pulses to measure the fastest intrinsic processes in solids. Our results reveal the influence of the band structure on excited-state lifetimes and extract fundamental electron interactions including attosecond electron screening and scattering.

LM1E.4 • 09:30 Invited

Exploring Ultrafast Quantum Dynamics of Electrons by Attosecond Transient Absorption, Chen-Ting Liao[1,6], Seth Camp[2], Xuan Li[3], Nathan Harkema[1], Daniel J. Haxton[3], Jens E. Bækhøj[2], Thomas N. Rescigno[3], Robert R. Lucchese[3], Kenneth J. Schafer[2], C.William McCurdy[3,4], Mette B. Gaarde[2], and Arvinder Sandhu[1]; [1]*Univ. of Arizona, USA;* [2]*Louisiana State Univ., USA;* [3]*Lawrence Berkeley Nat. Lab, USA;* [4]*Univ. of California, Davis, USA;* [6]*JILA, Univ. of Colorado and NIST, USA.* Extreme ultraviolet attosecond pulses were utilized to study coherently prepared excited states in atoms and molecules under strong and tunable light fields. These studies provide time-domain perspectives and controlling strategies on light-induced ultrafast electronic processes.

Washington 6

FiO

08:00–09:00
FM1F • Optical Interaction with Matters

Presider: Takashige Omatsu; Chiba University, Japan

FM1F.1 • 08:00 Invited

Ultrafast Laser Inscribed 3d Glass Photonics: From a Curiosity to Commercial Applications, Simon Gross[1], Andrew Ross-Adams[1], Thomas Gretzinger[1], Glen Douglass[1], Toney T. Fernandez[1], Michael J. Withford[1]; [1]*Macquarie Univ., Australia.* Ultrafast laser inscription has transformed from a laboratory curiosity to a commercially viable fabrication technique for 3D glass photonics. Advances in its application to optical communication and astronomical instrumentation will be reviewed.

FM1F.2 • 08:30

Ultra-Broadband UV to Microwave Coherent Radiation from Mid-Infrared Interactions in Thin Gas Jets and Clusters, Robert Schwartz[1], Daniel Woodbury[1], Ela Rockafellow[1], Dogeun Jang[1], Howard Milchberg[1], Ki-Yong Kim[1]; [1]*Univ. of Maryland, USA.* We report experimental results and simulations of ultra-broadband Brunel-like harmonic, THz, and microwave generation from the interaction of single and two-color mid-infrared laser fields in thin gas jets and clusters.

FM1F.3 • 08:45

Probing Ultrafast Molecular Dynamics by Time-Resolved Coincident Ion Momentum Imaging, Farzaneh Ziaee[1], Kurtis Borne[1], Kanaka Raju Pandiri[1], Ruaridh Forbes[2], Yubaraj Malakar[1], Balram Kaderiya[1], Travis Severt[1], Kevin D. Carnes[1], Itzik Ben-Itzhak[1], Artem Rudenko[1], Daniel Rolles[1]; [1]*Kansas State Univ., USA;* [2]*Stanford Univ., USA.* A setup for pump-probe experiments using ultraviolet and near-infrared femtosecond laser pulses in combination with coincident ion momentum imaging is presented. Characterization measurements show a pump-probe temporal resolution below 40 fs.

08:00–18:00 OSA Career Lab Workshop: Advancing Mid-Managers Summit, *Wilson C (Separate Registration Required)*

09:00–16:00 OSA Capitol Hill Meetings

10:00–10:30 Coffee Break, *Washington Rooms Foyer*

Washington 1

Theme: Autonomous Systems

10:30–12:30
FM3A • LiDAR Sensors and Systems
Presider: To be Announced

FM3A.1 • 10:30 Invited
Truly Solid-State Lidar Based on Metasurface Beam Steering Technology, Gleb Akselrod[1]; [1]*Lumotive LLC, USA*. Lumotive is developing a truly solid-state lidar based on a beam steering technology that uses the light bending properties of metasurfaces. We will discuss the metasurface technology and the lidar system based on these chips.

FM3A.2 • 11:00 Invited
Photonic Integration for Next-Gen FMCW LiDAR, Barrie Keyworth[1]; [1]*Lumentum, USA*. System level photonic integration is applied to FMCW LiDAR to address challenging targets for performance, size, cost and reliability, while providing benefits of extended range, immunity to interference, and instantaneous velocity measurement.

FM3A.3 • 11:30 Invited
Interference Challenges and Solutions for FMCW LiDAR, Phillip Sandborn[1], Sen Lin[1]; [1]*OURS Technology Inc., USA*. Soon, LiDAR makers must contend with LiDAR-congested environments. FMCW LiDAR has inherent advantages when dealing with interference. This talk will give an overview of interference challenges and solutions advanced by OURS and other LiDAR companies.

Washington 2

Theme: Nanophotonics and Plasmonics

10:30–12:00
FM3B • Quantum and Active Nanophotonics
Presider: Vahid Sandoghdar; Max Planck Inst. for the Science of Light, Germany

FM3B.1 • 10:30 Invited
Resonances and Local Fields of Second-order Nonlinear Plasmonic Metasurfaces, Martti Kauranen[1], Robert Czaplicki[2], Xiaorun Zang[1], Kalle Koskinen[1], Timo Stolt[1], Mikko J. Huttunen[1]; [1]*Tampere Univ., Finland;* [2]*Nicolaus Copernicus Univ., Poland*. We review our results on second-order nonlinear plasmonic metasurfaces. In addition to plasmon resonances, symmetry of the local fields is important for strong response. The response can also be enhanced by non-resonant effects.

FM3B.2 • 11:00 Invited
Title to be Determined, Mercedeh Khajavikhan[1]; [1]*Univ. of Central Florida, CREOL, USA*. Abstract not available.

FM3B.3 • 11:30 Invited
Controlling Light With a Single Photon, Edo Waks[1]; [1]*Univ. of Maryland, USA*. I will describe our recent progress in generating strong photon-photon interactions using quantum dots coupled to small mode-volume cavities, as well as our effort towards scaling to larger systems.

Washington 3

FiO

10:30–12:30
FM3C • Light Propagation and Transport in System
Presider: Yoshio Hayasaki; Utsunomiya University, Japan

FM3C.1 • 10:30 Invited
Generation of Periodic Structured Illumination Patterns with Compact Birefringent Elements, Roland A. Terborg[1], Juan P. Torres[1,3], Valerio Pruneri[1,2]; [1]*ICFO -Institut de Ciencies Fotoniques, Spain;* [2]*ICREA-Institució Catalana de Recerca i Estudis Avançats, Spain;* [3]*Universitat Politècnica de Catalunya, Spain*. We present and demonstrate a technique for transforming Gaussian beams into a variety of scalable periodic patterns by means of a simple and compact setup made of birefringent optical elements known as Savart plates

FM3C.2 • 11:00
Propagation of mid-infrared light in a tellurite hollow core optical fiber with non-touching circular cladding air-holes, Hoang Tuan Tong[1], Nobuhiko Nishiharaguchi[1], Takenobu Suzuki[1], Yasutake Ohishi[1]; [1]*Toyota Technological Inst., Japan*. A new tellurite HC-PCF with non-touching circular cladding air-holes was demonstrated in this work. Its measured transmission spectrum included high and low transmission bands which located from 2.0 up to 4.0 μm.

FM3C.3 • 11:15
Expanded Imaging Volume for Dual-Axis Optical Coherence Tomography, Evan T. Jelly[1], Yang Zhao[1], Kengyeh K. Chu[1], Michael Crose[1], Adam Wax[1]; [1]*Duke Univ., USA*. We present a method for expanding the imaging volume of a dual-axis optical coherence tomography system (DA-OCT), increasing the lateral scan range 25-fold and enhancing imaging performance in depth using dynamic focus tracking.

FM3C.4 • 11:30
Angular and Spatial Light Modulation by Single Digital Micromirror Device for Multi-Image Output and Nearly-Doubled Étendue, Brandon Hellman[1], Yuzuru Takashima[1]; [1]*Univ. of Arizona, USA*. The "Angular Spatial Light Modulator" (ASLM) uses a binary patterned programmable blazed grating to increase the étendue and number of output pixels of a DMD. We demonstrate an extended FOV display, a light-field projector, and a multi-view display.

FM3C.5 • 11:45
Optical Return Loss Control in Silicon Photonic Metamaterial Waveguides, Bo Peng[1,2], Tymon Barwicz[3], Yusheng Bian[1], Shuren Hu[2], Michal Rakowski[1], Karen Nummy[2], Ken Giewont[2], Ajey Jacob[1]; [1]*Globalfoundries CTO Research, USA;* [2]*Globalfoundries, USA;* [3]*IBM T. J. Watson Research Center, USA*. Metamaterial waveguides, allowing refractive index engineering, have been verified as solutions for integrated photonic devices in optical IO. Here, we report on optical return loss control in Si metamaterial waveguide design for low backscattering.

Washington 4

FiO

10:30–12:30
FM3D • Quantum Photonics
Presider: Jeff Thompson; Princeton University, USA

FM3D.1 • 10:30 Invited
Generation of Quantum Light in a Photon-number Superposition, Pascale Senellart[1]; [1]*CNRS-C2N, France*. We report on the generation of pure quantum light states in a photon-number superpositions of zero-, one-, and even two-photons from the spontaneous emission of a single semiconductor quantum dot.

FM3D.2 • 11:00
Quantum dots in micropillar cavities for scalable photonic applications, Magdalena Mozcala-Dusanowska[1], Tobias Huber[1], Lukasz Dusanowski[1], Stefan Gerhardt[1], Jonathan Jurkat[1], Andreas Pfenning[1], Rinaldo Trotta[2], Armando Rastelli[3], Niels Gregersen[4], Christian Schneider[1], Sven Höfling[1,5]; [1]*Universität Würzburg, Germany;* [2]*Sapienza Univ. of Rome, Italy;* [3]*Johannes Kepler Universität Linz, Austria;* [4]*Technical Univ. of Denmark, Denmark;* [5]*SUPA, Univ. of St Andrews, UK*. Scalable quantum photonic applications require wavelength reproducibility and high quality of the emitted photons. To address these issues, we investigate strain-tuning of self-assembled semiconductor quantum dots embedded into micropillar cavities.

FM3D.3 • 11:15
Test of Local Realism into the Past without Detection and Locality Loopholes, Ming-Han Li[1], Cheng Wu[1], Yanbao Zhang[2], Wen-Zhao Liu[1], Bing Bai[1], Yang Liu[1], Weijun Zhang[3], Qi Zhao[4], Hao Li[3], Zhen Wang[3], Lixing You[3], W.J. Munro[2], Juan Yin[1], Jun Zhang[1], Cheng-Zhi Peng[1], Xiongfeng Ma[4], Qiang Zhang[1], Jingyun Fan[1], Jian-Wei Pan[1]; [1]*USTC, China;* [2]*NTT Corporation, Japan;* [3]*Chinese Academy of Sciences, China;* [4]*Tsinghua Univ., China*. We report a test of local realism utilizing the randomness with cosmic photons. We close locality and detection loopholes simultaneously, testing the null hypothesis against local hidden variable mechanisms for events happened 11 years ago.

FM3D.4 • 11:30 Invited
Hybrid Integration of Quantum Dot-nanocavity Systems on Silicon, Yasutomo Ota[1], Ryota Katsumi[2], Alto Osada[1], Masahiro Kakuda[1], Satoshi Iwamoto[1,2], Yasuhiko Arakawa[1]; [1]*Nanoquine, The Univ. of Tokyo, Japan;* [2]*Inst. of Industrial Science, The Univ. of Tokyo, Japan*. We discuss a transfer printing method for on-silicon hybrid integration. This technique simplifies the integration process of III-V quantum dots in nanocavities on CMOS-processed circuits, enabling single photon sources and cavity QED systems on Si.

Washington 5

LS

10:30–12:30
LM3E • Plasmonics and Nanophotonics I
Presider: Gary Wiederrecht; Argonne National Lab., USA

LM3E.1 • 10:30 Invited
Hot-Electron Generation in Plasmonic Metastructures: Size and Shape Matter, Alexander O Govorov[1,2]; [1]*UESTC, China;* [2]*Ohio Univ., USA*. Generation of nonthermalized hot electrons is an intrinsic property of any plasmonic nanostructure under illumination. This talk describes the physical principles to design metastructures with a high efficiency of generation of plasmonic electrons.

LM3E.2 • 11:00 Invited
Photothermal Effects localized by Plasmonic Nanoparticles: from Cancer Therapy to Desalination Naomi J. Halas[1]; [1]*Rice Univ., USA*. Biocompatible nanoparticles that absorb light at wavelengths of high tissue transparency have been shown to be highly effective for photothermal cancer therapy: this same localized heating effect also substantially boosts efficiencies in solar desalination devices.

LM3E.3 • 11:30
Topological lasers generating and multiplexing large orbital angular momenta, Abdoulaye Ndao[1]; [1]*UC Berkeley, USA*. We report the first room-temperature integrated topological lasers directly generating and multiplexing coherent beams carrying arbitrarily large orbital angular momenta.

LM3E.4 • 11:45
Manifestation of Plasmon-Induced Transparency in Photonic Crystal Slab Coupled to Terahertz Metasurface, Chan Kyaw[1], Riad Yahiaoui[1], Zizwe Chase[1], Ranjan Singh[2,3], Thomas Searles[1]; [1]*Howard Univ., USA;* [2]*Division of Physics and Applied Physics, Nanyang Technical Univ., Singapore;* [3]*The Photonics Inst., Centre for Disruptive Photonic Technologies, Singapore*. Here, we utilize the dipolar eigenmode of split ring resonators coupled to the in-plane resonance of a thin, planar photonic-crystal slab to demonstrate a plasmonic analog of electromagnetically induced transparency in the terahertz (THz) regime.

Washington 6

FiO

10:30–12:30
FM3F • Spectral and Endoscopic Diagnosis on Cells and Tissues
Presider: Alvaro Casas-Bedoya; University of Sydney, Australia

FM3F.1 • 10:30 Invited
Bringing a Medical Device to Market: Startup Perspective, Gennadi Saiko[1]; [1]*Swift Medical Inc., Canada*. We developed a non-invasive system that assesses the tissue physiology of the skin and wounds in various settings, including home care. Combining multispectral imaging with smartphone technology enables the delivery of an affordable and portable solution.

FM3F.2 • 11:00
Polarization Sensitive Ultra-thin Color Filter with Highly Structured Nano-column, Joo-Hwan Ko[1], Young Jin Yoo[1], Young Min Song[1]; [1]*School of Electrical Engineering and Computer Science (EECS), GIST, South Korea*. We demonstrate a polarization sensitive ultra-thin color filter with nano-columnar structure. This ultra-thin color filter can be fabricated simply and shows the birefringence property representing polarization sensitive color change.

FM3F.3 • 11:15
Fast 3D Imaging With Lensless Holographic Endoscopy Employing Coherent Fiber Bundles, Juergen W. Czarske[1], Elias Scharf[1], Robert Kuschmierz[1]; [1]*Technische Universität Dresden, Germany*. We present an ultrathin fiber endoscope with digital optical phase conjugation and novel self-calibration. Minimally invasive 3D imaging and stimulation with subcellular resolution is provided for biomedical applications such as optogenetics.

FM3F.4 • 11:30 Invited
SRS Imaging of Metabolic Dynamics in Animals, Lingyan Shi[1], Wei Min[2]; [1]*Bioengineering, Univ. of California, San Diego, USA;* [2]*Chemistry, Columbia Univ., USA*. We developed a new method that combines deuterium probing and SRS microscopy to visualize metabolic dynamics in live animals. This technique can track de novo lipogenesis, protein biosynthesis with subcellular resolution in situ.

Washington 1

Theme: Autonomous Systems

FM3A • LiDAR Sensors and Systems—Continued

FM3A.4 • 12:00 Invited
Detail in 3D, Paul S. Banks[1]; [1]*Tetravue Inc., USA.*To date, depth sensing solutions have been hampered because of coarse resolution or very short range operation. High resolution 3D imaging promise better situational awareness from autonomous vehicles to augmented reality.

Washington 2

Theme: Nanophotonics and Plasmonics

FM3B • Quantum and Active Nanophotonics—Continued

Washington 3

FiO

FM3C • Light Propagation and Transport in System—Continued

FM3C.6 • 12:00
Light Transport in 3-Dimensional Hyperuniform Dielectric Networks, Jakub Haberko[1], Luis S. Froufe-Perez[2], Frank Scheffold[2]; [1]*AGH Univ. of Science and Technology, Poland;* [2]*Univ. of Fribourg, Switzerland.* Hyperuniform structures are characterized by a specific type of short-range order. This results in the emergence of a photonic band gap for sufficiently large refractive index. Here we study light transport properties of such media.

FM3C.7 • 12:15
Superresolution using parity sorting with partially coherent light, Sultan Abdul Wadood[1], Julia Allen[2], Yiyu Zhou[1], Jing Yang[1], Miguel Alonso[1], Andrew Jordan[1], Robert Boyd[1], Nick Vamivakas[1]; [1]*Univ. of Rochester, USA;* [2]*Brighton High School, USA.* We demonstrate supperresolution for incoherent sources using parity sorting. Simulations are performed for superresolution using parity sorting of partially coherent sources. We show that anti-correlation increases the measurement sensitivity.

11:00–12:00 Building Your Personal Brand, *Wilson AB*

12:00–18:00 Laser Science Symposium on Undergraduate Research, *Hoover*

12:30–14:00 Lunch Break on your Own

12:30–14:00 OSA Therapeutic Laser Applications Technical Group Birds of a Feather Lunch, *Wilson AB*

FM3D • Quantum Photonics—Continued

FM3D.5 • 12:00
Indistinguishable Photons from Deterministically Integrated Single Quantum Dots in Heterogeneous GaAs/Si_3N_4 Quantum Photonic Circuits, Peter Schnauber[1], Anshuman Singh[2,3], Johannes Schall[1], Suk In Park[4], Jin Dong Song[4], Sven Rodt[1], Kartik Srinivasan[2,5], Stephan Reitzenstein[1], Marcelo I. Davanco[2]; *[1]TU Berlin, Germany; [2]NIST, USA; [3]Univ. of Maryland, USA; [4]Korea Inst. of Science and Tech., South Korea; [5]Joint Quantum Inst., Univ. of Maryland, USA.* With *in situ* electron beam lithography we deterministically integrate single InAs quantum dots into hybrid GaAs/Si_3N_4 waveguide circuits. We show on-chip quantum dot emission of single, post-selected indistinguishable photons into Si_3N_4 waveguides.

FM3D.6 • 12:15
On-Chip Photon-Pair Generation in the Near-Visible, Yun Zhao[1], Bok Young Kim[1], Prathamesh Donvalkar[1,2], Chaitali Joshi[1,2], Xingchen Ji[1,2], Yoshitomo Okawachi[1], Michal Lipson[1], Alexander L. Gaeta[1]; *[1]Columbia Univ., USA; [2]Cornell Univ., USA.* We demonstrate a silicon-chip-based narrow-band photon-pair source in the near-visible regime that is compatible with Rb-based quantum memories. We also derive a model that describes the photon spectrum incorporating dispersion and pump detuning.

LM3E • Plasmonics and Nanophotonics I—Continued

LM3E.5 • 12:00
Nanophotonic Structures for Broadband Nanoscale Electric Field Enhancement, Ganapathi Subramania[1], Stavroula Foteinopoulou[2]; *[1]Sandia National Laboratories, USA; [2]Univ. of New Mexico, USA.* Broadband electric field enhancement confined to nanoscale volumes can be very important for many sensing applications. A non-resonant response of a double-grooved thin-film metal-optic structure to the incident light enables this phenomenon.

LM3E.6 • 12:15
Dielectric Nanoantennas on Epsilon-Near-Zero Materials: the Promise for Nonlinear Optics at the Nanoscale, Davide Rocco[1,2], Costantino De Angelis[1,2], Domenico de Ceglia[3], Luca Carletti[3], Michael Scalora[4], Maria Antonietta Vincenti[1,2]; *[1]DII - Univ. of Brescia, Italy; [2]National Inst. of Optics, National Research Council, Italy; [3]DEI, Univ. of Padova, Italy; [4]Charles M. Bowden Research Center, CCDEVCOM AVMC, US Army, USA.* We demonstrate how to boost conversion and collection efficiency from dielectric nanoantennas by exploiting epsilon-near-zero materials to efficiently backscatter the generated harmonic light while not hampering conversion efficiency with losses.

FM3F • Spectral and Endoscopic Diagnosis on Cells and Tissues—Continued

FM3F.5 • 12:00
Towards Light Sheet Integral Field Raman Microspectroscopy, Elia A. Zegarra Valverde[1], Walter Müller[1], Rainer Heintzmann[1,2]; *[1]Leibniz Inst. of Photonic Technology, Germany; [2]Inst. of Physical Chemistry and Abbe Center of Photonics, Friedrich-Schiller-Univ. Jena, Germany.* To increase the imaging rate of Raman microspectroscopy, light sheet microscopy is combined with integral field spectroscopy. Preliminary results show hyperspectral Raman images of 50x50 channels with an integration time of 30 s.

FM3F.6 • 12:15
Lens-Free Interferometric Microscope for Point-of-Care Label-Free Detection of Sepsis Biomarkers, Roland A. Terborg[1], Luc Duempelmann[1], Josselin Pello[1], Alican Noyan[1], Filiz Yesilkoy[2], Alexander A. Belushkin[2], Yasaman Jahani[2], Nuria Fabri-Faja[3], Priyanka Dey[3], Olalla Calvo-Lozano[3], M.-Carmen Estevez[3], Anna Fabrega[4], Juan J. Gonzalez-Lopez[4], Laura M. Lechuga[3], Hatice Altug[2], Valerio Pruneri[1]; *[1]ICFO, Spain; [2]EPFL - École Polytechnique Fédérale de Lausanne, Switzerland; [3] Inst. of Nanoscience and Nanotechnology, Spain; [4]Hospital Universitari Vall d'Hebron, Spain.* We present an ultra-sensitive label-free point-of-care platform for potential early diagnosis of sepsis based on lens-free interferometric phase imaging and localized surface plasmon resonance.

11:00–12:00 Building Your Personal Brand, *Wilson AB*

12:00–18:00 Laser Science Symposium on Undergraduate Research, *Hoover*

12:30–14:00 Lunch Break on your Own

12:30–14:00 OSA Therapeutic Laser Applications Technical Group Birds of a Feather Lunch, *Wilson AB*

Washington 1

Theme: Autonomous Systems

14:00–15:30
FM4A • Autonomous Unmanned Vehicles
Presider: To be Announced

FM4A.1 • 14:00 Invited
Applications of Autonomous Agents in ISR Sensor Systems, Thomas J. Walls[1]; [1]*US Naval Research Laboratory, USA*. Dynamic self-control of ISR sensors and platforms to enable real-time, on-board data exploitation and fusion is a critical driver for future autonomous operations. Enabling architectures and the results of field experimentation will be presented.

FM4A.2 • 14:30 Invited
Title to be Determined, Charles Pippin[1]; [1]*Georgia Tech Research Inst., USA*. Abstract not available.

FM4A.3 • 15:00 Invited
Near-Earth Sensing with Aerial, Ground, and Marine Robots for Environmental Sciences, Pratap Tokekar[1]; [1]*Univ. of Maryland at College Park, USA*. A connected network of robots and smart sensors can solve grand challenges in domains such as agronomy, oceanography, and infrastructure monitoring.

Washington 2

Theme: Nanophotonics and Plasmonics

14:00–15:30
FM4B • Topological and Nonlinear Nanophotonics
Presider: Kiyoul Yang; Stanford Univ., USA

FM4B.1 • 14:00 Invited
A Few Recent Developments in Nanophotonics, Marin Soljacic[1]; [1]*MIT, USA*. I will present some of our recent results in the field of nanophotonics, including novel phenomena in topology, and new models of electromagnetic phenomena at the nano-scale.

FM4B.2 • 14:30 Invited
Title to be Announced, Amy C. Foster[1]; [1]*Johns Hopkins Univ., USA*. Abstract not available.

FM4B.3 • 15:00 Invited
Spin Hall Effect of Light in Photonic Materials, Graciana Puentes[1]; [1]*Universidad de Buenos Aires, Argentina*. Photonic Spin Hall Effect (PSHE) results in a spin-dependent transverse shift of light intensity. Here, we will explore novel applications of PSHE in the fast growing fields of photonic precision metrology and spin-based photonic devices.

Washington 3

FiO

14:00–15:30
FM4C • Metasurface, Graphene and Liquid Crystal Lenses and Low Coherence Laser
Presider: Yunlong Sheng; Universite Laval, Canada

FM4C.1 • 14:00
Single-layer Planar Metasurface Lens with >170° Field of View, Mikhail Y. Shalaginov[1], Sensong An[2], Fan Yang[1], Peter Su[1], Anuradha Agarwal[1], Hualiang Zhang[2], Juejun Hu[1], Tian Gu[1]; [1]*Massachusetts Inst. of Technology, USA;* [2]*Univ. of Massachusetts Lowell, USA*. We demonstrated the first single-layer metasurface lens on a flat substrate capable of performing diffraction-limited focusing over >170° field of view (FOV). Wide-angle diffraction-limited imaging was also experimentally validated.

FM4C.2 • 14:15
A fiber tip graphene oxide lens towards fiber optic endoscope application, Guiyuan Cao[1], Han Lin[1], Xiaosong Gan[1], Baohua Jia[1]; [1]*Swinburne Univ. of Technology, Australia.* A graphene oxide (GO) ultrathin flat lens was fabricated on the tip of a single mode fiber. The GO lens is able to focus light from the fiber down to subwavelength resolution of 0.87λ.

FM4C.3 • 14:30
Design of Aspheric Rotation Optics, Ingo Sieber[1]; [1]*Inst. of Automation and Applied Informatics, Karslruhe Inst. of Technology, Germany.* Design of a novel varifocal freeform optics with aspheric surface profiles to reduce aberration effects. Its focal length will be tuned by rotating one of two helically formed lens bodies around the optical axis.

FM4C.4 • 14:45
On-chip low spatially coherent laser with directional emission, Kyungduk Kim[1], Stefan Bittner[1], Yongquan Zeng[2], Seng Fatt Liew[1], Qijie Wang[2], Hui Cao[1]; [1]*Yale Univ., USA;* [2]*Nanyang Technological Univ., Singapore*. We design and fabricate an electrically pumped semiconductor laser producing a directional beam with low spatial coherence. The device features decoherence time of a few nanoseconds, which will enable ultrafast speckle-free imaging and sensing.

FM4C.5 • 15:00 Invited
Variable Liquid Crystal Lens, Tigran V. Galstian[1]; [1]*Universite Laval, Canada*. We shall describe few electrically tunable liquid crystal lens designs that enable mobile imaging, accommodative vision, adaptive micro endoscopy, and smart lighting. Key design requirements for those applications and trade-offs will be discussed.

14:15–15:15 40 Top Jobs For STEM PhDs. Which Is Right For You?, *Wilson AB*

15:00–16:00 Meet OSA's Journal Editors, *Exhibit Hall B South (via the Washington rooms hallway)*

15:30–16:00 Coffee Break, *Washington Rooms Foyer*

15:30–16:30 Power Negotiating Your Salary Offer - How PhDs Get Paid What They Are Worth, *Wilson AB*

Washington 4

LS

14:00–15:30
LM4D • Quantum Science I
Presider: Hailin Wang; University of Oregon, USA

LM4D.1 • 14:00 Invited
The Quantum Optical Frequency Comb as a Quantum Computing Platform, Olivier Pfister[1]; [1]*Univ. of Virginia, USA.* Continuous-variable quantum information in quantum optical fields can be used to generate record-size cluster entangled states, engineered for quantum computing, in the quantum optical frequency comb of a single optical parametric oscillator.

LM4D.2 • 14:30 Invited
Control and Measurement of Quantum Optical Pulses, Brian J. Smith[1,2], Alex O. Davis[2,3], Valerian Thiel[1,2], Michal Karpinski[2,4]; [1]*Univ. of Oregon, USA;* [2]*Physics, Univ. of Oxford, UK;* [3]*Laboratoire Kastler Brossel, Sorbonne Universités, France;* [4]*Faculty of Physics, Univ. of Warsaw, Poland.* Deterministic modification of quantum pulses within an integrated optical platform by application of spectral and temporal phase modulation is presented. Using this technique we characterize quantum pulses by spectral shearing interferometry.

LM4D.3 • 15:00
Flexible engineering of quantum state using multi-stage nonlinear interferometer, Jiamin Li[1], Jie Su[1], Liang Cui[1], Xiaoying Li[1], Z. Y. Ou[2,1]; [1]*Tianjin Univ., China;* [2]*Indiana Univ.-Purdue Univ., USA.* Using spontaneous four-wave mixing in a 3-stage nonlinear interferometer for temporal mode shaping, we efficiently generate heralded single photons in telecom band with near ideal modal purity and heralding efficiency.

LM4D.4 • 15:15
Supersymmetric Microring Laser Arrays, Bikashkali Midya[1], Han Zhao[1], Xingdu Qiao[1], Pei Miao[1], Wiktor Walasik[2], Zhifeng Zhang[1], Natalia M. Litchinitser[2], Liang Feng[1]; [1]*Univ. of Pennsylvania, USA;* [2]*Duke Univ., USA.* We report the first observation of highly-efficient, low-threshold, and single transverse-mode lasing in a class III-V semiconductor microring laser array designed according to the principle of supersymmetric (SUSY) quantum mechanics.

Washington 5

FiO

14:00–15:30
FM4E • Optomechanical, PT-symmetric and Nonlinear Photonic Systems
Presider: Marcelo Davanco; NIST, USA

FM4E.1 • 14:00 Invited
Coherent diamond nano-optomechanics for spin control, Paul E. Barclay[1]; [1]*Univ. of Calgary, Canada.* Diamond optomechanical devices can support reservoir engineered optical memories and two color all optical switching. We report on these recent demonstrations and on efforts to use these devices for spin-optomechanics.

FM4E.2 • 14:30
Molecular Optomechanical Frequency Upconversion at the Single-photon Level, Philippe Roelli[1], Diego-Martin Cano[2], Tobias Kippenberg[1], Christophe Galland[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland;* [2]*Max Planck Inst. for the Science of Light, Germany.* We investigate an optomechanical platform to up-convert MIR-THz photons to the optical domain. The conversion enabled by molecular transducers inside nano-antennas can reach single photon sensitivity, opening new MIR-THz detection opportunities.

FM4E.3 • 14:45
Exceptional Point Transition of Electrically Pumped Photonic Crystal Nanolasers, Kenta Takata[1], Kengo Nozaki[1], Eiichi Kuramochi[1], Shinji Matsuo[1], Koji Takeda[1], Takuro Fujii[1], Shota Kita[1], Akihiko Shinya[1], Masaya Notomi[1]; [1]*NTT Nanophotonics Center, Japan.* We experimentally demonstrate the first exceptional point transition of two electrically pumped photonic crystal lasers. Clear spectral coalescence and enhancement by the process are observed via high-Q nanocavities with controlled current injection.

FM4E.4 • 15:00
Observation of anomalous Floquet insulator edge states in periodically-driven silicon photonic topological microresonator lattices, Shirin Afzal[1], David Perron[1], Tyler Zimmerling[1], Yang Ren[1], Vien Van[1]; [1]*Univ. of Alberta, Canada.* We realized a Floquet topological photonic insulator by using a square lattice of coupled octagonal resonators to emulate periodically-driven systems. Direct imaging of the edge states verifies the nontrivial topological behaviour of the lattice.

FM4E.5 • 15:15
Chip-Integrated Soliton Microcombs at Cryogenic Temperatures, Gregory Moille[1,2], Xiyuan Lu[1,2], Qing Li[1,3], Ashutosh Rao[1,2], Daron Westly[1], Leonardo Ranzani[4], Mohammad Soltani[4], Scott Papp[5,6], Kartik Srinivasan[1,7]; [1]*NIST., USA;* [2]*Univ. of Maryland, USA;* [3]*Carnegie Mellon Univ., USA;* [4]*Raytheon BBN Technologies, USA;* [5]*Time and Frequency Division, NIST., USA;* [6]*Univ. of Colorado, USA;* [7]*Joint Quantum Inst., NIST/Univ. of Maryland, USA.* We study Si3N4 microresonator combs at cryogenic temperatures. A large reduction of thermorefractive coefficient enables thermally-stable Kerr single solitons straightforwardly. Potential thermo-refractive noise reduction is also discussed.

Washington 6

FiO

14:00–15:30
FM4F • Structured Materials
Presider: Maciej Szkulmowski; Nicolaus Copernicus University, Poland

FM4F.1 • 14:00 Invited
Design and Engineering of Aperiodic Optical Nanostructures for Photonics, Luca Dal Negro[1]; [1]*Dept. of Electrical and Computer Engineering, Boston Univ., USA.* In this talk, I will discuss the theory, design, and engineering of aperiodic nanostructures and I will address focusing and directional light control for imaging and spectroscopic applications in the visible and infrared spectral ranges.

FM4F.2 • 14:30
Trapping nanoparticles with nearfield plasmonic tweezers, Theodoros Bouloumis[1], Xue Han[1], Domna Kotsifaki[1], Viet Giang Truong[1], Sile Nic Chormaic[1]; [1]*Light-Matter Interactions for Quantum Technologies, Okinawa Inst. of Science and Technology, Japan.* We present multiple polystyrene nanoparticle trapping at extremely low laser intensity, using a patterned gold array. High experimental trapping stiffness is obtained, in very good agreement with simulated values.

FM4F.3 • 14:45
Nonlinear Orbital Angular Momentum Generation by WS_2-Nanohole Hybrid Metasurfaces, Wenchao Zhao[1], Kai Wang[1], Peixiang Lu[1]; [1]*Huazhong Univ. of Science and Tech., China.* A nonlinear orbital angular momentum (OAM) beam was obtained by tungsten disulfide–gold nanohole hybrid metasurfaces. We determinate the topological charges of the optical vortex beam by using the coaxis metasurface interferometry, which were ~2.

FM4F.4 • 15:00
Anderson Localization by Virtual Transitions Only, Alex Dikopoltsev[1], Hanan H. Sheinfux[1,2], Mordechai Segev[1]; [1]*Technion, Israel;* [2]*ICFO, Spain.* We show that virtual transitions can cause Anderson localization, without any first-order scattering processes. Such high-order scattering leads to new mobility edges and short localization lengths even in directions where disorder does not exist

FM4F.5 • 15:15
Maximal Concentration of Optical Beams, Hyungki Shim[1], Haejun Chung[1], Owen Miller[1]; [1]*Yale University, USA.* We derive general bounds to optical superresolution, i.e., maximum intensity for optical beams from arbitrary wavefront-shaping devices that break the diffraction "limit." We use inverse design to discover metasurfaces operating close to our bounds.

Washington 1

Theme: Autonomous Systems

16:00–18:00
FM5A • Panel On Connectivity and Cyber-Security for Autonomous Systems
Presider: To be Announced

One of the major challenges for Autonomous vehicles is that in-vehicle networks, infotainment, and safety applications will generate and consume vast over-the-air real-time data streams at speeds of up to 24 Gbps, thanks to wireless communication and 5G cellular networks. Analysts envision that connected cars will send 25 gigabytes of data to the cloud every hour, using analytics to fuel and optimize complex, interdependent applications, making driving safer for everyone. Edge computing will also play a likely role in the networking. One other worry is that the communication systems between AV's and infrastructure present remote attack access for hackers to exploit system weaknesses and vulnerabilities.

Panelists:
John D'Ambrosia, *Futurewei, USA*
Steven Carlson, *High Speed Design Inc, USA*

Washington 2

Theme: Nanophotonics and Plasmonics

16:00–18:00
FM5B • Active Nanoplasmonics and Metamaterials
Presider: To be Announced

FM5B.1 • 16:00 Invited
III-V Nonlinear Nanoantennas for Frequency Conversion, Dragomir N. Neshev[1]; [1]*Australian National Univ., Australia.* We review the recent advances in nonlinear frequency conversion in III-V semiconductor nanoantennas. We demonstrate the control of directionality of emission in the processes of second-harmonic generation and spontaneous parametric down conversion.

FM5B.2 • 16:30 Invited
A Plasmon's Horizon and Beyond, Thomas Klar[1]; [1]*Johannes Keppler Univ. Linz, Austria.* Some fundamental concepts of plasmonics will be discussed such as the limited lifetime causing a finite horizon. Further, quantization of plasmons and electrons will be taken seriously, beyond the usual tunnelling aspect of "quantum plasmonics".

FM5B.3 • 17:00
Withdrawn

Washington 3

FiO

16:00–18:00
FM5C • Nano-Materials, Structure and Physics
Presider: Roland Terborg; ICFO -Institut de Ciencies Fotoniques, Spain

FM5C.1 • 16:00 Invited
Advanced Materials for Next Generation EO/IR Sensors, Clara Rivero-Baleine[1]; [1]*Lockheed Martin, USA.* Next generation Electro-Optical / Infrared (EO/IR) sensors will require innovative materials that can be engineered to serve complex optical functions. Here we highlight how these properties can be tailored to enable next generation EO/IR sensors.

FM5C.2 • 16:30
Dimensionality Reduction Based Method for Design and Optimization of Optical Nanostructures Using Neural Network, Mohammadreza Zandehshahvar[1], Omid Hemmatyar[1], Yashar Kiarashinejad[1], Sajjad Abdollahramezani[1], Ali Adibi[1]; [1]*Georgia Inst. of Technology, USA.* Here, we leverage a machine learning technique as an efficient alternative approach to traditional optimization techniques to significantly reduce the computation cost of the forward design problem in the optimization process of optical devices.

FM5C.3 • 16:45
Size-Selective Optical Printing of Silicon Nanoparticles through Their Dipolar Magnetic Resonance, Cecilia Zaza[1,4], Ianina L. Violi[1], Julian Gargiulo[2], German Chiarelli[1,4], Ludmila Schumacher[3], Jurij Jacobi[3], Jorge Olmos[5], Emiliano Cortes[2,6], Matthias König[3], Stephan Barcikowski[3], Sebastian Schlücker[3], Juan J. Saenz[5,7], Stefan A. Maier[2,6], Fernando D. Stefani[1,4]; [1]*CIBION-CONICET, Argentina;* [2]*Imperial College London, UK;* [3]*(CENIDE), Univ. of Duisburg-Essen, Germany;* [4]*Departamento de Física, Facultad de Ciencias Excatas y Naturales, UBA, Argentina;* [5]*Donostia International Physics Center (DIPC), Spain;* [6]*Ludwig-Maximilians-Universität München, Germany;* [7]*, Basque Foundation for Science, Spain.* Surfactant-free silicon nanoparticles of a predefined and narrow (σ < 10 nm) size range can be selectively immobilized on a substrate by optical printing from a polydisperse colloidal suspension.

FM5C.4 • 17:00
Structural Colors by Fano-resonances Supported in All-dielectric Metasurfaces Made of HfO_2, Omid Hemmatyar[1], Sajjad Abdollahramezani[1], Yashar Kiarashinejad[1], Mohammadreza Zandehshahvar[1], Ali Adibi[1]; [1]*Georgia Inst. of Technology, USA.* Leveraging sharp Fano-resonances supported by an all-dielectric metasurface (MS) fabricated from high-index HfO_2 nanoparticles (NPs), with zero loss in the visible range, we demonstrate a high contrast structural color with wide color gamut map.

FM5C.5 • 17:15
Withdrawn

Washington 4

LS

16:00–18:00
LM5D • Quantum Science II
Presider: Olivier Pfister; University of Virginia, USA

LM5D.1 • 16:00 Invited
Superconducting Nanowire Single-Photon Detectors, Karl Berggren[1]; [1]*Massachusetts Inst. of Technology, USA.* SNSPDs demonstrate sub-10ps jitter performance, imaging & photon-number-resolving capabilities attributed to their unique electrical, thermal & optical physical properties.These properties & possible extensions of SNSPD technology will be discussed.

LM5D.2 • 16:30 Invited
Superconducting Cavity Electro-Optics for Efficient Microwave-to-Optics Conversion, Hong Tang[1]; [1]*Yale University, USA.* We demonstrate microwave-to-optical photon conversion within a superconducting/photonic cavity, which integrates a superconducting resonator and a high Q AlN microrings Internal conversion efficiency of 26% and on-chip efficiency of 2% are realized.

LM5D.3 • 17:00 Invited
Rare-earth Atoms in Solids for Quantum Photonics, Elizabeth A. Goldschmidt[1]; [1]*US Army Research Laboratory, USA.* Rare-earth atoms in solids are an attractive candidate system for quantum optics due to their long coherence times and solid-state nature. We study the impact of inhomogeneous broadening on coherent optical processes in such systems

Washington 5

FiO

16:00–17:30
FM5E • Quantum Emitters
Presider: Sam Carter; Naval Research Lab, USA

FM5E.1 • 16:00 Invited
Organic Molecules for Quantum Technologies, Costanza Toninelli[1]; [1]*Univ. of Florence, Italy.* I will discuss how the huge flexibility of organic materials, brought at the single emitter level and combined with an integrated nanophotonic platform, can have immediate impact in quantum sensing, communication and metrology.

FM5E.2 • 16:30
Deterministically activated color centers in hBN coupled to plasmonic and microcavity systems, Nicholas Proscia[1], Harishankar Jayakumar[1], Robert Collison[1], Zav Shotan[1], Xiaochen Ge[2], Weidong Zhou[2], Carlos Meriles[1], Vinod Menon[1], Gabriel Lopez-Morales[1]; [1]*CUNY City College of New York, USA;* [2]*Univ. of Texas Arlington, USA.* We demonstrate coupling of hBN defect emission to Si_3N_4 microdisk cavities and high-Q plasmonic surface lattice resonances by using the topography of the photonic elements to engineer strain-activated color centers within the element's field-mode.

FM5E.3 • 16:45
Three-Quantum Dot Superradiance in a Photonic Crystal Waveguide Enabled by Scalable Strain Tuning, Joel Q. Grim[1], Allan S. Bracker[1], Maxim Zalalutdinov[1], Sam Carter[1], Alex C. Kozen[1], Mijin Kim[1], Chul Soo Kim[1], Jerome Mlack[1], Michael K. Yakes[1], Bumsu Lee[1], Dan Gammon[1]; [1]*US Naval Research Laboratory, USA.* We demonstrate scalable quantum interactions between quantum dots embedded in the same waveguide. The dots are tuned into resonance using laser-patterned strain with a step size down to the homogeneous linewidth and sub-micron spatial resolution.

FM5E.4 • 17:00
Supersensitive Optical Phase Measurement using Deterministically Generated Multiphoton Entangled State, Giora Peniakov[1]; [1]*Technion, Israel.* We use a multiphoton Greenberger-Horne-Zeilinger state to demonstrate optical phase measurement with sensitivity that beats the standard quantum limit. The state is produced deterministically at rates which exceed 300 MHz from a single point source.

FM5E.5 • 17:15
The True Origins of the Green Luminescence in the "Zero-dimensional" Perovskite Cs_4PbBr_6, Nicolas N. Riesen[1,2], Mark Lockrey[3,4], Kate Badek[5], Tanya Monro[1,6], Hans Riesen[5]; [1]*Univ. of South Australia, Australia;* [2]*The Univ. of Adelaide, Australia;* [3]*The Australian National Univ., Australia;* [4]*Univ. of Technology Sydney, Australia;* [5]*The Univ. of New South Wales, Australia;* [6]*Defence Science and Technology, Australia.* Amongst significant debate we provide conclusive proof showing that the green luminescence from Cs_4PbBr_6 perovskitesis in fact due to nanocrystalline $CsPbBr_3$ impurities. This is verified with cathodoluminescence imaging and EDX measurements.

Washington 6

FiO

16:00–18:00
FM5F • Optical and Acoustic Label-free Imaging on Biological Tissues
Presider: Felix Fanjul-Velez; University of Cantabria, Spain

FM5F.1 • 16:00 Invited
Advanced Concepts for Quantitative Doppler OCT, Christoph K. Hitzenberger[1]; [1]*Medizinische Universität Wien, Austria.* We present new concepts for improved quantitative blood flow measurements by Doppler OCT like multi-beam OCT and scan patterns along vessel traces. Methods and results achieved in the human retina are presented.

FM5F.2 • 16:30
Shedding Light onto Two Spatiotemporal Optical Coherence Manipulation (STOC) Implementations, Piotr F. Wegrzyn[1,2], Dawid Borycki[1], Maciej Wojtkowski[1]; [1]*Inst. of Physical Chemistry PAS, Poland;* [2]*Faculty of Physics, Univ. of Warsaw, Poland.* We introduce and apply spatiotemporal optical coherence manipulation (STOC) technique in two experimental configurations. The presented differences could be used in design optimization for imaging systems based on optical coherence tomography (OCT).

FM5F.3 • 16:45
Withdrawn

FM5F.4 • 17:00 Invited
High Resolution 3D Imaging Platform for In Vivo Assessment of Preclinical Murine Models, Weylan Thompson[1], Diego Dumani[2,3], Anthony Yu[2,3], Hans-Peter Brecht[1], Vassili Ivanov[1], Stanislav Emelianov[2,3], Sergey Ermilov[1]; [1]*PhotoSound Technologies, Inc., USA;* [2]*Georgia Inst. of Tech. and Emory Univ. School of Medicine, USA;* [3]*School of Electrical and Computer Engineering, Georgia Inst. of Tech., USA.* The platform integrates photoacoustic tomography and fluorescence enabling in vivo molecular 3D imaging of murine models. It addresses known deficiencies in sensitivity, anatomic registration, and spatial resolution of the individual modalities.

Washington 1

Theme: Autonomous Systems

FM5A • Connectivity and Cybersecurity—Continued

Washington 2

Theme: Nanophotonics and Plasmonics

FM5B • Active Nanoplasmonics and Metamaterials—Continued

FM5B.4 • 17:30 Invited

TiN Plasmonic Nanostructures: Highly Metallic Behavior with Low Loss, Evelyn Hu[1], Mena Gadalla[1], Andrew Greenspon[1]; [1]*John A. Paulson School of Engineering and Applied Sciences, Harvard Univ., USA*. TiN plasmonic nanostructures formed by sputter deposition exhibit high metallic behavior as well as low loss. NSOM is used analyze nanoscale antenna resonances; Surface Plasmon Polaritons exhibit propagation lengths as long as 10 microns.

Washington 3

FiO

FM5C • Nano-Materials, Structure and Physics—Continued

FM5C.6 • 17:30 Invited

Exploiting Novel Multi-Pulse Induced Physics for Fabrication, Boyang Zhou[1], Xiaoming Yu[1]; [1]*Univ. of Central Florida, USA*. By controlling laser-induced ultrafast dynamics in solids, it is possible to develop novel fabrication techniques that improve resolution, throughput, and energy efficiency.

16:45–18:00 The Rules of Engagement: Navigating Important Business Relationships, *Wilson AB*

17:00–18:00 OIDA Networking Happy Hour

18:00–19:00 OSA Fiber Optics Technology Technical Group Rapid-Fire Presentation & Networking Event, *Washington 1*

18:30–21:00 FiO + LS Awards Ceremony & Reception, *Carnegie Institution for Science*
(Separate Registration Required)

18:30–19:00 Explore DC - OSA Student Member Walking Tour of the Monuments, *World War II Memorial*

19:00–22:00 FiO Student Member Party, *The Brighton 949 Wharf St. SW*

Washington 4

LS

LM5D • Quantum Science II—Continued

LM5D.4 • 17:30
Coupling Silicon Vacancy Centers in a Thin Diamond Membrane to a Silica Optical Microresonator, Abigail Pauls[1], Ignas Lekavicius[1], Hailin Wang[1]; *[1]Univ. of Oregon, USA.* Silicon vacancy centers in a thin diamond membrane are coupled to whispering-gallery-modes in a silica optical microresonator with tunable resonance frequencies. This system should enable the achievement of good cavity limit in cavity-QED.

LM5D.5 • 17:45
Spectral manipulation of telecom single photons by aperiodic electro-optic time-lensing system, Filip Sosnicki[1], Michal J. Mikolajczyk[1], Ali Golestani[1], Michal Karpinski[1]; *[1]Faculty of Physics, Univ. of Warsaw, Poland.* We experimentally show an optically-driven, electro-optic time lens employing a photodiode as an electronic signal source. We combine two of those achieving a stable time-lensing system, used for spectral manipulation of telecom single photons.

Washington 5

FiO

FM5E • Quantum Emitters—Continued

Washington 6

FiO

FM5F • Optical and Acoustic Label-free Imaging on Biological Tissues—Continued

FM5F.5 • 17:30
Indocyanine Green-Enhanced Dual Photoacoustic Microscopy and Fluorescence Imaging for Visualization of Choroidal Neovascularization in a Rabbit Model, Phuc Nguyen[2,1], Yannis Paulus[2,3], Xueding Wang[3], Yanxiu Li[2], Jessica Henry[2], Michael Aaberg[2], Wei Zhang[3]; *[1]NTT Hi-tech Inst., Nguyen Tat Thanh Univ.,, Viet Nam; [2]Kellogg Eye Center, Dept. of Ophthalmology and Visual Sciences, Univ. of Michigan, USA; [3]Dept. of Biomedical Engineering, Univ. of Michigan, USA.* This study evaluates the potential of indocyanine green as an organic contrast agent for multimodal photoacoustic microscopy (PAM) and planar fluorescence imaging to non-invasively visualize choroidal neovascularization in rabbits

FM5F.6 • 17:45
Parallelized 3D microscopy based on reconfigurable incoherent light-sheet array multiplexing, Yuxuan Ren[1], Jianglai Wu[1], Queenie Iai[1], Kenneth Wong[1], Kevin Tsia[1]; *[1]The Univ. of Hong Kong, Hong Kong.* We demonstrate a new type of parallelized volumetric fluorescence imaging without any scanning mechanism, coined coded light-sheet array microscopy, based upon reconfigurable incoherent light-sheet array and multiplexed plane-wide encoding.

16:45–18:00 The Rules of Engagement: Navigating Important Business Relationships, *Wilson AB*

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19:00–22:00 FiO Student Member Party, *The Brighton 949 Wharf St. SW*

Washington 2

Theme:
Nanophotonics and Plasmonics / FiO

08:00–09:00
FTu1B • Nonlinear Nano- and Biophotonics
Presider: Ortwin Hess; Imperial College London, UK

FTu1B.1 • 08:00 Invited
Colour Engineering: Form Nature to Applications, Silvia Vignolini[1]; [1]*Cambridge Univ., UK*. The most brilliant colours in nature are obtained by nano-structuring biopolymers. Here, I will introduce striking example of natural photonic structures and review our advances to fabricate bio-mimetic photonic structures using the same material as nature.

FTu1B.2 • 08:30 Invited
How Light Behaves When the Refractive Index Vanishes, Robert W. Boyd[1]; [1]*Univ. of Ottawa, Canada*. We describe recent studies of the linear and nonlinear optical properties of materials that possess a near-vanishing dielectric permittivity and refractive index. Such materials provide very large nonlinear responses with important applications in photonics.

Washington 3

FiO

08:00–09:00
FTu1C • Optical Interconnects
Presider: Lyuba Kuznetsova; San Diego State University, USA

FTu1C.1 • 08:00 Invited
Efficient Optical Interconnects through Photonic-Electronic Co-design Approaches, Odile Liboiron-Ladouceur[1]; [1]*McGill University, Canada*. Silicon photonics allow for denser functionalities with greater bandwidth to meet the requirements of large-scale computing platforms (e.g., data centers). This talk discusses photonic-electronic co-designs towards efficient data communications.

FTu1C.2 • 08:30
Guiding Light in Waveguide Superlattice Bends, Robert Gatdula[1,2], Siamak Abbaslou[1,2], Ming Lu[3], Aaron Stein[3], Wei Jiang[1,2]; [1]*Electrical and Computer Engineering, Rutgers, The State Univ. of New Jersey, USA;* [2]*Inst. for Advanced Materials, Devices & Nanotechnology, Rutgers, The State Univ. of New Jersey, USA;* [3]*Center for Functional Nanomaterials, Brookhaven National Laboratory, USA*. Waveguide superlattices increase integrated optical channel density. However, flexible routing requires bending of them. We explore physical mechanisms in waveguide superlattice bends and demonstrate crosstalk ≤ -19.5 dB at 5~15 μm bending radii.

FTu1C.3 • 08:45
Yield Prediction for Coupled-Resonator Optical Waveguides Using Variation-Aware Compact Models, Sally I. Elhenawy[1], Christopher Lang[1], Duane S. Boning[1]; [1]*Massachusetts Inst. of Technology, USA*. We present a model for coupled-resonator optical waveguides (CROWs). A variation-aware Compact model provides CROW component S-parameters under varying spatial design perturbations, allowing efficient Monte-Carlo simulations and yield prediction.

10:00–15:30 Science & Industry Showcase, *Visit page 12 for a complete program schedule.*

10:00–10:30 Coffee Break, *Science & Industry Showcase Coffee Break Area*

Washington 4

FiO / Theme: Quantum Technologies

08:00–09:00
LTu1D • Quantum Science III
Presider: Brian Smith; University of Oregon, USA

LTu1D.1 • 08:00 Invited
Communicating via Ignorance & Imaging via Counting, Andrew G. White[1,2]; [1]*Centre for Engineered Quantum Systems, Australia;* [2]*School of Mathematics and Physics, Univ. of Queensland, Australia.* We use quantum technologies to improve communication & imaging, using: indefinite causal order to transmit information through a completely noisy channel; & photon-counting to image an order-of-magnitude more precisely than with traditional methods.

LTu1D.2 • 08:30
Optimising Photon-Pair Generation with Hybrid Optical Fibre, Oliver Gibson[1], Peter Mosley[1]; [1]*Univ. of Bath, UK.* We present the design and engineering of hybrid optical fibre incorporating air holes and high-index rods to realise simultaneous photon-pair generation and noise suppression.

LTu1D.3 • 08:45
Generation of Correlated Photon-Pairs in Short Thin-Film Lithium-Niobate Waveguides, Bradley S. Elkus[1], Kamal Abdelsalam[2], Ashutosh Rao[2], Vesselin Velev[1], Sasan Fathpour[2], Prem Kumar[1], Gregory Kanter[1]; [1]*Northwestern Univ., USA;* [2]*CREOL, Univ. of Central Florida, USA.* We generate photon-pairs in signal-idler channels separated by up to 120 nm with high coincidence-to-accidental ratios using a 300-μm-long periodically-poled lithium-niobate ridge waveguide bonded to silicon.

09:15–10:00
FTu2A • Visionary - Mohan Trivedi
Presider: To be Announced

FTu2A.1 • 09:15 VISIONARY
Autonomous Vehicles: Vision, Illusion and Realization, Mohan Trivedi[1]; [1]*Computer Vision and Robotics Research Laboratory, Univ. of California at San Diego, USA.* Autonomous vehicles are no longer restricted to science fiction or to specialized research laboratories. They are rapidly becoming available on public roads for a range of mobility modes, including taxis, freight trucks, delivery robots and personal vehicles. We will discuss how we have arrived at this exciting point in time and what issues require deeper, critical examinations and careful resolution to assure safe, reliable and robust operation of these highly complex systems.

Washington 5

LS

08:00–09:00
FTu1E • Quantum Photonics & Information Security
Presider: To be Announced

FTu1E.1 • 08:00 Invited
Long Distance Quantum Networks based on Color Centers in Diamond, Nathalie de Leon[1]; [1]*Princeton University, USA.* We have developed new methods to stabilize SiV^0 in diamond, and observe T_1>1 minute at 4K, and >90% of its emission into its zero phonon line, making it a promising single atom quantum memory for long distance quantum networks.

FTu1E.2 • 08:30
High quality photon pair generation with on-chip filtering, Dorian Oser[2], Florent Mazeas[1], Carlos Alonso Ramos[2], Xavier Le Roux[2], Laurent Vivien[2], Sébastien Tanzilli[1], Eric Cassan[2], Laurent Labonte[1]; [1]*INPHYNI, Université Côte d'Azur, CNRS, France;* [2]*C2N, Univ. of Paris-Saclay, France.* We demonstrate the production simultaneously of multiplexed pairs with near-perfect quality achieved using a ring resonator and a cascaded multimode filter which acts as pump filter (> 60dB) without any active tuning.

FTu1E.3 • 08:45
Highly nonlinear amorphous silicon micro-cavity as a platform for secure authentication, Neil S. MacFarlane[1], Jasper Stroud[1], A. Brinton Cooper[1], Mark A. Foster[1], Amy C. Foster[1]; [1]*Johns Hopkins Univ., USA.* We demonstrate the unclonability of an integrated photonic chaotic micro-cavity using highly nonlinear hydrogenated amorphous silicon (a-Si:H) as the material platform. Ultrafast pulses are used to characterize the uniqueness of our devices.

09:15–10:00
LTu2B • Visionary - Jelena Vuckovic
Presider: Prem Kumar; Northwestern University, USA

LTu2B.1 • 09:15 VISIONARY
Optimized (Quantum) Photonics, Jelena Vuckovic[1]; [1]*Stanford Univ., USA.* Combining state of the art optimization and machine learning techniques with high speed electromagnetic solvers offers a new approach to "inverse" design and implement classical and quantum photonic circuits with superior properties, including robustness to errors in fabrication and temperature, compact footprints, novel functionalities, and high efficiencies.

Washington 6

FiO

08:00–09:00
FTu1F • Molecular Contrast and Detection on Cells and Tissues
Presider: Szu-Yu Chen; National Central University, Taiwan

FTu1F.1 • 08:00 Invited
Quantitative Cytopathology of Breast Cancer, Anna N. Yaroslavsky[1]; [1]*Univ. of Massachusetts Lowell, USA.* Quantitative cancer detection method utilizing fluorescence polarization imaging of aqueous methylene blue will be presented. It holds the potential to provide unique capability to detect cancer accurately and rapidly *in vivo* at the cellular level.

FTu1F.2 • 08:30
In vivo animal image-guided surgery by fluorescence imaging applied to nerve, Felix Fanjul-Velez[1], Alvaro Marcelino Díaz-Martínez[2], Emilio Garro-Martínez[1,2], José Luis Arce-Diego[1]; [1]*Univ. of Cantabria, Spain;* [2]*Cantabria Biomedicine and Biotechnolgoy Inst., Spain.*Biological tissues identification is of utmost relevance in guided surgery. Nerve contrast is particularly critical, as undesired damage could cause severe collateral effects on patients. Fluorescence imaging could contribute to this aim.

FTu1F.3 • 08:45
***In Vivo* Super-Resolution Optical Localization for Imaging Neuron Activity Throughout the Brain,** Justin Patel[1], Brian Z. Bentz[1], Dergan Lin[1], Kevin J. Webb[1]; [1]*Purdue University, USA.* A super-resolution localization method for neuron activity throughout the brain uses temporal information from fluorescent calcium reporters. The approach could provide a resolution of about ten microns.

10:00–15:30 Science & Industry Showcase, *Visit page 12 for a complete program schedule.*

10:00–10:30 Coffee Break, *Science & Industry Showcase Coffee Break Area*

10:00–12:00
JTu3A • Poster Session I

JTu3A.1 *E-Poster*
An Analytical and Experimental Comparison of the Integrated Stiles-Crawford Effect of the First Kind, Alessandra M. Carmichael Martins[1]; Brian Vohnsen[1]; *[1]University College Dublin, Ireland.* The Stiles-Crawford effect of the first kind in normal viewing conditions integrated over a full pupil differs from the decay rate obtained with different pupil sizes, explained by the absorption across the photoreceptor cones.

JTu3A.2 *E-Poster*
Optical Chirality Enhancement in Vertical-cut Slant-gap Antenna, Shih-Hui G. Chang[1]; *[1]National Cheng Kung Univ., Taiwan.* The mechanism of optical chirality enhancements in slant gap antenna with vertical cut configuration by normal incident light are demonstrated. We also consider the substrate effect to accurately account for the asymmetric OCE distribution.

JTu3A.3 *E-Poster*
Didactic Simulation of the Optoacoustic Effect Prior to Treatment by Photodynamic Therapy for Cancer Patients, Evelyn Granizo[1]; *[1]ESPOCH, Ecuador.* In-silico tests of the optoacoustic effect were carried out for the didactic analysis of the physical interaction parameters and the importance and benefits of its applicability in the Biomedical area were established.

JTu3A.4 *E-Poster*
Nanophotonics Design Platform Based on Double-step Dimensionality Reduction, Yashar Kiarashinejad[1], Sajjad Abdollahramezani[1], Mohammadreza Zandehshahvar[1], Omid Hemmatyar[1], Ali Adibi[1]; *[1]ECE, Georgia Inst. of Technology, USA.* We present a novel approach based on dimensionality reduction for designing electromagnetic nanostructures. The method relies on reducing the dimensionality of the input/output space to reduce the complexity of forward and inverse design problems.

JTu3A.5 *E-Poster*
Nanoscale Core-Shell Hyperbolic Structure: A New Paradigm to Boost the Light-Matter Interaction, Hung-I Lin[1], Kanchan Yadav[1], Kun-Ching Shen[2], Chun-Che Wang[1], Ting-Jia Chang[1], Monika Kataria[1], Golam Haider[1], Pradip Kumar Roy[1], Yit-Tsong Chen[1], Yang-Fang Chen[1]; *[1]National Taiwan Univ., Taiwan; [2]Academia Sinica, Taiwan.* A novel nanoscale core-shell hyperbolic structure possesses a remarkably coupling effect in between the multishell composite due to the remarkable density of states than the plasmonic-based pure metal nanoparticles.

JTu3A.6
PDMS Microstructured Interferometric Sensor, Victor Argueta[1], Brianna Fitzpatrick[1]; *[1]Alma College, USA.* We present a micro-structured PDMS-waveguide sensor. The PDMS refractive index is tuned by changing the ratio of the base/curing agent. We measured an attenuation of 1.2 dB/cm at 650nm. We present a Mach-Zender configuration.

JTu3A.7 *RAPID*
Growth of NiO Thin Film for p-NiO/n-Si Heterojunction UV-Visible Photodetector, Savita Chaoudhary[1], Avijit Dewasi[1], Anirban Mitra[1]; *[1]IIT Roorkee, India.* We optimize the oxygen working pressure for pulsed laser deposition of NiO thin films for the fabrication of *p*-NiO/*n*-Si photodiode. We show the responsivity ~0.05 for UV illumination and 0.01 A/W in case of visible.

JTu3A.8
Directing the separated laser beams at the BSM into other fiber optics., Ahmed Y. Laarfi[1]; *[1]Florida Inst. of Technology Fit, USA.* A simulation of two laser beam launched through carrier fiber using an SDM system. Separating them at the demultiplexer, they are pointed within two fiber cables.

JTu3A.9
Application of Butterfly Wing Iridescence, Reflection Spectroscopy, and Chemometric Tools in Adulteration Sensing in Gasoline, Nancy M. Mwenze[1], Zephania Birech[1], Kenneth A. Kaduki[1]; *[1]Univ. Of Nairobi, Kenya.* Use of adulterated gasoline with kerosene has led to engine breakdowns, air pollution, and poor economic growth. By using *Papillon junonia* butterfly species, we were able to detect adulterated gasoline as low as 4.7% adulteration.

JTu3A.10 *RAPID*
Fabricating Periodically Poled Lithium Niobate Thin Films with Sub-Micrometer Fundamental Period, Jonathan Nagy[1], Ronald M. Reano[1]; *[1]Ohio State Univ., USA.* We present sub-micrometer periodic poling of ion-sliced x-cut magnesium oxide doped lithium niobate thin films. The poled domains are characterized by piezoresponse force microscopy. A fundamental period of 776 nm is achieved.

JTu3A.11
Image Segmentation of Adaptive Optics Images., Eduardo Perez[1]; *[1]DICIS, Mexico.* They investigate how RNFL morphology and microstructure is altered in papilledema secondary to idiopathic intracranial hypertension (IIH).

JTu3A.12
Frustrated Total Internal Reflection Filter with Heterogeneous Layer, Nikolai I. Petrov[1]; *[1]Russian Academy of Sciences, Russian Federation.* Influence of nanoparticles embedded into resonator layer of the frustrated-total-internal-reflection filter on transmission spectrum is analyzed. It is shown that the frequency dispersion causes splitting of the filter bandwidth.

JTu3A.13
Low-power, temperature-resistant IR range semiconductor laser diodes for automotive applications, Simona Pukiene[1], Jan Devenson[1], Vladimir Agafonov[1], Algirdas Jasinskas[1], Evelina Dudutiene[1], Bronislovas Cechavicius[1], Karolis Stasys[1], Renta Butkute[1]; *[1]Center for Physical Sciences and Technol, Lithuania.* In this work we are focusing on the semiconductor lasers based on AIII-B5-Bi, namely bismides, alloy grown by MBE. Bismide semiconductor laser diodes have a potential to become the foundation of optical systems for automotive applications.

JTu3A.14
A four-lens paraxial invisibility cloak with lenses of different focal lengths, Miguel L. Revilla[1], Nathaniel Hermosa[1]; *[1]National Inst. of Physics, Univ. of the Philippines Diliman, Philippines.* Four-lens paraxial cloak theory is extended to accommodate lenses with different focal lengths. Solutions of this case were found and cloaking as still observed in experiments, with only small background magnification.

JTu3A.15
Withdrawn

JTu3A.16 *RAPID*
Small polarons model for nondestructive testing of holograms in $LiNbO_3$:Fe crystal in external magnetic field, Lusine Tsarukyan[1], Ruben Hovsepyan[1], Rafael Drampyan[1]; *[1]Inst. for Physical Research of National Academy of Sciences of Armenia, Armenia.* A novel method of magnetic field controlled non-destructive testing of optically inducted refractive structures in photorefractive crystals is shown experimentally. Experimental results are explained in the model of polarons in a magnetic field.

JTu3A.17
Investigation of Light Patterns in a Ferrolens Subjected to a Magnetic Field, Alberto Tufaile[1], Adriana P. Tufaile[1], Timm A. Vanderelli[2], Michael Snyder[3]; *[1]Univ. of São Paulo, Brazil; [2]Ferrocell USA, USA; [3]Technical Space Science Center, Morehead State Univ., USA.* We have investigated the light patterns in a thin film of ferrofluid subjected to a magnetic field, in a device known as Ferrolens. We observed magnetic contours and light polarization effects.

JTu3A.18
Optical absorption and anisotropy of phosphorene flakes, Aleksandra Wieloszynska[1], Lukasz Macewicz[1], Pawel Jakobczyk[1], Krzysztof Pyrchla[1], Robert Bogdanowicz[1]; *[1]Faculty of Electronics, Telecommunications and Informatics, Gdansk Univ. of Technology, Poland.* Phosphorene is recently discovered 2D material. In addition to direct bandgap, the phosphorene absorption of polarized light is different in the armchair and the zigzag direction. We present studies of the phosphorene flakes versus aging processes.

JTu3A.19
185nm Guidance in a Hollow Core Optical Fibre, Bartlomiej Winter[1], Dmitry Vorobiev[2], Brian Fleming[2], Emily Witt[2], Wesley Gilliam[2], Kristina Rusimova[1], Stephanos Yerolatsitis[1], Tim Birks[1], William Wadsworth[1]; *[1]Centre for Photonics and Photonic Materials, Univ. of Bath, UK; [2]Laboratory for Atmospheric and Space Physics, Univ. of Colorado, USA.* We demonstrate guidance in the vacuum-ultraviolet at 185 nm using a hollow-core anti-resonant fibre. The fibre was manufactured using the stack and draw method followed by tapering.

JTu3A.20
Research of Spectral Characteristics of a Thin-Film Structure with a Metal-Semiconductor Barrier, Ruslan G. Zakirov[1]; *[1]Physical- technical Univ., Tashkent, Uzbekistan.* The paper presents photosensitive sandwich-structured Au-*v*GaAs: O-nCdS-nInP- Au-semiconductor formed by vacuum deposition of thin films of cadmium sulfide and indium phosphide on a single-crystal substrate of gallium arsenide.

JTu3A.21
Interferometric Measurement of Orbital Angular Momentum of Light, Athira B S[1], Anuraj Laha[2], Sayantan Das[2], Sounak Mukherjee[2], Nirmalya Ghosh[1,2], Dibyendu Nandy[1,2]; *[1]Center of Excellence Space Sciences India, Indian Inst. of Science Education and Research Kolkata, India; [2]Dept. of Physical Sciences, Indian Inst. of Science Education and Research Kolkata, India.* We provide the experimental evidence of orbital angular momentum Hall effect of light and present two different experimental strategies to quantify the Hall effect-induced change in orbital angular momentum and the phase structure of the beam.

JTu3A.22
Anti-reflection Microstructures for 2-6 um Range Fabricated with Direct fs Laser Ablation, Andrey A. Bushunov[1], Mikhail Tarabrin[1,2], Vladimir Lazarev[1], Valeriy Karasik[1], Yuriy Korostelin[2], Mikhail Frolov[2], Yan Skasyrsky[2], Vladimir Kozlovskiy[2]; *[1]Bauman Moscow State Technical Univ., Russian Federation; [2]Lebedev Physical Inst., Russian Federation.* We investigated antireflection microstructures fabrication on CdSSe crystal with fs direct laser ablation in several regimes and reflection reduction in 2-6 um range with maximum transmission of 99% at 2.3 um was achieved.

JTu3A.24
Fourier-Plane Surface-Enhanced Raman Microscopy from plasmonic Nanowire-Nanoparticle Junction, Adarsh B Vasista[1], Shailendra Kumar Chaubey[1], David J. Gosztola[2], Gary P. wiederrecht[2], Stephen K Gray[2], G V Pavan Kumar[1]; *[1]IISER Pune, India; [2]Argonne National Laboratory, USA.* Here we are studying the wavevector distribution of SERS emission from plasmonic nanowire-nanoparticle junction cavity using Fourier microscopy. The emission is confined to a narrow range of wavevectors and also excites guided modes of the nanowire.

JTu3A.25
Transport in Hybrid PEDOT:PSS-GeNCs-Si Heterostructures, Serhii Derenko[1,2], Serhiy Kondratenko[2]; *[1]Kyiv Youth Academy of Sciences, Ukraine; [2]Taras Shevchenko National Univ. of Kyiv, Ukraine.* The hybrid GeNCs-PEDOT:PSS-Si heterojunctions were studied by current-voltage and capacitance-voltage measurements. The impact of Ge NCs and PEDOT:PSS polymer film on potential barrier formation and electrical conduction mechanism was analyzed.

JTu3A.26
Analytical Characterization of Nitro-Derivatized Cyclometalating Ligands, Michael J. Ferry[1], Ryan M. O'Donnell[1], Neal K. Bambha[1], Trenton R. Ensley[1], William M. Shensky[1]; *[1]US Army Research Laboratory, USA.* The nonlinear photophysical properties of a series of iridium cyclometalated complexes containing nitro groups and differing pi conjugation were measured via transient absorption spectroscopy and Z-scan measurements at 532 nm.

JTu3A.27
Detection of Bread Mold using Terahertz Time Domain Spectroscopic Imaging, Diksha Garg[1], Aparajita Bandyopadhyay[1], Amartya Sengupta[1]; *[1]Indian Inst. of Technology, Delhi, India.* In this work, the promising potential of THz time domain spectroscopic imaging is demonstrated for detecting the presence of mold through the analysis of change in reflectivity of the examined bread sample.

JTu3A.28
Propagation of Ultrashort Pulses in Indium Tin Oxide Epsilon-Near-Zero Subwavelength Metamaterial at 2 μm, Jiaye Wu[1], Qian Li[1]; *[1]Peking Univ., China.* A numerical study of 2-μm ultrashort pulse propagation in indium tin oxide epsilon-near-zero subwavelength metamaterial is presented by using the finite-difference time-domain method.

JTu3A.29
Determination of the Size of Microspheres in Monodisperse Turbid Solutions, Kalpak Gupta[1], M. R. Shenoy[1]; *[1]Indian Inst. of Technology, Delhi, India.* We present a method to determine the size of spherical particles in a turbid medium, in terms of the ratio of the Mie phase function, by measuring the scattered light at two different angles.

JTu3A.30
Polarization-Independent Directionally Invisible Electromagnetic Scatterers, Elisa Hurwitz[1,2], Gregory J. Gbur[1]; *[1]Dept. of Physics and Optical Science, Univ. of North Carolina at Charlotte, NC, USA; [2]Lucifer Simulations, LLC, USA.* Nonmagnetic directionally invisible objects can be constructed with independent control of the permittivity and permeability, providing significant design flexibility. This technique may be used to design new types of invisible objects.

JTu3A.31
On the Nature of Photoelectric Effect in a *Ge*-on-*Si* SPAD at Sub-Photon Energy in Incident Pulsed Laser Radiation, Valeri I. Kovalev[1,2]; *[1]P.N. Lebedev Physical Inst., Russian Federation; [2]Physics, Heriot-Watt Univ., UK.* Measured experimentally detection efficiency in a *Ge*-on-*Si* single-photon avalanche detector at energies from 10 photons to photon/100 in incident pulsed laser radiation is interpreted in frames of classical electrodynamics of continuous media.

JTu3A.32
Pulse Laser Grinding Processing of Polycrystalline CVD Diamond Coated Cutting Tool Edge with Femtosecond Laser, Xiaoxu Liu[1], Kohei Natsume[1], Satoru Maegawa[1], Fumihiro Itoigawa[1]; *[1]Nagoya Inst. of Technology, Japan.* Femtosecond laser processing was innovatively used to achieve the sharpening of CVD diamond coated tool edge.

JTu3A.33
Bessel Beams Through Turbulence, Nokwazi Mphuthi[1,2], Andrew Forbes[1]; *[1]Univ. of the Witwatersrand, South Africa; [2]South African Radio Astronomy Observatory (SARAO), South Africa.* The properties of Bessel beams have shown remarkable performance through in-homogeneous media. We show experimentally that Bessel beams cannot self-heal after phase disturbances. We also demonstrate use of long-range Bessel beams through turbulence.

JTu3A.34
Mid-Infrared Supercontinuum Generation in Highly Nonlinear AsSe2 Chalcogenide Circular Photonic Crystal Fiber, Chauhan Pooja[1], Ajeet Kumar[1], Yogita Kalra[1]; *[1]Delhi Technological Univ., India.* Numerical simulations have been performed to generate an ultra-broadband supercontinuum spectrum spanning, 12,500 nm in the mid-infrared wavelength region at a pump wavelength of 3100 nm.

JTu3A.35
Investigation of the dynamics of the emission from the N_2^+ cation in light filaments, Ali Rastegari[1], Jean Claude Diels[1]; *[1]Univ. of New Mexico, USA.* Accurate streak camera measurements reveal a delay of tens of ps between ionization by a fs pulse and emission from the nitrogen ion cation.

JTu3A.36 *RAPID*
Two-Dimensional Constant-Intensity Waves in Non-Hermitian Scattering Media, Konstantinos Makris[1,2], Andre Brandstotter[3], Ivor Kresic[3], Stefan Rotter[3]; *[1]Univ. of Crete, Greece; [2]Inst. of Electronic Structure and Laser (IESL)-FORTH, Greece; [3]Inst. for Theoretical Physics, Vienna Univ. of Technology, Austria.* We show that constant-intensity waves without any interference fringes are possible in two-dimensional non-Hermitian landscapes. The general gain-loss distributions, under which multiple scattering can be fully controlled, are examined in detail.

JTu3A.37
Deterministic Single Photon Subtraction Using Solid State Emitters Coupled to Chiral Waveguides, Supratik Sarkar[1,2], Jinjin Du[2,1], Michal Bajcsy[1,2]; *[1]Dept. of Electrical and Computer Engineering, Univ. of Waterloo, Canada; [2]Inst. of Quantum Computing, Univ. of Waterloo, Canada.* We provide analytical treatment and numerical solutions using input-output formalism to explore the experimental feasibility and efficiency of deterministic single-photon subtraction using a three-level quantum emitter coupled to a chiral waveguide.

JTu3A.38
Intensity Correlation Measurement for Detecting Magneto-Optical Resonance at High Field, Gour S. Pati[1], Renu Tripathi[1], Raghwinder S. Grewal[1], Anthony W. Yu[2], Michael A. Krainak[2], Michael E. Purucker[2]; *[1]Delaware State Univ., USA; [2]NASA Goddard Space Flight Center, USA.* We demonstrate a new correlation technique for detecting magneto-optical resonances, which are produced by exciting 87Rb atoms in a vapor medium with modulated light. The technique can be used to improve the performance of remote magnetometry.

JTu3A.39
Kerr-frequency combs and dissipative Kerr-solitons in coupled-cavity waveguides, Juan P. Vasco[1], Vincenzo Savona[1]; *[1]Ecole Polytechnique Federale de Lausanne, Switzerland.* We formulate the theory of Kerr-frequency combs and dissipative Kerr solitons in coupled-cavity waveguides in presence of 2-photon absorption. We apply it to a band-engineered photonic crystal coupled-cavity waveguide in silicon at telecom wavelength

JTu3A.40 *RAPID*
Demonstration of Broadband Space-Time Wave-Packets Propagating 70 m, Murat Yessenov[1], Basanta Bhaduri[1], Danielle Reyes[1], Jessica Pena[1], Monjurul Meem[2], Shermineh Rostami Fairchild[1,3], Rajesh Menon[2], Martin Richardson[1,3], Ayman Abouraddy[1]; *[1]CREOL, Univ. of Central Florida, USA; [2]Department of Electrical and Computer Engineering, Univ. of Utah, USA; [3]Physics and Space Sciences, Florida Inst. of Technology, USA.* We demonstrate the experimental synthesis of broadband space-time light sheet of width ~700 microns and bandwidth ~25 nm propagating 70m in free-space, through introducing tight spatio-temporal spectral correlation.

JTu3A.41
High Degree Pulse Compression for Picosecond Pulses at 2 μm, Fumin Wang[1], Zihao Cheng[1], Dan Yu[1], Qian Li[1]; *[1]PKU Shenzhen graduate school, China.* Detailed fiber design of single-mode fiber (SMF) for two-stage higher-order soliton compression at 2 μm is presented, where different input pulse widths are considered.

JTu3A.42
Energetic ultrafast laser source tunable between 940 nm to 1250 nm for multi-photon deep imaging, Yang Yu[1,2], Shaobo Fang[2,3], Hao Teng[2,3], Jiangfeng Zhu[1], Junli Wang[1], Guoqing Chang[2,3], Zhiyi Wei[2,3]; *[1]Xidian Univ., China; [2]Beijing National Laboratory for Condensed Matter Physics, Inst. of physics, Chinese Academy of Science, China; [3]School of Physical Science,Univ. of Chinese Academy of Sciences, China.* We demonstrate a wavelength tunable ultrafast fiber laser source producing ~100-fs pulses with pulse energy up to 33 nJ at 1-MHz repetition rate, constituting a desired driving source for multi-photon deep imaging.

JTu3A.43 *RAPID*
Generating Tripartite Entanglement Using Four-Wave Mixing in Warm Atomic Vapor, Wenlei Zhang[1], Ryan T. Glasser[1]; *[1]Tulane Univ., USA.* We present a dual-pump setup for generating tripartite entanglement using four-wave mixing in warm atomic vapor. We derive the output state for vacuum inputs and show that this state is genuine tripartite entangled.

JTu3A.44
Development of glass nozzles for below threshold harmonics and high harmonic generation, Armando Valter F. Zuffi[1], Andreia d. Almeida[1], Nilson D. Viera Junior[1], Ricardo Elgul Samad[1]; *[1]Nuclear and Energy Research Inst., Brazil.* This work reports development of glass nozzles by ultrashort laser pulses machining for studies of harmonic generation in gases. Those nozzles generated odd harmonics (3rd up to 25th) in UV and VUV regions.

JTu3A.45
Characterization and applications of auto-locked vacuum-sealed diode lasers for precision metrology, Hermina Beica[1], Alex Pouliot[1], Adam Carew[1], Andrew Vorozcovs[1], Nima Afkhami-Jeddi[1], Thomas Vacheresse[1], Gehrig Carlse[1], Patrick Dowling[1], Boris Barron[1], A Kumarakrishnan[1]; *[1]York Univ., Canada.* We characterize a new class of vacuum-sealed, auto-locked diode lasers through the Allan deviation of the beat note and lock signal and demonstrate applications relevant to industrial gravimetry and lidar transmission.

JTu3A.46
Spectral mapping of an integrated type-II photon-pair source using quantum-classical correspondence, Hung-Pin Chung[1], Pawan Kumar[2], Kai Wang[3], Olivier Bernard[2], Chinmay Shirpurkar[2], Wen-Chiuan Su[1], Thomas Pertsch[2,5], Andrey Sukhorukov[3], Yen-Hung Chen[1,4], Frank Setzpfandt[2]; *[1]National Central Univ.,Taiwan, Taiwan; [2]Friedrich-Schiller-Universität Jena, Germany; [3]The Australian National Univ., Australia; [4]National Central Univ., Taiwan; [5]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* We experimentally characterize the spectral properties of photon pairs generated by type-II spontaneous parametric down-conversion waveguide. The spectral properties of cross-polarized photon-pair are determined by quantum-classical correspondence.

JTu3A.47
Exploiting the Nonlinear Optical Response of Gold Nanoantennas for ultrafast pulse characterisation, Paul M. Dichtl[1], Sylvain Gennaro[1,2], Yi Li[2], Rupert Oulton[1], Stefan Maier[2]; *[1]Imperial College London, UK; [2]Ludwigs-Maximilians-Universitaet, Germany.* Two femtosecond laser pulses in the near-infrared and near the edge of the visible waveband are characterized simultaneously by a time-resolved analysis of nonlinear scattering from gold nanoparticles.

JTu3A.48
Parallel Quantum Enhanced Plasmonic Sensing through Spatial Quantum Correlations, Mohammadjavad Dowran[1], Aye L. Win[1], Ashok Kumar[2], Benjamin Lawrie[3], Raphael C. Pooser[3], Alberto M. Marino[1]; *[1]Univ. of Oklahoma, USA; [2]Physics, Indian Inst. of Space Science and Tech., India; [3]Quantum Information Science Group, Oak Ridge National Lab., USA.* We present a parallel quantum enhanced sensing configuration that takes advantage of spatial quantum correlations in bright twin beams. We independently probe different spatial regions of plasmonic sensors with sensitives beyond the shot-noise limit.

JTu3A.49
Coherent Exciton-Phonon Interaction Explains Luminescence Behavior of Colloidal Quantum Dots, Meenakshi Khosla[2,1], Sravya Rao[1], Shilpi Gupta[1]; *[1]Indian Inst. of Technology Kanpur, India; [2]Cornell Univ., USA.* We present a theoretical model for a colloidal quantum dot interacting with both confined and bulk phonon modes. The model explains experimentally observed features in photoluminescence spectrum and decay dynamics at low temperatures.

JTu3A.50
Measurement Optimization for Gate-Model Quantum Computers, Laszlo Gyongyosi[1,2], Sandor Imre[2]; *[1]Univ. of Southampton, UK; [2]Budapest Univ. of Technology and Economics, Hungary.* Quantum measurement is a fundamental cornerstone of quantum computers. We define a measurement optimization for gate-model quantum computers. The dense measurement aims at fixing the main drawbacks of measurement procedures in quantum computers.

JTu3A.51
Random Laser from Beetle Elytral Surface with Circularly Polarized Light Emission, Seungsu Lee[1], Yoonchan Jeong[1,2]; *[1]Seoul National Univ., South Korea; [2]Inter-Univ. Semiconductor Research Center & Inst. of Applied Physics, South Korea.* We fabricate circularly polarized light emitting random laser with eco-friendly, natural material, the scarab beetle. Right-handed circularly polarized emission from the sample is measured when the angle of incidence of the pump beam is 30 degrees.

JTu3A.52
Modeling the coherent modal interactions in Q-switched optical vortex lasers, YuanYao Lin[1], Jhih-He Tu[1]; *[1]National Sun Yat-Sen Univ., Taiwan.* The spatiotemporal instability results in periodic and aperiodic oscillations in the vortex laser pulses while the vortex structure remains stable. It can be simulated by a modified Tang–Statz–DeMars model including coherent modal interactions.

JTu3A.53
Fast Polarization Basis Alignment For Quantum Communications, Mariana F. Ramos[2,1], Nuno A. Silva[2,1], Nelson J. Muga[2], Armando N. Pinto[2,1]; *[1]Dept. of Electronics, Telecommunications and Informatics, Univ. of Aveiro, Portugal; [2]Optical Networking, Instituto de Telecomunicações, Portugal.* We assess an algorithm for polarization basis alignment for quantum communication systems considering different polarization linewidth and transmission lengths. The algorithm has an overhead below 2% and guarantees an average channel QBER below 1%.

JTu3A.54
Withdrawn

JTu3A.55
A New Quantum Approach to Selective Detection in Gases and Liquid Media, Anna Herus[1], Aleksandr Pospelov[2], Andrei Savytskyi[1], Yurui Doronin[1], Vladymyr Vakula[1], Eric Faulques[3], Gennadii Kamarchuk[1]; *[1]B. Verkin ILTPE of NASU, Ukraine; [2]National Technical Univ. "Kharkiv Polytechnic Inst., Ukraine; [3]Institut des Matériaux Jean Rouxel (IMN), Université de Nantes, France.* We propose a new operating principle of selective detection in gases and liquids based on formation of an original quantum system and registration of its energy states in dynamic mode using dendritic point contacts.

JTu3A.56
Photon-assisted Tunneling Applied to Metal-Insulator-Metal Nanorods for High Efficiency Infrared Photodetection and Energy Harvesting., Shuo Sun[1], Joseph W. Haus[1], Partha P. Banerjee[1], Imad Agha[1], Andrew Sarangan[1], Parag Banerjee[2], Michael Scalora[3]; *[1]Univ. of Dayton, USA; [2]Materials Science and Engineering, Univ. of Central Florida, USA; [3]US Army AMRDEC, USA.* We applied the transfer matrix method to solve the Schrodinger equation for electron tunneling probability and predict the current-voltage characteristics to calculate the photodetection and energy harvesting efficiencies of MIM nanorods.

JTu3A.57
Tunable, Single-Longitudinal Mode 2 µm VECSEL, Jennifer M. Reed[1]; *[1]US Air Force Research Laboratory, USA.* A tunable, 2 µm, narrow linewidth vertical-external-cavity surface-emitting laser (VECSEL) is demonstrated. Single-longitudinal mode operation with sub-MHz linewidth is achieved over a tuning range of 80 nm.

JTu3A.58
Source-independent quantum random number generation with finite measurement range, Ziyong Zheng[1], Yichen Zhang[1], Yijia Zhao[1], Weinan Huang[1], Song Yu[1], Hong Guo[2]; *[1]Beijing Univ. of Posts and Telecommunications, China; [2]Peking Univ., China.* We present a source-independent quantum random number generator based on the measurement of quadrature of quantum optical field by applying a modified entropic uncertainty relation to circumvent the measurement range problem under certain conditions.

JTu3A.59
Experimental investigation of nonlinear dynamics and bifurcation in a quantum-dot laser with optical feedback, Kazuto Yamasaki[1], Kazutaka Kanno[1], Atsushi Matsumoto[2], Makoto Naruse[3], Naokatsu Yamamoto[2], Atsushi Uchida[1]; *[1]Saitama Univ., Japan; [2]National Inst. of Information and Communications Technology, Japan; [3]The Univ. of Tokyo, Japan.* We investigate the temporal dynamics of a quantum dot laser with optical feedback by changing the injection current and the optical feedback strength. We generate a two-dimensional bifurcation diagram.

JTu3A.60
Numerical simulation of a chain of super-Gaussian beam in a highly nonlocal media, Nickita Acharya[1], Manoj Mishra[1]; *[1]Department of Physics, Mody Univ. of Science and Tech., Lakshmangarh, India.* We demonstrate the propagation dynamics of a chain of super-Gaussian (SG) beam in highly nonlocal nonlinear media, modeled by nonlocal nonlinear Schrodinger equation(NNLSE) and simulated by split-step Fourier method(SSFM) for propagation dynamics.

JTu3A.61
A General Expression for the Output Intensity of an Orbital-Angular-Momentum (OAM) Mode Traversing a Perturbed Fiber, Ramesh Bhandari[1]; *[1]Laboratory for Physical Sciences, USA.* We derive a general formula for the output intensity of an orbital-angular-momentum (OAM) mode traversing a perturbed fiber. The predicted tilted *Linearly Polarized (LP)* mode patterns are in good agreement with existing experimental data.

JTu3A.62
RF Power and DC Biasing Analyses to Generate Flat Optical Frequency Combs in Dual-drive Mach-Zenhder Modulators, Leonid A. Huancachoque[1], Maria L. Santos[1], Alexander I. Pereira[1], Danierick V. Nascimento[1], Aldario C. Bordonalli[1]; *[1]Univ. of Campinas, Brazil.* An optical frequency comb generator based on dual-drive Mach-Zehnder modulator was used to obtain combs with a specific number of flat lines after obtaining proper RF power drive and DC biasing conditions from an algorithm.

JTu3A.63 *RAPID*
Stimulated Brillouin scattering-based slow light using single-mode As_2S_3 chalcogenide photonic crystal fiber for temperature sensing, Mbaye Diouf[1], Abderrahmen Trichili[3], Mourad Zghal[2]; *[1]Université Cheikh Anta Diop, Senegal, Senegal; [2]Univ. of Carthage, Tunisia; [3]King Abdullah Univ. of Science and Tech., Kingdom of Saudi Arabia, Saudi Arabia.* A Temperature sensor using stimulated Brillouin scattering based slow light is proposed and numerically demonstrated. A time delay of 190 ns can be achieved using 50 mW pump power in a chalcogenide photonic crystal fiber.

JTu3A.64
Optimization, amplification and characterization of a passive mode-locked fibre laser, Ikram Khan[1], Anil Prabhakar[1], Shruti Sundar[1]; *[1]IIT Madras, India.* An optimized passive mode-locked fibre laser yielded optical pulses of 6.5 ps, 32 pJ. These increased to 27 nJ in two amplifier stages. An intensity auto-correlator was developed for monitoring the pulse-width.

JTu3A.65
Efficient 2 µm Brillouin Laser and Multi-stokes Generation in Speciality Silica Fibers, Akhileshwar Mishra[1], Ravi Pant[1]; *[1]IISER Thiruvananthapuram, India.* We demonstrate efficient Brillouin lasing and multi-Stokes generation in SM1950 fiber at 2µm with low threshold, high slope efficiency and laser output power. Three-fold reduction in threshold is achieved compared to a similar length SMF.

JTu3A.66 *RAPID*
High-Performance Silicon Nitride Fork-shape Edge Coupler, Xin Mu[1], Sailong Wu[1], Lirong Cheng[1], Xin Tu[2], H.Y. Fu[1]; *[1]Tsinghua-Berkeley Shenzhen Inst., China; [2]School of Mechanical Engineering and Electronic Information, China Univ. of Geosciences, China.* We propose a fork-shape edge coupler based on silicon nitride for silicon photonic platform. The coupler exhibits low coupling loss, compact size and relaxed misalignment tolerance for both TE and TM modes.

JTu3A.67
Optical fiber's open surface as an optical range antenna, Anastasiya Kuryleva[1], Oleg Moskaletz[1], Artur Paraskun[1]; *[1]Construction and Technology of Electronic and Laser Equipment, SUAI, Russian Federation.* The opened end surface of a single-mode optical fiber is considered as an optical range dielectric antenna. Applied antennas' theory within the of computer simulation directivity patterns for three wavelengths is obtained at the optimum length.

JTu3A.68
Lazy Caterer's Approach in Construction of Base Units for Combined Hybrid DWDM System, Yugnanda Malhotra[1], Ashutosh Singhal[1]; *[1]ECE, BVCOE, India.* We propose the mapping of Lazy Caterer's series in construction of Base Units (BUs) for the combined hybrid DWDM system. The performance in terms of percentage non-uniformity between BUs, and reduced FWM intensities is reported.

JTu3A.69 *RAPID*

MMI coupler-type optical DFT filter for demultiplexing 25 Gsymbol/s sub-carrier-based optical OFDM signal, Koichi Takiguchi[1]; [1]*Ritsumeikan Univ., Japan.* An integrated-optic DFT filter, which mainly consists of a 4 x 4 MMI coupler and can demultiplex a 4 x 25 Gsymbol/s OFDM signal, is reported. The transmittance of the fabricated DFT filter is demonstrated.

JTu3A.70

Low-loss Silicon Rib Waveguide Crossing with Low Polarization Dependence Loss, Sailong Wu[1], Xin Mu[1], Lirong Cheng[1], Xin Tu[2], H.Y. Fu[1]; [1]*Tsinghua-Berkeley Shenzhen Inst., China;* [2]*China Univ. of Geosciences, Wuhan, China.* A low-loss silicon rib waveguide crossing with low polarization dependence loss is proposed. The insertion loss for TE (TM) polarization mode is -0.14 dB (-0.29 dB) and the crosstalk is -28 dB (-30 dB) at 1550 nm. The footprint is around 8×8 μm^2.

JTu3A.71

The growth of ZnO nanostructure arrays for SPR sensor sensitivity enhancement, Heesang Ahn[1], Hyerin Song[1], Taerim Yoon[1], Taeyeon Kim[1], Kyujung Kim[1]; [1]*Pusan National Univ., South Korea.* We studied the hydrothermal growth condition of ZnO nanostructure arrays which can be used as biosensor. The ZnO nanostructures are grown in nanorod or nanoflowers.

JTu3A.72

Graphene-hBN optical modulator integrated in a polymer waveguide with 55 GHz bandwidth, Wanderson Camacho[1], Hugo Fragnito[1], Eunezio Souza[1], Rafael de Oliveira[1], Lucia Saito[1]; [1]*Universidade Presbiteriana Mackenzie, Brazil.* We propose a compact electro-absorption optical modulator, composed by a graphene-hBN capacitive structure on top of the polymer waveguide. A bandwidth of 55 GHz was calculated by geometry and capacitance optimization.

JTu3A.73

Multifunctional metasurfaces with tailored dispersion, Wei-Ting Chen[1], Jared Sisler[1,2], Alexander Zhu[1], Federico Capasso[1]; [1]*Harvard Univ., USA;* [2]*Univ. of Waterloo, Canada.* We report metalenses capable of focusing blue and red wavelengths onto two focal planes. In addition, achromatic, refractive or diffractive focal length shifts can be imparted across different design bandwidths of the metalenses.

JTu3A.74

Far-field thermal emission at the optical topological transition, Sanjay Debnath[1], Evgenii Narimanov[1]; [1]*Purdue Univ., USA.* We develop a theoretical description of far-field thermal radiation from material near optical topological transitions. The predicted model is applicable in both naturally available and composite media.

JTu3A.75 *RAPID*

Parity–Time-Symmetric Circular Bragg Lasers: Enhanced Modal Discrimination between Azimuthal Modes, Ziyao Feng[1], Jingwen Ma[1], Zejie Yu[1], Xiankai Sun[1]; [1]*The Chinese Univ. of Hong Kong, Hong Kong.* We have proposed and analyzed parity–time-symmetric circular Bragg lasers by using coupled-mode theory and transfer-matrix method. These lasers are shown to have better control in their azimuthal modes with enhanced modal discrimination.

JTu3A.76

Towards III-Nitride on Silicon Active Photonic Circuits, Farsane Tabataba-Vakili[2,1], Stéphanie Rennesson[3], Benjamin Damilano[3], Laetitia Doyennette[4], Christelle Brimont[4], Thierry Guillet[4], Eric Frayssinet[3], Julien Brault[3], Jean-Yves Duboz[3], Iannis Roland[2], Moustafa El Kurdi[2], Xavier Checoury[2], Sébastien Sauvage[2], Fabrice Semond[3], Philippe Boucaud[3], Bruno Gayral[1]; [1]*CEA, IRIG-PHELIQS, Univ. Grenoble Alpes, France;* [2]*C2N, CNRS, Univ. Paris-Sud, Université Paris-Saclay, France;* [3]*Université Côte d'Azur, CRHEA-CNRS, France;* [4]*L2C, Université de Montpellier, France.* We present our progresses towards active photonic circuits based on III-nitride semiconductors epitaxially grown on silicon. We study in particular the critical coupling of lasing InGaN/GaN microdisks to adjacent suspended waveguides.

JTu3A.77

High-Q Fano Resonance Using All-dielectric Metamaterial in Optical Spectral Region, Son Hyunwoo[1], Sang-Eun Mun[1], Byoungho Lee[1]; [1]*Seoul National Univ., South Korea.* We propose Fano resonance in optical region using all-dielectric metamaterial. Selecting two dielectric materials, Si and GaN, for demonstration in the optical region, high Q-factor and modulation depth were realized in the proposed metamaterial.

JTu3A.78

Iterative opto-thermal analysis based on the temperature-dependent Drude-Lorentz dispersion model, Seongmin Im[1], Hongki Lee[1], Donghyun Kim[1]; [1]*School of Electrical and Electronic Engineering, Yonsei Univ., South Korea.* We explored the feasibility of iterative thermo-optical calculation under near-room temperature region. The method is based on the temperature-dependent Drude-Lorentz dispersion model. We verified the improvement of numerical analysis performance.

JTu3A.79

Angular and Polarization Multiplexed Metasurface for Flat Holographic Device, Junhyeok Jang[1], Gun-Yeal Lee[1], Byoungho Lee[1]; [1]*Seoul National Univ., South Korea.* We designed a metasurface that records and reconstructs wavefront according to polarization and direction of incidence. The proposed device can be used for diffractive optical elements due to independent phase modulation of different illuminations.

JTu3A.80

Multiwavelength Achromatic Metalens based on Quantized Phase Profile with Pixelated Nanostructure, Changhyun Kim[1], Gun-Yeal Lee[1], Byoungho Lee[1]; [1]*Seoul National Univ., South Korea.* We demonstrate a multiwavelength achromatic metalens based on binary phase profile with pixelated structure. The proposed metalens has the focal length of 199 μm and the numerical aperture of 0.51 for three target visible wavelengths.

JTu3A.81

Abundance of Exceptional Points in Two Dissimilar Coupled Diode Lasers, Yannis Kominis[1], Kent D. Choquette[2], Anastasios Bountis[3], Vassilios Kovanis[4]; [1]*National Technical Univ. of Athens, Greece;* [2]*Univ. of Illinois, USA;* [3]*Nazarbayev Univ., Kazakhstan;* [4]*Virginia Tech Research Center, USA.* We show the abundance of exceptional points in two coupled diode lasers with differential pumping and frequency detuning and we demonstrate their exact location in the solution and in the parameter space.

JTu3A.82

Toward Atto-joule/bit Energy Efficiency: Quantitative Analysis of Carrier-Driven Resonator Modulators, Erwen Li[1], Alan X. Wang[1]; [1]*Oregon State Univ., USA.* A model is developed to quantitatively describe a carrier-driven resonator modulator from three aspects: carrier dispersion strength, Purcell factor and total capacitance, which lays the theoretical foundation towards aJ/bit energy efficiency.

JTu3A.83

Coupling-assisted Dual ITO Electro-Optic Modulator, Zhizhen Ma[1], Mohammad Tahersima[1], Mario Miscuglio[1], Volker J. Sorger[1]; [1]*George Washington Univ., USA.* Here we demonstrate a coupling-assisted electro-optic modulator by integrating a dual-gated indium-tin-oxide layer placed at the bus-island coupler region. Our experimental modulator shows a 2.1 dB extinction ratio for just 4 μm short device.

JTu3A.84

Nonlinear Optical Studies of Chiral Organic Waveguides and Resonators, Nikolai Mitetelo[1], Evgeniy Mamonov[1], Dasari Venkatakrishnarao[2], Jada Ravi[2], Mikhail Popov[1], Anton Maydykovskiy[1], Rajadurai Chandrasekar[2], Tatiana Murzina[1]; [1]*M.V. Lomonosov Moscow State Univ., Russian Federation;* [2] *Univ. of Hyderabad, India.* We study multiphoton processes in optical active organic microrods and microspheres made by self-assembly technique which are perspective for possible applications as active waveguides and whispering gallery mode microresonators.

JTu3A.85

1T-TaS_2 - A strongly correlated material with a large photo-refractive effect at room temperature, Weijian Li[1], Gururaj V. Naik[1]; [1]*Rice University, USA.* We demonstrate a large photo-refractive effect in 1T-TaS_2 in the visible at low-intensity white light excitation. By using this optical tunability, we demonstrate tunable meta-gratings for nanophotonics applications.

JTu3A.86

Magnetization Induced Optical Second Harmonic Generation from Interfaces between Ferromagnetic and Heavy Metals, Mikhail E. Popov[1], Irina Kolmychek[1], Victoria Radovskaya[1], Denis Kopylov[1], Anton Maydykovskiy[1], Elena Shalygina[1], Tatiana Murzina[1]; [1]*Department of Physics, M.V. Lomonosov Moscow State Univ., Russian Federation.* Magnetization induced effects in optical second harmonic generation from interfaces between heavy and ferromagnetic metals reveal an important role played by magnetic anisotropy and second-order in magnetization effects in of their nonlinear response

JTu3A.87 *RAPID*

Modelling Bolometric Backaction in Cavity Optomechanics, André G. Primo[1], Rodrigo Benevides[1], Cauê Kersul[1], Pierre-Louis de Assis[1], Gustavo Wiederhecker[1], Thiago Alegre[1]; [1]*Universidade Estadual de Campinas, Brazil.* From thermodynamic considerations we derive a model for thermally driven stresses that induce changes on acoustic dynamics, enabling the engineering of devices where these effects are suppressed or enhanced when compared to optomechanical backaction.

JTu3A.88

Quantum sensing based on strong photon-emitter coupling, Zhiyuan Qian[1], Juanjuan Ren[1], Fan Zhang[1], Xueke Duan[1], Qihuang Gong[1], Ying Gu[1]; [1]*peking Univ., China.* Based on strong photon-emitter coupling of nanogap plasmon system, we propose the quantum plasmon sensing, where Rabi splitting is utilized to detect slight change of environment permittivity at the nanoscale.

JTu3A.89

Withdrawn

JTu3A.90
Crystallizing Kerr Cavity Pulse Peaks in a Timing Lattice, Hossein Taheri[1], Andrey Matsko[2]; [1]*Univ. of California Riverside, USA;* [2]*OEwaves Inc., USA.* We show theoretically that a pulse train pumped in a Kerr-nonlinear resonator with two coherent light sources separated by multiple cavity free spectral ranges can be regularized, creating a structure akin to a time crystal.

JTu3A.91
Withdrawn

JTu3A.92
Layered Graphene Oxide Films for Enhanced Nonlinear Optics in Integrated Waveguides, Jiayang Wu[1], Yunyi Yang[1], Xingyuan Xu[1], Yang Qu[1], Linnan Jia[1], Yuning Zhang[1], Yao Liang[1], Sai Chu[2], Brent Little[3], Roberto Morandotti[4], Baohua Jia[1], David J. Moss[1]; [1]*Swinburne Univ. of Technology, Australia;* [2]*City Univ. of Hong Kong, China;* [3]*Chinese Academic of Science, China;* [4]*INRS, Canada.* Enhanced Kerr optical nonlinearities of waveguides integrated with layered graphene oxide (GO) films is experimentally demonstrated. Up to ~9.5-dB enhancement of four-wave mixing conversion efficiency is achieved for a waveguide with 2 layers of GO.

JTu3A.93 *RAPID*
Ultrasensitive Phototransistor Based on Multi-layered $MoTe_2$, Ti Xie[1], Volker J. Sorger[1], Rishi Maiti[1]; [1]*ECE, George Washington Univ., USA.* Here, we demonstrate a back-gated $MoTe_2$ phototransistors with a mobility ($1cm^2/V*s$) and ON/OFF ratio ($3*10^2$) at room temperature

JTu3A.94
A tunable optical filter based on the electrowetting controlled sagging effect of a liquid droplet on a waveguide Bragg grating formed superhydrophobic substrate, Meng Zhang[1], Jiansheng Liu[1], Weifeng Cheng[2], Jiangtao Cheng[2], Hongwen Zhou[1], Xinxuan Ma[1], Yuhang Wan[1]; [1]*Beihang Univ., China;* [2]*Virginia Tech, USA.* A tunable optical filter combining a waveguide Bragg grating and the electrowetting controlled sagging effect of a liquid droplet is proposed. A tuning range above 40 nm with a bandwidth of 0.6 nm is achieved.

JTu3A.95
Broadband dispersion optimization enabled by coupled silicon nitride waveguides with a partially etched gap, Zijun Yao[1], Yu Zhang[1], Xinxuan Ma[1], Yuhang Wan[1], Zheng Zheng[1,2]; [1]*School of Electronic and Information Engineering, Beihang Univ., China;* [2]*Beihang Univ., Beijing Advanced Innovation Center for Big Date-based Precision Medicine, China.* Partially etched gap is introduced to optimize the dispersion performance of coupled silicon nitride waveguides. Anomalous low dispersion over a 220 nm range around 1500 nm can be realized with 515 nm-thick SiN waveguides.

JTu3A.96 *RAPID*
Radio-sensitivity of 4T1 Chemo-treated Breast Cancer Cells Measured by Laser Trapping, Endris Muhammed[2], Li Chen[3], Ying Gao[1], Daniel B. Erenso[1]; [1]*Middle Tennessee State Univ., USA;* [2]*Department of Physics, Addis Ababa Univ., Ethiopia;* [3]*Guangxi Univ. of Science and Tech., China.* Laser trapping technique used to study the radio-sensitivity of chemo-treated 4T1 breast cancer cells. The threshold radiation dose (TRD) for different treatment period calculated and the results showed TRD decreases with treatment period increase.

JTu3A.97 *RAPID*
Quantifying Subcellular Localization of Methylene Blue in Cultured Brain Cells, Xin Feng[1], Peter R. Jermain[1], Alona Muzikansky[2], Alonzo Ross[3], Michael Hamblin[4], Anna N. Yaroslavsky[1,4]; [1]*UMASS Lowell Advanced Biophotonics Laboratory, USA;* [2]*Massachusetts General Hospital Biostatistics Center, USA;* [3]*UMASS Medical School, USA;* [4]*Wellman Center for Photomedicine, Massachusetts General Hospital, USA.* Subcellular distribution of Methylene blue (MB) in six cultured brain cell lines was investigated. Results demonstrate MB accumulates significantly more in mitochondria of glioblastoma cells relative to normal astrocytes.

JTu3A.98
Gold Nanorod Contrast-Enhanced Molecular Imaging of Retinal Neovascularization using Dual Photoacoustic Microscopy and Optical Coherence Tomography in Rabbits, Phuc Nguyen[1], Yannis Paulus[1], Xueding Wang[1], Yanxiu Li[1], Jessica Henry[1], Michael Aaberg[1], Wei Zhang[1]; [1]*Univ. of Michigan, USA.* This study evaluates the potential of gold nanorods conjugated to RGD as a molecular contrast agent for multimodal photoacoustic microscopy (PAM) and optical coherence tomography (OCT) to visualize choroidal neovascularization in living rabbits.

JTu3A.99 *RAPID*
Real-time multimodal high resolution biomedical imaging instrument using supercontinuum optical sources, Gianni Nteroli[1], Stella Koutsikou[3], Peter Moselund[2], Adrian Podoleanu[1], Adrian Bradu[1]; [1]*Applied Optics Group, Univ. of Kent, UK;* [2]*Photonics A/S, Denmark;* [3]*Univ. of Kent, UK.* We present progress towards developing a multimodality imaging instrument, OCT/PAM. By utilizing supercontinuum optical sources, we devised a real-time instrument which can be employed to image biological tissues.

JTu3A.100
Determining the Photoacoustic Source Size from Frequency Dependent Differential Photoacoustic Cross-section Data, Anuj Kaushik[1], Deepak Sonker[1], Ratan K. Saha[1]; [1]*Indian Inst. of Info Tech., India.* A method is proposed to determine the size of the photoacoustic (PA) source. The frequency dependent differential PA cross-section data have been fitted with tri-axes ellipsoid form factor model to estimate the source size.

JTu3A.101
Clinical Carbon Nanoparticles Based Photoacoustic Sentinel Lymph Node Imaging In Vivo, Songde Liu[1], Jiangning Dong[1], Shengchun Liu[2], Wenhao Huang[1], Ronald Xu[1,3], Chao Tian[1]; [1]*Univ. of Science and Tech. of China, China;* [2]*Harbin Engineering Univ., China;* [3]*The Ohio State Univ., USA.* We present a contrast-enhanced photoacoustic imaging technique based on a clinically-approved lymphatic tracer, i.e., carbon nanoparticles, for sentinel lymph node mapping and fine needle aspiration guidance with clinical translation prospects.

JTu3A.102
Acquisition Control System of the SPARC4 Astronomical Instrument, Denis V. Bernardes[1], Eder Martioli[2], Danilo H. Spadoti[1], Luciano Fraga[2]; [1]*Itajubá Federal Univ., Brazil;* [2]*Laboratório Nacional de Astrofísica, Brazil.* We present the acquisition control system of the SPARC4 astronomical instrument. Four EMCCD cameras are used allowing efficient acquisition of high sensitivity astronomical images at maximum rate of 26 fps in four simultaneously spectral bands

JTu3A.103
Generation of CGH with Expanded Viewing Angle by Using the Scattering Properties of the Random Phase Mask, Woo-Young Choi[1], Kwan-Jung Oh[2], Keehoon Hong[2], Hyon-Gon Choo[2], Jisun Park[3], Seung-Yeol Lee[1]; [1]*Kyungpook National Univ., South Korea;* [2]*Electronics and Telecommunications Research Inst., South Korea;* [3]*JLab, South Korea.* We propose a method of expanding the viewing angle of the computer generated hologram(CGH) by attaching a pixelated high-resolution random phase mask. The viewing angle is increased according to the resolution of the random phase mask.

JTu3A.104
Evaluation of Sampling Techniques for Ray Tracing Algorithms for Digital Holography, Mark Green[1]; [1]*Faculty of Science, UOIT, Canada.* The efficiency of ray tracing algorithms for computational holography is largely determined by the sampling strategy they use. This paper evaluates three sampling techniques in terms of their efficiency and impact on image quality.

JTu3A.105 *RAPID*
Quantitative Phase-shifting Zernike Phase Imaging Method for Accurate Object Reconstruction, Jianhui Huang[1], Huiliang Jin[1], Qian Ye[1], Guoxiang Meng[1]; [1]*Shanghai Jiao Tong Univ., China.* An accurate quantitative phase imaging technique with three phase shifts on focal plane is proposed. Without approximation to $exp(i\varphi)$, the new method is applicable to arbitrary complex-valued objects and can obtain accurate object reconstruction.

JTu3A.106 *RAPID*
Top-Down Illumination Photometric Stereo Imaging Using Light-Emitting Diodes and a Mobile Device, Emma S. Le Francois[1], Johannes Herrnsdorf[1], Laurence Broadbent[2], Martin D. Dawson[1], Michael J. Strain[1]; [1]*Dept. of Physics, Univ. of Strathclyde, UK;* [2]*Aralia Systems, Bristol Robotics Lab., UK.* 3D reconstruction of objects can be achieved using a top-down illumination, photometric stereo imaging configuration with four modulated white LEDs and a mobile phone. The Standard deviation for the reconstruction is ranging from 3.5% to 10.4%.

JTu3A.107
Compact Digital Holographic Microscopy Unit Using Volume Grating, Byounghyo Lee[1], Byoungho Lee[1], Kisueng Bang[1]; [1]*Seoul National University, South Korea.* We present compact digital holographic microscopy unit using volume grating. The volume grating is used for low-pass filter, allowing the reference beam to be acquired from output of conventional microscope.

JTu3A.108
Polarization 3D Imaging having highlighted areas, Xuan Li[1], Fei Liu[1], Yudong Cai[1], Shengzhi Huang[1], Pingli Han[1], XiaoPeng Shao[1]; [1]*Xidian Univ., China.* This study focused on a polarization three-dimensional imaging technology under the natural scene. By solving the problem of diffuse reflection information missing, highlighted areas three-dimensional imaging is possible.

JTu3A.109
Gemstone Screening and Identification Using Fluorescence Spectroscopy, Tsung-Han Tsai[1], Ulrika D'Haenens-Johansson[1]; [1]*Gemological Inst. of America, USA.* We demonstrate a fluorescence spectroscopy based gemstone screening system. The fluorescence features can be used to separate mined diamonds from lab-grown diamonds and diamond simulants, detect treated pink diamonds, and identify certain gemstones.

JTu3A.110
A Road Centerline Extraction Method for High-Resolution Remote Sensing Imagery, Tingting Zhou[1], Xiaohu Zhou[2], Chenglin Sun[1]; [1]*College of Physics, Jilin Univ., China;* [2]*College of Electronic Science and Engineering, Jilin Univ., China.* After segmentation, the fast marching method algorithm is employed acquire the initial centerline and the tensor voting is applied for connecting the broken centerline. The correctness of the centerline is up to 95%.

JTu3A.111
Experimental Characterization of a Fiber Based SPR Sensor in Terms of Stability and Limit of Detection, Andon Bano[1], Alberto Vallan[1], Guido Perrone[1], Massimo Olivero[1]; [1]*Politecnico di Torino, Italy.* A fiber based surface plasmon resonance sensor to be used as refractometer for aqueous media is experimentally characterized. The sensor exhibits a standard deviation of $4x10^{-6}$ RIU for short term and a trend not bigger than $2x10^{-6}$ RIU per minute.

JTu3A.112
Demonstration of the Generalized-Kennedy Receiver for Quantum-Limited Discrimination of Photon-Starved Classical Light, Jonathan Habif[1], Samuel Gartenstein[1], Arunkumar Jagannathan[1]; [1]*Information Sciences Inst., USA.* We present an experimental implementation of a generalized Kennedy receiver and demonstrate its capability to approach the quantum sensitivity limit for discrimination between coherent and thermal radiation at photon-starved intensities.

JTu3A.113
Integrable and steerable vortex lasers using bound states in the continuum, Abdoulaye Ndao[1]; [1]*UC Berkeley, USA.* Using wave singularities known as bound states in the continuum, we report an integrated device that simultaneously generates and directs coherent beams carrying orbital angular momentum.

JTu3A.114
Probing the Structure of Molecular Cavity Polaritons with Vibronic Spectroscopy, Aaron Rury[1]; [1]*Wayne State Univ., USA.* The strong coupling of light and molecular transitions manipulates excited state potential energy surfaces central to photochemistry. We discuss vibronic spectroscopic approaches to establish these manipulations and their impacts in model systems.

JTu3A.115
Ferroelectric Properties of Barium Titannate Films Grown by Streaming Process for Electrodeless Electrochemical Deposition Technique, Gbadebo T. Yusuf[1]; [1]*Osun State Polytechnic, Nigeria.* Barium titanate films were grown by Streaming Process for Electrodeless Electrochemical Deposition method. The highest and lowest value of the remnant polarization at 2.0 and 2.4 ml/min flow rates were 2.3 and 1.7 μC/cm^2 respectively.

JTu3A.116
Standard Deviation Positions of Intensity Profiles of a Focused Femtosecond Pulse, José Agustín Moreno-Larios[1], Martha Rosete-Aguilar[1]; [1]*Univ. Nacional Autonoma de Mexico, Mexico.* Standard deviation of spatial and time intensity profiles from direct and experimental simulations when propagating a femtosecond pulse trough an achromatic doublet were calculated. The position of minimum values in the optical axis coincides.

JTu3A.117
Demonstration of snapshot terahertz spectral power characterization with a microbolometer focal plane array, Hanran Jin[1], Dogeun Jang[1], Ki-Yong Kim[1]; [1]*Univ. of Maryland at College Park, USA.* We demonstrate non-scanning terahertz spectroscopy using a Mach-Zehnder interferometer with a microbolometer focal plane array. This can measure terahertz field autocorrelations over a range exceeding 30 THz with a spectral resolution of 0.5 THz.

JTu3A.118
Time-reversal invariant scaling of light propagation in one-dimensional non-Hermitian systems, José David Hernández Rivero[2,1], Li Ge[2]; [1]*CUNY Graduate Center, USA;* [2]*Physics and Astronomy, College of Staten Island, CUNY, USA.* We prove the existence of a universal scaling that gives identical transmittance and reflectance in time-reversed partner systems with arbitrary gain/loss profile. Such robust scaling generalizes the photon-flux conservation in non-Hermitian systems.

JTu3A.119
Large Field Enhancement in Acousto-Optic Crystals, Nikolai I. Petrov[1], Vladislav Pustovoit[1]; [1]*STC UI, Russian Academy of Sciences, Russian Federation.* The Bragg diffraction problem in the Fabry-Perot resonator formed by two dynamic acousto-optic mirrors is considered. It is shown that the intensity of incident wave in anisotropic crystal can be enhanced by extremely large factor.

JTu3A.120
Subnanoscale Localization of Rare-Earth-Ion in a Doped Crystal with Standing-Wave Fields, Onkar N. Verma[1], Koustav Dey[1], Sourabh Roy[1]; [1]*NIT Warangal, India.* We propose a method for subnanoscale localization of rare-earth-ion in a doped crystal via coupling it with a plane-wave probe field and a standing-wave control field in the dark state of electromagnetically induced transparency.

JTu3A.121
Universal scaling laws of symmetry breaking in Floquet systems: application to harmonic generation, Matan Even Tzur[1], Ofer Neufeld[1], Avner Fleicher[2], Oren Cohen[1]; [1]*Technion – Israel Inst. of Technology, Israel;* [2]*Tel Aviv Univ., Israel.* We apply perturbation theory, analyzing the general behavior of symmetry broken Floquet systems. We implement the theory to harmonic generation, and classify different symmetry breaking cases, while formulating the scaling laws for harmonic emission.

JTu3A.122
Design of RF to Terahertz and Terahertz to RF Frequency Converters using Variable Width Plasmonic Structures, Michael Shur[1,2], John Mikalopas[3], Gregory Aizin[3]; [1]*Rensselaer Polytechnic Inst., USA;* [2]*Electronics of the future, Inc., USA;* [3]*Kingsborough College, The City Univ. of New York, USA.* Plasmonic instability in variable width symmetric InGaAs plasmonic structures should enable RF to THz frequency conversion at room temperature using RF and THz antennas and driven wirelessly by RF signal.

JTu3A.123
Pressure Controlled Phase Matching in Kagome PC Fiber in picosecond CARS, Aysan Bahari[1], Yujie Shen[1], Alexei Sokolov[1]; [1]*Texas A&M Univ., USA.* We study properties of Kagome fiber and calculate phase mismatching for several gases in this fiber. We find an appropriate pressure in which the phase mismatch is minimized in a Coherent anti-Stokes Raman Spectroscopy (CARS).

JTu3A.124
A DC Measurement Technique for Characterizing the Frequency Chirp of Mach Zehnder Modulators, Iam Bui[1]; [1]*CQ Univ., Australia.* A simple method for determining the chirp-factor α of Mach Zehnder modulators using only DC measurements is proposed. Simulations show a good agreement between the results and the theory over the entire range of α.

JTu3A.125
Relaxed Alignment Tolerances in Waveguide Coupling Using Single-Element Lenses Printed by Machine-Vision-Assisted Direct Laser Writing, Edgar Perez[1,2], Xiyuan Lu[1,2], Daron Westly[2], Kartik Srinivasan[2,1]; [1]*Univ. of Maryland, USA;* [2]*Physical Measurement Lab., NISTnology, USA.* Using two-photon lithography, we print single-element lenses on photonic chip facets. Our machine-vision-based approach avoids shadowing and achieves fiber-to-chip coupling efficiencies similar to lensed fibers but with improved alignment tolerances.

JTu3A.126
Elementary novel all optical Reversible logic gate using Si3N4 based optical microring resonator, Ankur Saharia[1], Ravi Kuamr maddila[1], Ghanshyam Singh[1]; [1]*Malaviya National Inst. of Tech., India.* We propose a silicon nitride based all optical reversible logic gate with use of microring resonating structures. The performance parameters like extinction ratio, Quality factor, finesse, quantum cost have been analysed to realise its feasibility

JTu3A.127
Thermal Modeling and Simulation for Optical Illumination to Extract Cancer Cells from Human Tissue Samples, Chang-Mu Han[1], Edo Waks[1], Benjamin Shapiro[2,3]; [1]*IREAP, USA;* [2]*Fischell, Bioengineering, USA;* [3]*xMD Diagnostics, USA.* Expression microdissection (xMD) allows extraction of target cancer cells from human tissue, to reduce misdiagnoses caused by non-target cell contamination. A thermal model and simulations are presented to assess thermal response in the xMD process.

JTu3A.128
Image Quality Degradation by Imperfection of Surface in Waveguide-type Near-eye Display, Chanhyung Yoo[1], Minseok Chae[1], Byoungho Lee[1]; [1]*Seoul National Univ., South Korea.* We analyze image degradation by the imperfect surface flatness of the optical waveguide. The image blurring is confirmed by simulation results. Experimental results show that the image quality is deteriorated depending on the incidence angle.

JTu3A.129
Spatial-Resolution-Enhancement of Light-Field Camera Utilizing Virtual Moving Micro-Lens Array, Jun-Chan Choi[1], Tae-Hyun Lee[1], Min-Kyu Park[1], Kyung-Il Joo[1], Jae-Won Lee[1], Ki-Chul Kwon[2], Munkh-Uchral Erdenebat[2], Yougn-Tae Lim[2], Nam Kim[2], Hak-Rin Kim[1]; [1]*Kyungpook National Univ., South Korea;* [2]*Chungbuk National Univ., South Korea.* We propose a spatial-resolution-enhancement of light-field (LF) camera. The proposed LF camera with time-multiplexing method shows the improved resolution properties as 4 times higher compared to the single MLA based on conventional LF camera.

JTu3A.130
Withdrawn

JTu3A.131
Nanoscale Thermal Transport Probed with Ultrafast Electron Diffraction, Jianming Cao[1]; [1]*Florida State Univ., USA*. We measured the thermal boundary conductance (TBC) across a GaAs/AlGaAs interface using ultrafast electron diffraction. The TBC was found to increase with the temperature imbalance across the interface, even beyond the Debye temperature.

12:45–13:30 Lunch, *Science & Industry Showcase Coffee Break Area*

13:30–15:30
JTu4A • Poster Session II

JTu4A.1 *E-Poster*
Accelerating spiral optical wave-packets, Konstantinos Makris[1,2], Apostolos Brimis[1,2], Dimitris Papazoglou[1,2]; [1]*Univ. of Crete, Greece;* [2]*Inst. of Electronic Structure and Laser (IESL)-FORTH, Greece.* By superimposing vortex ring-Airy beams of opposite handedness spiral accel-erating optical wave-packets are generated. The superimposed beams are tuned to abruptly auto-focus at overlapping focal regions while following distinct trajectories.

JTu4A.2 *E-Poster*
Sensing of biotissues utilizing circularly polarized light, Mariia Borovkova[1], Alexander Bykov[1], Alexey Popov[1], Jens Pahnke[2], Igor Meglinski[1]; [1]*Univ. of Oulu, Finland;* [2]*Univ. of Oslo, Norway.* The study is focused on the separation of scattering and birefringence contributions in phase retardation of circularly polarized light and the screening of fixed tissue blocks of mice brain with different stages of Alzheimer's disease.

JTu4A.3 *E-Poster*
Improving Quantum Noise Suppression Using Spatial Beam Profile Optimization, Savannah Cuozzo[1], Austin Kalasky[1], Nikunj Prajapati[1], Elisha Siddiqui[2], Safura Sharifi[2], Lior Cohen[2], Yaser Banadaki[2], Jonathan Dowling[2], Irina Novikova[1], Eugeniy Mikhailov[1]; [1]*William & Mary, USA;* [2]*Louisiana State Univ., USA.* We study how the addition of spatial masks, applied to a pump beam, improve quantum noise suppression using machine learning algorithms, and explore new ways of imaging quantum light structure.

JTu4A.4 *E-Poster*
Stopped Light Mediated by Mode Transitions in Hyperbolic Waveguides, Pilar Pujol Closa[1], Jordi Gomis-Bresco[1], J. Sebastian Gomez-Diaz[2], David Artigas[3]; [1]*The Inst. of Photonic Sciences, Spain;* [2]*Univ. of California Davis, USA;* [3]*Universitat Politecnica de Catalunya, Spain.*We show that symmetric three layer waveguides with Type II hyperbolic metamaterials lack cut-off. Instead, modes transit from parallel to orthogonal propagation with respect to the optical axis. This transition process results in stopped light.

JTu4A.5 *E-Poster*
Using Mean Speckle Patterns to Improve Robustness of Compressive Multimode Fiber Imaging against Fiber Bend, Yangyang Xiang[1], Di Guan[1], Li Gao[1], Junhui Li[2], Bin Luo[2], Mingying Lan[1], Song Yu[2], Guohua Wu[3]; [1]*School of Digital Media and Design Arts, Beijing Univ. of Post and Telecom., China;* [2]*State Key Lab. of Information Photonics and Optical Communications, Beijing Univ. of Post and Telecommunication, China;* [3]*School of Electronic Engineering, Beijing Univ. of Post and Telecommunication, China.* More robustness against fiber bend is demonstrated in compressive multimode fiber imaging using mean speckle patterns captured at multiple potential bending configurations beforehand, rather than sticking to single patterns at initial configuration.

JTu4A.6
Mirror Characterization and Complex Refractive Index Measurements with Hz-level Resolution Fourier Transform Spectrometry, Dominik Charczun[1], Grzegorz Kowzan[1], Akiko Nishiyama[1], Przemyslaw Staniszewski[1], Agata Cygan[1], Daniel Lisak[1], Ryszard S. Trawinski[1], Piotr Maslowski[1]; [1]*Inst. of Physics, Nicolaus Copernicus Univ. in Torun, Poland.* We present broadband measurements of intracavity loss and dispersion, which enables retrieval of complex refractive index. Results were obtained with a Fourier transform spectrometer achieving Hz-level resolution thanks to frequency comb light.

JTu4A.7 *RAPID*
Optimization of Space-time Bandwidth for Shearography, Surya Gautam[1]; [1]*Indian Inst. of Space Science & Tech., India.* We propose an approach where temporal as well as the spatial phase shifts are utilized simultaneously in order to reduce the number of shots and also the carrier frequency currently employed in digital shearography.

JTu4A.8
Diffraction Imaging of Self-assembled Photonic Crystals, Sravya Rao[1], Rahul Shaw[1], Dipak Rout[1], Govind Kumar[1], R. Vijaya[1], Shilpi Gupta[1]; [1]*Indian Inst. of Technology Kanpur, India.* We experimentally demonstrate a remote imaging technique, based on Fraunhofer diffraction, to detect cracks in large area (~ inch^2) self-assembled photonic crystals. The acquired images are well explained by our 2D Fourier transform based modeling.

JTu4A.9
Withdrawn

JTu4A.10 • 13:30
Improving the SDM system; Separation of the rings formed at the Output end, and for the first time, the SDM system becomes one of the tools of specialized photonics software systems, Ahmed Y. Laarfi[1]; [1]*Florida Inst. of Technology Fit, USA.* Design four input SDM system, separate the launched lasers resulted at BSM, take the output file of the used software and then use it as an input for more measurements

JTu4A.11
Differential phase metrology using a common-path image inversion interferometer, Walker D. Larson[1], Bahaa E. Saleh[1]; [1]*UCF CREOL, USA.* We use a common-path image inversion interferometer to measure a spatially varying phase. Our system does so without splitting beam paths, offering a practical advantage over traditional interferometric methods.

JTu4A.12 *RAPID*
Heterodyne Phase-shift-amplified Interferometry with Improved Shot-noise-limited Sensitivity, Egor Liokumovitch[1], Shmuel Sternklar[1]; [1]*Ariel Univ., Israel.* Heterodyne phase-shift-amplified interferometry is demonstrated. A phase-shift-amplification factor of 30 is achieved. Theory predicts a shot-noise-limited sensitivity improvement of √2 compared to a standard heterodyne Mach-Zehnder interferometer.

JTu4A.13
Application of Butterfly Wing Iridescence, Reflection Spectroscopy, and Chemometric Tools in Adulteration Sensing in Gasoline, Nancy M. Mwenze[1], Zephania Birech[1], Kenneth K. Aminga[1]; [1]*Univ. of Nairobi, Kenya.* Use of adulterated gasoline with kerosene has led to engine breakdowns, air pollution, and poor economic growth. By using *Papillon junonia* butterfly species, we were able to detect adulterated gasoline as low as 4.7% adulteration.

JTu4A.14
Low Oil Viscosity Determination in Oil and Gas Industry by Spectrometry Analysis, Eduardo Perez[1]; [1]*DICIS, Mexico.* We present a study made in the Refinery of Salamanca, Mexico. One of the most complete in Latin America, recently, studies of the chemical y have demonstrated by a patent that they are able to reduce viscosity in the Oil process

JTu4A.15
Holographic AR Glasses, Wontaek Seo[1], Chang-Kun Lee[1], Bongsu Shin[1], Sunil Kim[1], Juwon Seo[1], Jae-Seung Chung[1], Yun-Tae Kim[1], Geeyoung Sung[1], Jungkwuen An[1], Chil-Sung Choi[1], Hoon Song[1], Yongkyu Kim[1], Young Kim[1], Kanghee Won[1], Myungjae Jeon[1], Jang-Woo You[1], Yunhee Kim[1], Jong-Young Hong[1], Hong-Seok Lee[1], Sunghoon Hong[1]; [1]*Samsung Advanced Inst. of Tech., South Korea.* We report the glasses-type device for augmented reality. By utilizing holographic display method and designing compact optical system, we removed usual discomfort in existing AR apparatus, and developed the approach to the ideal display.

JTu4A.16 *RAPID*
Fabrication of p-NiO/p-CuO/n-CdO:ZnO heterojunctions by RF magnetron sputtering for fast UV photodiode applications, Saheer Cheemadan[1,2], Sai Guru Srinivasan[1], Santhosh Kumar M.C.[1]; [1]*Physics, National Inst. of Technology, India;* [2]*Physics, Muhammed Abdurahiman Memorial Orphanage College, India.* This study focuses the fabrication of NiO/CuO/CdO:ZnO multilayer structures for UV photodiode using the RF magnetron sputtering. The results show that the fabricated photodiodes have the potential to replace the commercially available UV photodiodes.

JTu4A.17
Tellurite Antiresonant Hollow Core Microstructured Fiber for Mid-IR Power Delivery, Andrea Ventura[1], Juliano Hayashi[1], Jaroslaw Cimek[1], Fedia Ben Slimen[1], Nick White[1], Hesham Sakr[1], Natalie Wheeler[1], Francesco Poletti[1]; [1]*Univ. of Southampton, UK.* We report fabrication of an antiresonant hollow core fiber made from Tellurite glass. Initial results are promising for fabrication of a low loss mid-IR fiber made from non-toxic and durable glass for power delivery applications.

JTu4A.18
Multimode Hollow-Core Anti-Resonant Optical Fibres, Bartlomiej Winter[1], Tim Birks[1], William Wadsworth[1]; [1]*Centre for Photonics and Photonic Materials, Univ. of Bath, UK.* We report fabrication of a multimode hollow optical fibre with a core diameter of 164 µm guiding approximately 10 modes. The number of modes is found to scale more rapidly than the core area.

JTu4A.19 *RAPID*
Lasing Threshold Properties of Rhodamine B in Glycerol Aqueous Solution based on Evanescent Wave Pump, Yuan X. Zhang[1], Xiaoyun Pu[1], Dongyang Li[1], Yonxiong Ou[1]; [1]*Yunnan Univ., China.* Optically pumped along the fiber axis, the recorded lasing threshold decreases at first and then increases with the increase of both RhB dye concentration and the RI of the RhB glycerol aqueous solution.

JTu4A.20
Microstructure of in-situ Twinning-induced Plasticity Steel After Laser Beam Welding, Vagner Braga[2,1], Rafael H. De Siqueira[1], Isabela Atilio[2,1], Milton S. Fernandes de Lima[1]; [1]*Instituto de Estudos Avançados (IEAv), Brazil;* [2]*Technological Inst. of Aeronautics (ITA), Brazil.* The present work studies the Lap joint microstructural evaluation of Twinning-induced Plasticity steel welded by Yb: fiber laser.

JTu4A.21
Generation of High Power Multi-Soliton Regimes in Passively Mode-Locked Thulium-Doped All-Fiber Ring Oscillator, Vasiliy Voropaev[1], Alexander I. Donodin[1], Dmitrii Vlasov[1], Daniil Batov[1], Andrei Voronets[1], Andrey A. Bushunov[1], Mikhail Tarabrin[1,2], Vladimir Lazarev[1], Alexander Krylov[3], Valeriy Karasik[1]; [1]*Bauman Moscow State Technical Univ., Russian Federation;* [2]*Russian Academy of Sciences, Russian Federation;* [3]*Russian Academy of Sciences, Russian Federation.* We demonstrate a regime switching between soliton rain and soliton bunches at the central wavelength of 1.9 um in the mode-locked thulium-doped all-fiber ring oscillator with fully negative group velocity dispersion cavity.

JTu4A.22
Propagation of a Gaussian-profile beam through extended MVKS phase turbulence under interchangeable source and receiver positions, Monish R. Chatterjee[1], Ali A. Mohamed[1]; [1]*Univ. of Dayton, USA.* Electromagnetic (EM) propagation through turbulence is examined using Hufnagel-Valley model for different turbulent/diffractive path ratios. Performance is assessed via cross-correlation (CC) products for interchangeable source/receiver positions.

JTu4A.23
A study of the solvent effect on linear optical properties of a perylene molecule, Danyellen D. Galindo[1], Leonardo D. Boni[1]; [1]*USP - São Paulo Univ., Brazil*. Solvent has been suggested responsible for variation in the photophysical properties of matter. In this work, we studied the optical properties of perylene molecule in a mixture of solvents, such as dimethyl sulfoxide and water.

JTu4A.24
Scattering: Challenge of Terahertz Time Domain Spectroscopy, Diksha Garg[1], Aparajita Bandyopadhyay[1], Amartya Sengupta[1]; [1]*Indian Inst. of Technology, Delhi, India*. In this work, the limitation of terahertz time domain spectroscopy influenced by scattering effect in granular samples is investigated towards developing a successful model for Agri-Food applications.

JTu4A.25
Attosecond Photoemission Spectroscopy at High Photon Energies and MHz Repetition Rate, Stephan Heinrich[2,1], Tobias Saule[2,1], Maximilian Högner[2,1], Ioachim Pupeza[2], Ulf Kleineberg[1,2]; [1]*Fakultät für Physik, Ludwig-Maximilians-Universität München, Germany;* [2]*Max-Planck-Institut für Quantenoptik, Germany*. We report on space-charge-free time- and angle-resolved photoelectron spectroscopy at MHz repetition rate utilizing attosecond pulse trains. High photon energies obtained by intracavity high-harmonic generation allow to access tungsten core levels.

JTu4A.26
Detection of Casimir Radiation from the Sun, Richard A. Hutchin[1]; [1]*Optical Physics Company, USA*. The vacuum field has been shown to vary in the lab but not in space. Here we present experimental data from multiple sources that support annual variations and also emission by the Sun.

JTu4A.27
Dynamic characteristics of photoanisotropic materials based on biogenic and synthetic polyelectrolytes, Irakli Chaganava[1,2], Irine Kobulashvili[1]; [1]*Inst. of Cybernetics of Georgian Technical Univ., Georgia;* [2]*Georgian State Teaching Univ. of Physical Education and Sport, Georgia*. The paper presents the results of a study comparing polarization-sensitive media based on polar hydrophilic polymers with oppositely charged and similarly charged macromolecules.

JTu4A.28
Quantum-state tomography in hot atomic vapour, Marek Kopciuch[1], Szymon Pustelny[1]; [1]*Marian Smoluchowski Inst. of Physics, Poland*. We present investigations of the collective quantum state of room-temperature atomic vapour. Our method is based on Faraday rotation of off-resonance light transmitted through the vapour. The results are supported by theoretical calculations.

JTu4A.29
The impact of rare-earth element to femtosecond laser induced damage of Dy^{3+} doped $Ga_{0.8}As_{39.2}S_{60}$ and $Ga_{0.8}As_{29.2}Sb_{10}S_{10}$ chalcogenide glasses, Iutao Liu[1,2]; [1]*Xi'an Inst. of Optics and Precision Mechanics, Chinese Academy of Sciences (CAS), China;* [2]*2. Univ. of Chinese Academy of Sciences (UCAS), China*. Laser induced damage threshold (LIDT) of Dy^{3+} doped $Ga_{0.8}As_{39.2}S_{60}$ and $Ga_{0.8}As_{29.2}Sb_{10}S_{60}$ glasses are investigated. Both Dy^{3+} doped glasses show lower LIDT which may be due to more energy absorbed by Dy^{3+} without converting it all to fluorescence.

JTu4A.30
Disrupting Phase Matching of SHG and SFG with Counterpropagating Light, Amy L. Lytle[1], Eric Dyke[1], Etienne Gagnon[1]; [1]*Franklin & Marshall College, USA*. Counterpropagating ultrafast pulses can disrupt phase matching of harmonic generation, allowing all-optical QPM. We report on improved theoretical understanding of this disruption based on multiple nonlinear three-wave processes.

JTu4A.31
Hot-carrier Cooling Dynamics of Type-II InAs/$AlA_{1-x}Sb_x$ Quantum Wells, Herath P. Piyathilaka[1], Hamidreza Esmaielpour[2], Vince Whiteside[2], Tetsuya Mishima[2], Michael Santos[2], Ian Sellers[2], Alan D. Bristow[1]; [1]*Dept. of Physics and Astronomy, West Virginia Univ., USA;* [2]*Dept. of Physics and Astronomy, Univ. of Oklahoma, USA*. Transient AC photoconductivity is used to investigate the photocarrier relaxation dynamics in quasi-type-II quantum wells. Hot carriers are observed as a plateau in relaxation due to a blockade of the phonon-mediated processes.

JTu4A.32
From Loosely Focused Multifilamentation to Superfilamentation: Effect of Focusing Conditions, Dmitrii V. Pushkarev[1], Ekaterina Mitina[1], Georgii Gospodinov[1], Alexey Murzanev[2], Daria Uryupina[1], Nikita Zhidovtsev[1], Roman Volkov[1,3], Andrei Stepanov[2], Olga Kosareva[1,3], Andrei Savel'ev[1,3]; [1]*Faculty of Physics, Lomonosov Moscow State Univ., Russian Federation;* [2]*Inst. of Applied Physics of the Russian Academy of Sciences, Russian Federation;* [3]*International Laser Center of Lomonosov Moscow State Univ., Russian Federation*. Nonlinear increase of energy deposition results in superfilamentation under femtosecond multifilamentation in air with $NA<<10^{-2}$ focusing, while for $NA \geq 10^{-2}$ it grows linearly with filament number.

JTu4A.33
Predicting refractive index dispersion of ionic liquids, Carlos Damián Rodríguez Fernández[1], Yago Arosa[1], Bilal S. Algnamat[1], Elena Lopez-Lago[1], Luis M. Varela[1], Raul De la Fuente[1]; [1]*Universidade de Santiago de Compostela, Spain*. Ionic Liquids are materials with potential applications in many fields. However, their optical properties are scarcely studied. We propose and test an effective semiempirical method to predict the refractive index dispersion of ionic liquids.

JTu4A.34
Modelling Nonlinear Near-Zero-Index Media through Carrier Kinetic Models, Ray R. Secondo[1], Nathaniel Kinsey[1]; [1]*Virginia Commonwealth Univ., USA*. To optimize the excitation and predict behavior of nonlinear interactions in near-zero-index media, physically accurate models are needed. We describe a phenomenological model that can extract standard coefficients and optical excitation conditions.

JTu4A.35
Optical Magnetometry using Fluorescence Resonance in Sodium D_2 Manifold, Renu Tripathi[1], Raghwinder S. Grewal[1], Gour S. Pati[1], Anthony W. Yu[2], Michael A. Krainak[2], Michael E. Purucker[2]; [1]*Delaware State Univ., USA;* [2]*NASA Goddard Space Flight Center, USA*. Magnetic resonance produced by amplitude modulated light in sodium D_2 manifold is investigated for remote magnetometry application

JTu4A.36
Measuring Ultralow Charge Densities In Gases With Picosecond Mid-IR Laser Breakdown, Daniel C. Woodbury[1], Robert Schwartz[1], Ela Rockafellow[1], Howard Milchberg[1]; [1]*Univ. of Maryland at College Park, USA*. Avalanche breakdown with picosecond, mid-IR lasers allows the detection of single free electrons in gases with precise spatial location. Using this method, we measure radiation-induced charge densities (down to 10^3 cm^{-3}) near a radioactive source.

JTu4A.37
Strong Two Photon Absorption in BiOBr Nanoflakes, Linnan Jia[1], Dandan Cui[2], Jiayang Wu[1], Haifeng Feng[3], Tieshan Yang[1], Yi Du[3], Weichang Hao[2], Baohua Jia[1], David J. Moss[1]; [1]*Swinburne Univ. of Technology, Australia;* [2]*Beihang Univ., China;* [3]*Univ. of Wollongong, Australia*. We observe extremely high two photon absorption (TPA) of BiOBr nanoflakes using the Z-scan technique. We report a TPA coefficient as high as ~ 6.697×10^{-7} m/W – much higher than other typical 2D materials.

JTu4A.38 *RAPID*
Maximum Differential Group Delay Achievable by a Space-Time Wave-Packet in Free Space, Murat Yessenov[1], Lam Mach[1], Basanta Bhaduri[1], Davood Mardani[2], Hasan E. Kondakci[1], George Atia[2], Miguel Alonso[3,4], Ayman Abouraddy[1]; [1]*Univ. of Central Florida, CREOL, USA;* [2]*Dept. of Electrical and Computer Engineering, Univ. of Central Florida, USA;* [3]*The Inst. of Optics, Univ. of Rochester, USA;* [4]*Aix Marseille Univ., France*. We investigate theoretically and experimentally the maximum group delay that realistic finite-energy space-time wave-packets can achieve with respect to a pulse traveling at c, and find that the delay is solely determined by the spectral uncertainty.

JTu4A.39
Ultra-Fast Phenomena in Perovskite Oxide $La_{0.7}Sr_{0.3}MnO_3$ Thin Films, Saeed Yousefi Sarraf[1], Sobhit Singh[1,2], Andres Camilo Garcia Castro[3], Robbyn Trappen[1], Navid Mottaghi[1], Guerau Cabrera[1], Chih-Yeh Huang[1], Shalini Kumari[1], Ghadendra Bhandari[1], Alan Bristow[1], Aldo Romero[1], Mikel Holcomb[1]; [1]*Department of Physics and Astronomy, West Virginia Univ., USA;* [2]*Department of Physics and Astronomy, Rutgers Univ., USA;* [3]*Department of Physics, Universidad Industrial de Santander, Colombia*. Transient reflectivity (TR) measurements for $La_{0.7}Sr_{0.3}MnO_3$ thin films indicate enhanced surface recombination of charge carriers for thinner films ($d < 20$ nm). Wavelet analysis of residual TR shows abrupt oscillatory modes with close energy ranges.

JTu4A.40
Versatile Patterns of Bright Pulse and Dark Pulse in a Mode-Locked Fiber Ring Laser, Dan Yu[1], Renlai Zhou[1], Xuanyi Liu[1], Qian Li[1], H.Y. Fu[2]; [1]*PKU Shenzhen Graduate School, China;* [2]*Tsinghua-Berkeley Shenzhen Inst. (TBSI), China*. We have experimentally studied versatile patterns of bright pulse and dark pulse in a mode-locked fiber ring laser. The orthogonal polarized pulse components of the combined dark-bright pulse pairs are investigated.

JTu4A.41
Withdrawn

JTu4A.42 *RAPID*
Revealing the Number of Single Photons in Real Time, Leonardo Assis Morais[1,2], Marcelo P. Almeida[1,2], Geoff Gillett[1,2], Andrew G. White[1,2]; [1]*School of Mathematics and Physics, The Univ. of Queensland, Australia;* [2]*ARC Centre of Excellence for Engineered Quantum Systems, Australia*. We report a reconfigurable Field-Programmable Gate Array processor for transforming signals from transition-edge sensors into photon-number-resolving measurements, providing on-the-fly data analysis with photon resolution, up to 15 photons at 820 nm.

JTu4A.43
Precise determination of atomic lifetimes based on optical photon echoes, Hermina Beica[1], Alex Pouliot[1], Patrick Dowling[1], Adam Carew[1], Thomas Vacheresse[1], Gehrig Carlse[1], Louis Marmet[1], A Kumarakrishnan[1]; [1]*York Univ., Canada*. We demonstrate a technique based on optical photon echoes that can be used to measure the $5^2P_{3/2}$ excited state lifetime in rubidium vapor with a precision of 0.02% in four hours of data acquisition.

JTu4A.44
Filtering Coerent Signal from Thermal Noise by Photon-Number Thresholding, Lior Cohen[1], Elisha Siddiqui[1], Yoni Sher[2], Daniel Istrati[2], Hagai Eisenberg[2], Jonathan Dowling[1]; [1]*Louisiana State Univ., USA;* [2]*Physics, Racah Institue of Physics, Hebrew Univ. of Jerusalem, Israel*.We filter low photon-number using photon-number-resolving detector, for improving the signal-to-noise-ratio (SNR) of rangefinders and lidars. We investigate the technique properties and show where it surpasses the classical SNR.

JTu4A.45
Coaction of Disorder and PT-symmetry in Deep Subwavelength Multilayers, Alex Dikopoltsev[1], Ariel Shaham[1], Adi Pick[1], Hanan H. Sheinfux[1,2], Mordechai Segev[1]; [1]*Technion, Israel;* [2]*ICFO, Spain.* We study nonHermitian PT-symmetric subwavelength photonic structures. Surprisingly, disorder lowers the critical gain/loss required to break PT-symmetry. Biasing these structures with loss makes them nearly perfect absorbers with a single input beam.

JTu4A.46
Photon-Number-Resolving Detection for Viable Gottesman-Kitaev-Preskill State Preparation, Miller Eaton[1], Rajveer Nehra[1], Olivier Pfister[1]; [1]*Univ. of Virginia, USA.* We include photon-number-resolving detection in ``photon catalysis" and apply it to generating non-Gaussian quantum states, including perfectly displaced single-photon states, high-fidelity squeezed cat and Gottesman-Kitaev-Preskill states.

JTu4A.47
Resource Prioritization and Resource Balancing for the Quantum Internet, Laszlo Gyongyosi[1,2], Sandor Imre[2]; [1]*Univ. of Southampton, UK;* [2]*Budapest Univ. of Tech. and Economics, Hungary.* Methods of resource prioritization and resource balancing for the quantum Internet are defined. The aim of the solutions is to optimize the resource allocations and to reduce the resource consumptions of the quantum Internet.

JTu4A.48
Few-Femtosecond Localized Nanoplasmonic Fields Studied by Interferometric Time- and Energy-Resolved Photoemission Electron Microscopy, Alexander Gliserin[4,1], Soo Hoon Chew[5,1], Sungho Choi[1,2], Kyoungmin Kim[3], Daniel T. Hallinan[3], Jin-Woo Oh[4], Kim Seungchul[5], Kim Dong Eon[1,2]; [1]*Pohang Univ. of Science and Tech., South Korea;* [2]*Max Planck POSTECH/Korea Research Initiative, South Korea;* [3]*FAMU-FSU College of Engineering, USA;* [4]*Pusan National Univ., South Korea;* [5]*National Univ., South Korea.* A phase-stabilized interferometric time-resolved normal-incidence photoemission electron microscope reveals strong field enhancement and few-fs localized surface plasmon dynamics at a monolayer of 40-nm gold spheres via the autocorrelation method.

JTu4A.49
pyLLE: a Fast and User Friendly Software Package for Microcomb Simulations, Gregory Moille[1,2], Qing Li[1,3], Xiyuan Lu[1,2], Ashutosh Rao[1,2], Kartik Srinivasan[1,4]; [1]*NISTnology, USA;* [2]*Univ. of Maryland, USA;* [3]*Electrical and Computer Engineering, Carnegie Mellon Univ., USA;* [4]*Joint Quantum Inst., USA.* We present pyLLE, a freely accessible Lugiato-Lefever equation solver programmed in Python and Julia and optimized for the simulation of microresonator frequency combs. Examples illustrating its operation and performance are presented.

JTu4A.50
High-efficiency fast superconducting nanowire single-photon detector with a reflection grating structure, Min Gu[1], Xiaolin Lin[1], Dongmei Liu[1], Wencong Wang[1], Xianqiu Wu[1]; [1]*South China Normal Univ., China.* Superconducting nanowire single-photon detectors with a reflection grating structure are designed. The absorption capacity reached 92% at 1550 nm. It reduced the total filling factor of superconducting nanowires and improved count rates.

JTu4A.51
Integrated Path-encoded CNOT Quantum Gate Fabricated by Femtosecond Laser Direct Writing, Meng Li[1], Qian Zhang[1], Qihuang Gong[1,2], Yan Li[1,2]; [1]*Peking University, China;* [2]*Shanxi University, China.* We demonstrate the fabrication of an integrated path-encoded CNOT quantum gate inside glass using femtosecond laser direct writing. The quantum interference visibility can reach 0.97 and average fidelity of the reconstructed truth table is 0.98.

JTu4A.52
Heralded single photons using commercial birefringent optical fiber, Jasleen Lugani[1], Robert J. A. Francis-Jones[1], Joelle Boutari[1], Ian A. Walmsley[1]; [1]*Physics, Univ. of Oxford, UK.* We report a bright and tunable heralded single photon source at telecom using four-wave-mixing in a commericial birefringent fiber. The source exhibits a purity of 85\%, CAR of 100 and raw heralding efficiency of 30\%

JTu4A.53
Influence of the Screw Dislocation on the Interband Light Absorption Coefficient and in the Threshold Frequency in Quantum Dots, Gilson A. Rodrigues[1], Cleverson Filgueiras[2], Moises Rojas[2], Edilberto Silva[3]; [1]*Universidade Estadual da Paraíba - UEPB, Brazil;* [2]*Universidade Federal de Lavras, Brazil;* [3]*Universidade Federal do Maranhão, Brazil.* We investigate the changes of a screw dislocation in the absorption coefficient of light interband and frequency of the absorption threshold in quantum dots, because of their importance for the improvement of semiconductor electronic technology.

JTu4A.54
Quantum Memory Efficiency in a Frequency Comb of Atomic Population Inversion, Mingzhen Tian[1]; [1]*George Mason Univ., USA.* A theoretical model was developed in a three-level system to study quantum memory efficiency in atomic frequency combs of ground and excited state population. Experimental results with higher than 100% efficiency show agreement with the theory.

JTu4A.55 *RAPID*
Nonlinear Microscopy of Strain in Lead Iodide Nanosheets, Jingshi Yan[1], Qingdong Ou[2], Maria Antonietta Vincenti[3], Costantino De Angelis[3], Qiaoliang Bao[2], Dragomir N. Neshev[1]; [1]*Australian National Univ., Australia;* [2]*Monash Univ., Australia;* [3]*Università degli Studi di Brescia, Italy.* We investigate the nonlinearity of PbI_2 nanosheets by strain. Using the polarization and thickness dependence of the nonlinear harmonic emissions, we can determine their thickness and crystalline orientation with a non-invasive optical method.

JTu4A.56
Orbital-Angular-Momentum (OAM) Mode Mixing in Slightly Elliptical Fibers in Perturbation Theory, Ramesh Bhandari[1]; [1]*Laboratory for Physical Sciences, USA.* We report analytic expressions for orbital-angular-momentum (OAM) modal crosstalk in a slightly elliptical fiber, illustrated with application to a step-index multimode fiber. These expressions can be useful in the analysis and design of fibers.

JTu4A.57
SOA-based Optical Fiber Loop for Optical Frequency Comb Generation Using Different Modulation Approaches, Maria Luisa Matias dos Santos[1], Aldario C. Bordonalli[1]; [1]*Univ. of Campinas, Brazil.* An optical frequency comb generator based on a recirculation loop using semiconductor optical amplifiers and different optical modulators is proposed. The amplifier nonlinear behavior provided up to 30 comb lines under best operational conditions.

JTu4A.58
Fabrication and analysis of Long-Period Gratings by Electric Arc Discharge, Koustav Dey[1]; [1]*Physics, National Inst. of Technology Warangal, India.* Here we report about the fabrication and analysis of Long Period Gratings in a single mode optical fiber, by means of Electric Arc Discharge technique with different arc times, length and arc power.

JTu4A.59
Harvesting Planck Radiation for Free-Space Optical Communications in the Long-Wave Infrared Band, Jonathan Habif[1], Arunkumar Jagannathan[1]; [1]*Information Sciences Inst., USA.* We present a free-space optical communications architecture using Planck radiation, inherently generated by all warm objects, as an optical source for a communications signal, and modern LWIR imaging technology as a communications receiver.

JTu4A.60
Self pulsing detection and optimization in pump modulated fibre amplifiers using statistical measures, Ikram Khan[1], Anil Prabhakar[1]; [1]*IIT Madras, India.* Self-pulsing is mitigated using pump modulation and optimized the pump pulse-width and offset current. Self-pulsing characteristics were captured using a constant fractional discriminator and improvements quantified using the Kolmagorov-Smirnov test.

JTu4A.61
Stimulate Brillouin Scattering Based Slow Light at 2 μm, Akhileshwar Mishra[1], Varun MK[1], Ravi Pant[1]; [1]*IISER Thiruvananthapuram, India.* We report the first demonstration of stimulated Brillouin scattering based slow light and tunable optical delay around 2 μm. We achieve a maximum delay of 30ns for a 50ns input pulse using a gain of 16.88dB.

JTu4A.62
Polarization Dependence of the Speed of Vortex Light in Optical Fiber, Nikolai I. Petrov[1]; [1]*Scientific and Technological Center of Unique Instrumentation of the Russian Academy of Sciences, Russian Federation.* The mode-group delay in graded-index fiber due to spin-orbit interaction is demonstrated. It is shown that the delay time between vortex Laguerre-Gauss modes with different circular polarizations of the order of 1ns/km can be observed.

JTu4A.63
Efficient Self-Similar Spectral Compression of Chirped Soliton Pulses in Nonlinear Fibers with Exponentially Increasing Dispersion, Jiaye Wu[1], Qian Li[1]; [1]*Peking Univ., China.* The self-similar spectral compression of chirped soliton pulses is numerically demonstrated in fibers with exponentially increasing dispersion. A spectral compression factor of 16.12 is achieved, which is higher than that of chirp-free input pulses.

JTu4A.64
A Photonic Crystal Fiber with High Birefringence-stress Stability for Interferometric Fiber Optic Gyroscope, Wang Xiaowei[1], Song Ningfang[1], Song Jingming[1], Li Weile[1], Yitong Song[1]; [1]*Beihang Univ., China.* A photonic crystal fiber (PCF) with an spiral rectangles array is proposed to achieve high birefringence-stress stability. The PCF can be used for winding the coil of fiber optic gyroscopes with a lower birefringence-stress sensitivity.

JTu4A.65
Achromatic Varifocal Metalens for the Visible Spectrum, Maxwell D. Aiello[1], Adam Backer[2], Aryeh Sapon[1], Janis Smits[1], John Perreault[3], Patrick Llull[3], Victor M. Acosta[1]; [1]*Univ. of New Mexico, USA;* [2]*Sandia National Laboratories, USA;* [3]*Google, USA.* Metalenses provide an ultra-thin alternative to refractive lenses. We report the design, fabrication, and characterization of metalenses wtih a polarization-dependent response. We use this property to demonstrate varifocal imaging with white light.

JTu4A.66
Robust Sub-Wavelength Grating Coupler for On-Chip Silicon Nitride Waveguides, Amir Begovic[1], Stephen Anderson[1,2], Alexander Chen[3], Zhaoran R. Huang[1]; [1]*Electrical, Computer, and Systems Engineering, Rensselaer Polytechnic Inst., USA;* [2]*Sensors and Electronic Devices Directorate, Army Research Laboratory, USA;* [3]*Physics, Rensselaer Polytechnic Inst., USA.* A sub-wavelength grating (SWG) coupler is designed for coupling from a lensed fiber to an on-chip SiN waveguide. The designed SWG is compared with an inverse taper and analyzed for fabrication inaccuracies and misalignment conditions.

JTu4A.67
Atto-joule Efficient Graphene Integrated Plasmonic Modulator, Ipsita Chakraborty[1], Vivek Dixit[1], Kapil Debnath[1]; [1]*IIT Kharagpur, India.* A novel graphene integrated plasmonic modulator is presented. The proposed modulator achieves 0.36 THz optical bandwidth and 320 aJ/bit switching energy using sub-wavelength modal confinement and strong graphene light-matter interaction.

JTu4A.68
A Novel Microellipsoid Whispering-Gallery-Mode Microcavity with High Q Value, Zhenmin Chen[1], Xin Tu[2], Xin Mu[1], H.Y. Fu[1]; [1]*Tsinghua-Berkeley Shenzhen Inst., China;* [2]*China Univ. of Geosciences, China.* A new type of whispering-gallery-mode microellipsoid microcavity has been prepared by optical fiber fusion. The measured Q value can be as high as 9×10^7. Theoretical investigation indicates the microellipsoid owns small mode volume.

JTu4A.69
Perfect absorption in lossy dielectric media, Sanjay Debnath[1], Emroz Khan[1], Evgenii Narimanov[1]; [1]*Purdue Univ., USA.* We theoretically demonstrate perfect absorption in lossy anisotropic dielectric planar structures. Our result shows that many existing natural materials exhibit this effect in different frequency bands.

JTu4A.70
Parity–Time-Symmetric Mechanical Array with the Cavity Optomechanical Effect, Ziyao Feng[1], Jingwen Ma[1], Xiankai Sun[1]; [1]*The Chinese Univ. of Hong Kong, Hong Kong.* An ultracompact PT-symmetric mechanical array with gain/loss provided by the optomechanical effect is proposed, theoretically analyzed, and numerically simulated for the first time, where the property of unidirectional reflection is identified.

JTu4A.71
A photonic interface of chiral Purcell enhancement, Ying Gu[1], Fan Zhang[1], Juanjuan Ren[1], Lingxiao Shan[1], Xueke Duan[1], Zhiyuan Qian[1], Yan Li[1], Tiancai Zhang[2], Qihuang Gong[1]; [1]*Peking Univ., China;* [2]*Shanxi Univ., China.* We propose a coupled photonic crystal and metallic nanoparticle structure for nonreciprocal quantum source, where the rate of photons emitting into the waveguide reaches several tens of γ_0 and ~95% photons propagate unidirectionally.

JTu4A.72
Thermal polarimetry based on metallic nanowire array, Seongmin Im[1], Eunji Sim[2], Donghyun Kim[1]; [1]*School of Electrical and Electronic Engineering, Yonsei Univ., South Korea;* [2]*Dept. of Chemistry, Yonsei Univ., South Korea.* We have explored opto-thermal properties of a metallic nanowire-grid polarizer. Thermal extinction ratio was obtained at 4.78 dB with a temperature difference *DT* = 54.3 K between *p* and *s*-polarized light component.

JTu4A.73
Dielectric Metamaterial based Broadband Reflector in Visible spectrum, Baljit Singh[1], Yogita Kalra[1], Kamal Kishor[1]; [1]*Delhi Technological Univ., India.* A novel design of metamaterial based broadband reflector made up of amorphous TiO2 has been proposed. The reflection spectra of the proposed design have been investigated. Optical constants are also calculated using parameter retrieval algorithm.

JTu4A.74
Antiresonances and Ultrafast Resonances in Coupled Semiconductor Lasers, Yannis Kominis[1], Kent D. Choquette[2], Anastasios Bountis[3], Vassilios Kovanis[4]; [1]*National Technical Univ. of Athens, Greece;* [2]*Univ. of Illinois, USA;* [3]*Nazarbayev Univ., Kazakhstan;* [4]*Virginia Tech Research Center, USA.* We study the linear modulation response of coupled semiconductor lasers for cases of strong and weak coupling and we show the existence of sharp antiresonances and ultrafast resonances far beyond the free running relaxation frequencies.

JTu4A.75
Withdrawn

JTu4A.76
Silicon Resonant Cavity Enhanced $MoTe_2$ Schottky Photodetectorat 1.55 µm, Rishi Maiti[1], Chandraman Patil[1], Xie Ti[1], Volker Sorger[1]; [1]*George Washington Univ., USA.* Here we demonstrate a TMD-based photodetector heterogeneously integrated into a silicon photonics platform. The photodetector shows high photoresponsivity (~0.1A/W) as compared to straight waveguide at 1550 nm.

JTu4A.77
Second Harmonic Generation in Chiral Nanoholes, Irina Kolmychek[1], Evgeniy Mamonov[1], Nikolai Mitetelo[1], Alexander Ezhov[1,2], Oleg Rogov[2], Vladimir Artemov[2], Maxim Gorkunov[2], Tatiana Murzina[1]; [1]*Moscow State Univ., Russian Federation;* [2]*Shubnikov Inst. of Crystallography, Russian Federation.* Circular dichroism in optical second harmonic generation (SHG) is studied in different arrays of 3D chiral nanoholes in silver film. The results are compared with the SHG microscopy data for the isolated nanoholes of different symmetry.

JTu4A.78
Non-Hermitian Selective Thermal Emitters Using Hybrid Plasmonic-Photonic Resonators, Chloe F. Doiron[1], Gururaj V. Naik[1]; [1]*Rice Univ., USA.* We experimentally demonstrate passive *PT*-symmetry in thermal emission at 700 ^{0}C using a hybrid plasmonic-photonic selective thermal emitter. Additionally, we demonstrate the effect of the internal oscillator phase on far-field thermal emission.

JTu4A.79
Observation of Exceptional Points in Passive Plasmonic Nanostructure, Abdoulaye Ndao[1]; [1]*UC Berkeley, USA.* We propose a passive plasmonic nanostructures operating at an exceptional point (EP), which get enhanced sensitivity with small external perturbation. EP plasmonic sensor will pave the way to highly sensitive plasmonic devices

JTu4A.80
Polarimetrical optical sensing using plasmonic nanocrescent dimer based nanoantenna arrays, Rishi Aneja[1], Ayush Paliwal[1], Jorawar Singh Dham[1], Chauhan Pooja[1], Ajeet Kumar[1]; [1]*Delhi Technological Univ., India.* Nanocrescent dimer based array is studied for applications as an optical polarimetric plasmonic sensor. Variation in geometry and refractive index on field enhancement and spectral response has been studied.

JTu4A.81
Two-photon Luminescence and Second Harmonic Generation in Resonant Organic Crystalline Microstructures, Mikhail E. Popov[1], Evgeniy Mamonov[1], Nikolai Mitetelo[1], Dasari Venkatakrishnarao[2], Anton Maydykovskiy[1], Rajadurai Chandrasekar[2], Tatiana Murzina[1]; [1]*Moscow State Univ., Russian Federation;* [2]*Univ. of Hyderabad, India.* Here we report on the observation of Fabry-Perot and quasi-whispering gallery modes in two-photon luminescence and second harmonic spectra in organic crystalline microstructures with the shape of parallelepipeds, squares, diamonds and pyramids.

JTu4A.82
A Highly Sensitive Trace Gas Sensor Based on Retro-reflection-cavity-enhanced Photoacoustic Spectroscopy, Shunda Qiao[1], Yufei Ma[1], Ying He[1], Yu Li[1], Zhonghua Zhang[1], Frank K. Tittel[2]; [1]*Harbin Inst. of Technology, China;* [2]*Rice Univ., USA. A retro-reflection-cavity-enhanced photoacoustic spectroscopy based gas sensor with high sensitivity was demonstrated. Acetylene was chosen as the target gas. A minimum detection limit of 600 ppt was achieved with a fiber amplified diode laser.*

JTu4A.83 *RAPID*
Wireless Optical Communications with GaAs Solar Cells, Daniel L. Salas[1], Xiaozhe Fan[1], Yizhou Zhang[1], Sindhubala Kadirvelu[2,1]; [1]*Purdue Univ., USA;* [2]*B. S. Abdur Rahman Crescent Inst. of Science and Technology, India.* Modulation of the luminescent radiation of a GaAs solar cell to transmit information wirelessly is explored. The impulse response is measured to determine the transmission speed of binary symbols using square pulses.

JTu4A.84
Dissipative Quartic Kerr Solitons for WDM Applications, Mohammadreza Ghasemkhani[1], Anatoliy Savchenkov[2], Andrey Matsko[2], Hossein Taheri[1]; [1]*Univ. of California Riverside, USA;* [2]*OEwaves Inc., USA.* Pulses generated in Kerr-nonlinear microresonators with dominant pure quartic modal dispersion are reported, and their conversion efficiency and 3dB bandwidth is studied for wavelength-division-multiplexing (WDM) data communication applications.

JTu4A.85 *RAPID*
Tuning a Plasmonic Metasurface Partial Polarizer in the Quantum Regime using a Control Laser, Solomon A. Uriri[1], Yaseera Ismail[1], Francesco Petruccione[1]; [1]*Physics, Univ. of kwaZulu-Natal, South Africa.* Metamaterials have open up new ways of manipulating and controlling light, making them a useful material in quantum communication. We experimentally tune a plasmonic metasurface partial polarizer in the quantum regime using an external laser

JTu4A.86
Optimized Si/SiO_2 nanobeam cavity for linear and nonlinear applications, Juan P. Vasco[1], Dario Gerace[2], Vincenzo Savona[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland;* [2]*Dipartimento di Fisica, Università di Pavia, Italy.* We optimize an encapsulated Si/SiO_2 nanobeam cavity using a global optimization algorithm and found quality factors in the 7×10^6 regime. Effects of the nanobeam size and disorder on the *Q*-factor are also studied.

JTu4A.87
Anderson Localization in Disordered Arrays of Hybrid Plasmonic Waveguides, Huizhong Xu[1], Justin Isaac[1], Weining Man[1]; [1]*Department of Physics and Astronomy, San Francisco State Univ., USA.* We study modes supported by disordered arrays of hybrid plasmonic waveguides and have found strong localization of fields can occur as a result of increasing disorder with characteristics different from confinement due to surface plasmons.

JTu4A.88
Grating-assisted waveguide coupler for stimulating the WGMs in the low index droplet resonator, Meng Zhang[1], Haitao Liu[1], Jiansheng Liu[1], Hongwen Zhou[1], Xinxuan Ma[1], Yuhang Wan[1]; [1]*Beihang Univ., China.* We propose to use grating-assisted waveguide coupler to excite the whispering gallery modes in low refractive-index water droplets for a compact optofluidic device.

JTu4A.89
High-order mode suppressed microresonators based on multimode waveguide and low-loss mode remover, Yu Zhang[1], Yuhang Wan[1], Xinxuan Ma[1], Mengxuan Cheng[1], Zheng Zheng[1,2]; [1]*Beihang Univ., China;* [2]*Beihang Univ., China.* A microresonator structure is proposed, where the high-order mode could be removed with a curved waveguide coupler, where the fundamental mode in the multimode ring waveguide is left undisturbed as alternative low-loss mode filters.

JTu4A.90
Physiological Changes of Human Skin after Sun Exposure Revealed by the Principle Components of Skin Diffuse Reflection Spectrum, Szu-Yu Chen[1], Pang-Lung Li[1], Wei-Chien Hu[1]; [1]*National Central Univ., Taiwan.* After sun exposure, the concentrations of melanin and hemoglobin in human skin keep changing within 6 weeks. Measuring the diffuse reflection spectra and finding the principle components, the related physiological changes can thus be revealed.

JTu4A.91
Propagation of partially coherent light through scattering biological tissues modeled by Green's functions, José Luis Ganoza-Quintana[1], Felix Fanjul-Velez[1], José Luis Arce-Diego[1]; [1]*Univ. of Cantabria, Spain.* Light propagation in biological tissues usually neglects coherence effects. Green's functions can be used for scattering modeling. Partially coherent light may significantly influence light distribution and affect diagnosis, treatment or surgery.

JTu4A.92
Femtosecond Laser Bone Drilling with the Second-harmonic-generation Green Positioning and On-line Spectral Monitoring, Guoqing Hu[2,1], Yang Song[2], Zheng Zheng[3,4], Yingchun Guan[2,5]; [1]*Beihang Univ., Hefei Innovation Research Inst. of Beihang Univ., China;* [2]*Beihang Univ., School of Mechanical Engineering & Automation, China;* [3]*Beihang Univ., School of Electronic and Information Engineering, China;* [4]*Beihang Univ., Beijing Advanced Innovation Center for Big Date-based Precision Medicine, China;* [5]*Beihang Univ., National Engineering Laboratory of Additive Manufacturing for Large Metallic Components, China.* We experimentally demonstrate a carbide-free femtosecond laser bone drilling with real-time parameter optimization based on on-line spectral monitoring after second-harmonic-generation green positioning, indicating a simple bone processing method.

JTu4A.93
On the Origin of a Low Intensity Microwave Irradiation Effect on Tobacco Mosaic Virus Activity, Valeri I. Kovalev[1,2], Sergei M. Pershin[4], Marina V. Arkhipenko[3], Alexander N. Fedorov[4], Olga Karpova[3], V Oshurko[4]; [1]*P.N. Lebedev Physical Inst., Russian Federation;* [2]*Physics, Heriot-Watt Univ., UK;* [3]*Lomonosov Moscow State Univ., Russian Federation;* [4]*Prokhorov General Physics Inst. of the Russian Academy of Sciences, Russian Federation.* Up to 50% deactivation of tobacco mosaic virus by a low intensity 9&12 GHz microwave irradiation with the net effect enhanced at 9 GHz are observed experimentally and interpreted theoretically in frames of classical electrodynamics.

JTu4A.94
Plasmonic Gold Nanorods for theranostic photoacoustic microscopy and optical coherence tomography imaging enhancement and photodynamic therapy of retinal neovascularization in a rabbit model, Phuc Nguyen[1,2], Yanxiu Li[1,3], Jessica Henry[1], Michael Aaberg[1], Wei Zhang[3], Xueding Wang[3]; [1]*Kellogg Eye Center, Univ. of Michigan, USA;* [2]*NTT Hi-tech Inst., Nguyen Tat Thanh Univ. Viet Nam;* [3]*Dept. of Biomedical Engineering, Univ. of Michigan, USA.* This study demonstrates the potential application of gold nanorods as theranostic agents for photoacoustic microscopy and optical coherence tomography imaging enhancement and photodynamic therapy of retinal neovascularization in rabbits *in vivo*.

JTu4A.95 *RAPID*
Low-cost, multispectral imaging mini-microscope for longitudinal oximetry in small animals., Victor Ochoa[1], Pavan Konda[1], Andrew Harvey[1], Julien Reboud[1], Jonathan M. Cooper[1]; [1]*Univ. of Glasgow, UK.* We present a multispectral imaging mini-microscope for longitudinal oximetry in small animals. By replacing expensive and complex imaging systems using a low-cost imaging system.

JTu4A.96
Visual Search Performance Depending on Target-Distractor Difference on Volumetric Display and Flat Panel Display, Tatjana Pladere[1], Mara Velina[1], Vita Konosonoka[1], Kristaps Klava[1], Marina Seleznova[1], Karola Panke[1], Gunta Krumina[1]; [1]*Univ. of Latvia, Latvia.* The search items were demonstrated on the volumetric display and flat panel display. In contrast to the correct response rate, the search time and number of interactions were considerably affected by the type of visualization.

JTu4A.97
Direct Observation of the Spectral Shift and Broadening in Brillouin Microscopy, Roni Shaashoua[1], Itay Remer[2], Alberto Bilenca[1,3]; [1]*Biomedical Engineering Dept., Ben-Gurion Univ. of the Negev, Israel;* [2]*Agilent Research Laboratories, Israel;* [3]*Ilse Katz Inst. for Nanoscale Science and Technology, Ben-Gurion Univ. of the Negev, Israel.* We report measurements of the line-shift/broadening in Brillouin microscopy with high spectral resolution using a stimulated Brillouin gain spectrometer. Unlike previous works, we identified the shift/broadening at medium numerical-aperture optics.

JTu4A.98 *RAPID*
Interpretation and Mitigation of Negativity Artifacts in Photoacoustic Tomography, Kang Shen[1], Chao Tian[1]; [1]*Univ. of Science and Tech. of China, China.* We analyzed the presence of negativity artifacts in back-projection based photoacoustic tomography and studied major contributing factors. Two methods were studied to mitigate the artifacts and their performance was compared.

JTu4A.99
Photonic Architecture of Entanglement Assisted Binary Quantum Tensor Product Codes, Priya J. Nadkarni[1], Shayan S. Garani[1]; [1]*Indian Inst. of Science, Bangalore, India.* We propose an architecture of an error correction scheme for a quantum communication system using integrated optics. Our scheme corrects burst errors using entanglement assisted binary quantum tensor product codes with an interleaver.

JTu4A.100
Experimental evaluation of spatial resolution and depth of focus in digital holographic display, Keehoon Hong[1], Hayan Kim[1], Yongjun Lim[1], Jinwoong Kim[1], Jeongil Seo[1]; [1]*Electronics and Telecom Research Inst., South Korea.* We propose a method to measure spatial resolution and depth of focus of reconstructed hologram images, which can be applied to general digital holographic displays. Experimental results for a projection-type holographic display are presented.

JTu4A.101 *RAPID*
Point-Scan Volumetric Imaging Rate Increased by an Optimized Linear Sparse Sampling Pattern, Courtney C. Johnson[1], Kevin Welsher[1]; [1]*Duke Univ., USA.* Conventional point-scan volumetric imaging requires long acquisition times. Constant focal scanning during a 2D frame scan creates sparse 3D patterns enabling up to 4x speed increase through interpolation as implemented in a two-photon microscope.

JTu4A.102
Speckle Reduction Technique Using an Echelon for Holographic Display, Dukho Lee[1], Kisueng Bang[1], Byounghyo Lee[1], Byoungho Lee[1]; [1]*Seoul National Univ., South Korea.* In this paper, we present a speckle reduction technique for holographic display. The proposed technique is confirmed by mathematical models and experiments. Experimental results show that the technique reduces the speckle contrast by about 55%.

JTu4A.103
Fourier Transform Photoacoustic Spectroscopy with Supercontinuum Light Source, Tommi Mikkonen[1], Caroline Amiot[1,2], Antti Aalto[1], Kim Patokoski[1], Goëry Genty[1], Juha Toivonen[1]; [1]*Tampere Univ., Finland;* [2]*Institut FEMTO-ST, UMR 6174 CNRS - Université Bourgogne Franche-Comté, France.* We demonstrated broadband photoacoustic spectroscopy using a supercontinuum light source and a Fourier transform spectrometer. This method enables multi-gas analysis using small sample volumes and better sensitivity compared to conventional methods.

JTu4A.104
Compressive Digital Fresnel Holographic Encryption using Circular Harmonic Key, Lokesh Reddy[1], Utkal Pandurangi[1], Anith Nelleri[1]; [1]*Vellore Inst. of Technology, Chennai, India.* Compressive digital Fresnel holographic encryption using a circular harmonic key and inline two-step PSDH is numerically demonstrated. The compressive optical encryption uses a digital mirror device and a single pixel detector.

JTu4A.105
Underwater polarization imaging based on image correlation, Yi Wei[1], Fei Liu[1], Pingli Han[1], Kui Yang[1], XiaoPeng Shao[1]; [1]*XiDian Univ. , China.* The degree of polarization of the target light in the underwater scene is accurately estimated based on the image correlation, by which the target light is recovered successful without loss of energy

JTu4A.106
Characterization of Defects in Organic Photovoltaic Devices via Thermoreflectance Imaging, Valerie Wang[1], Katheryn Kornegay[1], Alfred Molina[1], Tyler Jones[1], Adam Dvorak[1], Fernando Ayala[3], Sabrina Li[2], Catherine Horng[2], David Tanenbaum[1], Janice Hudgings[1]; [1]*Pomona College, USA;* [2]*Cornell Univ., USA;* [3]*San Jose State Univ., USA.* To characterize defects in organic photovoltaic devices, we develop and implement a thermoreflectance imaging technique, using it to pinpoint and monitor the behavior of "hot spots" and background signals under varying electrical bias conditions.

JTu4A.107
Forest Type Classification Method Using Multi-source Remote Sensing Data in Northeast China, Xiaohu Zhou[1], Lingjia Gu[1], Ruizhi Ren[1]; [1]*Jilin Univ., China.* Combined with the sentinel-1 radar and sentinel-2 optical data, the Random Forest (RF) method is used, and the overall classification accuracy is 90%, which is better than the classification result of a single data source.

JTu4A.108
Surface Time-Resolved Optical Kerr Effect on Liquid-Solid Interfaces, Vinicius C. Ferreira[1], Guilherme C. Vebber[2], Ricardo R. Correia[1]; [1]*Instituto de Física, Universidade Federal do Rio Grande do Sul, Brazil;* [2]*Unidade de Bento Gonçalves, Universidade Estadual do Rio Grande do Sul, Brazil.* We examine the molecular dynamics related to the optical anisotropy generated by a pump beam on the total internal reflected probe beam at a liquid-solid interface by a Surface Time-Resolved Optical Kerr Effect (STROKE).

JTu4A.109
Influence of the Pump-Induced Loss for the Efficiency of Blue Diode-laser-pumped Ti:sapphire Laser, Shunji Kataoka[1], Tomoki Kanetake[1], Masashi Shibata[1], Ryo Kobayashi[1], Yu Aoyagi[1], Junya Maeda[1], Sakae Kawato[1]; [1]*Univ. of Fukui, Japan.* We investigate decrease of laser efficiency in blue diode-laser-pumped continuous-wave Ti:sapphire laser. We confirmed that the pump-induced loss may cause decrease of the mode-overlapping efficiency.

JTu4A.110 *RAPID*

Nonlinear Spectroscopy with Temperature-Controlled Entangled Photons, Roberto d. Leon Montiel[1], Juan P. Torres[2,3], Alfred B. U'Ren[1]; *[1]National Autonomous Univ. of Mexico, Mexico; [2]ICFO - Institut de Ciencies Fotoniques, Spain; [3]Signal Theory and Communications, Universitat Politecnica de Catalunya, Spain.* We put forward a simple experimental scheme for the implementation of entangled-photon virtual-state spectroscopy, a unique tool capable of providing new and detailed information about the dynamics and chemical structure of complex molecular systems.

JTu4A.111

Transverse Force in the Mie Regime for a TEM_{00} and TEM^{*}_{01} Trapping Beam, Darby Paez Amaya[1]; *[1]Universidad de Pamplona, Colombia.* Theoretic expressions in Mie regime for the radiation force on a dielectric sphere captured by TEM_{00} and TEM^{*}_{01} beams are compared with experimental measurements obtained with a direct force measurement device based on light-momentum detection

JTu4A.112

Colloidal Self-Assembled Approach Towards Hybrid Waveguide-Plasmon Resonances, Swagato Sarkar[1,2], Tobias A. Koenig[2,3], Joby Joseph[1]; *[1]Indian Inst. of Technology, Delhi, India; [2]Nanostructured materials, Leibniz-Institut für Polymerforschung Dresden e.V., Germany; [3]Cluster of Excellence Center for Advancing Electronics Dresden (cfaed), Technische Universität Dresden, Germany.* We demonstrate a hybrid opto-plasmonic structure formed through top-down laser-interference lithography and bottom-up colloidal self-assembly methods. The supported hybridized resonances are compared experimentally along with simulation models.

JTu4A.113

Second Harmonic Generation from GaAs Enhanced by Surface Profile with Au Nanostrips, Cindy J. Valencia Caicedo[1], Anatoli V. Khomenko[1], Marco A. García Zárate[1], Elena Chaikina[1]; *[1]CICESE, Mexico.* In this numerical and experimental study, we search for optimal parameters of the GaAs surface profile and Au nanostripes for maximum efficiency of second harmonic generation enhanced by localized surface plasmon resonance.

JTu4A.114

Classical Hardware, for Solving the Toughest Problems in Computer Science, Eli Yablonovitch[1], T. Patrick Xiao[1], Sri K. Vadlamani[1]; *[1]Univ. of California Berkeley, USA.* Classical analog computing is now solving hard Computer Science problems that were thought to require a Quantum Computer. There are now classical machines that do Ising type optimizations, opening the door toward other NP-hard problems as well.

JTu4A.115

Applications of Layered Double Hydroxides (LDH's) Thin Films Deposited via Laser Techniques, Luminita Nicoleta Dumitrescu[1]; *[1]INFLPR, Romania.* Tailoring interlamellar nanospace of Layered Double Hydroxides (LDH's) thin films deposited via MAPLE techniques for a vast field of applications.

JTu4A.116

Evaluation of 30kW Laser Power Measurement Uncertainty by Least Square Linear Fitting Method, Wang Cheng[1,2], Yunfeng Ma[1,3], Aiping Wu[1,2], Nan Jiang[1,2], Lifeng Liao[1,2], Peng Zhao[1,2], Zhongwei Fan[1,2]; *[1]Academy of Opto-electronics, Chinese Academy of Sciences, China; [2]China National Laser Device Quality Supervision and Inspection Center, China; [3]Univ. of Chinese Academy Sciences, China.* We present a high-precision method to accurately estimate the uncertainty for 30kW laser power measurement. The result of total output power is at 30.99kW, and relative expanded uncertainty is 8% (k=2).

JTu4A.117

Large-Area Perfect Blackbody Sheets from Nano-Precision Microtextured Elastomers, Kuniaki Amemiya[1], Yuhei Shimizu[1], Hiroshi Koshikawa[2], Masatoshi Imbe[1], Tetsuya Yamaki[2], Hiroshi Shitomi[1]; *[1]National Metrology Inst. of Japan, National Inst. of Advanced Industrial Science and Technology, Japan; [2]National Inst. for Quantum and Radiological Science and Technology, Japan.* We are developing large-area perfect blackbody sheets from microtextured polydimethylsiloxane, exhibiting an extremely low reflectance of ≤0.001 across the entire thermal infrared wavelengths while maintaining their high resilience and uniformity.

JTu4A.118

Soliton Frequency Combs in Dual Microresonators, Zhen Qi[1], Curtis Menyuk[1]; *[1]Univ. of Maryland Baltimore County, USA.* We study soliton frequency combs generated in dual microresonators with different group velocity dispersion. We obtain stable bright and dark solitons at different pump amplitudes.

JTu4A.119

Photo-charge Effect in Semiconductors and Metals, Nikolai I. Petrov[1], Lyudmila Burmak[1], Pavel Martyanov[1], Alexander Lyashenko[1]; *[1]STC UI, Russian Academy of Sciences, Russian Federation.* Surface photo-charge effect in solids illuminated by laser beam is investigated experimentally. Factors influencing on the amplitude of measured signal are determined. It is found that effect is stronger when ambient lighting is switched off.

JTu4A.120

Stimulated Raman and Self Focusing in Liquids using Complex Vortex Vector Beams, Henry Meyer[1], Sandra Mamani[1], Robert R. Alfano[1]; *[1]City College of New York, USA.* Stimulated Raman signals in methanol are produced for complex vector vortex beams with OAM values of 1,2,3, and 4. The observed intensities and filaments are compared to beams with homogeneous polarization fields.

JTu4A.121

Ultrahigh-Repetition-Rate Half-Cycle Pulse Synthesizer Operating at 125 THz, Akihiro Tomura[1], Chiaki Ohae[1,2], Kaoru Minoshima[1,3], Masayuki Katsuragawa[1,2]; *[1]Graduate School of Infomatics and Engineering, Univ. of Electro-Communications, Japan; [2]Inst. for Advanced Sciences, Univ. of Electro-Communications, Japan; [3]JST ERATO Minoshima Intelligent Optical Synthesizer Project, Univ. of Electro-Communications, Japan.* Ultrahigh-repetition-rate pulse train synthesizer with CW lasers harnessed by nonlinear phase-locking is reported. The pulse duration is 1.4 femtosecond and the repetition rate is 125 THz.

JTu4A.122

Determining Quantum Efficiency of the pH-sensitive Dye in Mesoporous Thin Films Using a Metal Sphere, Ersan Ozelci[1,2], Bastian Rühle[2], Florian Weigert[2], Boaz Lubotzky[3], Günter Kewes[1], Ute Resch-Genger[2], Oliver Benson[1]; *[1]Institut für Physik & IRIS Adlershof, Humboldt Universität zu Berlin, Germany; [2]Bundesanstalt für Materialforschung und –prüfung (BAM), Germany; [3]The Racah Inst. of Physics, The Hebrew Univ. of Jerusalem, Israel.* We show that Drexhage-type experiment where the silver-coated millimeter-sized sphere is used to measure the local quantum efficiency of pH-dependent fluorescein isothiocyanate bound to a mesoporous silica thin film.

JTu4A.123

Supercontinuum Induced Pulse Compression at 800 nm Through Self-similar Analysis, Esther Lidiya A. Arockiam[1], Vasantha Jayakantha Raja R[1]; *[1]SEEE, SASTRA Deemed to be Univ., India.* We numerically demonstrate a supercontinuum induced pulse compression mechanism in a taper photonic crystal fiber modeled on the basis of self-similar analysis. Performance study results an effective compression at high input pump powers.

JTu4A.124

Optical Phased Array with Electromechanical Phase Shifters, Marcel W. Pruessner[1], Rita Mahon[1], Brian J. Roxworthy[1], Dmitry Kozak[1], Nathan Tyndall[1], Todd H. Stievater[1], Peter G. Goetz[1], William S. Rabinovich[1]; *[1]US Naval Research Laboratory, USA.* We propose a chip-scale optical phased array (OPA) enabling steering along two orthogonal angles using integrated electromechanical optical phase shifters. Initial experimental results from fabricated silicon nitride OPAs are presented.

JTu4A.125

Silica Toroid Microcavity Coupled to Silicon Photonic Chip, Hajime Kumazaki[1], Yuyang Zhuang[1,2], Shun Fujii[1], Koki Yube[1], Takasumi Tanabe[1]; *[1]Keio Univ., Japan; [2]Nanjing Univ., China.* We experimentally demonstrated efficient optical coupling between low-index silica whispering galley mode microresonator with high-index silicon chip. We can minimize the phase index mismatch by using photonic crystal waveguide as a coupler.

JTu4A.126

Study of the bite force using rigid occlusal device instrumented by Fiber Bragg Gratings: in vivo assays, Danielle M. Fontenele[1], Ana Paula G. de Oliveira[1], Ilda Abe[1]; *[1]UTFPR, Brazil.* In this work the Fiber Bragg Gratings (FBG) were used for the measurement of the rigid occlusal device through the analysis of the human bite strength measured in-vitro and in vivo assay.

JTu4A.127

The Effect of Optical Scattering on Infrared Heating, Jeremy B. Ford[1], E. D. Jansen[1,2]; *[1]Biomedical Engineering, Vanderbilt Univ., USA; [2]Neurological Surgery, Vanderbilt Univ., USA.* A joint Optical-Thermal model was used to assess changes in laser heating when varying a phantom's reduced scattering coefficient. Simulated results were validated using thermal imaging of polyacrylamide gel phantoms.

JTu4A.128

Analysis on Image Brightness for Optimal Viewing Zone in Waveguide Near-Eye Displays, Minseok Chae[1], Chanhyung Yoo[1], Dongheon Yoo[1], Byoungho Lee[1]; *[1]Seoul National Univ., South Korea.* We analyze the image brightness of a waveguide near-eye display considering the optical absorbance by holographic optical elements. We obtain the optimal viewing zone in terms of brightness uniformity based on the simulation results.

JTu4A.129

Coherent LiDAR Detection System Optimized for Reducing the Effect of Speckles on the Detector Aperture Based on a Dedicated Simulation Program, Shun Ishikura[1], Andrea Zirotti[1,2], Hiroyuki Tsuda[1]; *[1]Keio Univ., Japan; [2]Politecnico di Milano, Italy.* To solve speckle issue present on the aperture of coherent LiDAR detection systems, a new approach featuring multiple fibers is presented. Moreover, speckles on the aperture are simulated implementing a dedicated tunable program.

JTu4A.130
Postselection-Loophole-Free Time-Bin Entanglement Bell Test, Francesco Vedovato[2,1], Costantino Agnesi[2], Marco Tomasin[2], Marco Avesani[2], Jan-Åke Larsson[3], Giuseppe Vallone[2], Paolo Villoresi[2]; [1]*Centro di Ateneo di Studi e Attività Spaziali "G. Colombo", Università degli Studi di Padova, Italy;* [2]*Dipartimento di Ingegneria dell'Informazione, Università degli Studi di Padova, Italy;* [3]*Linköping Universitet, Institutionen för systemteknik, Sweden*. Time-bin entanglement is an important resource for quantum information protocols, rendered unusable by the postselection-loophole. We present the first time-bin entanglement Bell test free of this loophole, enabling its use in future implementations.

JTu4A.131
Optical Frequency Comb Generator based on Stimulated Brillouin Pump Power., Arpita Sinha Roy[1]; [1]*IIT Kanpur, India*. We experimentally present the enhancement of the number of comb lines with increasing Brillouin pump power. We obtain 9 and 11 spectral lines in 0.033 nm bandwidth with 0.88 and 1.42 dB gain flatness respectively.

14:30–15:00 Coffee Break, *Science & Industry Showcase Coffee Break Area*

Washington 1

Themes: Autonomous Systems / Virtual Reality and Augmented Vision

15:30–17:00
FTu5A • Optical Challenges of the Past, Present, and Future
Presider: To be Announced

FTu5A.1 • 15:30 Invited
State of the Art in AR/VR Display Systems, Douglas Lanman[1]; [1]*Facebook Reality Labs, USA.* Head-mounted displays offer a unique means to deliver richer visual experiences than past direct-view displays: tuning all elements for a single user. This talk will review the state of the art and provide an overview of the AR/VR Theme at FiO 2019.

FTu5A.2 • 16:00 Invited
Nextgen AR Glasses: Autofocus, Telepresence, and Situationally Aware Personal Assistants, Henry Fuchs[1]; *1Univ. of North Carolina at Chapel Hill, USA.* Just as today's mobile phones are much more than simply telephones, tomorrow's Augmented Reality glasses will be much more than simply displays. They will have autofocus for real-world surroundings; depth-accommodation for virtual imagery; eye, face, and body tracking for gaze control, user-interface, and telepresence; and virtually embodied, situationally aware personal assistants.

FTu5A.3 • 16:30 Invited
Reality Needs You! Challenges at the Intersection of Optics, Graphics, and Human Perception, David Q. Luebke[1]; [1]*NVIDIA Corporation, USA.* Luebke will review the tremendous potential and interdisciplinary challenges of virtual and augmented reality, describe some breakthroughs required in optics and displays, and illustrate with examples how rethinking graphics and understanding human vision can help.

Washington 2

Theme: Nanophotonics and Plasmonics / FiO

15:30–17:00
FTu5B • Data Centers, Free Space and Microwave Photonics
Presider: Alexey Turukhin; TE Subcom, USA

FTu5B.1 • 15:30 Invited
Energy Efficient Data Centers Photonic Architectures with Bandwidth Steering, Keren Bergman[1]; [1]*Columbia Univ., USA.* Data centers are increasingly bottlenecked by the energy costs of networks. We introduce a bandwidth-steering architecture that leverages embedded photonics to deeply disaggregate compute/memory resources for flexible energy-efficient connectivity.

FTu5B.2 • 16:00
Artificial Neural Networks for Turbulence Correction of Structured Light, Narayan Bhusal[1], Sanjaya Lohani[2], Chenglong You[1], Aidan Lambert[1], Erin M. Knutson[2], Jonathan Dowling[1], Ryan T. Glasser[2], Omar Magana-Loaiza[1]; [1]*Louisiana State Univ., USA;* [2]*Tulane Univ., USA.* Turbulence imposes major limitations to free-space protocols for optical communication and cryptography. Here, we report our progress on the experimental demonstration of turbulence correction of Laguerre-Gauss modes using artificial neural networks.

FTu5B.3 • 16:15
Robust Free Space OAM Communications with Unsupervised Machine Learning, Sanjaya Lohani[1], Ryan T. Glasser[1]; [1]*Tulane Univ., USA.* We design a state-of-the-art generative machine learning system that mitigates the distortion effects of turbulence and reduces detector noise, which results in remarkably lowered bit error ratios, while requiring no feedback.

FTu5B.4 • 16:30
Real-time Temporal Signal Stitching Using Polarization-Dependent Optical Wave Mixing, Qidi Liu[1], Mable P. Fok[1]; [1]*The Univ. of Georgia, USA.* A real-time temporal stitching technique is proposed and experimentally demonstrated based on polarization-dependent four wave mixing. The technique can operate over tens of GHz frequency range and with transition time of less than 50 ps.

Washington 3

FiO

15:30–17:00
FTu5C • Heterogeneous Integration
Presider: Tingyi Gu; University of Delaware, USA

FTu5C.1 • 15:30
Athermal lithium niobate microring resonators, Jingwei Ling[1], Rui Luo[2], Yang He[1], Mingxiao Li[1], Hanxiao Liang[1], Qiang Lin[1,2]; [1]*ECE, Univ. of Rochester, USA;* [2]*Inst. of Optics, Univ. of Rochester, USA.* We report high-Q lithium niobate microring resonators cladded with a TiO_2 thin film, which exhibit nearly zero thermo-optic coefficient around room temperature, while the photorefractive effect is permanently quenched by cladding.

FTu5C.2 • 15:45
High-extinction electro-optic modulation on lithium niobate thin film, Mingwei Jin[1], Jia-Yang Chen[1], Yong-Meng Sua[1], Yu-Ping Huang[1]; [1]*Physics, Stevens Inst. of Technology, USA.* We exploit a cascaded MachZehnder interferometry design to offset inevitable fabrication errors, demonstrating up to 53 dB modulation extinction for a wide range of wavelengths between 1500 nm and 1600 nm.

FTu5C.3 • 16:00
Narrow Linewidth Single-Mode Chip Laser Operating at 2.9 μm, Philippe Guay[1,2], Jérôme Genest[1], Vincent Michaud-Belleau[1], Nicolas Bourbeau Hébert[1], David G. Lancaster[2]; [1]*Centre d'optique, photonique et laser, Université Laval, Canada;* [2]*Laser Physics and Photonics Devices Laboratory, Future Industries Inst., and School of Engineering, Univ. of South Australia, Australia.* With strong potential for spectroscopic applications and metrology, a single-frequency 2.9 μm laser is presented. A side-mode suppression ratio above 40 dB was achieved and a Lorentzian linewidth below 30 Hz was measured.

FTu5C.4 • 16:15
Ultranarrow Linewidth and Stable Photonic-Atomic Laser, Liron Stern[1], Wei Zhang[1], David Carlson[1], Douglas Bopp[1], Zachary Newman[1], Songbai Kang[1], John Kitching[1], Scott Papp[1]; [1]*Time and Frequency, NIST, USA.* We report a compact photonic-atomic laser comprising a monolithic high-Q optical cavity integrated with a micromachined atomic vapor-cell. Leveraging the frequency-stability of the cavity and atoms, we realize an atomic stable 200 Hz linewidth laser.

FTu5C.5 • 16:30
Dispersion Engineering of Crystalline Microresonator Fabricated with Computer-controlled Diamond Turning, Shun Fujii[1], Yuka Hayama[1], Shuya Tanaka[1], Shota Sota[1], Koshiro Wada[1], Yasuhiro Kakinuma[1], Takasumi Tanabe[1]; [1]*Keio Univ., Japan.* We demonstrated the dispersion engineering of high-Q crystalline microresonators fabricated with computer-controlled machining enabling precise structure control. In addition, we investigated the ideal resonator structure for 100 GHz microcomb.

Washington 4

FiO / Theme: Quantum Technologies

15:30–17:00
FTu5D • Quantum Computing With Atoms and Photons II
Presider: William Munro; NTT Basic Research Laboratories, Japan

FTu5D.1 • 15:30 Invited
Quantum Control of Ultracold Dipolar Molecules, Huanqian Loh[1]; [1]*Centre for Quantum Technologies and Department of Physics, National Univ. of Singapore, Singapore*. Ultracold polar molecules can serve as versatile quantum simulators due to their long-range anisotropic interactions. We report on progress towards quantum control of polar molecules at the single-state, single-molecule level for quantum simulation.

FTu5D.2 • 16:00 Invited
Scalable Instrumentation for Quantum Computing and Sensing, Jelena Trbovic[1]; [1]*Zurich Instruments, Switzerland*. Efficient system integration and channel synchronization are crucial in handling complex qubit systems. We present Quantum Computing Control System as a scalable solution for increased system complexity applicable to different qubit technologies.

FTu5D.3 • 16:30 Invited
Optically-Inspired Quantum Algorithms, Techniques, and Ansatzes, Jonathan Olson[1]; [1]*Zapata Computing Inc., USA*. We discuss a variety of advances in quantum computing that were either inspired by or analogous to quantum optics protocols, and what the next generation of these techniques may be.

Washington 5

LS

16:00–17:00
LTu5E • Plasmonics and Nanophotonics II
Presider: Gary Wiederrecht; Argonne National Lab, USA

LTu5E.1 • 15:30 Invited
Withdrawn

LTu5E.2 • 16:00
Engineering metasurface dispersion for achromatic optics, Wei-Ting Chen[1], Alexander Zhu[1], Federico Capasso[1]; [1]*Harvard Univ., USA*. We show the dispersion of optical metasurfaces can be engineered over a broad wavelength range. This technique can render traditional refractive lenses, ranging from simple singlet to objective lenses, achromatic over large bandwidths.

LTu5E.3 • 16:15
Sub-mW Optical Parametric Oscillation Across Visible and Telecommunications Bands Using Silicon Nanophotonics, Xiyuan Lu[1,2], Gregory Moille[1,2], Anshuman Singh[1,2], Qing Li[1,3], Daron Westly[1], Ashutosh Rao[1,2], Su-Peng Yu[1,4], Travis C. Briles[1,4], Tara Drake[1,4], Scott Papp[1,4], Kartik Srinivasan[1,2]; [1]*National Inst. of Standards & Technology, USA; [2]Univ. of Maryland College Park, USA; [3]Carnegie Mellon Univ., USA; [4]Univ. of Colorado, USA*. We demonstrate the first optical parametric oscillator (OPO) across visible and telecommunications bands using silicon nanophotonics. Its sub-mW threshold power is ≈ 50 to 400 times smaller than widely separated OPOs demonstrated in other platforms.

LTu5E.4 • 16:30
Circular Dichroism Property of Conjugated Gammadion Metasurface Integrated on Silicon Waveguide, Shih-Hui G. Chang[1]; [1]*National Cheng Kung Univ., Taiwan*. We numerically investigate circular dichroism properties of conjugated gammadion structures on the end facet of Si waveguide by exciting different waveguide modes. The CD value will switch sign as the orientation of the gammadion structure changes.

Washington 6

FiO

15:30–17:00
FTu5F • Excitons and Photons
Presider: Hui Deng; University of Michigan Ann Arbor, USA

FTu5F.1 • 15:30 Invited
Manipulating Light and Matter using Strong Light-Matter Coupling, Stephane Kena-Cohen[1]; [1]*Department of Engineering Physics, Ecole Polytechnique de Montreal, Canada*. In the strong light-matter coupling regime, half-light, half-matter states termed polaritons are created. We will describe how in this regime, light can acquire strong nonlinearities and exhibit fascinating phenomena such as superfluidity. At the same time, we will describe how strong lightmatter coupling can be used to modify the photophysical processes that occur in organic molecules, such as intersystem crossing and chemical reactions.

FTu5F.2 • 16:00
All-Optical Exciton-Polariton Transistor at Room Temperature, Anton V. Zasedatelev[1,2], Anton V. Baranikov[1], Darius Urbonas[3], Fabio Scafirimuto[3], Ullrich Scherf[4], Thilo Stöferle[3], Rainer F. Mahrt[3], Pavlos G. Lagoudakis[1,2]; [1]*Skolkovo Inst. of Science and Technology, Russian Federation; [2]Department of Physics and Astronomy, Univ. of Southampton, UK; [3]IBM Research GmbH, Switzerland; [4]Inst. for Polymer Technology, Bergische Universität Wuppertal, Germany.* Using a ladder-type polymer in an optical microcavity in strong coupling, we demonstrate an all-optical transistor with record net gain of ~10 dB/μm, sub-ps switching time, cascaded amplification and all-optical logic operation at ambient conditions.

FTu5F.3 • 16:15
Giant and Tunable Optical Nonlinearity in Single-Crystalline 2D Perovskites due to Excitonic and Plasma Effects, Paul M. Dichtl[1], Ibrahim Abdelwahab[1,2], Gustavo Grinblat[1], Kai Leng[2], Xiao Chi[2,3], In-Hyeok Park[2], Michael Nielsen[4], Rupert Oulton[1], Kian Ping Loh[2], Stefan Maier[5,1]; [1]*Imperial College London, UK; [2]Centre for Advanced 2D Materials (CA2DM) and Department of Chemistry, Singapore; [3]4Singapore Synchrotron Light Source, National Univ. of Singapore, Singapore; [4]Univ. of New South Wales, Australia; [5]Ludwigs-Maximilians-Univeritaet, Germany.* 2D Ruddlesden-Popper lead halide perovskites exhibit a strong third-order nonlinear response around excitonic resonance, which is characterized with Z-scan. We find large absolute values and a sign change of both nonlinear refraction and absorption.

FTu5F.4 • 16:30
Quantum Optics of a Driven Quantum Dot Molecule, Sam Carter[1], Bumsu Lee[3], Brennan C. Pursley[3], Sophia Economou[2], Michael K. Yakes[1], Allan S. Bracker[1], Dan Gammon[1]; [1]*Naval Research Laboratory, USA; [2]Department of Physics, Virginia Tech, USA; [3]NRC Research Associate at the Naval Research Laboratory, USA*. We measure the quantum optical properties of a laser-driven system of two coupled quantum dots and demonstrate control of the spectral and temporal properties of single photons emitted through a Raman spin-flip process.

Washington 1

Themes:
Autonomous Systems / Virtual Reality and Augmented Vision

FTu5A • Optical Challenges of the Past, Present, and Future—Continued

Washington 2

Theme:
Nanophotonics and Plasmonics / FiO

FTu5B • Data Centers, Free Space and Microwave Photonics—Continued

FTu5B.5 • 16:45
Compensation of Fourth-Order Dispersion Induced Distortion in Comb-Based Microwave Photonic Filters, Zahra Serahati Jouybari[1], Eduardo Temprana[1], Evgeny Myslivets[1], Vahid Ataie[1], Nikola Alic[1], Stojan Radic[1]; *[1]Univ. of California San Diego, USA.* We demonstrate fourth-order dispersion compensation of fiber using a pulse shaper to synthesize a sub-800 MHz flat-top microwave photonic filter based on a wideband optical parametric comb.

Washington 3

FiO

FTu5C • Heterogeneous Integration—Continued

FTu5C.6 • 16:45
Towards the Integration of C-band Amplifiers on Silicon Nitride via Transfer Printing, Camiel Op de Beeck[1,2], Lukas Elsinger[1,2], Bahawal Haq[1,2], Günther Roelkens[1,2], Bart Kuyken[1,2]; *[1]Department of Information Technology, Ghent Univ. - imec, Belgium; [2]Center for Nano- and Biophotonics, Belgium.* We demonstrate a strategy for the integration of C-band operating amplifiers on a silicon-nitride-on-insulator platform. A layer of hydrogenated amorphous silicon is used to bridge the index contrast between the nitride and the active device.

15:30–16:30 Be a Part of the Solution: Ally & Bystander Training, *Wilson AB*

17:15–18:15 Postdeadline Presentations, *Washington 1 & 2*
View the conference update sheet for a complete list of presentations.

17:15–18:15 DLS Business Meeting, *Washington 5*

17:30–18:30 OSA Business Meeting, *Wilson C*

18:30–20:30 FiO + LS Conference Reception, *Thurgood Marshall Ballroom, Mezzanine Level*

Washington 4

FiO / Theme: Quantum Technologies

FTu5D • Quantum Computing With Atoms and Photons II—Continued

Washington 5

LS

LTu5E • Plasmonics and Nanophotonics II—Continued

LTu5E.5 • 16:45
Femtosecond Polarization Pulse Shaping by Dielectric Metasurfaces, Lu Chen[1,2], Wenqi Zhu[1,2], Cheng Zhang[1,2], Henri Lezec[1], Amit K. Agrawal[1,2]; [1]*National Inst. of Standards & Technology, USA;* [2]*IREAP, Univ. of Maryland, USA.* Metasurfaces offer the ability to control optical dispersion with large bandwidth and high resolution. Here, we demonstrate temporal polarization pulse shaping of femtosecond pulses by controlling the spectral phase using dielectric metasurfaces.

Washington 6

FiO

FTu5F • Excitons and Photons—Continued

FTu5F.5 • 16:45
Spin-Selective AC Stark Shifts in a Charged Quantum Dot, Tristan A. Wilkinson[1], Dillion Cottrill[1], Joshua Cramlet[1], Cole Maurer[1], Collin Flood[1], Allan S. Bracker[2], Michael K. Yakes[2], Dan Gammon[2], Edward Flagg[1]; [1]*West Virginia Univ., USA;* [2]*Navy Research Laboratory, USA.* We demonstrate a spin-selective modification to the energy structure of a charged quantum dot using the AC Stark effect. This mechanism offers a potentially rapid, reversible, and coherent control of the energy structure.

15:30–16:30 Be a Part of the Solution: Ally & Bystander Training, *Wilson AB*

17:15–18:15 Postdeadline Presentations, *Washington 1 & 2*
View the conference update sheet for a complete list of presentations.

17:15–18:15 DLS Business Meeting, *Washington 5*

17:30–18:30 OSA Business Meeting, *Wilson C*

18:30–20:30 FiO + LS Conference Reception, *Thurgood Marshall Ballroom, Mezzanine Level*

Washington 1

Theme:
Virtual Reality and Augmented Vision

08:00–09:00
FW1A • Applications of AR/VR
Presider: To be Announced

FW1A.1 • 08:00 Invited
Autofocals: Gaze-contingent Eyeglasses for Presbyopes, Nitish Padmanaban[1], Robert Konrad[1], Gordon Wetzstein[1]; [1]*Stanford Univ., USA.* Presbyopia, the age-related loss of accommodation to near distances, affects all humans with age. We designed and built a new presbyopia correction, autofocals, that outperforms traditional corrections by externally mimicking natural accommodation.

Washington 2

FiO

08:00–09:00
FW1B • Fiber Lasers and Lasers on Silicon
Presider: Mihaela Dinu; LGS Innovations, USA

FW1B.1 • 08:00 Invited
Sub-Micron Buried Heterostructure Photonic-Crystal Lasers on Silicon, Koji Takeda[1,2], Shinji Matsuo[1,2]; [1]*NTT Device Technology Labs, Japan;* [2]*NTT Nanophotonics Center, Japan.* We formed InP-based photonic-crystal with buried heterostructure active region on Si waveguides. Continuous-wave operation has been achieved with a threshold current of 42 μA. We confirmed the light was successfully guided through the Si waveguides.

FW1B.2 • 08:30
20 W fiber-based continuous-wave single frequency laser at 780 nm, Jinyan Dong[1], Lei Zhang[2], Huawei Jiang[1], Yan Feng[1]; [1]*Shanghai Inst. of Optics and Fine Me, China;* [2]*Precilasers Co. Ltd., China.* We demonstrate a 21.2 W continuous-wave single frequency 780 nm laser by efficient single-pass frequency doubling of a 1560 nm fiber amplifier in a periodically-poled magnesium-oxide-doped lithium niobate (MgO:PPLN) crystal.

FW1B.3 • 08:45
Slab Waveguide-to-Fiber Coupling based on Multiplane Light Conversion, Yuanhang Zhang[1], He Wen[1], Shengli Fan[1], Huiyuan Liu[1], Rachel Sampson[1], Ning Wang[1], Shuo Pang[1], Patrick LiKamWa[1], Guifang Li[1]; [1]*Univ. of Central Florida, CREOL, USA.* We propose low-loss, low-crosstalk slab waveguide-to-fiber coupling using multiplane light conversion. For coupling between a 6-mode waveguide and fiber, insertion and mode dependent losses are 0.38 dB and 0.23 dB, respectively, with 7 phase plates.

Washington 3

FiO

08:00–09:00
FW1C • Optical Signal Processing
Presider: Imad Agha; University of Dayton, USA

FW1C.1 • 08:00
Demonstration of a Free-Space Optical Delay Line Using Space-Time Wave Packets, Murat Yessenov[1], Ayman Abouraddy[1]; [1]*Univ. of Central Florida, CREOL, USA.* We show that space-time wave-packets whose group velocities are continuously tunable in free space provide a potential platform for optical delay-lines and all-optical buffers by providing group delays that far exceed the pulse widths.

FW1C.2 • 08:15
Nonvolatile Electrically Reconfigurable Silicon Photonic Switches Using Phase-Change Materials, Jiajiu Zheng[1], Zhuoran Fang[1], Shifeng Zhu[1], Peipeng Xu[2], Jonathan Doylend[3], Sanchit Deshmukh[4], Eric Pop[4], Scott Dunham[1], Arka Majumdar[1]; [1]*Univ. of Washington, Seattle, USA;* [2]*Ningbo Univ., China;* [3]*Intel Corporation, USA;* [4]*Stanford Univ., USA.* We report nonvolatile electrically reconfigurable silicon photonic switches using phase-change materials by in-situ silicon PIN heaters. High speed (~10 kHz), high extinction ratio (~5 dB), near-zero extra loss, and high cyclability (>100) are shown.

FW1C.3 • 08:30 Invited
Analog Photonic Synaptic Processor for Acceleration of Neural Network Training, Roger F. Dangel[1], Folkert Horst[1], Bert Offrein[1]; [1]*Science & Technology, IBM Research GmbH - Zurich, Switzerland.* We present our work on an integrated optical analog circuit for optically processing synaptic weights enabling acceleration of backpropagation-algorithm-based training of artificial neural networks.

Theme: Quantum Technologies

LS

FiO

08:00–09:00
FW1D • Quantum Computing With Atoms and Photons III
Presider: To be Announced

FW1D.1 • 08:00 Invited
Title to be Announced, Ronald Holzwarth[1]; [1]*Menlo Systems, Germany.* Abstract not available.

08:00–09:00
LW1E • Plasmonics and Nanophotonics III
Presider: Anne Myers Kelley;University of California Merced, USA

LW1E.1 • 08:00 Invited
Meta-optics: Meta-lens for Imaging and Sensing, Din Ping P. Tsai[1], Mu-Ku Chen[1]; [1]*Academia Sinica, Taiwan.* Metalenses consisting of a large number of nano-antennas can manipulate the incoming light for specific output wavefront. A 3600 GaN achromatic metalens array in visible frequency are used for light field imaging and sensing.

08:00–09:00
FW1F • Novel Materials and Optical Fields
Presider: Eva Hemmer; University of Ottawa, Canada

FW1F.1 • 08:00 Invited
Up and Down - Exploring Optical Properties of Lanthanide-based Materials, Eva Hemmer[1]; [1]*University of Ottawa, Canada.* Upconverting and downshifting lanthanide-based materials are candidates for applications from biomedicine to optoelectronics. This presentation will shine light on the versatile landscape of these materials focusing on synthesis and optical features.

LW1E.2 • 08:30
What makes an optimum selective emitter for an efficient thermophotovoltaic system?, Sakib Hassan[1], Gururaj V. Naik[1]; [1]*Rice Univ., USA.* Thermophotovoltaic conversion is a promising solid-state heat-to-electricity conversion technology suffering from poor efficiency. Our analysis shows that 70% of Carnot efficiency is achievable by an optimum emitter design.

FW1F.2 • 08:30
Bragg reflection and conversion between helical Bloch modes in twisted three-core optical fiber, Sébastien Loranger[2], Yang Chen[2], Paul Roth[2], Michael H. Frosz[2], Goran Ahmed[2], Gordon Wong[2], Philip S. Russell[2,1]; [1]*Friedrich-Alexander Univ., Germany;* [2]*Max Planck Inst. for the Science of Light, Germany.* Fiber Bragg gratings are written for the first time into a three-fold rotationally symmetric twisted fiber with three cores, and the reflection of helical Bloch modes explored as the wavelength is tuned.

LW1E.3 • 08:45
Ultrafast Nanophotonics Applied to Quantum Optics and Hot Plasmonic Electron Generation, Gary Wiederrecht[1], Xuedan Ma[1]; [1]*Argonne National Laboratory, USA.* We report on ultrafast processes in semiconductor and metallic nanoparticles following photoexcitation that are important for improved efficiency in nanophotonic applications in quantum optics and for hot plasmonic carriers.

FW1F.3 • 08:45
Coherently Driven Embedded Eigenstates, Aleksandr Krasnok[1], Zarko Sakotic[2], Norbert Cselyuszka[2], Nikolina Jankovic[2], Andrea Alú[1]; [1]*CUNY Advanced Science Research Center, USA;* [2]*BioSense Inst.-Research Inst. for Information Technologies in Biosystems, Univ. of Novi Sad, Serbia.* In this work, we demonstrate how the concept of coherent excitation can pave the way to light scattering control in an extreme fashion in non-Hermitian PT-symmetrical systems supporting an embedded eigenstate.

09:15–10:00
FW2A • Visionary - John Martinis
Presider: To be Announced

FW2A.1 • 09:15 VISIONARY
Quantum Supremacy: Checking a Quantum Computer With a Classical Supercomputer, John Martinis[1]; [1]*Univ. of California Santa Barbara, USA.* I will explain how a 7 by 7 array of superconducting xmon qubits with nearest-neighbor coupling, and with programmable single- and two-qubit gate with errors of about 0.2%, can execute a modest depth quantum computation that fully entangles the 49 qubits. Sampling of the resulting output can be checked against a classical simulation to demonstrate proper operation of the quantum computer and compare its system error rate with predictions. With a computation space of 2^49 = 5 x 10^14 states, the quantum computation can only be checked using the biggest supercomputers. I will show experimental data towards this demonstration from a 9 qubit adjustable-coupler "gmon" device, which implements the basic sampling algorithm of quantum supremacy for a computational (Hilbert) space of about 500. We have been testing the quantum supremacy chip.

09:15–10:00
LW2B • Visionary - Steven T. Cundiff
Presider: Susan Dexheimer; Washington State University, USA

LW2B.1 • 09:15 VISIONARY
Multdimensional Coherent Spectroscopy of Semiconductor Nanostructures, Steven T. Cundiff[1]; [1]*Univ. of Michigan, USA.* Multdimensional coherent spectroscopy has become an important tool for studying condensed phase systems and nanocrystals by combining the best features of time and frequency domain techniques. It provides deep insight by removing the effects of inhomogeneous broadening and revealing coupling between states, including many-body effects. Recent advances have demonstrated high spatial resolution, providing a path towards coherent microspectroscopy.

Science & Industry Showcase

Joint FiO / LS

10:00–12:00
JW3A • Poster Session III

JW3A.1 *E-Poster*
Component-level Test of Complex Beam Shaping Optics for Quasi-point Sources, Tobias Binkele[1], David Hilbig[1], Mahmoud Essameldin[1], Thomas Henning[1], Friedrich Fleischmann[1]; [1]*Univ. of Applied Sciences Bremen, Germany.* The measurement of complex optical components is a challenging task. We propose a contact free measurement technique to cover the test of complex beam shaping optics for quasi-point sources on component level.

JW3A.2 *E-Poster*
A Microfluidic Frequency-Selective Metasurface, Francis S. Dela Cruz[1,2], Romeric F. Pobre[1,2]; [1]*Physics Department, De La Salle Univ.-Manila, Philippines;* [2]*Philippine-California Advanced Research Inst., Commission on Higher Education, Philippines.* We designed a tunable microwave bandpass filter and mirror deployed in a microfluidic microwave metasurface (MMM) platform using a 2nd order Fractal Pseudo-Hilbert Curve (PHC) split ring resonator hybrid design.

JW3A.3
Withdrawn

JW3A.4 *E-Poster*
Laguerre-Gaussian beams diffraction through mobile slit for orbital angular momentum detection, Jadze Princeton C. Narag[1], Nathaniel Hermosa[1]; [1]*National Inst. of Physics, Philippines.* The orbital angular momentum (OAM) of light are central to different areas of research because they can provide theoretically infinite allowable states. Here, use a movable slit to probe the OAM of Lagguerre-Gaussian beams

JW3A.5 *E-Poster*
A portable visible resonance Raman analyzer with a hand-held optical fiber probe for in vivo diagnosis of brain glioblastoma multiforme in an animal model, Yan Zhou[2], Shengjia Zhang[6], Binlin Wu[1], Xinguang Yu[4,5], Gangge Cheng[2], Ke Zhu[5], Mingyue Zhao[2], JiChun Zheng[2], Mingqian Zhang[7], Qijun Liang[7], Cheng-hui Liu[3], Robert R. Alfano[3]; [1]*Southern Connecticut State Univ., USA;* [2]*Air Force Medical Center, PLA, China;* [3]*City Univ. of New York, USA;* [4]*PLA General Hospital, China;* [5]*Chinese Academy of Sciences (CAS), China;* [6]*Jiangsu Raman Medical Equipment Co., Ltd, China;* [7]*China Academy of Space Technology, China.* A VRR-LRR analyzer with handheld fiber optic probe is reported for the first time for diagnosis of brain GBM *in vivo*. The sensitivity for identification is 80% compared with histopathology examination.

JW3A.6 *RAPID*
Critical wavelength in the Transmission Spectrum of a Directional Coupler, Garima Bawa[1], Indrajeet Kumar[1], Saurabh M. Tripathi[1]; [1]*IIT Kanpur, India.* Critical wavelength has been observed experimentally in the transmission spectrum of a Directional Coupler, employing two single mode fibers. The sensitivity has been observed to be maximum for the transmission max or min nearest to this wavelength.

JW3A.7
Measuring the temperature of LED chips encapsulated by transparent silicone rubber, Te-Yuan Chung[1], Yong-Siang Hsu[1], Ting-Wei Liang[1]; [1]*National Central Univ., Taiwan.* Silicone rubber has a transparent window in 3.6-4.5 mm. Therefore, the thermal radiation of high power LED encapsulated by transparent silicone rubber can be measured through this window. The corresponding temperature can then be estimated.

JW3A.8
Single-mode laser in sub-micron semiconductor optical microcavities, Hongxing Dong[1]; [1]*Shanghai Inst. of Optics and Fine Me, China.* A tunable single-mode laser with high performance from all-inorganic cesium lead halide sub-micron optical cavities. The wavelength of single-mode laser can be continuously tuned from red down to the violet color.

JW3A.9
Withdrawn

JW3A.10
Holographic femtosecond laser processing with sub-diffraction-limit focusing, Yoshio Hayasaki[1], Satoshi Hasegawa[1], Daisuke Barada[1], Yusuke Ogura[2], Jun Tanida[2]; [1]*Utsunomiya Univ., Japan;* [2]*Osaka Univ., Japan.* Femtosecond laser processing with sub-diffraction-limit focusing beyond the diffraction limit is demonstrated. It is realized with a computer-generated hologram designed by a proximity-complex amplitude optimization method.

JW3A.11 *RAPID*
Demonstration of Polarization-Distinguishability Driven Degree of Coherence for Electromagnetic Fields, Sethuraj K.R.[1], Bhaskar Kanseri[1]; [1]*Indian Inst. of Technology, Delhi, India.* We demonstrate, both experimentally and through simulation, versatile control of the degree of coherence possessed by any degree of freedom of the homogeneous vector light fields using the degree of polarization and distinguishability.

JW3A.12
Application to gas permeable metal plates for pattern defect reduction in photoimprint lithography, Takao Kameda[1], Satoshi Takei[2], Kaori Yasuda[2], Naoto Sugino[1]; [1]*Sankogosei Ltd., Japan;* [2]*Toyama Prefectural Univ., Japan.* Applications to photo nanoimprint lithography using gas permeable metal plates have been reported due to reduced pattern defects, air trapping problems, and template damage by gases such as nitrogen generated from UV cross-linked materials.

JW3A.13
Visible Blind, Wearable, and Omnidirectional Near Infrared Photodetector: A Filterless Approach, Monika Kataria[1,3], Wei-Hua Wang[1], Yang-Fang Chen[2,4]; [1]*Inst. of Atomic and Molecular Sciences, Academia Sinica, Taiwan;* [2]*Dept. of Physics, National Taiwan Univ., Taiwan;* [3]*Dept. of Physics, National Central Univ., Taiwan;* [4]*Advanced Research Centre for Green Materials Science and Tech., National Taiwan Univ., Taiwan.* We present a highly sensitive, filtlerless, visible blind, omnidirectional and wearable near infrared hybrid photodetector composed of lanthanides doped upconversion nanoparticles, graphene and micro-pyramidical poly(dimethylsiloxane) film.

JW3A.14 *RAPID*
Demonstration of Intrinsic Non-Separability and Locked Entropy in Partially Coherent Optical Fields, Varun A. Kelkar[3], Chukwuemeka Okoro[1], Kimani C. Toussaint[2], Ayman Abouraddy[4]; [1]*Wellman Center for Photomedicine, Massachusetts General Hospital, Harvard Medical School, USA;* [2]*Mechanical Science and Eng., Univ. of Illinois at Urbana-Champaign, USA;* [3]*Electrical and Computer Engineering, Univ. of Illinois at Urbana-Champaign, USA;* [4]*CREOL, The College of Optics & Photonics, Univ. of Central Florida, USA.* By introducing a fourfold taxonomy of vector fields based on their coherency-matrix rank, we demonstrate surprising phenomena, like the intrinsic non-separability of rank-3 fields which limits entropy-exchange between polarization at different points

JW3A.15
Optimize the Bandwidth Available at the Output End of Sdm System by Separating them Using a New Technique, Ahmed Y. Laarfi[1]; [1]*Florida Inst. of Technology Fit, USA.* A simulation of number of laser beams are launched at the same wavelength and received at the end point get separated for more advantages (using Zemax trail version)

JW3A.16
Withdrawn

JW3A.17 *RAPID*
Optical Phased Arrays based on ITO Phase Shifter Modulator on Silicon Photonics, Xiaoxuan Ma[1], Mario Miscuglio[1], Soo Jin Kim[2], Hamed Dalir[3], Volker J. Sorger[1]; [1]*The George Washington Univ., USA;* [2]*Korea Univ., South Korea;* [3]*Omega Optics, Inc., USA.* Beam steering using optical phase arrays is desirable way to implement LIDAR. Here, we demonstrate an optical phased arrays using ITO electro-optic and a short period end-fire antenna with large steering angle (140 degree).

JW3A.18
Non-Linear Spectroscopy Applied to Elaboration of Ultra Low Sulphur Fuels., Eduardo Perez[1]; [1]*DICIS, Mexico.* Variation of nonlinear filters applied to a spectrometer installed in the Refinery of Salamanca, Guanajuato where we have been producing low sulfur fuels as gasoline and diesel

JW3A.19 *RAPID*
Withdrawn

JW3A.20
Foundry-fabricated Inverse Designed Photonics, Alexander Y. Piggott[1,3], Logan Su[1], Neil V. Sapra[1], Andrew M. Netherton[2], Akhilesh S. Khope[2], John E. Bowers[2], Jelena Vuckovic[1]; [1]*Stanford Univ., USA;* [2]*UC Santa Barbara, USA;* [3]*PointCloud Inc., USA.* Fabrication-constrained inverse-designed silicon photonic devices are fabricated at a foundry and experimentally characterized, including a spatial mode demultiplexer with measured <1.25 dB insertion loss.

JW3A.21 *RAPID*

Large Optical Nonlinearity in Epsilon-Near-Zero Metamaterials in the Visible Regime, Sisira S. Suresh[1], Orad Reshef[1], Zahirul Alam[1], Jeremy Upham[1], Mohammad Karimi[1], Robert Boyd[1,2]; *[1]Univ. of Ottawa, Canada; [2]Department of Physics and Astronomy, Univ. of Rochester, USA.* We demonstrate metamaterials composed of sub-wavelength multilayer metal-dielectric stacks designed to exhibit an epsilon-near-zero response within the visible spectrum. We experimentally demonstrate nonlinear optical enhancement in their ENZ regime.

JW3A.22 *RAPID*

Wearable Heads up Displays for Transportation AR, Jonathan D. Waldern[1], Alastair J. Grant[1], Milan M. Popovich[1]; *[1]DigiLens, Inc., UK.* DigiLens Switchable Bragg Grating (SBG) waveguide technology enables compact color HUDs for consumer transportation AR applications with a wide field of view, high brightness fabricated using a low-cost printing process.

JW3A.23

Analysis of Displacement Offset in the Single-spot Two-dimensional Displacement Measurement System, Xin Xu[1], Kaiyi Zhu[1], Yidong Tan[1]; *[1]Dept. of Precision Instrument, Tsinghua Univ., China.* The possible causes of measurement offset in the single-spot two-dimensional displacement measurement system are analyzed. Multi-channel feedback crosstalk will cause sinusoidal disturbances , which brings the measurement error.

JW3A.24

Interior lighting evaluation and Visualization of light function by simulation : a new analysis method and guidance based on visual thinking algorithm in interior lighting, Seok-Jun Yang[1], Ingo Schneider[1]; *[1]JVISUSA, USA.* The purpose of this study is to provide a new analysis method and guidance based on visual thinking algorithm in interior lighting.

JW3A.25

New Experimental Approaches in Pulsed Laser Deposition: air at atmospheric pressure and multipulse excitation, Matias R. Tejerina[3], Luis Ponce[2], Fernando C. Alvira[1]; *[1]Laboratorio de Biomembranas, Universidad Nacional de Quilmes, Argentina; [2]San Petersburg Electrotechnical Univ., Russian Federation; [3]Centro de Tecnología de Recursos Minerales y Cerámica, Argentina.* We show nontraditional experimental implementations of pulsed laser deposition. Such implementations are uses as excitation source multipulse laser, and monopulse in air at atmospheric pressure. We have grown and characterized nanolayers of TiO_2

JW3A.26

Withdrawn

JW3A.27

Increase in Efficacy of Near-Infrared Femtosecond Micromachining in Ophthalmic Hydrogels with the Addition of Biocompatible Dopants, Sara Campaign[1], Wayne H. Knox[1,2]; *[1]Inst. of Optics, Univ. of Rochester, USA; [2]Center for Visual Science, Univ. of Rochester, USA.* Soaking hydrogels in biocompatible dopants before near-infrared femtosecond micromachining produced greater refractive index change using lower powers, suggesting potential for a near-infrared vision correction technique in cornea.

JW3A.28

High-performance ultrafine-structured graphene supercapacitors fabricated by femtosecond laser nanolithography, Xi Chen[1], Min Gu[1]; *[1]USST, China.* The microsized structure of laser-scribed supercapacitor electrodes is a barrier for achieving high performances. Here we report on fs laser lithography for ultrafine-structured supercapacitor fabrication. A performance breakthrough can be achieved.

JW3A.29

Two-photon Absorption of GaN and $Al_xGa_{1-x}N$ Thin Films, Diego da Silva Manoel[1], Jessica Dipold[1], Renato J. Martins[1], Ruben D. Rodriguez[1], Tobias Voss[2], Andreas Waag[2], Marcelo G. Vivas[3], Cleber R. Mendonça[1]; *[1]São Carlos Inst. of Physics, Univ. of São Paulo, Brazil; [2]Braunschweig Univ. of Technology, Germany; [3]Federal Univ. of Alfenas, Brazil.* Nonlinear absorption of GaN and $Al_xGa_{1-x}N$ thin films were studied by the Z-scan technique in the range of 0.53~0.63 E_{photon}/E_g, with values ranging from 0.8 to 2.2 cm/GW depending of sample composition, indicating its influences on the nonlinearity.

JW3A.30

Withdrawn

JW3A.31

Withdrawn

JW3A.32

Modulation properties of mid-IR quantum cascade laser using higher-harmonic modulation spectroscopy, May Hlaing[1], Panisara Chinsuti[1], Caio Azevedo[1], Amir Khan[1]; *[1]Delaware State University, USA.* We present quantification of laser transients, tuning characteristics and modulation properties of a mid-infrared quantum cascade laser (7.8μm) utilizing higher-harmonic wavelength modulation spectroscopy.

JW3A.33

100% Reliable Frequency-Resolved-Optical-Gating Pulse Retrieval Algorithmic Approach, Rana Jafari[1], Travis Jones[1], Rick Trebino[1]; *[1]Georgia Inst. of Technology, USA.* We introduce a fast, reliable approach for pulse-retrieval in FROG. We obtain a significantly better initial guess by retrieving the spectrum *directly* from the measured trace and implementing a multi-grid scheme with multiple initial guesses.

JW3A.34

Formation of Rydberg Atoms near an Optical Nanofiber, Krishnapriya Subramonian Rajasree[1], Tridib Ray[1], Kristoffer Karlsson[1], Sile Nic Chormaic[1]; *[1]Okinawa Inst. of Science and Technology Graduate Univ., Japan.* An optical nanofiber is overlapped with a magneto-optical trap in order to investigate formation and characteristics of Rydberg atoms near a dielectric surface. Formation of Rydberg atoms was confirmed and atom loss rates were determined.

JW3A.35

Third-Order Nonlinear Optical Properties of ALD Grown TiO_2 Thin Films, Robinson A. Kuis[1], Isaac Basaldua[1], Paul Burkins[2], Jaron Kropp[3], Theodosia Gougousi[3], Anthony Johnson[1,3]; *[1]Computer Science and Electrical Engineering, Univ. of Maryland, Baltimore County, USA; [2]Harford Community College, USA; [3]Physics, Univ. of Maryland, Baltimore County, USA.* Nonlinear index values as high as $1\pm.1x10^{-9}$ cm^2/W were measured of ALD based TiO_2 films. The 1000-fold increase in the index is believed to be due to the incorporation of nitrogen during growth.

JW3A.36

Weak absorption and scattering losses from the visible to the near-infrared in single-crystal sapphire grown by different techniques, Jessica Ma[1], Michael Thomas[2], Marc Airola[2], James Spicer[1]; *[1]Johns Hopkins Univ., USA; [2]Johns Hopkins Univ. Applied Physics Laboratory, USA.* Weak absorption and scattering in single-crystal sapphire from the visible to the near-infrared were measured. Mechanisms underlying related low loss phenomena that were contributed from different growth methods and surface polishing are discussed.
Withdrawn

JW3A.38

Optical Attenuation without Absorption, Ian C. Nodurft[1], Richard A. Brewster[1], Todd B. Pittman[1], James D. Franson[1]; *[1]Univ. of Maryland Baltimore County, USA.* We consider a coherent state incident upon an ensemble of atoms initially in their ground state. Post-selection on all of the atoms having remained in the ground state can give either enhanced attenuation or amplification.

JW3A.39

Study of a broad-spectrum source in the visible range by concatenating different thin-core fiber, C. A. Quintero-Mata[1], Julian Moises Estudillo Ayala[1], D Jauregui-Vazquez[1], Roberto Rojas Laguna[1], Juan Carlos Hernandez Garcia[2], Juan Manuel Sierra Hernandez[1], D Garcia-Mina[3], J R. Reyes-Ayona[1]; *[1]Universidad de Guanajuato, Mexico; [2]CATEDRAS, CONACYT, Mexico; [3]Departamento de Fisica, Universidad Autonoma de Occidente, Colombia.* We show a broad spectrum source by pumping short pulses from 600 ps at 532nm wavelength in two thin-core fiber sections achieving a source with a spectral width of approximately 300 nm.

JW3A.40

Two-dimensional Molybdenum Disulfide Passively Q-switched Nd:$GdYNbO_4$ Laser, Baofa Ran[1], Yufei Ma[1], Zhenfang Peng[1], Shoujun Ding[2], Haiyue Sun[1], Qingli Zhang[3]; *[1]Harbin Inst. of Technology, China; [2]Anhui Univ. of Technology, China; [3]Chinese Academy of Sciences, China.* A diode-pumped MoS_2 passively Q-switched Nd:$Gd_{0.69}Y_{0.3}NbO_4$ laser at 1066 nm was demonstrated. The maximum value of pulsed peak power was 1.63W with the pulse duration of 532 ns and the repetition rate of 122 kHz.

JW3A.41 *RAPID*

Tunable Multi-structured Beam Optical Parametric Oscillator, Varun Sharma[1], S. Chaitanya Kumar[2], G. K. Samanta[1], M. Ebrahim-Zadeh[3,4]; *[1]PRL Ahmedabad, India; [2]Radiantis, Polígon Camí Ral, Spain; [3]ICFO-Institut de Ciencies Fotoniques, The Barcelona Inst. of Science and Technology, Spain; [4]Institucio Catalana de Recerca i Estudis Avancats (ICREA), Spain.* We report a coherent light source simultaneously producing tunable beam of various spatial structures. Based on a picosecond optical parametric oscillator, the source generates Gaussian, vortex, Airy, and vortex Airy beams across 1457-1680 nm.

JW3A.42

Digital holographic microscopy of optically trapped microparticles with using of "bottle beam" optical tweezers, Nataliya V. Shostka[1], Olga Karakchieva[1], Bohdan Sokolenko[1]; *[1]V.I. Vernadsky Crimean Federal Univ., Russian Federation.* We report on development of optical tweezers based on uniaxial crystal anisotropy for generation of adjustable "bottle" beam trap carrying optical vortex for spatially confinement of microparticles in the in-line digital holographic microscopy setup.

JW3A.43

Beam Deflection Measurement of Air n2 in Mid-IR, Salimeh Tofighi[1], Natalia Múnera[1], David Hagan[1], Eric Van Stryland[1]; *[1]Univ. of Central Florida, USA.* We used the polarization-resolved beam-deflection technique to separate the bound-electronic and molecular-rotational components of the transient nonlinear refraction (NLR) of ambient air in the Mid-IR spectral range below the ionization threshold

JW3A.44

Generation of 40 W, 400 fs pulses at 1 MHz repetition rate from efficient, room temperature Yb:YAG double-pass amplifier seeded by fiber CPA system, Laurynas Veselis[1,2], Tadas Bartulevicius[1,2], Karolis Madeikis[1,2], Andrejus Michailovas[1,2]; *[1]Ekspla Ltd., Lithuania; [2]Center for Physical Sciences and Technology, Lithuania.* We presented a compact 400 fs high average power (40 W) and high energy (40 uJ) laser based on efficient room-temperature Yb:YAG double-pass amplifier and Yb fiber seed laser.

JW3A.45
Higher order correlations in a levitated nanoparticle phonon laser, Kewen Xiao[1], Robert M. Pettit[2,3], Nick Vamivakas[2,3], Mishkatul Bhattacharya[1,3]; [1]*School of Physics and Astronomy, Rochester Inst. of Technology, USA;* [2]*Inst. of Optics, Univ. of Rochester, USA;* [3]*Center for Coherence and Quantum Optics, Univ. of Rochester, USA.* We present theoretical calculations of higher order correlations for a phonon laser, demonstrated recently using an optically levitated nanoparticle. Our results for steady state and transient correlations agree well with experimental data.

JW3A.46
Mode-selective image upconversion through turbulence, He zhang[1], Santosh Kumar[1], Yu-Ping Huang[1]; [1]*Stevens Inst. of Technology, USA.* We experimentally and numerically show the selective image up-conversion of Laguerre-Gaussian modes through turbulent noise, with potential applications in areas of image recognition and free-space optical communications.

JW3A.47
Generation of 4.5mJ 2.5- pulses from a single stage Cr^{2+}:ZnSe Chirped-Pulse amplifier, Fangjie Zhou[1]; [1]*Univ. of Central Florida, USA.* We demonstrate the generation of 4.5mJ, 2.5- central wavelength, broad band laser pulses with 1kHz repetition rate in a 4-pass, single stage, in Cr^{2+}:ZnSe Chirped Pules Amplifier

JW3A.48
State-Selective Analysis of Ultrafast Molecular Dynamics Driven by Broadband XUV Pulses, Seyyed Javad j. Robatjazi[1], Shashank Pathak[1], Wright lee Pearson[1], Jeffry Powell[1], Narges Anbardar[2], Johannes Burger[3], Kanaka Raju Pandiri[1], Daniel Rolles[1], Artem Rudenko[1]; [1]*Kansas State Univ., Physics Dept., USA;* [2]*Harvard John A. Paulson School of Engineering and Applied Sciences, USA;* [3]*Department of Physics, Ludwig-Maximilians-Universitat Munich, Germany.* We present the results of a time-resolved photoelectron-photoion coincident experiment on laser-induced dissociation of the XUV-photoionized CO_2 molecule. This allows for a state-selective analysis of molecular dynamics driven by broadband pulses.

JW3A.49
Operating speed measurement of GaSb/GaInAsSb/GaAlAsSb photodetector at wavelength of 1.9 μm, Dmitrii Vlasov[1], Gleb Konovalov[2], Igor Andreev[2], Yurii Yakovlev[2], Vasiliy Voropaev[1], Alexander I. Donodin[1], Mikhail Tarabrin[1,3], Andrey A. Bushunov[1], Vladimir Lazarev[1], Valeriy Karasik[1]; [1]*Bauman Moscow State Technical Univ., Russian Federation;* [2]*Ioffe Physical Technical Inst. of the Russian Academy of Sciences, Russian Federation;* [3]*P. N. Lebedev Physical Inst. of the Russian Academy of Sciences, Russian Federation.* We study the rise time and fall time of high-speed photodetector based on GaSb/GaInAsSb/GaAlAsSb heterostructures with frontal bridge contact at the wavelength of 1.9 μm by using ultra-fast fiber laser and high-speed oscilloscope.

JW3A.50
Modelling and Measurement of Two-photon Absorption in Semiconductor Quantum Wells, Nicholas A. Cox[1], Junxiong Wei[2], Simon-Pierre Gorza[2], David Hagan[1], Eric Van Stryland[1]; [1]*Univ. of Central Florida, USA;* [2]*OPERA-Photonique, Université libre de Bruxelles, Belgium.* Pump probe measurements of nondegenerate two-photon absorption in MBE-grown AlGaAs/GaAs semiconductor quantum well waveguides are presented. The results agree well with a model based on perturbation theory.

JW3A.51
Withdrawn

JW3A.52
Pulsed entanglement measured by parametric amplifier assisted homodyne detection, Yuhong Liu[1], Jiamin Li[1], Nan Huo[1], Chang Feng[1], Z. Y. Ou[1,2], Xiaoying Li[1]; [1]*Tianjin Univ., China;* [2]*Department of Physics, Indiana Univ.-Purdue Univ. Indianapolis, USA.* Using the detection system consisting of a phase sensitive amplifier and standard homodyne detectors, we experimentally demonstrate that the influence of detection loss and multi-mode property of entangled fields can be greatly mitigated.

JW3A.53
Measurements of the Nonlinear Optical Response of Semiconductors with Intense 10μm Laser Pulses, Daniel A. Matteo[1], Jeremy Pigeon[1], Sergei Tochitsky[1], Ulrich Huttner[2], Mackillo Kira[3], Stephan W. Koch[2,4], Jerome V. Moloney[4], Chan Joshi[1]; [1]*Univ. of California Los Angeles, USA;* [2]*Philipps-Universtät Marburg, Germany;* [3]*Univ. of Michigan, USA;* [4]*College of Optical Sciences, Univ. of Arizona, USA.* We measure four-wave mixing efficiency and nonlinear absorption in GaAs, Ge, and ZnSe using a GW/cm^2 CO_2 laser. At high fields the nonlinear optical response can be enhanced almost 100x by decreasing the beat frequency.

JW3A.54
3 Pulse Differential Phase Shift Quantum Key Distribution with Spatial, or Time, Multiplexed, Gautam K. Shaw[1], Shyam Shreedharan[1], Foram Shingala[1], Shashank Ranu[1], Prabha Mandayam[1], Anil Prabhakar[1]; [1]*IIT Madras, India.* We demonstrated 3 pulse differential phase shift quantum key distribution with 30 km quantum channel with two different approaches, namely path superposition and time bin superposition.

JW3A.55
Hybrid Plasmonic Lasing from Zinc-Doped GaAs Nanowires up to Room Temperature, Gyanan Aman[3], Fatemesadat Mohammadi[1], Mykhaylo Lysevych[2], Hoe Tan[2], Chennupati Jagadish[2], Heidrun Schmitzer[4], Marc Cahay[3], Martin Fraenzl[5], Hans-Peter Wagner[1,3]; [1]*Univ. of Cincinnati, USA;* [2]*The Australian National Univ., Australia;* [3]*Univ. of Cincinnati, USA;* [4]*Xavier Univ., USA;* [5]*Univ. of Leipzig, Germany.* We observe hybrid plasmonic lasing from highly Zn-doped GaAs nanowires on a gold substrate and from nanowires coated with a 10 nm thick gold layer at temperatures ranging from 5 K up to room temperature.

JW3A.56
Space-Based Global Quantum Internet, Anthony Brady[1], Sumeet Khatri[1], Renee Desporte[1], Manon Bart[1], Jonathan Dowling[1]; [1]*Louisiana State Univ., USA.* We consider a satellite constellation for global entanglement distribution. We simulate the constellation's dynamics and estimate entanglement bit rates between earthbound receivers connected by quantum repeaters hosting multimode quantum memories.

JW3A.57
Conditional waiting-time probabilities for the nth photodection for classical and quantum light sources, Luis F. Morales Bultron[1], Reeta Vyas[1], Surendra Singh[1]; [1]*Univ. of Arkansas, USA.* Waiting-time probabilities for detecting the nth photon, given that counting commenced at the detection of a photon, for stationary classical and quantum sources are studied and compared with unconditional waiting-time probabilities.

JW3A.58
Strengthened Nonlinear Processes Owing to Oxide Based 2D Electron Gas Supported Surface Plasmons, Jingwen Zhang[1], Yingce Wang[1], Chao Wang[1], Hua Zhao[1]; [1]*Harbin Inst. of Technology, China.* Threshold of nonlinear processes are lowered to a few W/cm^2 in Y-cut Fe:$LiNbO_3$slabs coated with indium-tin-oxide film, stemming from polarity catastrophe resulted 2D electron-gas supported surface plasmons mediated with two sets of phase gratings.

JW3A.59
Designing a New Few Modes Fiber for Multiplexing Spatial Division, Rodrigo Acuña Herrera[1], Carolina Mira Fernández[1,2]; [1]*Universidad Nacional de Colombia, Colombia;* [2]*Antioquia, Universidad de Antioquia, Colombia.* We investigate a new design of a few-mode fiber (FMF), considering the joint effect of three parameters: a dip at core, the graded-index-core profile, and a trench at the cladding.

JW3A.60
Distributed-feedback Raman Laser based on Random FBG Array in a Short PM Fiber, Sofia R. Abdullina[1], Mikhail I. Skvortsov[1,2], Alexander A. Vlasov[1], Evgenyi V. Podivilov[1,2], Sergey A. Babin[1,2]; [1]*Inst. of Automation and Electrometry, Russian Federation;* [2]*Novosibirsk State Univ., Russian Federation.* 7-m PM fiber with random FBG array exhibits ~10mW single-longitudinal-mode generation with ~50kHz linewidth, low mode number up to ~0.1W with further transition to incoherent regime at Watts power, in agreement with the developed model.

JW3A.61
Step-wise Numerical Study on Mode Instability, Hanbyul Chang[1], Kyoungyoon Park[1], Byungho Kim[1], Yoonchan Jeong[1]; [1]*Seoul National Univ., South Korea.* We develop a simulation model elucidating mode instability manifestation in high power fiber amplifiers. Power fraction of each mode is calculated by Runge-Kutta method. Using the model, we analyze occurrence and alleviation of mode instability.

JW3A.62
Breaking the no cross-coupling condition of polarization-maintaining optical fibers, Nestor Lozano-Crisostomo[1], Julio C. Garcia-Melgarejo[1], Jesus I. Espinoza-Blanco[1], Esteban I. Garcia-Villanueva[1], Javier Sanchez-Mondragon[2]; [1]*FIME, Universidad Autónoma de Coahuila, Mexico;* [2]*INAOE, Mexico.* We show how the condition of no cross-coupling of optical power between the two orthogonal polarization modes in polarization-maintaining optical fibers is broken

JW3A.63
Characterization of Fiber Bragg Gratings using a 3D Quantitative Phase Imaging Approach, Grayson Noah[1], Yijun Bao[1], Thomas Gaylord[1]; [1]*Georgia Inst. of Technology, USA.* Quantitative Phase Imaging (QPI) is used to recover 3D refractive index (RI) distributions of Fiber Bragg Gratings (FBGs), revealing high-spatial-frequency patterns. Additionally, quantitative comparisons are made with theoretical calculations.

JW3A.64
Experimental Study of Initial Conditions for Dissipative Soliton Resonance in a Figure-Eight Er/Yb-Doped Fiber Laser, Berenice Posada Ramirez[1], Manuel Duran-Sanchez[1], Baldemar Ibarra-Escamilla[1], Hector Santiago-Hernandez[2], R. I. Alvarez-Tamayo[3], Miguel Bello-Jimenez[4], Evgeny Kuzin[1]; [1]*INAOE, Mexico;* [2]*Universidad de Guadalajara, Mexico;* [3]*Universidad Autonoma de Nuevo Leon, Mexico;* [4]*Universidad Autonoma de San Luis Potosi, Mexico.* We experimentally investigate the appropriate transmission adjustments on a NOLM to obtain DSR dynamics in a passively mode-locked figure-eight EYDCF laser. At maximum pump power, a 46.18 ns maximum pulse duration was obtained.

JW3A.65 *RAPID*

Radio Frequency Spectrum Control Based on Wideband Jamming and Photonic Jamming Cancellation, Yang Qi[1], Ben Wu[1]; *[1]Rowan Univ., USA.* We propose and demonstrate a radio frequency spectrum control platform based on wideband jamming and photonic jamming cancellation. The radio frequency communication is disabled for malicious users without affecting authorized communications.

JW3A.66

On an Finite-Difference Time-Domain Model for Silicon Photonic Modulators, Qun Zhang[1], Xi Wang[1], Xuanhui Wu[1], Nabin Bhattarai[1], Puteri Hamari[1], Muhammad Khaliq[1]; *[1]Minnesota State Univ. Mankato, USA.* A second-order finite-difference time-domain (FDTD) large signal model for silicon phonics (SiP) modulators is compared against a first-order large signal model, via studies of both electrical RF driving signals and optical modulated signals.

JW3A.67

An ITO-based Mach-Zehnder Modulator with Lateral MOS-Capacitor on SOI Platform, Rubab Amin[1], Rishi Maiti[1], Zhizhen Ma[1], Mario Miscuglio[1], Hamed Dalir[2], Volker Sorger[1]; *[1]The George Washington Univ., USA; [2]Omega Optics, Inc., USA.* We demonstrate an integrated compact plasmonic ITO Mach-Zehnder electro-optic modulator on SOI platform, implementing a lateral MOS-stack, featuring a high-performance halfwave voltage and active device length product of $V_\pi L$ = 63 V-µm.

JW3A.68 *RAPID*

SPPC Based Beam Splitter and Alignment Sensor: The Passive and Active Control of its Functionality Parameters, Maria I. Benetou[1,2]; *[1]Univ. College London, Greece; [2]Mbh-Qet.Ltd., UK.* A beam splitter based on a surface plasmon polaritonic crystal (SPPC) is experimentally demonstrated. Its functionality parameters can be controlled by engineering the SPPC boundary and manipulating the alignment with the illuminating beam.

JW3A.69 *RAPID*

Integrated nanophotonic waveguide cavity with coupled micromechanical resonant reflectors, Eikhyun Cho[1], Jason J. Gorman[1]; *[1]NIST, USA.* A nanophotonic waveguide cavity with integrated Bragg reflectors containing micromechanical beam resonators is presented. This cavity provides a path towards coupling micromechanical resonators for mechanical state transfer and synchronization.

JW3A.70

Surface Tension Measurements Using a Two-Hole Optical Fiber, Natanael Cuando-Espitia[1], Jose Rafael Guzman-sepulveda[2], Miguel Fuentes-Fuentes[3], Miguel Torres-Cisneros[4], Karina Gonzalez-Gutierrez[5], Patrick LiKamWa[2], Daniel May-Arrioja[3]; *[1]DICIS, Univ. of Guanajuato, Mexico; [2]CREOL, Univ. of Central Florida, USA; [3]Centro de Investigaciones en Optica, Mexico; [4]DICIS, Univ. of Guanajuato, Mexico; [5]Motorola Solutions de México, Mexico.* A time-dependent trace of the reflection at the end of a two-hole fiber (THF) is use to measure surface tension. Gas is injected through the THF channels while reflection is measured through the fiber core.

JW3A.71

High Plasmonic Quality Titanium Nitride Thin Films on Si (001) with MgO Buffer, Kai Ding[1], Dhruv Fomra[1], Vitaliy Avrutin[1], Nathaniel Kinsey[1], Ümit Özgür[1], Hadis Morkoç[1]; *[1]Virginia Commonwealth Univ., USA.* We demonstrate high plasmonic quality TiN on Si (001) via PE-ALD. Employment of a MgO buffer improved the figure of merit (FoM) at 1550 nm from 2.0 to 2.5 and the peak FoM from 2.4 to 2.8.

JW3A.72

Multimodal Fiber Sensor with High Visibility Fringes for Measurement of Displacement, Julian Moises Estudillo-Ayala[1], Roberto Rojas Laguna[1], Juan Carlos Hernandez Garcia[1], Juan Manuel Sierra Hernandez[1], Daniel Jauregui Vazquez[1], Luis David Pineda Vergara[1], Luis Fernando Granados Zambrano[1], Sergio D. Guevara Hernandez[1]; *[1]Universidad de Guanajuato, Mexico.* Fiber optic sensor with an SC source through at 1km optical fiber to obtain a broad spectrum in the 1300-1650 nm section for the realization of a displacement sensor by means of a Fabry-Perot interferometer.

JW3A.73

Scalable Time-Multiplexed Optical Neural Networks based on Homodyne Detection, Ryan Hamerly[1], Liane Bernstein[1], Alex Sludds[1], Marin Soljacic[1], Dirk Englund[1]; *[1]Massachusetts Inst. of Technology, USA.* We present an optical neural-network accelerator based on coherent (homodyne) detection that is scalable to large networks, and analyze the fundamental (quantum) and practical limits to its performance.

JW3A.74

Controlling Resonance nature and Spectral Line shapes in Terahertz Metamaterials, Subhajit Karmakar[1], Ravendra K. Varshney[1], Dibakar Roy Chowdhury[2]; *[1]Indian Inst. of Technology Delhi, India; [2]Physics, Mahindra Ecole Centrale, India.* We propose active conversion from symmetric Lorentzian resonance to asymmetric Fano resonance and vice versa by changing the conductivity of split-gaps in THz metamaterials. Such resonance transition can lead to futuristic nano-photonics devices.

JW3A.75

Experimental Investigation of Intensity Modulation of a Graphene-covered Silicon-based Hybrid Plasmonic Waveguide, Yonghan Kim[1], Min-Suk Kwon[1]; *[1]School of Electrical and Computer Engineering, Ulsan National Inst. of Science and Technology, South Korea.* We experimentally investigate a graphene-covered silicon-based hybrid plasmonic waveguide, which is based on a metal-insulator-silicon-insulator-metal waveguide, as an intensity modulator. The modulation depth of the waveguide is 0.276 dB/µm.

JW3A.76

Spectral Degeneracies in Optically Injected Quantum Well Lasers, Panagiotis Papagiannis[1], Yannis Kominis[1], Vassilios Kovanis[2]; *[1]National Technical Univ. of Athens, Greece; [2]Electrical and Computer Engineering, Virginia Tech Research Center, USA.* We dissect the dynamics of optically injected quantum well lasers and we find the domains of existence of Exceptional Points within the stable phase-locking parameter region. Implication on the system's noise response are discussed.

JW3A.77

Withdrawn

JW3A.78 *RAPID*

Integrated photonic digital to analog conversion based on unsymmetrical directional coupler, Jiawei Meng[1], Mario Miscuglio[1], Volker Sorger[1]; *[1]GWU, USA.* We present a N-bit integrated and scalable photonic digital to analog (PDAC) converter based on the integrated electro-optic circuit.

JW3A.79

Mie particle Phonon Laser, A K. Mohamed[1], Kewen Xiao[1], Robert M. Pettit[2], Nick Vamivakas[2], Mishkatul Bhattacharya[1,2]; *[1]School of Physics and Astronomy, Rochester Inst. of Technology, USA; [2]Inst. of Optics, Univ. of Rochester, USA.* We theoretically describe a levitated Mie particle phonon laser, obtained by coupling the particle oscillations to a whispering gallery mode via laser radiation. We show that ultrasensitive force sensing can be performed using this platform.

JW3A.80

Surface Imprinted Carbon Nanotubes as Sensing Matrix for a Plasmonic SMX Sensor, Anisha Pathak[1], Banshi D. Gupta[1]; *[1]IIT Delhi, India.* A fiber optic SPR sensor has been reported for Sulfamethoxazole (SMX). Silver film has been utilized as plasmonic material with a selective sensing layer of molecularly imprinted polymer on the surface of carbon nanotubes.

JW3A.81

Antenna Model For Metasurface-Assisted Enhancement Of Light-Matter Interaction, Vinodh Raj Rajagopal Muthu[1,2], Supratik Sarkar[1,2], Behrooz Semnani[1,2], Michal Bajcsy[1,2]; *[1]Inst. for Quantum Computing, Univ. of Waterloo, Canada; [2]Department of Electrical and Computer Engineering, Univ. of Waterloo, Canada.* This work applies the antenna formalism to a system formed by a single quantum emitter and a metasurface. The goal is to design topology-optimized metasurfaces to extract light from quantum emitters embedded in dielectric materials.

JW3A.82

High Frequency Dark Mode Generation in All-Dielectric Asymmetric Metamaterials, Shubhanshi Sharma[1], Rajat K. Sinha[1], Saawan K. Bag[1], Basudev Lahiri[1], Shailendra K. Varshney[1]; *[1]IIT Kharagpur, India.* We report all-dielectric metamaterial to produce the dark mode at high frequency, which can be utilized for sensing, lasing, and photovoltaics. The structure has been simulated using commercial finite-element method-based software.

JW3A.83

Design and Simulation of Sub wavelength Silicon based Metalens on Optical Fiber Tip, Rajat K. Sinha[1], Shubhanshi Sharma[1], Saawan K. Bag[1], Basudev Lahiri[1], Shailendra K. Varshney[1]; *[1]Indian Inst. of Technology Kharagpur, India.* Fiber-based silicon metalens with a focus length of 10µm is designed at λ_0=1.55µm. The structure is analyzed using phase distribution relation and simulated using FDTD.

JW3A.84

Fast and numerically exact metasurface simulation, Rahul Trivedi[1], Logan Su[1], Seunghoon Han[2], Shanhui Fan[1], Jelena Vuckovic[1]; *[1]Stanford Univ., USA; [2]Samsung Advanced Inst. of Technology, South Korea.* We present a efficient and accurate simulations of large area metasurfaces that exactly account for interactions between different meta-atoms. Our GPU-accelerated method achieves two orders of magnitude speed up over FDTD.

JW3A.85 *RAPID*

Imaging of Surface Plasmons from the Bulk and Surface State of Topological Insulator Bi_2Te_2Se, Prabhu Kumar Venuthurumilli[1], Xiaolei Wen[2], Vasudevan Iyer[1], Yong P. Chen[1], Xianfan Xu[1]; *[1]Purdue Univ., USA; [2]Univ. of Science and Technology of China, China.* Surface plasmons arising from the bulk and surface state of topological insulator Bi_2Te_2Se are studied. The plasmon wavelength of surface state is 100 times smaller than the incident wavelength, in contrast to the bulk.

JW3A.86

Withdrawn

JW3A.87

High Spectral Resolution Graphene-based Multiplex Surface-enhanced CARS for Bio-sensing, Zhongbo Yan[1]; *[1]Univ. of California, Los Angeles, USA.* A surface-enhanced CARS system is constructed through a graphene-Au nanostructure hybrid platform, which provides a surface enhancement and a bio-compatible surface. Single molecule level sensitivity with high spectral resolution is achieved.

JW3A.88
Measurement of Transverse Chromatic Aberrations in Virtual Reality Headsets, Ryan Beams[1], Andrea Kim[1], Aldo Badano[1]; *[1]Food and Drug Administration, USA.* We demonstrate a digital test pattern and a methodology for measuring the transverse chromatic aberrations in head-mounted displays. The test pattern was also used for psychophysics TCA measurements, which agreed with the laboratory results.

JW3A.89
Magnetic imaging of malarial nanocrystals with diamond sensors, Ilja Fescenko[1], Abdelghani Laraoui[1], Janis Smits[1,2], Nazanin Mosavian[1], Pauli Kehayias[1,3], Jong Seto[4], Lykourgos Bougas[5], Andrey Jarmola[6,7], Victor M. Acosta[1]; *[1]Univ. of New Mexico, USA; [2]Laser Center, Univ. of Latvia, Latvia; [3]Department of Physics, Harvard Univ., USA; [4]School of Medicine, Univ. of California-San Francisco, USA; [5]Johannes Guttenberg Univ., Germany; [6]Department of Physics, Univ. of California - Berkeley, USA; [7]ODMR Technologies Inc., USA.* We report magnetic microscopy of natural and synthetic malarial nanocrystals at room temperature by using optically detected magnetic resonance imaging of near-surface diamond nitrogen-vacancy centers.

JW3A.90
Thermal Modeling and Simulation for Optical Illumination to Extract Cancer Cells from Tissue Samples, Chang-Mu Han[1], Edo Waks[1], Benjamin Shapiro[2]; *[1]IREAP, USA; [2]xMD Diagnostics, USA.* Expression Microdissection (xMD) allows target cancer cell extraction from human tissue, to reduce misdiagnoses caused by nontarget cell contamination. A thermal model and simulations are presented to assess thermal distribution in the xMD process.

JW3A.91 *RAPID*
Polarized Reflectance Texture Distinguishes Superficial Damage of Bovine Articular Cartilage Explants, Ruby Huynh[1], Benjamin Pesante[1], George Nehmetallah[2], Christopher Raub[1]; *[1]Biomedical Engineering, Catholic Univ. of America, USA; [2]Electrical Engineering and Computer Science, Catholic Univ. of America, USA.* Polarized reflectance maps of bovine articular cartilage are rich in texture content. Image texture analysis extracts quantitative parameters useful to assess intact cartilage versus cartilage with mechanical surface damage or enzymatic degradation.

JW3A.92
Analysis of 3D Collagen Organization in Non-pregnant Rat Cervix Tissue, Woowon Lee[1], Amir Ostadi Moghaddam[1], Barbara McFarlin[2], Amy Wagoner Johnson[1], Kimani C. Toussaint[1,3]; *[1]Department of Mechanical Science and Engineering, Univ. of Illinois at Urbana-Champaign, USA; [2]Department of Women, Children and Family Health Science, Univ. of Illinois at Chicago, USA; [3]Bioengineering, Univ. of Illinois at Urbana-Champaign, USA.* We quantitatively analyze non-pregnant rat cervix on three distinct regions using second-harmonic generation imaging. 3D structural parameters related to collagen organization are obtained on each region respectively.

JW3A.93
Microscopic Three-dimensional Reconstruction based on Structured Light, Taichu Shi[1], Yang Qi[1], Ben Wu[1]; *[1]Rowan Univ., USA.* We proposed and demonstrated a three-dimensional microscopy method based on structured light illumination, which greatly reduce reconstruction time used. 50 μm resolution is achieved with 8~10 cm working distance.

JW3A.94
Application of bioluminescence for the drug discovery to rickets caused by gene mutation of vitamin D receptor, Kaori Yasuda[1], Hiroki Mano[1], Miyu Nishikawa[1], Shinichi Ikusiro[1], Atsushi Kittaka[2], Toshiyuki Sakaki[1]; *[1]Toyama Prefectural Univ., Japan; [2]Teikyo Univ., Japan.* There is no suitable medicine for rickets caused by mutation of vitamin D receptor (VDR). In the present study, we found the promising new compounds for this disease using bioluminescence assay.

JW3A.95
Implementation of optical feedback modulation in photonic reservoir computing, Binti Haya Afeeqah Amalina[1], Chihiro Sugano[1], Kazutaka Kanno[1], Atsushi Uchida[1]; *[1]Saitama Univ., Japan.* We investigation photonic reservoir computing using a single semiconductor laser with time-delayed feedback modulation. We perform time-series prediction task and achieve better results using phase modulation compared to intensity modulation.

JW3A.96
Analysis of an Analog Optical Neural Network, Simon Geoffroy-Gagnon[1], Farhad Shokraneh[1], Odile Liboiron-Ladouceur[1]; *[1]Electrical and Computer Engineering, McGill, Canada.* A single layer analog optical neural network based on a 4×4 reconfigurable optical processor is analyzed through simulation. Using a stochastic optimization algorithm and a synthetic dataset, the network yields a final accuracy of 95.6%

JW3A.97 *RAPID*
Modulated Amplitude Reflectance Spectroscopy to Spatially Map Charge Carrier Density and Mobility in Organic Field Effect Transistors, Yannai Kashtan[1], Ricardo Espinoza[1], Janice Hudgings[1], David Tanenbaum[1]; *[1]Pomona College, USA.* Organic field effect transistors are used as a model system to explore charge transport in semiconducting polymers. Modulated amplitude reflectance spectroscopy is used to spatially map the carrier density and to quantify the carrier mobility.

JW3A.98
Investigating Stochastic Resonance to Enhance the Resolution of CCD-based Thermoreflectance Imaging, EliseAnne Koskelo[1], Janice Hudgings[1]; *[1]Pomona College, USA.* Thermoreflectance imaging is a high-resolution imaging technique, which employs a 4-bucket algorithm that averages over many sample modulation periods. We develop a model of measurement noise to optimize stochastic resonance of the averaging process.

JW3A.99
Underwater Small and Dim target detection method, Fei Liu[1], Yi Wei[1], Pingli Han[1], XiaoPeng Shao[1]; *[1]Xidian Univ., China.* The reflected light of small and dim target and backscattered light can be separated according to their sparsity and low-rank properties. The polarization azimuth images with the smallest light intensity are most suitable for separation

JW3A.100
Parallelization in reservoir computing based on a mutually coupled electro-optic delay system, Kento Saito[1], Kazutaka Kanno[1], Atsushi Uchida[1]; *[1]Department of Information and Computer Sciences, Saitama Univ., Japan.* We propose reservoir computing based on a mutually coupled electro-optic delay system. We experimentally show that the performance of reservoir computing can be improved using the mutually coupled system.

JW3A.101
Proximity Effect on Nanophotonic Phased Arrays, Xuetong Sun[1], Yang Zhang[1], Po-Chun Huang[1], Mario Dagenais[1], Martin Peckerar[1], Amitabh Varshney[1]; *[1]Univ. of Maryland College Park, USA.* Proximity effect can affect thermal-modulated nanophotonic phased array holographic displays. The impact of proximity effect on holographic imagery is investigated and the improvement using proximity effect correction methods is demonstrated.

JW3A.102
Research on Building Extraction of Multi-temporal Remote Sensing Image Based on Deep Learning, Yuhan Wang[1], Lingjia Gu[1], Ruizhi Ren[1], Xiaohu Zhou[1]; *[1]Jilin Univ., China.* The building texture features of multi-temporal remote sensing images were introduced into the VGG neural network. Building extraction accuracy of multi-temporal images can reach 90.6%, which is significantly higher than that of single-phase images.

JW3A.103
Resolution in Quantum Imaging with Undetected Photons, Jorge Fuenzalida[1,2], Armin Hochrainer[1,2], Gabriela Lemos[3], Mayukh Lahiri[1,2], Anton Zeilinger[1,2]; *[1]Inst. for Quantum Optics and Information, Austria; [2]Faculty of Physics, Univ. of Vienna, Austria; [3]Univ. of Massachusetts, USA.* In 2014, an experiment [Nature 512, 409] demonstrated imaging with undetected photons. We investigate the resolution of this imaging system. I will present experimental results and theoretical analysis of our research.

JW3A.104
High Efficiency Laser-Diode-Pumped Hemisperical Short Cavity Laser by High Intensity Pumping, Ryo Kobayashi[1], Fumihiro Sugiki[1], Yu Aoyagi[1], Shunji Kataoka[1], Junya Maeda[1], Masashi Shibata[1], Sakae Kawato[1]; *[1]Univ. of Fukui, Japan.* A single-emitter laser-diode-pumped continuous-wave hemispherical short cavity laser was investigated. As a result, the optical-to-optical conversion efficiency of 57% for the incident pump power was obtained by high intensity pumping.

JW3A.105
Pulse Parameter for Characterization of Transform-Limited Properties, Sergiy Mokhov[1]; *[1]Univ. of Central Florida, CREOL, USA.* Pulse parameter P^2 based on second-order momentums of time and frequency is proposed. It is similar to beam quality M^2. P^2 conserves with propagation described by parabolic equation and with adding quadratic phase to profile.

JW3A.106
Withdrawn

JW3A.107
Squeezed Light Detection Using Quantum Imaging, Elisha Siddiqui[1], Savannah Cuozzo[2], Lior Cohen[1], Hwang Lee[1], Irina Novikova[2], Eugeniy Mikhailov[2], Jonathan Dowling[1]; *[1]Louisiana State Univ., USA; [2]Physics, College of William and Mary, USA.* We propose a method to measure the noise in squeezed light field. We analyze appropriate spatial correlations using quantum imaging, and reduce the effect of pump fluctuations that override the quantum statistics of the field.

JW3A.108
Withdrawn

JW3A.109
Three axis vector atomic magnetometer in spin self-sustaining mode, Qin Zhao[1], Shiguang Wang[1], Lijun Wang[1]; *[1]Tsinghua Univ., China*. We demonstrate a vector atomic magnetometer based on spin self-sustaining method with 1/τ property. The sensitivity of magnetic field magnitude and directionmeasurements are 0.64 pT/√Hz and 3.5×10^{-6} rad/√Hz, respectively.

JW3A.110
Investigation of Raman Dissipative Solitons Generation in an External Phosphosilicate-Fiber Cavity, Denis S. Kharenko[1,2], Anastasia E. Bednyakova[3,2], Innokentiy Zhdanov[1,2], Evgenyi V. Podivilov[1,2], Mikhail Fedoruk[2,3], Sergey A. Babin[1,2]; *[1]Inst. of Automation and Electrometry SB RAS, Russian Federation; [2]Novosibirsk State Univ., Russian Federation; [3]Inst. of Computational Technologies, SB RAS, Russian Federation*. An external-cavity generation of highly-chirped dissipative solitons near 1.3 μm in all-fiber scheme by using Raman effect and a new type of phosphosilicate polarization maintaining fiber was investigated both experimentally and numerically.

JW3A.111
Planar electromagnetic propagation of an *s*-polarized wave across an achiral/chiral interface under variable magnetic permeability, Monish R. Chatterjee[1], Nagi Buaossa[1]; *[1]Univ. of Dayton, USA*. Propagation of *s*-polarized electromagnetic (EM) waves across an achiral/chiral interface is examined using Fresnel coefficients (FCs). Both materials across the interface are considered magnetic in nature; resulting anomalies are investigated.

JW3A.112
Development of Reflective Filter by Suppressing Sidelobes by BBAR Coating using Ion Assisted Deposition (IAD) Technique, Vemuri Srs Praveen Kumar[2,1], Naini Garg[1], Mukesh Kumar[1], Neelam Kumari[2,1], VInod Karar[1], Amit Sharma[2,1]; *[1]Central Scientific Instruments Organization, India; [2]Academy of Scientific & Innovative Research (AcSIR), India*. This Paper reports the suppression of sidelobes using 3 layer BBAR coating for reflective multilayer stack. Thin films of Al_2O_3, SiO_2 and TiO_2 were deposited by ion-assisted deposition technique and characterized by UV-Vis-NIR spectrophotometer

JW3A.113
Majorana-like Photons from Cylindrical Vector Beams Propagating through Brain tissue, Sandra Mamani[1,2], Lingyan Shi[1,3], Daniel Nolan[4], Robert R. Alfano[1,2]; *[1]IUSL at City College, USA; [2]Electrical engineering, The Grove School of Engineering,The City College of the City Univ. of New York, USA; [3]Department of Biomedical Engineering, Univ. of California San Diego, USA; [4]Corning Research and Development Corporation, USA*. For the first time, we show mathematically that entangled states of class of vector beams are Majorana–like. Experimentally, enhanced transmission is observed in mouse brain from Majorana–like vector photons with orbital angular momentum.

JW3A.114
Graphene-based layered metamaterial platform for functional photonic devices, Yunyi Yang[1], Han Lin[1], Minghui Hong[2], Baohua Jia[1]; *[1]Swinburne Univ. of Technology, Australia; [2]National Univ. of Singapore, Singapore*. We show the ultra-thin graphene-based metamaterial platform with stacked multilayer structures for functional photonic devices. Various high-performance photonic devices are realized and presented based on this platform.

JW3A.115
Enhanced Color Purities for Additive Colors Enabled by 1D Metal-insulator Resonator, Do Hyeon Kim[1], Young Jin Yoo[1], Joo-Hwan Ko[1], Yeong Jae Kim[1], Young Min Song[1]; *[1]School of Electrical Engineering and Computer Science (EECS), Gwangju Inst. of Science and Technology (GIST), South Korea*. We demonstrate a planar double-stacked metal-insulator (MIMIM) structure which provides tunable dual-resonance mode. By changing the reflectance dips, we achieved high purity additive colors (i.e., red, green and blue).

JW3A.116
A Microwave Photonic Downconverter with the Third-order Distortion Suppression, Hongbiao Zhang[1], Yunxin Wang[1], Dengcai Yang[1], Feng Yang[1], Dayong Wang[1]; *[1]Beijing Univ. of Technology, China*. A microwave photonic downconverter with the third-order distortions suppression is proposed. The distortions can be suppressed by turning a bias voltage and polarizations. The SFDR can achieve 113.2 $dB.Hz^{2/3}$.

JW3A.117
Simulating Quantum Mechanics with Light: The Quantum Pendulum Via Mathieu Beams, Enrique J. Galvez[1], Fabio J. Auccapuclla[1,2], Yingsi Qin[1], Kristina L. Wittler[1]; *[1]Colgate Univ., USA; [2]Ciencias, Seccion Fisica, Pontificia Universidad Catolica del Peru, Peru*. We simulate the nonlinear quantum pendulum using non-diffracting solutions of the 2-dimensional Helmholtz equation in elliptical coordinates. Stationary and wavepacket Mathieu spatial modes are in quantitative agreement with the quantum probabilities.

JW3A.118
Polarization-Resolved Single-Photon Measurements of Nonlinear Thomson Scattering, Michael Ware[1], Daniel Hodge[1], Brittni Pratt[1], Mahonri Romero[1], Christoph Shulzke[1], Justin Peatross[1]; *[1]Brigham Young Univ., USA*. We report measurements of polarization-resolved nonlinear Thomson scattering made using single-photon detection techniques in a regime of low density electrons. This low density allows the study of electron dynamics in a high-intensity focus.

JW3A.119
Application of the Fractional Sampling Theorem for Light Propagation in Fresnel Domain, Daniel F. Borrero Landazabal[1], Rafael Á. Torres Amaris[1]; *[1]Industrial Univ. of Santander, Colombia*. We show briefly how the fractional sampling theorem is applied to the case when the electric field is diffracted by a slit and we perform some numerical solutions to Fresnel integrals that satisfy the theorem.

JW3A.120
Spectrally-Tunable Absorption Enhancement in Cooperative Antenna–Cavity Hybrid Systems, Qinglan Huang[1], Brian T. Cunningham[1]; *[1]Univ. of Illinois at Urbana-Champaign, USA*. Integrating plasmonic nanoantennas onto a dielectric photonic crystal slab yields ultrasharp strongly enhanced absorption that are spectrally tunable. We elucidate the cooperative antenna–cavity coupling through a temporal coupled mode theory.

JW3A.121
Nanoscale Spectroscopy of Surface States on a Three-Dimensional Topological Insulator, Helena C. Weigand[1], Fabian Mooshammer[1], Fabian Sandner[1], Markus A. Huber[1], Martin Zizlsperger[1], Markus Plankl[1], Christian Weyrich[2], Martin Lanius[2], Jörn Kampmeier[2], Gregor Mussler[2], Detlev Grützmacher[2], Jessica L. Boland[1], Tyler L. Cocker[3], Rupert Huber[1]; *[1]Universität Regensburg, Germany; [2]Forschungszentrum Juelich, Germany; [3]Michigan State Univ., USA*. We retrieve the local dielectric function of a few-nm-thick surface layer on a three-dimensional topological insulator by mid-infrared nano-tomography and find the coexistence of a massive electron gas and the topologically protected surface states.

JW3A.122
Frequency-multiplexed Photonic Reservoir Computing, Lorenz Butschek[1], Akram Akrout[1], Evangelia Dimitriadou[1], Marc Haelterman[1], Serge Massar[1]; *[1]Université libre de Bruxelles, Belgium*. We present a coherent wavelength division multiplexed reservoir computer based on intracavity phase modulation. We report preliminary results on a signal classification task using a small number (7) of frequency sidebands.

JW3A.123
Substrate Effect on Sensing Characteristics of Gold Thin Films and Gratings, Indrajeet Kumar[1], Ranjeet Dwivedi[1], Saurabh M. Tripathi[1]; *[1]IIT Kanpur, India*. The refractive index sensitivity of gold thin film as well as the grating structure was studied numerically and found to be increasing for a decrease in substrate refractive index from 1.7231 to 1.4570.

JW3A.124
Silicon Photodetectors Integrated with GSST Phase Change Material for Switchable Color Filter Pixels, Roseanna Lawandi[1], Remona Heenkenda[1], Andrew Sarangan[1]; *[1]Univ. of Dayton, USA*. We report the use of an optical phase change material, $Ge_2Sb_2Se_4Te_1$, in a color filter integrated on a photodetector for low-loss and fast-switching applications. Filter design and simulations along with the photodetector fabrication are presented.

JW3A.125
A cascaded interface to connect quantum memory, quantum computing and quantum transmission frequencies, Oliver Slattery[1], Lijun Ma[1], Xiao Tang[1]; *[1]National Inst. of Standards & Technology, USA*. We implement a cascaded interface connecting three essential frequencies for quantum communications including 1540-nm for long-distance transmission, 895-nm for Cesium quantum memory and 369-nm for Ytterbium ion quantum computing applications.

12:45–13:30 Lunch, *Science & Industry Showcase Coffee Area*

JW4A.1 *E-Poster*
Non-diffracting Broadband Incoherent Space-Time Fields Produced from LED, Murat Yessenov[1], Basanta Bhaduri[1], Hasan E. Kondakci[1], Monjurul Meem[2], Rajesh Menon[2], Ayman Abouraddy[1]; [1]*Univ. of Central Florida, CREOL, USA;* [2]*Department of Electrical & Computer Engineering, Univ. of Utah, USA.* We demonstrate the synthesis of diffraction-free incoherent space-time light sheets by virtue of judicious spatio-temporal correlation introduced between the spatial and temporal degrees-of-freedom while lacking spatial and temporal coherence.

JW4A.2 *E-Poster*
Confocal and Multiply Scattered Light Images of Biomarkers in Age-Related Macular Degeneration and Inherited Retinal Degeneration: Wavelength Effects, Ann E. Elsner[1,2], Joel A. Papay[1,2], Robert N. Gilbert[1], Bryan P. Haggerty[1], Thomas J. Gast[1,2], Matthew S. Muller[2]; [1]*Indiana Univ., USA;* [2]*Aeon Imaging, LLC, USA.* Optical signatures of pathological retinal changes such as drusen and focal hyperpigmentation provide well-defined targets. Detection success depends upon imaging mode and wavelength, which vary with aging of ocular media and pigmentation.

JW4A.3 *E-Poster*
Adaptive pre-shaping for ultrashort pulse propagation in aluminum-doped zinc oxide multilayered metamaterial, Priscilla Kelly[1], Lyuba Kuznetsova[1]; [1]*San Diego State Univ., USA.* FDTD numerical simulations show that the use of an adaptive pre-shaping can yield increased electric field strength and improved pulse temporal profile for 100 fs pulse propagated through AZO/ZnO metamaterial at the epsilon-near-zero spectral point.

JW4A.4 *E-Poster*
A Mathematical Method for Designing Superresolution Lenses Using Superoscillations, Matt Smith[1], Gregory J. Gbur[1]; [1]*Univ. of North Carolina at Charlott, USA.* We demonstrate a mathematical method of designing a superresolution lens using a superoscillation technique. Our method is conceptually and mathematically simpler than other methods, allowing for ease of design.

JW4A.5 *E-Poster*
Impact of the Glass Thickness in Fluid-Filled Negative Curvature Fibers for Temperature Sensing, Chengli Wei[1], Joshua Young[2], Curtis Menyuk[3], Jonathan Hu[2]; [1]*Univ. of Mary Hardin-Baylor, USA;* [2]*Department of Electrical and Computer Engineering, Baylor Univ., USA;* [3]*Department of Computer Science and Electrical Engineering, Univ. of Maryland, Baltimore County, USA.* We study fluid-filled negative curvature fibers with relatively larger air holes as temperature sensors. Negative curvature fibers with thicker glass tubes have a higher sensitivity.

JW4A.6 *RAPID*
Fabrication and Characterization of High Temperature Polycrystalline Diamond Pressure Sensor, Hyungdae Bae[1], Bibek Ramdam[1], Gary L. Harris[2], Aaron Jackson[2]; [1]*Department of Mechanical Engineering, Howard Univ., USA;* [2]*Department of Electrical and Computer Engineering, Howard Univ., USA.* Diamond has a very high melting point, elastic modulus, and thermal conductivity. In this work, a diamond based fiber optic sensor is proposed which is fabricated by a polycrystalline diamond diaphragm and silicon housing structure.

JW4A.7
Cryogenic (4 K) Performance Projections for Ultra-Small Cavity Oxide-Free VCSELs, Mina Bayat[1], Dennis Deppe[1,2]; [1]*CREOL, Univ. of Central Florida, USA;* [2]*sdPhotonics, USA.* Very-low-power and high-reliability data transfer at cryogenic is possible via small-sized VCSELs. We make projections for 4K operation of oxide-free VCSELs sizes of 2-6μm, where we previously had shown experimentally its efficient operation at 300K.

JW4A.8
Withdrawn

JW4A.9 *RAPID*
Resolution Enhancement for Optical Imaging Interferometric Microscopy, Preyom K. Dey[1], Alexander Neumann[1], Steven R. Brueck[1]; [1]*Univ. of New Mexico, USA.* The resolution of optical microscopy can be extended by synthetic aperture techniques using extreme off-axis illumination. Illuminating the object through a sapphire substrate extends the resolution to <100 nm at a 405 nm wavelength.

JW4A.10
Dual Cavity Refractivity measurements using a single Laser, Kevin O. Douglass[1], Jacob E. Ricker[1], Stephen P. Eckel[1], Jay H. Hendricks[1]; [1]*National Inst. of Standards & Technology, USA.* We present a method for measuring refractivity-based pressure changes using a dual Fabry-Perot cavity utilizing a single laser with off-set sideband locking to the second cavity. Preliminary data illustrate the utility of the technique.

JW4A.11 *RAPID*
Fabrication of Structured GLS-Se Glass Preforms by Extrusion for Fibre Drawing, Fernando Guzman[1], Andrea Ravagli[1], Christopher Craig[1], Bruno Moog[1], Daniel Hewak[1]; [1]*Optoelectronics Research Centre, UK.* Chalcogenide glasses due to their low phonon energy and high ion solubility, make them an ideal candidate for active and passive fibres for infrared applications. Co-extrusion process for structured preform fabrication is explored.

JW4A.12
Reflection Technique for Determination of Nonlinear-refractive Index of Thin-film Semiconductors Using an Electrically Focus-tunable Lens, Julian D. Henao Escobar[1], Edgar Rueda[1], Juan H. Serna[2], Hernando Garcia[3]; [1]*Universidad de Antioquia, Colombia;* [2]*Universidad Pontificia Bolivariana, Colombia;* [3]*Southern Illionois Univ., USA.* We propose a modification of the F-scan technique, named reflection F-scan, that can be used to measure the nonlinear-refractive index of thin-film and opaque semiconductors, and transparent materials with a measurable-reflectivity signal.

JW4A.13
Graphene/Al_2O_3/Graphene Heterojunction for Light Emitting Tunneling Diode, Haoyan Kang[1], Rishi Maiti[1], Rohit Hemnani[1], Mario Miscuglio[1], Volker Sorger[1]; [1]*George Washington Univ., USA.* Here we demonstrate a graphene/Al_2O_3/graphene heterojunction device towards light emitting tunnel diode. The negative differential resistance has been observed confirming the tunneling effect.

JW4A.14
Polarization-Sensitive Materials Reactions on Polarized Light, Barbara N. Kilosanidze[1], George Kakauridze[1], Irine Kobulashvili[1]; [1]*Georgian Tech. Univ., Inst. of Cybernetics, Georgia.* Method for determining scalar and vector reactions of polarization-sensitive materials is presented based on the polarization hologram recording on these materials and on the probing beam polarization analysis by the polarization-holographic element

JW4A.15 *RAPID*
Progress On Static Structures For Leaky Mode Waveguides, Manusha Korimi[1]; [1]*Electrical And Computer Engineering, Brigham Young Univ., USA.* This work progresses towards increased field of view from multi-order leaky mode devices. Specifically we move from our previously published simulation toward physical instantiation including a glass-based test rig. OCIS codes: 090.2870,090.2890.

JW4A.16
Estimation of 30kW Laser Power Measurement Uncertainty by Least Square Linear Fitting Method, Wang Cheng[1,3], Yunfeng Ma[1,2], Aiping Wu[1,3], Nan Jiang[1,3], Lifeng Liao[1,3], Peng Zhao[1,3], Zhongwei Fan[1,2]; [1]*Academy of Opto-electronics, Chinese Academy of Sciences, China;* [2]*Univ. of Chinese Academy of Sciences, China;* [3]*China National Laser Device Quality Supervision and Inspection Center, China.* We present a high-precision method to accurately estimate the uncertainty for 30kW power measurement.The result of total output power is at 30.99kW, and relative expanded uncertainty is 8% (k=2).

JW4A.17
Withdrawn

JW4A.18
Authentication of paintings by the method of speckle interferometry, Dmitry A. Poletaev[1], Bohdan V. Sokolenko[1], Andrei V. Prisyazhniuk[1]; [1]*V.I. Vernadsky Crimean Federal Univ., Russian Federation.* In this paper a method of speckle interferometry for authentication of paintings was proposed. A scheme for the experiment is proposed and analyzed.

JW4A.19
Advanced ultraviolet nanoimprint lithography using gas-permeable templates for reduction of pattern failure, Naoto Sugino[1], Kaori Yasuda[2], Satoshi Takei[2]; [1]*Sankogosei Ltd., Japan;* [2]*Toyama Prefectural Univ., Japan.* Progress to advanced ultraviolet (UV) nanoimprint lithography using gas permeable templates was reported for reduction of pattern failure, air-trapping issue, and template damage by gases such as nitrogen generated from UV cross-linked materials.

JW4A.20
Advanced photolithography of water soluble resist material using water-coating and water-developable processes on functional plastic film, Satoshi Takei[1], Kaori Yasuda[1], Naoto Sugino[1]; [1]*Toyama Prefectural Univ. , Japan. Surface photolithography on functional plastic film is expected for antimicrobial materials, heat sink, and electronic packaging. Advanced photolithography using water soluble resist materials was demonstrated on functional plastic film.*

JW4A.21
5×5 Phase Coupled Surface Emitting Laser Array with Mental Grid Electrodes, Meng Xun[1], Chen Xu[2], Guanzhong Pan[1], Yun Sun[1], Jingtao Zhou[1]; [1]*Inst. of Microelectronics, CAS, China;* [2]*Beijing Univ. of Technology, China.* Large 5×5 in-phase VCSEL arrays were successfully achieved via applying mental grid and optimized implant energy. The measured divergence is 1.87°. This approach provides a potential to fabricate larger in-phase coupled VCSEL arrays.

JW4A.22
Optical Angular Momentum Transfer to Sub-Wavelength Quantum Systems, Andrei Afanasev[1]; [1]*George Washington Univ., USA.* We use photoexcitation of a single atom by twisted light to demonstrate that optical angular momentum transfer to an atom CM motion depends on its location with respect to the optical vortex center and multipolarity of the quantum transition.

JW4A.23
Propagation of a left-circularly polarized electromagnetic wave through a chiral slab resonator based on Fresnel coefficients, Rajab Y. Ataai[1], Monish R. Chatterjee[1]; [1]*Univ. of Dayton, USA.* Propagation of a left-circularly polarized (LCP) electromagnetic wave through a chiral slab is examined for its effective amplitude and power transmission coefficients, examining any resulting resonance behavior relative to propagation frequency.

JW4A.24
Towards high-power mid-IR frequency combs via 2-µm-pumped difference frequency generation, Qian Cao[1,2], Franz X. Kaertner[1,2], Guoqing Chang[3]; [1]*DESY, Germany;* [2]*Physics, Univ. of Hamburg, Germany;* [3]*Inst. of Physics, Chinese Academy of Sciences, China*. We numerically demonstrate that 2-µm-pumped DFG in a GaSe is able to generate mid-IR pulses with sub-Watt level average power thanks to a reduced group-velocity mismatch compared with conventional 1-µm-pumped DFG.

JW4A.25
Single-shot Intensity-Corrected Phase Tagging for Weak Carrier-Envelope-Phase Effects, Soo Hoon Chew[1,2], Alexander Gliserin[1], Jürgen Schmidt[2], Ulf Kleineberg[2]; [1]*College of Nanoscience and Engineering, Pusan National Univ., South Korea;* [2]*Faculty of Physics, Ludwig Maximilian Univ. of Munich, Germany.* We demonstrate intensity tagging as a new approach to improve the detection sensitivity of carrier-envelope-phase tagging technique. A weak carrier-envelope-phase effect of ~1% modulation depth from a tungsten surface is thus successfully retrieved.

JW4A.26 *RAPID*
A Wannier Perspective On High Harmonic Generation In Solids, Guilmot Ernotte[1], Marco Taucer[2], Paul B. Corkum[1,2]; [1]*Univ. of Ottawa, Canada;* [2]*National Research Council of Canada, Canada*. We theoretically investigate high-harmonic generation in a 1D crystal in the natural real-space basis for periodic systems, the Wannier states. A full quantum simulation confirms our semi-classical model and its interpretation.

JW4A.27
Comparison of Ultrafast Nonlinear Refraction and Absorption Measurements of Single-layer and Multi-layer Graphene., Manuel R. Ferdinandus[1], Trenton R. Ensley[2], Daniel S. Choi[2], Rahul Gupta[2], Carl Liebig[1], Shashi P. Karna[2]; [1]*U.S. Air Force Research Laboratory, USA;* [2]*CCDC U.S. Army Research Laboratory, USA*. We compare effective and temporal dynamics of nonlinear refraction and absorption of single-layer and multi-layer graphene. Non-instantaneous components are observed to dominate the nonlinear refraction of which decreases with additional layers.

JW4A.28
Examining Vibration-Cavity Polariton Dynamics via Ultrafast Infrared Spectroscopy, Andrea B. Grafton[1,2], Adam D. Dunkelberger[1], Kenan P. Fears[1], Blake S. Simpkins[1], Jeffrey C. Owrutsky[1]; [1]*U.S. Naval Research Laboratory, USA;* [2]*National Research Council, National Academy of Science, USA*. Time resolved IR pump-probe and 2D IR spectroscopy were used to measure the vibrational dynamics of strong chromophores in optical cavities. The observed spectral features are characterized in terms of polartion modes and reservoirs.

JW4A.29
Optimization and Pulse Control of Diode-pumped Cesium Vapor Laser by Pump Laser Frequency Modulation, Seongjin Hong[1], Byungjoo Kong[1], Yong Soo Lee[1], Sanggwon Song[1], Seokjin Kim[1], Minkyu Lee[1], Kyunghwan Oh[1]; [1]*Yonsei Univ., South Korea*. We experimentally demonstrated an optimized diode-pumped cesium laser using frequency locking of a pump laser and quasi-continuous-wave pulse modulation to control both the pulse width and the repetition rate using fast mode-hopping in pump laser.

JW4A.30
Scalable Terahertz Generation from a Large-Aperture Lithium Niobate Wafer at 80 TW Laser Power, Dogeun Jang[1], Chul Kang[2], Seong Ku Lee[2], Jae Hee Sung[2], Ki-Yong Kim[1]; [1]*Univ. of Maryland at College Park, USA;* [2]*GIST, South Korea*. We demonstrate energy scalable terahertz generation from large-surface lithium niobate wafers at Ti:sapphire laser power up to 80 TW. This scheme provides 0.19 mJ of terahertz energy with conversion efficiency of ~10^{-4}.

JW4A.31
Spinning Radiation from Topological Insulator, Emroz Khan[1], Evgenii Narimanov[1]; [1]*Purdue Univ., USA*. We show thermal radiation from topological insulator carries a nonzero average spin angular momentum.

JW4A.32
Measuring the Effect of Air Turbulence on FIlament Collapse Location with a Microphone Array, Ilia Larkin[1], Jesse Griff-McMahon[1], Aaron Schweinsberg[2], Anthony Valenzuela[2], Andrew Goffin[1], Howard Milchberg[1]; [1]*Univ. of Maryland, USA;* [2]*CCDC Army Research Lab, USA*. Air turbulence leads to increased spread of filament collapse locations; this is measured by means of a synchronized array of microphones which capture the full energy deposition profile in a single shot.

JW4A.33
Withdrawn

JW4A.34
Multi-millijoule Ho:YLF based amplifier for pumping mid-infrared OPCPA at 1 kHz, Krishna Murari[1,2], Yanchun Yin[1,2], Yi Wu[1,2], Zenghu Chang[1,2]; [1]*CREOL, USA;* [2]*Univ. of Central Florida, USA*. Here we present Ho:YLF based multi-pass amplifier operating at 1 kHz repetition rate and seeded by 3-mJ pulses from DC-OPA emitting pulses at 10 mJ energy and compressed duration of 5.6 ps. The pulses are stretched and compressed in same CVBG.

JW4A.35
Simplified Single-shot Supercontinuum Spectral Interferometry (SSSSI), Dhruvit P. Patel[1], Dogeun Jang[1], Ki-Yong Kim[1]; [1]*Univ. of Maryland at College Park, USA*. We show the validity of an algorithm that pre-characterizes the chirp of a probe pulse in single-shot supercontinuum spectral interferometry, in as few as 2 measurements, via simulation and experiment.

JW4A.36
The influence of reverse saturable absorption of SWCNTs on mode locking in a fiber-ring resonator, Ishida Rammaru[1], Tomoki Suzuki[1], Shun Fujii[1], Takasumi Tanabe[1]; [1]*Keio Univ., Japan*. We made a CNT-PDMS composite and measured reverse saturable absorption (RSA) with a lifetime of 76 µs. We achieved mode-locking even in the presence of RSA thanks to the fast response of the SA property.

JW4A.37
Terahertz Generation by Optical Rectification in Chalcopyrite Crystals $ZnGeP_2$, $CdGeP_2$ and $CdSiP_2$, Rishmali Sooriyagoda[1], Herath P. Piyathilaka[1], Vikum Dewasurendra[1], Matthew Johnson[1], Kevin Zawilski[2], Peter Schunemann[2], Alan D. Bristow[1]; [1]*Department of Physics and Astronomy, West Virginia Univ., USA;* [2]*BAE Systems, USA*. Optical rectification of near-infrared laser pulses generates broadband terahertz radiation in chalcopyrite crystals $CdGeP_2$, $ZnGeP_2$ and $CdSiP_2$. In this work emission of THz was compared with respect to excitation photon energy and the pump intensity.

JW4A.38 *RAPID*
Optical Elements Based In Dynamical Systems, Adriana P. Tufaile[1], Janaina D. Silva[1], Alberto Tufaile[1]; [1]*Soft Matter Lab., EACH,, Universidade de São Paulo, Brazil*. We developed some optical elements to observe some peculiar laser patterns. We obtained the Spiralbow and the involute of a circle. We designed a Hyperbolic Prism and obtained the pattern know as the Parlaseric Circle.

JW4A.39
Attosecond X-ray Phase Retrieval by Deep Neural Network, Jonathon White[1], Zenghu Chang[1]; [1]*Univ. of Central Florida, USA*. It is demonstrated that a deep neural network is able to retrieve phases of broadband attosecond pulses from experimentally measured streaking traces containing high statistic noise. The retrieval speed is much faster than iterative schemes.

JW4A.40
Demonstration of An All-fiber Dual-wavelength Mode Locked Laser Based on Lyot Filtering Effect, Luo Xing[1], Hoang Tuan Tong[1], Than Saini[1], Hoa Nguyen[1], Takenobu Suzuki[1], Yasutake Ohishi[1]; [1]*Toyota Technological Inst., Japan*. We report an all-fiber dual-wavelength mode locked laser based on Lyot filtering effect. Proper laser adjustment provides the stable dual-wavelength asynchronized pulse trains with repetition rate difference of hundreds of Hertz.

JW4A.41
Space-Time Wave Packets That Propagate in Materials at the Speed of Light in Vacuum, Basanta Bhaduri[1], Murat Yessenov[1], Ayman Abouraddy[1]; [1]*Univ. of Central Florida, CREOL, USA*. We experimentally demonstrate specially structured wave packets that traverse non-dispersive optical materials (liquids, glasses, and crystals) at the speed of light in vacuum, independently of the refractive index of the material.

JW4A.42
Generation of ultra-stable period-multiplied pulsing in a figure-of-9 fiber cavity, Jiaqi Zhou[1], Weiwei Pan[1], Yan Feng[1]; [1]*Shanghai Inst. of Optics & Fine Mech., China*. We report on an Yb-doped figure-of-9 fiber laser which can generate period-multiplied pulses with long-term stability. The period multiplication is first time reported in a nonlinear loop mirror based all-polarization-maintaining fiber cavity.

JW4A.43 *RAPID*
Quantum-enhanced Rejection of Environmental Noise with Spectral Entanglement, Alex O. Davis[1,2], Valérian Thiel[2,3], Alistair Smith[2], Brian J. Smith[3,2]; [1]*Laboratoire Kastler-Brossel, France;* [2]*Department of Physics, Oxford Univ., UK;* [3]*Department of Physics and Oregon Center for Optical, Molecular, and Quantum Science, Univ. of Oregon, USA*. We show enhancement in phase estimation precision in a noisy channel using entanglement with an observer-retained ancilla. We perform a proof-of-principle experiment, improving the precision of an optical path measurement with spectral Bell states.

JW4A.44
Characterization of iron doped zinc oxide nanoparticles using fluorescence spectroscopy, Mihiri Fernando[2], Rahul Singhal[3], Peter LeMaire[3], Binlin Wu[1]; [1]*Southern Connecticut State Univ., USA;* [2]*Cheshire High School, USA;* [3]*Central Connecticut State Univ., USA*. ZnO and Fe-doped ZnO nanoparticles were analyzed in ethanol solution and dry powder form using fluorescence spectroscopy. Near-band-edge emission (NBE) and defect emission (DE) peaks were studied. A blue-shift was observed with the NBE emission peak.

JW4A.45
Gas-pressure Tunable Photon-pair Generation in a Suspended Core Fiber, Jonas Hammer[1,2], Maria V. Chekhova[1,2], Philip S. Russell[1,2], Nicolas Y. Joly[2,1]; [1]*Max-Planck Inst., Science of Light, Germany;* [2]*Physics, Friedrich-Alexander Univ., Germany.* Four-wave-mixing in a suspended core fiber is spectrally tuned by filling the fiber with argon. This allows the generation of photon pairs to be tuned over at least 40 nm, extendible using even higher pressures.

JW4A.46
Withdrawn

JW4A.47
Withdrawn

JW4A.48
Monitoring a free-space quantum communication channel using machine learning techniques, Yaseera Ismail[1], Ilya Sinayskiy[1], Francesco Petruccione[1]; *[1]Univ. of KwaZulu-Natal, South Africa.* Free-space quantum communication faces challenges related to losses in the transmission channel. Machine learning is resourceful for monitoring these channels. Here, supervised learning was used to predict the atmospheric strength of the channel.

JW4A.49
Dynamics of Quantum Dot Lasers Subject to Optical Feedback and Current Modulation, Tianyao Huang[1], Yanhua Hong[2], Hong Lin[1]; *[1]Bates College, USA; [2]Bangor Univ., UK.* Interplay of optical feedback and modulation dynamics has been studied experimentally. Complete suppression of feedback dynamics by polarization-rotated feedback is achieved in a certain range of modulation frequency and amplitude.

JW4A.50 ***RAPID***
Characterizing Two-Photon Absorption With g2, Michael Mazurek[1,2], Alex Mikhaylov[2], Kristen Parzuchowski[2], Daniel Lum[3], Lynden K. Shalm[1], Christian Drago[4], John Sipe[4], Sae Woo Nam[1], Marcus Cicerone[3], Charles Camp[3], Ralph Jimenez[2], Thomas Gerrits[1], Martin Stevens[1]; *[1]NIST Boulder, USA; [2]JILA and Univ. of Colorado Boulder, USA; [3]NIST Gaithersburg, USA; [4]Univ. of Toronto, Canada.* Two-photon absorption may be enhanced with squeezed vacuum states of light. We argue that g2 measurements are well suited to characterizing this enhancement.

JW4A.51
Vortex Light Emission from Solid-State Microchip Diode-Pumped Lasers, Alex Okulov[1]; *[1]Russian Academy of Sciences, Russian Federation.* It is shown numerically via FFT split-step method that broad area microchip laser is capable to emit topologically charged structured light under transversal misalignment and a certain inclination of optical pump to cavity axis.

JW4A.52
Generating Photon-Added States Without Adding a Photon, Saurabh U. Shringarpure[1], James D. Franson[1]; *[1]Univ. of Maryland Baltimore County, USA.* A range of nonclassical states can be generated using an optical parametric amplifier post-selected to contain a single photon in both the input and output of the idler mode, with no photons added or subtracted.

JW4A.53 ***RAPID***
Photophysical Characterization of Quantum Emitters in Hexagonal Boron Nitride (h-BN), Yanan Wang[1], Vivian Zhou[1], Jesse Berezovsky[1], Philip Feng[1]; *[1]Case Western Reserve Univ., USA.* Optical emission and Raman characteristics of defect centers in h-BN have been systematically investigated within different dielectric environments. These studies provide new insight into better creation and engineering of h-BN based quantum emitters

JW4A.54
Dissipative Soliton Resonance Interruption and Restoration, Luming Zhao[1,2], Yufei Wang[1], Lei Li[1], Junqing Zhao[1], Lei Su[2], Dingyuan Tang[1], Deyuan Shen[1]; *[1]Jiangsu Normal Univ., China; [2]School of Engineering & Materials Science, Queen Mary Univ. of London, UK.* Dissipative soliton resonance (DSR) interruption and restoration are reported in a fiber laser. Pump increase ceases the characteristically linear pulse broadening of DSR. DSR operation restores after the newly-generated pulse is pushed faraway.

JW4A.55
Tm Gain-switched Fiber Laser Pumped by a Passive Q-switched Fiber Laser Generated Simultaneously, Jared Alaniz Baylon[1], Manuel D. Sanchez[1], Baldemar Ibarra-Escamilla[1], Berenice Posada[1], R. I. Alvarez-Tamayo[3], Miguel Bello-Jimenez[2], Evgeny Kuzin[1]; *[1]Instituto Nacional de Astrofísica Óptica, Mexico; [2]UASLP, Mexico; [3]UANL, Mexico.* We present the Gain-switching laser operation with a Tm-doped fiber generating pulses at 1.86-μm, pumped by a passive Q-switched fiber laser where both lasers are generated simultaneously in the same linear cavity resonator

JW4A.56
New concept of a polymer optical ray splitter simulated by Raytracing with a new Bisection-Algorithm, Carsten Backhaus[1], Florian Dötzer[1], Gerd-Albert Hoffmann[2], Lukas Lorenz[3], Ludger Overmeyer[2], Karlheinz Bock[3], Norbert Lindlein[1]; *[1]Inst. of Optics, Information and Photonics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany; [2]Inst. of Transport and Automation Technology, Gottfried Wilhelm Leibniz Universität Hannover, Germany; [3]Inst. of Electronic Packaging Technology, Technische Universität Dresden, Germany.* Recent fabrication methods print polymer optical waveguides (POWs) on threedimensional carriers. The special geometry of the POWs enables the realisation of an optical ray splitter which is simulated by raytracing using a new bisection-algorithm.

JW4A.57
Perfectly Vertical Grating Coupler for O and C-band, Lirong Cheng[1], Xin Mu[1], Sailong Wu[1], Xin Tu[2], H.Y. Fu[1]; *[1]Tsinghua Univ., China; [2]China Univ. of Geosciences, China.* We design and simulate a perfectly vertical grating coupler for dual-wavelength-band operation on 220 nm SOI platform. Peak coupling efficiency of the proposed coupler can reach 70.8% for C-band and 45.0% for O-band.

JW4A.58
Designing Slow-Light Waveguides, Stavroula Foteinopoulou[1]; *[1]Univ. of New Mexico, USA.* With a paradigm waveguide system analyzed here we assert that the widespread figure of merit for slow-light waveguides, the normalized delay-bandwidth product, is not a good measure in the ultra-slow light regime.

JW4A.59
Fiber Optic Bending Sensor Based on Hollow Core Fiber, Ivan Hernandez-Romano[1], Sigifredo Marrujo-Garcia[1], Miguel Torres-Cisneros[1], Daniel Lopez-Cortes[2], Daniel A. May-Arrioja[2], David Monzon-Hernandez[3]; *[1]Universidad de Guanjuato, Mexico; [2]FiOLAB, CIO, Mexico; [3]GSOM, CIO, Mexico.* An easy to construct curvature sensor is proposed and experimentally demonstrated. The device was fabricated splicing a segment of hollow core fiber (HCF) between two segments of coreless fiber (CLF) forming a Mach-Zehnder interferometer (MZI).

JW4A.60
Mid-infrared broadband coherent supercontinuum spectrum in AsSe2/As2S5 chalcogenide based waveguides, Lucien Mandeng Mandeng[1], Mbaye Diouf[3], Clément Tchawoua[1], Mourad Zghal[2]; *[1]Universite de Yaounde I, Cameroon; [2]Engineering School of Communication of Tunis (Sup'Com), GreS'Com Laboratory, Univ. of Carthage, Tunisia; [3]Department of Physics, Laboratoire Atome-Laser, Univ. of Cheikh Anta Diop, Senegal.* We show that by launching sub-nJ pulses in two AsSe2/As2S5 chalcogenide waveguides as a photonic crystal fiber (PCF) and a rib waveguide (ChRW), the latter is better with a spectrum spanning from 1000 to 20000 nm.

JW4A.61
Holographic Data Storage based Orbital Angular Momentum, Jesús H. Mendoza-Castro[1], Vladimir Jerez[2], Yezid Torres[1], Ernesto Aguilera[3]; *[1]Physics, Universidad Industrial de Santander, Colombia; [2]Bucaramanga, Universidad de Investigacion y Desarrollo, UDI, Colombia; [3]School of Electrical, Electronics and Telecommunications Engineering, Universidad Industrial de Santander, Colombia.* HDS based integer OAM beams with different TC on a Photorefractive Crystal (PhRC) through a Mach Zehnder interferometer is reported. Using a SLM the write beam is controlled. Pentagonal aperture are used to verify the phase state retrieved.

JW4A.62
Wave propagation analysis of Laguerre–Gaussian beam through PRPP, Pramod Panchal[1], Rekshma J[2]; *[1]IIST TRIVANDRUM, India; [2]Optoelectronics, Univ. of Kerala, India.* LG beams are generated using vortex phase plate and analysed the propagation through a PRPP. One of the quantities of physical interest such as the twist parameter is estimated from the variance matrix generated from SHWFS data.

JW4A.63
Study of the experimental conditions to obtain dual-wavelength emission in a mode-locked Er-doped fiber laser with strict polarization control, Ivan A. Rivera[1], Luis A. Rodriguez-Morales[1], Baldemar Ibarra-Escamilla[1], Manuel D. Sanchez[1], Evgeny Kuzin[1]; *[1]INAOE, Mexico.* We report the experimental investigation of a dual-wavelength passive mode-locked fiber laser (PMLFL) with double-twist fiber to cancel both, circular and linear birefringence. To obtain dual-wavelength emission, we vary the losses inside the cavity

JW4A.64 ***RAPID***
Optical ammonia sensors based on Hollow core fiber and photoacoustic spectroscopy., Abubakar Isa Adamu[1], Manoj K. Dasa[1], Kyei Kwarkye[1], Getinet Woyessa[1], Ole Bang[1,2], Christos Markos[1,2]; *[1]Technical Univ. Of Denmark, Denmark; [2]NORBLIS IVS,, Denmark.* We report on the sensing of ammonia using two optical modalities; An all-fiber based hollow-core ammonia gas sensing and a photoacoustic based sensing of ammonia solution.

JW4A.65 ***RAPID***
$MoTe_2$ Based Electro-optic Modulator on Mach-Zehnder Interferometer, Nayeem Ansari[1], Rubab Amin[1], Rishi Maiti[1], Volker J. Sorger[1]; *[1]The George Washington Univ., USA.* Here we have demonstrated $MoTe_2$ based Mach-Zehnder Interferometer (MZI) on Silicon photonics in plasmonic mode by placing 2D heterostructures on top of Si photonic chip by using our 2D printer technique.

JW4A.66
Bloch-Floquet Waves in Optical Ring Resonators, Kathleen McGarvey-Lechable[1], Pablo Bianucci[1]; *[1]Concordia Univ., Canada.* Using Bloch-Floquet theory, we develop a theory of the modal coupling of degenerate resonances in optical ring resonators. This theory allows us to engineer, on a mode-by-mode basis, the splitting in fabricated silicon nitride rings.

JW4A.67
High-NA, Achromatic, Visible-Frequency Metalenses by Inverse Design, Haejun Chung[1], Owen Miller[1]; *[1]Yale Univ., USA.* We demonstrate broadband achromatic metalenses working in the high NA regime via inverse design scheme at visible wavelength. Lithography compatible geometry showed constant focal length up to 0.9 NA while freeform geometry achieved near-unity NA.

JW4A.68 *RAPID*

Design of a Nanolaser for Neuromorphic Computing, Maxime Delmulle[1,2], Sylvain Combrié[1], Fabrice Raineri[2,3], Alfredo De Rossi[1]; [1]*Thales Research & Technology, France;* [2]*Centre de Nanoscience et Nanotechnologies, France;* [3]*Université Paris Diderot, Sorbonne Paris Cité, France.* We introduce a model describing a photonic crystal III-V/Silicon nanolaser composed of two sections. We predict an excitable dynamics mimiking a neuromorphic response. This technology is scalable and amenable to massive integration

JW4A.69

Accumulation and directionality of large spontaneous emission enabled by epsilon-near-zero film, Xueke Duan[1], Fan Zhang[1], Zhiyuan Qian[1], He Hao[1], Lingxiao Shan[1], Qihuang Gong[1], Ying Gu[1]; [1]*Peking Univ., China.* We demonstrate spectral accumulation of large spontaneous emission for nanocavities with different sizes in coupled Ag nanorod-epsilon near zero film system. Due to infinite impedance of the film, the far field radiation is almost directional.

JW4A.70 *RAPID*

Miniaturized folded metasurface hyperspectral imager, MohammadSadegh Faraji-Dana[1], Ehsan Arbabi[1], Hyounghan Kwon[1], Seyedeh Mahsa Kamali[1], Amir Arbabi[2], Andrei Faraon[1]; [1]*California Inst. of Technology, USA;* [2]*Univ. of Massachusetts Amherst, USA.* We demonstrate a miniaturized hyperspectral imager using the folded metasurface platform. Weighing 20mg in an 8.5-mm^3 volume, the hyperspectral imager resolves ~70 spectral and ~400 angular points in 750–850nm range with a 30-degree field-of-view.

JW4A.71

Metamaterial Longwave Infrared Tunable Notch Filters, Neelam Gupta[1], Gerard Dang[1], Mark S. Mirotznik[2]; [1]*US Army Research Laboratory, USA;* [2]*Department of Electrical and Computer Engineering, Univ. of Delaware, USA.* We present metamaterial tunable notch filters operating from 8 to 12 µm based on the guided-mode resonance phenomenon using high-refractive index dielectric materials and their characterization using a customized infrared spectrometer.

JW4A.72

Floquet Chern Insulators of Light, Li He[1], Zachariah Addison[1], Jicheng Jin[2], Eugene Mele[1], Steven Johnson[3], Bo Zhen[1]; [1]*Univ. of Pennsylvania, USA;* [2]*Peking Univ., China;* [3]*Massachusetts Inst. of Technology, USA.* We achieve Floquet Chern insulators of light in dynamically driven nonlinear photonic crystals. Through numerical simulation, we show topological phase transitions and the existence of topologically-protected chiral edge states.

JW4A.73

Effects of Angled Side Walls on Mode Hybridization in X-cut and Z-cut LNOI Multimode Waveguides, Archana Kaushalram[1], Srinivas Talabattula[1]; [1]*Indian Inst. of Science, India.* Mode hybridization in multimode waveguides is useful for polarization rotations and mode conversions. The effects of angled side walls on mode hybridization widths are numerically investigated in Z-cut and X-cut multimode LNOI waveguides.

JW4A.74

Transmission-Type Color Filters with Silicon Mie Resonators using Guided-Mode-Resonance, Young Jin Kim[1], Jongwoo Hong[1], Jangwoon Sung[1], Byoungho Lee[1]; [1]*Seoul National Univ., South Korea.* Transmission-type color filters based on Si with short period are desired in practical applications. However, high extinction coefficient obstructs printing high frequency region colors. Using guided-mode-resonance enables to generate various colors.

JW4A.75

Narrow bandpass optical filter realized by subwavelength grating waveguide coupled with microsphere, Haitao Liu[1], Meng Zhang[1], Jiansheng Liu[1], Hongwen Zhou[1], Xinxuan Ma[1], Yu Zhang[1], Yuhang Wan[1]; [1]*Beihang Univ., China.* Coupling between an excitation waveguide and a microsphere consisting of diverse materials with a large index difference is realized by using a coupling section with backward scattering grating. Narrow bandpass transmissive filters could be realized.

JW4A.76

Nanoscale Confinement of Vibrational Energy States, Henry Meyer[1], Richard Brun[1], Allison L. Zhang[2], Robert R. Alfano[1]; [1]*City College of New York, USA;* [2]*Physics, IUSL High School Internship at CCNY, USA.* Polar and nonpolar molecules are confined into 2.5, 5, 10, and 20nm glass pores. Raman signals are then collected to show the effects of nano confinement on vibrational resonate energy and linewidth.

JW4A.77

Tunable perfect absorption in a subwavelength metallic grating-coupled graphene plasmonic meta-surface, Seyededriss Mirniaharikandi[1]; [1]*Florida Inst. of Technology, USA.* Electronically tunable perfect absorption in subwavelength-metallic-grating-coupled graphene plasmonic is proposed for the near-infrared to visible range. Perfect absorption is reported in graphene plasmonics with the absorption of 99.5% at 410 THz.

JW4A.78

Detecting polarization states via plasmonic polarizers consisting of distributed nanoslit pair, Seong-Won Moon[1], Seung-Yeol Lee[1]; [1]*Kyungpook National Univ., South Korea.* We proposed an ultracompact plasmonic polarimeter with plasmonic lens formed by distributed nanoslits. The polarizers detecting four linear and two circular polarization states was designed by tuning orientation of nanoslit pairs.

JW4A.79

Silicon Nitride Photonic Platform for 2D Materials Integration, Chandraman Patil[1], Rishi Maiti[1], Volker J. Sorger[1]; [1]*George Washington Univ., USA.* Here, we demonstrate the fabrication of Silicon Nitride photonic platform for visible wavelength (~640 nm). The optimized passive SiN platform could be interesting for integrated 2D materials based photonic devices exploiting sharp exciton resonance.

JW4A.80 *RAPID*

Compact grating coupler using asymmetric waveguide scatterers, Ashutosh Patri[1], Xiao Jia[1], Muhammad Mohsin[1], Stephane Kena-Cohen[1], Christophe caloz[1]; [1]*Polytechnique Montreal, Canada.* We demonstrate a novel grating coupler design based on double asymmetric and vertically oriented waveguide scatterers to efficiently couple normally incident light to a fundamental mode silicon waveguide laying on a buried oxide layer.

JW4A.81

Withdrawn

JW4A.82 *RAPID*

Hybrid Plasmonic High Q-factor Resonances in a Periodic Metasurface, Md Saad-Bin-Alam[1], Orad Reshef[4], Mikko J. Huttunen[2], Graham Carlow[3], Brian Sullivan[3], Jean-Michel Ménard[4], Robert W. Boyd[4,1], Ksenia Dolgaleva[1,4]; [1]*School of Electrical Engineering and Computer Science, Univ. of Ottawa, Canada;* [2]*Tampere Univ., Finland;* [3]*Iridian Spectral Technologies Inc., Canada;* [4]*Department of Physics, Univ. of Ottawa, Canada.* By tuning the thickness of a micrometer-thin cladding-layer on top of a plasmonic metasurface, we experimentally split a broad localized surface plasmon resonance into a series of narrower high Q-factor resonances.

JW4A.83

Broadband Omni-Resonance Doubles the Near-Infrared Quantum-Efficiency of a Thin Film Solar Cell, Abbas Shiri[1], Massimo Villinger[1], Soroush Shabahang[1,2], ali Kazemi Jahromi[1], Christopher Villinger[1], Ayman Abouraddy[1]; [1]*CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA;* [2]*The Wellman Center for Photomedicine at Massachusetts General Hospital,, Harvard Medical School, USA.* By realizing coherent perfect absorption in a broadband omni-resonant cavity, the coherently enhanced absorption results in doubling the near-infrared external quantum efficiency of a thin-film amorphous silicon solar cell integrated into the cavity.

JW4A.84

One-to-Three Silicon Photonic Grid Power Splitter for Optical Mesh Solver, Shuai Sun[1], Mario Miscuglio[1], Ruoyu Zhang[1], Zhizhen Ma[1], Engin Kayraklioglu[1], Tarek El-Ghazawi[1], Volker J. Sorger[1]; [1]*George Washington Univ., USA.* Here we show a novel Silicon Photonic 1-to-3 power splitter design for grid topology, which can be applied to optical mesh network and emulate real-world problems such as Laplace's equations and Poisson equations.

JW4A.85 *RAPID*

Adiabatic quantum state preparation in photonic tight-binding lattices, Konrad Tschernig[2], Armando Pérez-Leija[2], Kurt Busch[1,2]; [1]*Humboldt-Universität zu Berlin, Germany;* [2]*Theory, Max-Born-Institut, Germany.* In this work we apply the principles of adiabatic quantum computation in order to design an analog quantum eigenstate solver for bosonic particles in tight-binding lattices in the realm of integrated linear optics.

JW4A.86

Towards Exciton-near Plasmon Slot-waveguide MoTe-2Photodetector on SOI, Hao Wang[1], Zhizhen Ma[1], Rishi Maiti[1], Mario Miscuglio[1], Volker J. Sorger[1]; [1]*GWU , USA.* We demonstrate a silicon integrated plasmonic photodetector based on few-layered MoTe2 operate in near-infrared region. The field enhanced via an ultra-narrow metallic slot. The guided mode within the slot results in strong light-Mote2 interaction.

JW4A.87

Broadband $\chi^{(2)}$ and $\chi^{(3)}$ nonlinear frequency up-conversion from planar silicon nitride microcavities, Jinghui Yang[1], Shu-Wei Huang[2], Zhenda Xie[3], Mingbin Yu[4,5], Dim-Lee Kwong[5], Chee Wei Wong[1]; [1]*Univ. of California Los Angeles, USA;* [2]*Electrical, Computer & Energy Engineering, Univ. of Colorado, Boulder, USA;* [3]*School of Electronic Science and Engineering, Nanjing Univ., China;* [4]*Shanghai Inst. of Microsystem and Information Technology, China;* [5]*Inst. of Microelectronics, Agency for Science, Technology and Research (A*STAR), Singapore.* We study $\chi^{(2)}$ and $\chi^{(3)}$ frequency up-conversion in Si_3N_4 microrings pumped by telecom laser, resulting broadband converted frequency from 437-nm to 816-nm assisted by clustered microcombs, with $\chi^{(2)}$ effect from nitride-oxide surface symmetry-breaking.

JW4A.88

Withdrawn

JW4A.89
Partial Wave Spectroscopy Detection of Cancer Stages using Tissue Microarrays (TMA) Samples, Prakash Adhikari[1], Fatemah Alharthi[1], Prabhakar Pradhan[1]; [1]*Department of Physics and Astronomy, Mississippi State Univ., USA*. Mesoscopic physics based partial wave spectroscopy (PWS) can probe the structural alterations at the nanoscale level in cancerous cells/tissues. Here we show improved PWS technique to detect cancer stages using TMA samples.

JW4A.90 *RAPID*
Utility of Raman Spectroscopy in obesity detection with bands associated with fructose and branched chain amino acids as biomarkers, Zephania Birech[1], Peter W. Mwangi[2]; [1]*Department of Physics, Univ. of Nairobi, Kenya;* [2]*Department of medical Physiology, Univ. of Nairobi, Kenya*. We report potential utility of Raman spectroscopy in obesity screening with bands associated with fructose (638, 812 and 1217 cm^{-1}) and branched chain amino acids (478, 1033 and 1318 cm^{-1}) as biomarkers.

JW4A.91 *RAPID*
Direct three-dimensional mapping of refractive index via dual geometry Brillouin microscopy, Antonio Fiore[1], Carlo Bevilacqua[2,3], Giuliano Scarcelli[1]; [1]*Univ. of Maryland, USA;* [2]*Dipartimento Interateneo di Fisica, Università degli Studi di Bari, Italy;* [3]*European Molecular Biology Laboratory, Germany*. We present an imaging technique that directly maps the refractive index of a sample. To achieve this result, we designed a dual geometry Brillouin microscope that samples the same phonon axis within a confocal voxel.

JW4A.92
Motion-Based Coherent Optical Sensing and Imaging in a Heavily Scattering Medium, Ryan L. Hastings[1], Qiaoen Luo[1], Kevin J. Webb[1]; [1]*Purdue Univ., USA*. We demonstrate that speckle intensity correlations over object position allow high-resolution coherent imaging and sensing with heavily scattered light. Natural motion can be exploited and applications include *in vivo* imaging and material inspection.

JW4A.93
TiO_2-polymer hybrid photonic crystal cavity for optical humidity sensing, In Soo Kim[1], Gumin Kang[1]; [1]*Nanophotonics Research Center, Korea Inst. of Science & Technology, South Korea*. We report a TiO_2-polymer photonic crystal cavity for optical humidity sensing applications. The hybrid photonic crystal cavity was fabricated using laser interference lithography which is suitable for large area, sub-um scale manufacturing.

JW4A.94
Color temperature line: forward and inverse transformation, Volodymyr Pyliavskyi[1]; [1]*ONAT n.a. O.S.Popov, Ukraine*. The paper proposes an analytical expression that binds the color temperature dependence and its location in the system Yxy.

JW4A.95
Assessing Mitochondria by Laser Induced Autofluorescence and Photoacoustic Measurements: A Preliminary *In Vitro* Study, Raghushaker CR[1], Subhash Chandra[1], Kapaettu Satyamoorthy[1], Krishna K. Mahato[1]; [1]*Manipal Academy of Higher Education, India*. In this preliminary study, fluorescence and photoacoustic signals recorded from mitochondrial fractions of HepG2 and SiHa cells by using LIF and PAS spectroscopy. The outcomes revealed higher LIF and PAS signal strengths of HepG2 than SiHa.

JW4A.96
Study on the memory effect in focusing light through scattering media, Longjie Fang[1], Wenxue Li[1]; [1]*Sichuan Univ., China*. There exists a correlation among the optimized phase distributions of adjacent focal points in focusing through scattering media. The simulation indicates that the phase difference between the two adjacent focal points shows a fringe pattern.

JW4A.97
Photothermal Imaging of Cellular Medium, Joseph G. Thomas[1], Shichao Chen[1], Yizheng Zhu[1]; [1]*Virginia Tech, USA*. The photothermal effect can generate optical absorption contrast of different biochemical species. By detecting a photothermally induced refractive index change, spectral modulation interferometry generates absorbance contrast microscope images.

JW4A.98
Multi-photon Imaging with Rare-earth Doped Nanocrystals Beyond the Diffraction Limit, Qiming Zhang[1], Liangliang Liang[2], Simone Lamon[3], Xiaogang Liu[2], Min Gu[1,3]; [1]*Univ. of Shanghai for Science and Technology, China;* [2]*National Univ. of Singapore, Singapore;* [3]*RMIT Univ., Australia*. Multi-photon imaging beyond the diffraction limit has been demonstrated with rare-earth doped nanocrystals. A resolution of 100 nm has been predicted with the excitation and depletion beam at a wavelength of 980 nm.

JW4A.99 *RAPID*
Two Defocus Quantitative Phase Imaging Methods: Comparison and Improvements, Yijun Bao[1], Thomas Gaylord[1]; [1]*Georgia Inst. of Technology, USA*. Two defocus-based quantitative phase imaging (QPI) methods are compared, then solutions to overcome all the disadvantages are provided. After the improvements, the original worse one becomes the better one due to its better noise robustness.

JW4A.100
Double-frequency TPU method with geometric constraints and polynomial adjust, Andrés L. González[1], Jaime E. Meneses[1]; [1]*Universidad Industrial de Santander, Colombia*. Inspired in the Hyun and Zhang's work, in this paper a double-frequency TPU algorithm is proposed. This does not require the calibration of the projector and instead a polynomial adjust is used.

JW4A.101
Highly-parallel Optical Fourier Intensity Convolution Filter For Image Classification, Zibo Hu[1], Mario Miscuglio[1], Jonathan George[1], Volker J. Sorger[1]; [1]*George Washington Univ., USA*. Convolution Neural Networks (CNN) extracts features from large dataset by spatial filtering. We experimentally demonstrate convolutional filtering using Fourier optics. We show amplitude-based convolutions performing one layer of an artificial CNN.

JW4A.102
Compensating high-order optical aberrations induced by abnormal shape of cornea in holographic displays, Dongyeon Kim[1], Kiseung Bang[1], Youngmo Jeong[1], Byoungho Lee[1]; [1]*Seoul National Univ., South Korea*. In this work, optical path difference is simulated by ray tracing approach with given schematic eye model to compensate optical aberration caused by abnormal shape of cornea. The shape of cornea is fitted to Taylor polynomials.

JW4A.103
Measuring the topography of microelements by synthetic longitudinal spatial coherence function, Juan Martinez-Carranza[1], Marta Mikula[1], Tomasz Kozacki[1]; [1]*Warsaw Univ. of Technology, Poland*. This work presents a new technique for measuring the topography by using synthetic longitudinal spatial coherence function. This approach allows obtaining high axial resolution and extending the unambiguous measurement range in digital holography.

JW4A.104
Decision making using lag synchronization of chaos in mutually-coupled semiconductor lasers, Takatomo Mihana[1], Yusuke Mitsui[1], Mizuho Takabayashi[1], Kazutaka Kanno[1], Makoto Naruse[2], Atsushi Uchida[1]; [1]*Department of Information and Computer Sciences, Saitama Univ., Japan;* [2]*Department of Information Physics and Computing, Graduate School of Information Science and Technology, The Univ. of Tokyo, Japan*. Photonic reinforcement learning and decision making has been used to solve multi-armed bandit problem. We propose a method of decision making using lag synchronization of chaos in mutually-coupled semiconductor lasers.

JW4A.105
High-Fidelity Visible-Light Spectroscopy using Aluminum Plasmonic Grating Filter Array, Jyotindra Shakya[1], Farzana Shashi[1], Alan Wang[1]; [1]*Oregon State Univ., USA*. We designed and fabricated narrow-band plasmonic grating filter array for on-chip visible-light spectroscopy. Using only 20 filters, we successfully reconstructed high-fidelity visible-light spectra based on snapshot imaging and matrix inversion.

JW4A.106
Optical Engineering for Plasmonic Quasi-Bandgap by Effective Asymmetric Plasmonic Waveguide: Applications to High Efficiency Organic Light Emitting Diodes, Lee TaeWoo[1], Dohong Kim[1], Kyung Cheol Choi[1]; [1]*KAIST, South Korea*. An effective asymmetric insulator/metal/insulator electrode for high efficiency OLEDs is proposed. The proposed structure has quasi-plasmonic bandgap property in the blue visible wavelength region, and enhances the efficiency of blue OLEDs.

JW4A.107
Detection of Laser Reflection in Wild, Honbo Zhang[1]; [1]*Virginia Military Instuitue, USA*. The residual network is used for laser reflection detection task. Results showed that the residual network is able to detect the laser reflection in a high precision.

JW4A.108
Research on Maize Biomass Inversion Methods in Northeast China Based on Sentinel-1 Satellite Data, Fachuan He[1], Lingjia Gu[1], Ruizhi Ren[1], Xiaohu Zhou[1]; [1]*Jilin Univ., China*. Sentinel-1 data was trained to estimate maize biomass. Classical machine learning techniques (SVR, RF and XGBoost) were used. The results showed that RF had better performance, R2 was 0.894 and MSE was 1.754 Kg/m2.

JW4A.109
The micromaser in a dissipative cross-cavity, Julio C. Garcia-Melgarejo[1], Nestor Lozano-Crisóstomo[1], A. G. Esmeralda[1], Ariel Dominguez-Pachecano[1], Javier Sanchez-Mondragon[2]; [1]*Universidad Autonoma de Coahuila, Mexico;* [2]*Instituto Nacional de Astrofísica, Óptica y Electrónica, Mexico*. We present the theory of a micromaser for the Jaynes-Cummings interactions performed in a cross-cavity. We also discuss the generation of a $|1001\rangle$ state in this configuration.

JW4A.110
Nondispersing Trojan-Like Wavepackets on Langmuir Click-Clack Balls Oscillatory Trajectories in Helium Atom and Quantum Dots, Matt Kalinski[1]; [1]*Utah State Univ., USA*. New kind of Trojan-like nondispersing two-electron wave packets is discovered on the Langmuir oscillating model trajectories with the electrons half-orbiting nucleus and periodically bouncing from each other in the analogy to the Click-Clack Balls.

JW4A.111 *RAPID*

Resonant Radiation of Mid-infrared Laser Filaments Driven by a 2.4 μm Femtosecond Cr:ZnSe Laser, Sang Hoon Nam[1], Garima C. Nagar[2], Dennis Dempsey[2], Ondrej Novak[3], Bonggu Shim[2], Kyung-Han Hong[1]; *[1]RLE, MIT, USA; [2]Physics, Applied Physics, and Astronomy, Binghamton Univ., USA; [3]HiLASE centre, Czechia.* We experimentally observe the resonant radiation (RR) of mid-infrared laser filaments in YAG, pumped by 2.4 μm, 220 fs Cr:ZnSe laser pulses in anomalous dispersion regime, and numerically investigate the phase matching of RR.

JW4A.112

Bound States in Continuum and Gapless Surface States by Distributed-Bragg-Reflector Pillars, Tetsuyuki Ochiai[1]; *[1]National Inst. for Materials Science, Japan.* We present two novel photonic-state formations using distributed-Bragg-reflector (DBR) pillars, bound states in continuum by isolated DBR pillars and gapless surface states by a two-dimensional periodic arrangement of core-shell DBR pillars.

JW4A.113

Withdrawn

JW4A.114

Optical Measurement Tools for Molecular Dynamics Studies Applied to Transcription Factors, Marie Fournier[1], Alessandro Furlan[1], Dorian Champelovier[1], Florence Agbazahou[1], Aymeric Leray[3], Ignacio Izeddin[2], Bernard Vandenbunder[1], Christian Hubert[4], Gabriel Bidaux[5], Laurent Héliot[1]; *[1]PhLAM, France; [2]ESPCI, France; [3]Université de Bourgogne, France; [4]Errol Laser, France; [5]Univ-Lyon, France.* In order to further understand genetic expression in eukaryotic cells, we combine several molecular dynamics analysis technics in one microscopy module. This module can perform confocal (CLSM), wide field (TIRFM/HiLo) and light-sheet illuminations.

JW4A.115

Progress in OCT-based Through Silicon Via (TSV) Metrology, Wolfgang A. Iff[2], Jean-Paul Hugonin[2], Christophe Sauvan[2], Monder Besbes[2], Pierre H. Chavel[1,5], Guillaume Vienne[6], Laurent Milord[6], Dario Alliata[6], Etienne Herth[4,3], Philippe Coste[3,4], Alain Bosseboeuf[3,4]; *[1]Université Jean Monnet de Saint Etienne, Université de Lyon, France; [2]Inst d Optique Lab Charles Fabry, France; [3]Centre de Nanosciences et de Nanostructures, CNRS, France; [4]Université Paris Sud, France; [5]Institut d Optique Graduate School, France; [6]Unity-SC, France.* Transitioning from a scalar to an electromagnetic approach, and adding a damped least squares estimation, the accuracy of Time-Domain OCT (optical coherence tomography) metrology applied to TSV (vertical interconnect through silicon) is improved.

JW4A.116

Acceleration of quasi-mono-energetic electron bunches to 5 MeV at 1 kHz with few-cycle laser pulses, Fatholah Salehi[1], Manh Le[1], Howard Milchberg[1]; *[1]Inst. for Research in Electronics and Applied Physics, Univ. of Maryland, USA.* We demonstrate the acceleration of quasi-mono-energetic electron bunches to 5 MeV at 1kHz repetition rate using few-cycle laser pulses focused on a near-critical density hydrogen gas jet.

JW4A.117

Planar electromagnetic propagation of a *p*-polarized wave across an achiral/chiral interface without and with dispersion, Monish R. Chatterjee[1], Akram Muntaser[1]; *[1]Univ. of Dayton, USA.* Propagation of a *p*-polarized electromagnetic (EM) wave across an achiral/chiral (ACC) interface is examined for beams and imaging using Fresnel coefficients (FCs). Anomalies in reflection and transmission including under dispersion are investigated.

JW4A.118

Fundamental Selectivity Limits of Gas Spectroscopy, Kamanashis Saha[1], Yuze Sun[1], Michael Vasilyev[1]; *[1]Univ. of Texas at Arlington, USA.* We relate chemical selectivity of any gas spectroscopy system to its spectral resolution and signal-to-noise ratio by deriving error probability in decision between two gases and Cramer-Rao error bound for concentration estimate in multi-gas mixture.

JW4A.119

Probing Surface Properties of Colloidal Nanoparticles in Aqueous Environments by Second Harmonic Scattering, Marie Bischoff[1], Arianna Marchioro[1], Sylvie Roke[1]; *[1]Ecole polytechnique federale de Lausanne, Switzerland.* Polarimetric angle-resolved second harmonic scattering was used to determine the surface potential and the orientation of water molecules at the surface for colloidal SiO_2 particles in different ionic strength conditions.

JW4A.120

Measurement-device-independent quantum key distribution using unidimensional Gaussian-modulated coherent states, Luyu Huang[1], Yichen Zhang[1], Ziyang Chen[2], Bin Luo[1], Song Yu[1]; *[1]Beijing Univ. of Post and Telecommunication, China; [2]Peking Univ., China.* We report a measurement-device-independent quantum key distribution protocol using unidimensional Gaussian-modulated coherent states in both sides, which shows the potential of long-distance secure communication with simple modulation method.

JW4A.121

POGNAC: an all-fiber self-compensating polarization modulator for QKD, Costantino Agnesi[1], Marco Avesani[1], Andrea Stanco[1], Paolo Villoresi[1], Giuseppe Vallone[1]; *[1]Dipartimento di Ingegneria dell'Informazione, Università degli Studi di Padova, Italy.* Here we present the POGNAC, an all-fiber polarization modulator for Quantum Key Distribution based on a Sagnac loop. Its self-compensating design allows high stability and low intrinsic Quantum Bit Error Rate.

JW4A.122

Spin Orbit and *Contact* Interactions in Orbital Angular Momentum Modes in a Fiber, Ramesh Bhandari[1]; *[1]Laboratory for Physical Sciences, USA.* We investigate analytically and numerically the spin-orbit and *contact* interactions in orbital angular momentum modes propagating within a fiber and conclude that the *contact* interaction can be a very large contributor to polarization corrections.

JW4A.123

Atomic Layer Deposition of Titanium Nitride for Robust Plasmonic Color Security Devices, Dhruv Fomra[1], Kai Ding[1], Vitaliy Avrutin[1], Ümit Özgür[1], Nathaniel Kinsey[1]; *[1]Virginia Commonwealth Univ., USA.* Patterned titanium nitride films grown via PE-ALD exhibit plasmonic colors along with being scratch resistant and durable making them an attractive choice for applications that require robust materials such as security holograms and labels.

JW4A.124

Fabrication of Three-dimentional SERS Substrate in Microfluidic Chip for Label-free Dopamine Sensing, Lang Li[1], Zhuyuan Wang[1], Yang Lu[1], Zhile Wang[1], Kuo Yang[1], Zhaoyan Yang[1], Shenfei Zong[1], Yiping Cui[1]; *[1]Southeast Univ. (China), China.* Three-dimentional (3D) SERS substrate was fabricated by layer-by-layer assembly of Ag nanostars, which provides greatly enhanced SERS signal and enables the label-free detection of dopamine in serum environment with the limit of detection of 0.1nM.

JW4A.125

All-dielectric complementary-asymmetric-arcs metasurface based refractive index sensor, Keshav Samrat Modi[2,1], Jasleen Kaur[2,1], Satya Pratap Singh[1], Umesh Tiwari[1,2], Ravindra Kumar Sinha[3,2]; *[1]Advanced Materials and Sensors (Photonics V-4), CSIR-Central Scientific Instruments Organization, India; [2](AcSIR), Academy of Scientific and Innovative Research, India; [3]CSIR-Central Scientific Instruments Organization, India.* We proposed a complementary-asymmetric-arcs metasurface which shows Fano resonance at 1125 nm with Q-factor of 385. The numerical investigation shows that the proposed metasurface have maximum sensitivity and FoM of 130 nm/RIU and 43.33, respectively

JW4A.126

Spectral Band Selection and Tolerancing for Multispectral Filter Arrays, Travis W. Sawyer[1], Calum Williams[2], Sarah Bohndiek[2]; *[1]Univ. of Arizona, USA; [2]Physics, Univ. of Cambridge, UK.* Recording specific spectral signatures is a useful tool to target clinical biomarkers in multispectral imaging. We present a method for selecting optimal spectral bands for multispectral filter arrays, including tolerancing bandwidth and wavelength.

JW4A.127

GAs in Scattering Media Absorption Spectroscopy (GASMAS) technology for a non-invasive respiratory healthcare in neonates, Andrea L. Pacheco Tobo[1]; *[1]Tyndall, Ireland.* Biophotonics@Tyndall is developing GASMAS, a novel non-invasive technology to improve the lung function assessment in neonates. This technique provides information about the gas content in the lung and its concentration.

JW4A.128

Photoinduced surface dynamics of V_3O_5: visualization of autocorrelation function from light scattering data, Larry Theran[1], Armando Rua[1], Nardeep Kumar[1], Felix Fernandez[1], Sergiy Lysenko[1]; *[1]Univ. of Puerto Rico, USA.* Ultrafast transition in V_3O_5 shows complex dynamics of the surface autocorrelation function. Phase-retrieval algorithms with filtering of stochastic scattering component provide reconstruction of specific/hidden features of photoexcited surface.

JW4A.129

Coal-gangue Mixture Degree Recognition Using Different Illuminant Method in Underground Coal Mining, Jinwang Zhang[1], Lianghui Li[1]; *[1]China Univ. of Mining & Technology, Beijing, China.* Based on the advantages and shortages of Watershed Algorithm, the different illuminance method is proposed to analys the coal-gangue mixture degree, which the recognition accuracy and speed significantly outperforms state-of-the-art techniques.

JW4A.130

Distorted object recognition and identification based on Krawtchouk moments, Yang Meng[1], Junhui Li[1], Dongyue Yang[1], Chen Chang[1], Guohua Wu[1]; *[1]Beijing Univ. of Posts and Telecomm, China.* A reference-free criteria based on Krawtchouk moments is proposed,which shows outstanding robustness against kinds of distortion,being able to distinguish similar targets with minor difference even when distortions have made images indistinguishable.

JW4A.131

Propagation and imaging using chiral lenses under variable chirality and lens parameters, Monish R. Chatterjee[1], Salah G. Bugoffa[1]; *[1]University of Dayton, USA.* Ray propagation through achiral thick lenses with spherical boundaries is examined via ABCD parameters for transmission of 1D objects and imaging under different chirality bands and physical parameters for right- and left-circular (RCP/LCP) modes.

14:30–15:00 Coffee Break, *Science & Industry Showcase Coffee Area*

Washington 1

Theme: Virtual Reality and Augmented Vision

15:30–17:00
FW5A • State of the Art in VR Optics
Presider: To be Announced

FW5A.1 • 15:30 Invited
Tradeoffs in VR Optics, Brian Wheelwright[1]; [1]*Facebook Reality Labs, USA*. Compelling VR requires system tradeoffs in field of view, resolution, form factor, dynamic range, and complexity. These tradeoffs are discussed in the context of research-grade VR prototypes.

FW5A.2 • 16:00 Invited
Foveated imaging for AR and VR displays, Shin-Tson Wu[1]; [1]*University of Central Florida, USA*. To overcome the inadequate resolution problem of near-eye displays, foveated imaging offers a promising solution. An optical system for achieving 5x resolution enhancement and a liquid crystal beam deflector for eye tracking will be presented.

Washington 2

FiO

15:30–16:45
FW5B • Emerging Optical Fiber Technology
Presider: Mina Esmaeelpour; Stanford University, USA

FW5B.1 • 15:30 Invited
Recent Advances in Hollow Core Fiber Technology, Francesco Poletti[1], Tom Bradley[1], John Hayes[1], Hesham Sakr[1], Yong Chen[1], Greg Jasion[1], Eric Numakm Fokoua[1], Ian Davidson[1], Natalie Wheeler[1], David Richardson[1]; [1]*Univ. of Southampton, UK*. We will review our latest results on the fabrication of antiresonant hollow core optical fibers. These will include fibers with record-low loss and ultra-wide bandwidth for use in data and laser power delivery applications.

FW5B.2 • 16:00
Highly-efficient and low return-loss coupling of standard and antiresonant hollow-core fibers, Dmytro Suslov[1], Matej Komanec[1], Stanislav Zvanovec[1], Tom Bradley[2], Francesco Poletti[2], David Richardson[2], Radan Slavik[2]; [1]*Czech Technical Univ. in Prague, Czechia;* [2]*Univ. of Southampton, UK*. We show early results on adopting our new technique for connecting solid-core fibers with hollow-core photonic bandgap fibers, to connect solid-core to antiresonant hollow-core fibers. We achieved insertion loss below 0.5 dB per interconnection.

FW5B.3 • 16:15
Soliton Dynamics in Multi-Core Fibers: Supermode Transitions and Raman-Shift Suppression, Aku J. Antikainen[1,2], Govind P. Agrawal[1]; [1]*Inst. of Optics, Univ. of Rochester, USA;* [2]*Electrical and Computer Engineering, Boston Univ., USA*. A Raman-induced supermode transition and total suppression of soliton red-shift are demonstrated numerically inside a seven-core fiber with frequency-dependent coupling between the cores.

FW5B.4 • 16:30
Measurement of Effective Nonlinear Coefficients in Few-Mode Fibers, Liang Cui[1], Cheng Guo[1], Zhenzhen Zhang[1], Ningbo Zhao[1], Michael Vasilyev[2], Xiaoying Li[1]; [1]*Tianjin Univ., China;* [2]*Univ. of Texas Arlington, USA*. The averaged intra- and inter-modal effective nonlinear coefficients in few-mode fiber are experimentally measured by exploiting self-phase and cross-phase modulation effects. Results are in accordance with predictions using Manakov equation.

Washington 3

FiO

15:30–17:00
FW5C • Silicon Waveguides & Resonators
Presider: Jay Matthews; University of Dayton, USA

FW5C.1 • 15:30
Efficient coupled-cavity electro-optic modulator on silicon for high carrier frequency, narrowband RF signals, Hayk Gevorgyan[1], Anatol Khilo[1], Milos A. Popovic[1]; [1]*Boston University, USA*. We demonstrate a coupled-cavity electro-optic modulator with 5.5 GHz bandwidth centered at 41 GHz. The device, driven with a -5 dBm RF signal, shows -27 dB pump-to-sideband conversion efficiency, a 15 dB improvement over a regular ring modulator.

FW5C.2 • 15:45
High-Speed Compact Silicon Nanocavity Modulator with Transparent Conductive Oxide Gate, Erwen Li[1], Bokun Zhou[1], Yunfei Bo[1], Alan X. Wang[1]; [1]*Oregon State Univ., USA*. We demonstrate a compact transparent conductive oxide gated silicon photonic crystal nanocavity electro-optical modulator with 2.5GHz operation speed. Digital modulation is measured up to 5Gbps with 2V voltage swing and 11fJ/bit energy efficiency.

FW5C.3 • 16:00 Invited
Next Generation Silicon Photonics, Michal Lipson[1]; [1]*Columbia Univ., USA*. In the past decade, silicon photonics has been shown as a platform for high-performance massively integrated optical devices that can be integrated with state-of-the-art microelectronics. The toolbox of integrated Nanophotonics today is rich: from the ability to modulate, guide and amplify at GHz bandwidths, to opto-mechanical and nonlinear devices. The explosion of silicon photonics enabled components with unprecedented performance, and opened the door to a vast variety of applications ranging from micro-lidars for self-driving cars to implantable devices for neural activation. In this talk I will review the current challenges and recent achievements in the field of silicon Nanophotonics and present recent results.

FW5C.4 • 16:30
Vertical Waveguide Arrays as Wavelength Selective Nanostructured Silicon Photodetector Pixels, Jasper Cadusch[1], Jiajun Meng[1], Kenneth B. Crozier[1,2]; [1]*Electrical and Electronic Engineering, Univ. of Melbourne, Australia;* [2]*School of Physics, The Univ. of Melbourne, Australia.* We demonstrate nanostructured Si photodetectors consisting of arrays of subwavelength vertical waveguides. Our device combines spectral-filtering and photocurrent-generation. We show that absorption and responsivity can be tuned by appropriate design

FW5C.5 • 16:45
Silicon Nanophotonics Platform for Radiation Dosimetry, Nikolai Klimov[1], Zeeshan Ahmed[1], Lonnie T. Cumberland[1], Ileana M. Pazos[1], Fred Bateman[1], Ronald E. Tosh[1], Ryan Fitzgerald[1]; [1]*NIST, USA*. We have examined the impact of cobalt-60 gamma-ray radiation up to 1 megagray absorbed dose on silicon photonic devices. We do not find any systematic impact of radiation, indicating the durability of silicon photonics devices under harsh conditions.

16:00–18:00 OSA Senior Member Reception, *Stone's Throw Restaurant, Lobby Level*

LS

15:30–16:45
LW5E • Condensed Phase and Nanocrystal Spectroscopy I
Presider: Anne Kelley; University of California Merced, USA

LW5E.1 • 15:30 Invited
Hybrid Organic: Inorganic Junctions for Energy Conversion and Transport, Emily K. Raulerson[1], Michael S. Azzaro[1], Jon A. Bender[1], Honghao Wang[1], Brittany R. Pollok[1], Sean Roberts[1]; [1]*Chemistry, Univ. of Texas at Austin, USA.* Structures that manipulate electron spin to split or sum photons offer promise for improved energy conversion and catalysis. Here, we describe efforts to design hybrid organic:inorganic junctions for directing energy migration within such structures.

LW5E.2 • 16:00 Invited
Carotenoid-mediated Light Harvesting in Plants, Gabriela Schlau-Cohen[1]; [1]*Massachusetts Inst. of Technology, USA.* We utilize ultrabroadband two-dimensional electronic spectroscopy to map out energy flow in plants across the visible range. Our results reveal that a carotenoid in LHCII mediates the large energy gap via a previously-debated dark state.

LW5E.3 • 16:30
Angle-Tunable Photocurrent and Photoluminescence from Interlayer Excitons in Twisted Bilayer Graphene and 2D Semiconductors, Hiral Patel[1], Kyle Vogt[1], Cheol-Joo Kim[3], Jiwoong Park[2], Matthew W. Graham[1]; [1]*Oregon State Univ., USA;* [2]*Chemistry, Univ. of Chicago, USA;* [3]*Chemistry, Pohang Univ. of Science and Technology, South Korea.* Using ultrafast microscopy we find bound interlayer excitons in twisted bilayer graphene. By quantifying the binding energy, photoluminescence and ultrafast photocurrent we show such bilayer quantum materials enable fast, broadband photosensing.

LW5E.4 • 16:45
Withdrawn

FiO

15:30–17:00
FW5F • Structured Light
Presider: Carlos Lopez-Mariscal; Underwater Photonics, Mexico

FW5F.1 • 15:30 Invited
Topological Transformation of Spirally Polarized Vector Fields, Julio C. Gutierrez-Vega[1], Benjamin Perez-Garcia[1], Raul I. Hernández-Aranda[1], Carlos Lopez-Mariscal[2]; [1]*Tecnologico de Monterrey, Mexico;* [2]*Underwater Photonics, Mexico.* We characterize the streamline morphologies of spirally polarized vector beams and its transformation by polarization optical systems. The streamlines of the output field exhibit spirals, saddles, nodes, ellipses, and stars.

FW5F.2 • 16:00
Measurement of Vortex Interactions in Light, Jasmine M. Andersen[1], Andrew A. Voitiv[1], Mark Lusk[2], Mark Siemens[1]; [1]*Univ. of Denver, USA;* [2]*Colorado School of Mines, USA.* We experimentally and theoretically study dynamics of a pair of point vortices in a large Gaussian laser beam. We observe annihilation of opposite charge optical vortices and characterize the effect of changing vortex core size.

FW5F.3 • 16:15
Diffraction of a vortex beam by rotationally symmetric superposition of Fermat-spiral pinholes array, Shun Tian[1], Zilong Zhang[1], Changming Zhao[1], Kun Gui[1], Haiyang Zhang[1]; [1]*Beijing Inst. of Technology, China.* Diffraction property of a vortex beam passing through a diffraction plate with rotationally symmetric superposition of Fermat-spiral pinholes array is investigated. Diffracted beam is focused by a lens and beam patterns' variations are observed.

FW5F.4 • 16:30
Optical Vortex Braiding in Composite Bessels, Andrew A. Voitiv[2], Mark Siemens[2], Jasmine M. Andersen[2], Mark Lusk[1]; [1]*Department of Physics, Colorado School of Mines, USA;* [2]*Physics & Astronomy, Univ. of Denver, USA.* We theoretically propose and experimentally demonstrate the braiding of optical vortices in a linear laser beam with more than 2π rotation by superposing Bessel modes.

FW5F.5 • 16:45
Direct Measurement of Linearly Imposed Spatiotemporal Optical Vortices (STOVs), Sina Zahedpour Anaraki[1], Scott W. Hancock[1], Howard Milchberg[1]; [1]*Univ. of Maryland at College Park, USA.* Spatiotemporal optical vortices (STOVs), arise naturally during nonlinear self-focusing collapse arrest. Here, we use a 4-f pulse shaper to impose STOVs linearly on a Gaussian pulse and directly measure the vortex in spatiotemporal domains.

16:00–18:00 OSA Senior Member Reception, *Stone's Throw Restaurant, Lobby Level*

Washington 1

Theme:
Virtual Reality and Augmented Vision

17:15–18:45
FW6A • State of the Art in AR Optics
Presider: To be Announced

FW6A.1 • 17:15 Invited
AR/VR Display Using Metalens and Focus Tunable Lens, Byoungho Lee[1]; [1]*Seoul National Univ., Korea (the Republic of)*. We demonstrate the use of metasurface lens and focus tunable lens to improve field-of-view and number of image depth planes for head-mounted-displays for augmented and virtual reality.

FW6A.2 • 17:45 Invited
Magic Leap One light field operational modalities, Michael Klug[1], W. Hudson Welch[1], Björn Vlaskamp[1]; [1]*Magic Leap, USA*. Magic Leap One offers several operational modalities based on producing two distinct content focal planes. This presentation presents focal plane positional rationale, switching alternatives, and other details concerning function and user experience.

Washington 2

FiO

17:15–18:45
FW6B • Optical Manipulations
Presider: Carlos Lopez-Mariscal; Underwater Photonics, Mexico

FW6B.1 • 17:15
Multiphoton quantum metrology without pre- and post-selected measurements, Chenglong You[1], Thomas Gerrits[2], Peter Bierhorst[3], Adriana Lita[2], Scott Glancy[2], Narayan Bhusal[1], Steve Kolthammer[4], Jonathan Dowling[1], Emanuel Knill[2,5], Sae Woo Nam[2], Richard Mirin[2], Omar Magana-Loaiza[1]; [1]*Department of Physics and Astronomy, Louisiana State Univ., USA;* [2]*NISTnology, USA;* [3]*Mathematics Department, Univ. of New Orleans, USA;* [4]*QOLS, Blackett Laboratory, Imperial College London, UK;* [5]*Center for Theory of Quantum Matter, Univ. of Colorado, USA*. We demonstrate the first protocol for quantum metrology without pre- and post-selected measurements. Our experiment, with an efficiency of 82%, utilizes TMSV states and photon-number-resolving detection to surpass the standard quantum limit.

FW6B.2 • 17:30
Determining the Nature of Optical Forces with the Photon-Drag Effect, Jared Strait[1], Glenn Holland[1], Cheng Zhang[1,2], Wenqi Zhu[1,2], Christian Haffner[1,2], Junyeob Song[1,3], Wei Zhou[1,3], B. R. Ilic[1], Amit K. Agrawal[1], Domenico Pacifici[1,4], Henri Lezec[1]; [1]*NISTnology, USA;* [2]*Univ. of Maryland, USA;* [3]*Virginia Tech, USA;* [4]*Brown Univ., USA*. The photovoltage generated in metal films conflicts with the prevailing intuitive model of light-metal momentum exchange, establishing the need for a new microscopic model of radiation pressure, and newly revealing the distribution of optical forces.

FW6B.3 • 17:45
Optimal Light Fields for Micromanipulation in Complex Scattering Environments, Michael Horodynski[1], Matthias Kühmayer[1], Andre Brandstötter[1], Kevin Pichler[1], Yan V. Fyodorov[2], Ulrich Kuhl[3], Stefan Rotter[1]; [1]*Vienna Univ. of Technology, Austria;* [2]*King's College London, UK;* [3]*Université Nice Sophia Antipolis, France*. We demonstrate both theoretically and experimentally how to achieve wave states that are optimal for transferring momentum, torque, etc. on a target of arbitrary shape embedded in an arbitrary environment.

FW6B.4 • 18:00
Majorana-like Photons from Vector Vortex Beams of Classically Entangled Photons Propagating through Brain, Sandra Mamani[1], Lingyan Shi[1,2], Daniel Nolan[3], Robert R. Alfano[1]; [1]*IUSL at City College, USA;* [2]*2Department of Biomedical Engeneering, Univ. of California San Diego, USA;* [3]*3Corning Research and Development Corporation, Sullivan Park, USA*. Majorana like photons are introduced from class of classically entangled Cylindrical Vector Vortex Beams. An enhanced transmission is observed in mouse brain from Majorana vector photons with orbital angular momentum due to their non-separability.

Washington 3

FiO

17:15–18:45
FW6C • Integrated Frequency Combs
Presider: Xu Yi; University of Virginia, USA

FW6C.1 • 17:15
Monolithic Mid-Infrared Optical Frequency Comb Generator via Parametric Down Conversion, Kunpeng Jia[1,2], Xiaohan Wang[1,2], Xin Ni[1], Jian Guo[1], Zhenda Xie[1], Shu-Wei Huang[2], Shining Zhu[1]; [1]*Nanjing Univ., China;* [2]*Department of Electrical, Computer, and Energy Engineering, Univ. of Colorado Boulder, USA*. We demonstrate the first mid-infrared frequency comb generation via optical parametric down conversion from a high-Q $\chi^{(2)}$ optical superlattice box resonator. Low noise comb is achieved with high output power.

FW6C.2 • 17:30
Broadband Resonator-Waveguide Coupling for Octave-Spanning Microresonator Frequency Comb, Gregory Moille[1,2], Qing Li[1,3], Travis C. Briles[4,5], Su-Peng Yu[4,5], Tara Drake[4,5], Xiyuan Lu[1,2], Ashutosh Rao[1,2], Daron Westly[1], Scott Papp[4,5], Kartik Srinivasan[1,6]; [1]*NIST., USA;* [2]*Univ. of Maryland, USA;* [3]*Carnegie Mellon Univ., USA;* [4]*NISTn., USA;* [5]*Univ. of Colorado, USA;* [6]*Joint Quantum Inst., USA*. We characterize pulley coupling for extracting octave-spanning spectral bandwidths generated within microrings. We compare measurements with modeling and show 20dB improvement in extraction at short wavelengths compared to straight waveguide coupling

FW6C.3 • 17:45 Invited
Microcomb-based Frequency Metrology & Optical Frequencies Synthesis, Scott A. Diddams[1]; [1]*National Inst. of Standards & Technology, USA*. Abstract to be Provided.

Theme: Quantum Technologies

LS

FiO

17:15–18:45
FW6D • Quantum Communications and the Future Quantum Internet I
Presider: Eleni Diamanti; Universite Pierre et Marie Curie, France

FW6D.1 • 17:15 Invited

Designing Quantum Networks: From QKD links to the Quantum Internet, William Munro[1,2], Kae Nemoto[2]; [1]*NTT Basic Research Laboratories, Japan;* [2]*National Inst. of Informatics, Japan*. With point-to-point QKD systems commercially available, the critical issue is establishing the next steps towards the realization of a quantum internet. Here we explore memory assisted mdiQKD as a natural bridge to entanglement-based quantum networks.

FW6D.2 • 17:45 Invited

Demonstrating quantum advantage with practical photonic systems, Eleni Diamanti[1]; [1]*CNRS and Sorbonne Univ., France*. We discuss examples of demonstration of advantage in security and efficiency due to the use of quantum resources for useful applications in the context of quantum networks, including quantum cryptographic tasks and quantum communication complexity.

17:15–18:45
LW6E • Condensed Phase and Nanocrystal Spectroscopy II
Presider: Gabriela Schlau-Cohen; Massachusetts Institute of Technology, USA

LW6E.1 • 17:15 Invited

Probing Metal Electron and Plasmon Dynamics Using Two-dimensional Electronic Spectroscopy, Kenneth Knappenberger[1], Hongjun Zheng[1]; [1]*Pennsylvania State Univ., USA*. Coherent electron dynamics for metal nanoparticles will be described. Ultrafast 2D electronic spectroscopy resolves electron-electron scattering for plasmonic excitations and the influence of passivating ligands on electronic intraband dephasing.

LW6E.2 • 17:45

Resonance Hyper-Raman Spectra of CdSe and CdS Nanocrystals, Anne M. Kelley[1], Rui Tan[1], David Kelley[1]; [1]*Univ. of California Merced, USA*. Resonance hyper-Raman spectra are reported for CdS and CdSe quantum dots and CdSe/CdS core/shell tetrapods. The effects of crystal structure and resonance condition on hyper-Raman to hyper-Rayleigh ratios are discussed.

LW6E.3 • 18:00

Spectral Evolution of Nonlinear Excitations in a Quasi-One-Dimensional Charge Density Wave Material, Sarah S. Kim[1], Jason A. Leicht[1], Susan L. Dexheimer[1]; [1]*Washington State Univ., USA*. We follow the spectral evolution and vibrational dynamics as an initially generated exciton in a quasi-one-dimensional charge density wave system localizes and then undergoes charge transfer to form a soliton/antisoliton pair.

17:15–18:45
FW6F • 3D and Light -Field Optics
Presider: Jung-Ping Liu; Feng Chia University, Taiwan

FW6F.1 • 17:15 Invited

Holographic Displays of Incoherent Light, Tomasz Kozacki[1]; [1]*Warsaw Univ. of Technology, Poland*. The paper presents architectures of holographic displays using incoherent illumination. The different solutions of the LED displays are discussed. This are full and single parallax only and displays using different Spatial Light Modulators.

FW6F.2 • 17:45

Phase-based Stereo Matching for High-accuracy Three-dimensional Optical Sensing, Jae-Sang Hyun[1], Song Zhang[1]; [1]*Purdue University, USA*. This paper introduces a stereo matching algorithm based on phase domain. Two absolute phase maps generated by fringe patterns help to find corresponding pairs for 3D reconstruction fast and accurately.

FW6F.3 • 18:00

Sub-pixels Receiver Array based Laser Scanning for High Speed Imaging with Improved Resolution, Pallab K. Choudhury[1], Chang-Hee Lee[1]; [1]*KAIST, South Korea*. MEMS mirror and downscaled receiver array based laser scanning method is proposed and experimentally demonstrated. An image with 500×500 pixels is reconstructed at 15 *fps* by using the receiver sub-pixel array size of 50×50.

Washington 1

Theme: Virtual Reality and Augmented Vision

FW6A • State of the Art in AR Optics—Continued

Washington 2

FiO

FW6B • Optical Manipulations—Continued

FW6B.5 • 18:15 Invited

Retinal tracking at 1240 Hz, Maciej Szkulmowski[1]; [1]*Nicolaus Copernicus Univ., Poland*. We present a retinal tracking system based on scanning laser ophthalmoscopy principle that acquires 1240 frames per second to calculate eye motion from image differences.

Washington 3

FiO

FW6C • Integrated Frequency Combs—Continued

FW6C.4 • 18:15

Microcomb-based RF transversal filters, Xingyuan Xu[1], Mengxi Tan[1], Jiayang Wu[1], Thach Nguyen[2], Sai Chu[3], Brent E. Little[4], Roberto Morandotti[5], Arnan Mitchell[2], David J. Moss[1]; [1]*Swinburne Univ. of Technology, Australia;* [2]*RMIT Univ., Australia;* [3]*City Univ. of Hong Kong, China;* [4]*Xi'an Inst. of Optics and Precision Mechanics, China;* [5]*INRS, Canada*. We demonstrate high-Q RF filters based on a 49GHz-FSR integrated microcomb source that provides 80 wavelengths across the C-band. A Q factor of 73.7 and an out-of-band rejection of 48.9 dB are demonstrated.

FW6C.5 • 18:30

Applications of Kerr Micro-combs to RF Photonics, Jiayang Wu[1], Xingyuan Xu[1], Mengxi Tan[1], Thach Nguyen[2], Yang Qu[1], Linnan Jia[1], Yuning Zhang[1], Sai Chu[3], Brent Little[4], Roberto Morandotti[5], Arnan Mitchell[2], David J. Moss[1]; [1]*Swinburne Univ. of Technology, Australia;* [2]*RMIT Univ., Australia;* [3]*City Univ. of Hong Kong, China;* [4]*Chinese Academic of Science, China;* [5]*INRS, Canada*. We present our recent progress on RF applications based on integrated Kerr micro-combs, including a broadband photonic microwave mixer, adaptive photonic RF filters with 80 taps, and photonic RF filters implemented via RF bandwidth scaling methods.

19:30–20:30 Movie Night: Quantum Shorts Film Festival, *Wilson AB*

Washington 4

Theme: Quantum Technologies

FW6D • Quantum Communications and the Future Quantum Internet I—Continued

Washington 5

LS

LW6E • Condensed Phase and Nanocrystal Spectroscopy II—Continued

LW6E.4 • 18:15
Mechanism of Broadband Emission in Low Dimension Hybrid Perovskites, Adedayo M. Sanni[1], Sydney Lavan[1], Aaron Rury[1]; [1]*Wayne State Univ., USA*. We assign the origin of broadband emission in 2D perovskites to similar charged defects earlier reported elsewhere using spectroscopic techniques. We note that the emission in these HOIPs is now reproducible in analogue materials.

LW6E.5 • 18:30
Phase-resolved multidimensional coherent spectroscopy with automated polarization control, Jared K. Wahlstrand[2], Galahad M. Wernsing[2], Alan D. Bristow[2,1]; [1]*West Virginia Univ., USA;* [2]*NISTnology, USA*. Automated, polarization-controlled 2D coherent spectroscopy is shown based on liquid-crystal variable retarders. Polarization-dependent rephasing spectra are recorded in a single scan, with absolute phase determined by a single auxiliary measurement.

Washington 6

FiO

FW6F • 3D and Light -Field Optics—Continued

FW6F.4 • 18:15
Time of Flight Based 3D Imaging Through Multimode Optical Fibres, Daan Stellinga[1], David B. Phillips[2], Adam Selyem[1], Sergey Turtaev[3], Tomas Cizmar[3,4], Miles J. Padgett[1]; [1]*Univ. of Glasgow, UK;* [2]*Physics, Univ. of Exeter, UK;* [3]*Leibniz Inst. of Photonic Technology, Germany;* [4]*Inst. of Scientific Instruments of the CAS, Czechia*. Multimode optical fibres can be employed as an alternative to traditional endoscopes through high-speed wavefront shaping. Using a pulsed source and time of flight we achieve far field 3D imaging through optical fibres.

FW6F.5 • 18:30
Boundary Processing for Holographic Near to Eye Displays with Replicated Eyeboxes, Myeong-Ho Choi[1], Yeon-Gyeong Ju[1], Jae-Hyeung Park[1]; [1]*Inha Univ., South Korea*. A boundary processing method which wraps the hologram angular spectrum is proposed. It presents correct images in the holographic three-dimensional NEDs with replicated eyeboxes even when the eye is located at the boundaries between them.

19:30–20:30 Movie Night: Quantum Shorts Film Festival, *Wilson AB*

Washington 1

Theme: Virtual Reality and Augmented Vision

08:00–09:00
FTh1A • Capturing and Recreating Photorealistic Experiences
Presider: To be Announced

FTh1A.1 • 08:00 Invited
Title to be Announced, Andrew Jones[1]; [1]*Unaffiliated, USA.* Abstract not available.

FTh1A.2 • 08:30 Invited
Through the Looking Glass, Shawn Frayne[1]; [1]*The Looking Glass Factory, USA.* This presentation includes a live demonstration of the Looking Glass, a unique group-viewable superstereoscopic display currently used by thousands of people around the world. Details of how the technology works will also be covered.

Washington 2

FiO

08:00–09:00
FTh1B • High Field Light Matter Interaction
Presider: Nelson Tabiryan; Beam Enginering for Advanced Measurements Co., USA

FTh1B.1 • 08:00 Invited
Generation of Strong-field Terahertz Radiation and its Applications, Xiaojun Wu[1]; [1]*Beihang Univ., China.* I will introduce our recent progress on mJ-level THz generation through optical rectification and present how to manipulate the generation of radiated THz waves from spintronic and topological insulator THz sources and some applications.

FTh1B.2 • 08:30
Single Shot Measurement of Pulse Collapse and Spatio-temporal Optical Vortex (STOV) Formation in Sapphire, Scott W. Hancock[1], Sina Zahedpour Anaraki[1], Howard Milchberg[1]; [1]*Physics, Univ. of Maryland, USA.* Spatiotemporal Optical Vortices (STOVs), optical orbital angular momentum structures arising naturally in collapsing laser pulses, are crucial to filament propagation. We characterize STOVs directly in the spatiotemporal domain.

FTh1B.3 • 08:45
Design of an Efficient Dual-Resonator Electro-Optic Frequency Comb Generator, Brandon Buscaino[1], Mian Zhang[2,3], Marko Loncar[2], Joseph M. Kahn[1]; [1]*Stanford Univ., USA;* [2]*Harvard Univ., USA;* [3]*HyperLight Corporation, USA.* We propose and characterize a novel resonator-enhanced electro-optic frequency comb generator that utilizes a second resonator to increase comb conversion efficiency by over 30% (corresponding to a 14-dB increase in average comb power).

Washington 3

FiO

08:00–09:00
FTh1C • Plasmonics & Metamaterials
Presider: Ke-Yao Wang; Inphi Corporation, USA

FTh1C.1 • 08:00
Ultra-Compact All-Metamaterial NDIR CO_2 Sensor, Alexander Lochbaum[1], Yuriy Fedoryshyn[1], Juerg Leuthold[1]; [1]*ETH Zurich, Switzerland.* We demonstrate an ultra-compact optical CO_2 sensor by combining metamaterial-enhanced MEMS components with an efficient multi-reflection cell (5.7×5.7×4.5 mm^3). We measure a CO_2 sensitivity of 23.3 $ppmCO_2/\sqrt{Hz}$ at an energy consumption of 58.6 mJ.

FTh1C.2 • 08:15
See-through metalens for augmented reality near-eye display with ultrawide viewing angle, Gun-Yeal Lee[1], Jong-Young Hong[1], Byoungho Lee[1]; [1]*Seoul National Univ., South Korea.* We propose a see-through metalens for augmented reality near-eye display. Experimental and theoretical results show that the metalens with a dual function operates as a transmissive eyepiece to dramatically increase viewing angle.

FTh1C.3 • 08:30
On-Chip Integrated Polarization Rotation, Nanofocusing and Nonlinear Enhancement on a TE-SOI Hybrid-Plasmonic Waveguide, Alessandro Tuniz[1,2], Oliver Bickerton[1,2], Fernando Diaz[1], Thomas Käsebier[3], Stefanie Kroker[4], Ernst Kley[3], Stefano Palomba[1,2], Martijn de Sterke[1,2]; [1]*Inst. of Photonics and Optical Science, Australia;* [2]*The Univ. of Sydney Nano Inst., Australia;* [3]*Inst. of Applied Physics, Friedrich-Schiller-Universität Jena, Germany;* [4]*Physikalisch-Technische Bundesanstalt, Germany.* We present a TE-to-TM hybrid plasmonic nano-focusser which monolithically interfaces with a TE SOI waveguide. Second harmonic generation measurements show a huge intensity enhancement at the 10nm gold apex, in quantitative agreement with simulations.

FTh1C.4 • 08:45
Colloidal Self-Assembled Approach Towards Hybrid Waveguide-Plasmon Resonances, Swagato Sarkar[1,2], Tobias A. Koenig[2,3], Joby Joseph[1]; [1]*Indian Inst. of Technology, Delhi, India;* [2]*Nanostructured materials, Leibniz-Institut für Polymerforschung Dresden e.V., Germany;* [3]*Cluster of Excellence Center for Advancing Electronics Dresden (cfaed), Technische Universität Dresden, Germany.* We demonstrate a hybrid opto-plasmonic structure formed through top-down laser-interference lithography and bottom-up colloidal self-assembly methods. The supported hybridized resonances are compared experimentally along with simulation models.

10:00–10:30 Coffee Break, *Washington Rooms Foyer*

Washington 4

Theme: Quantum Technologies

08:00–09:00
FTh1D • Quantum Computing with Atoms and Photons IV
Presider: To be Announced

FTh1D.1 • 08:00 Invited
Software and Hardware for Improved Quantum Volume of Transmon Processors, Lev S. Bishop[1]; [1]*IBM Research Center, USA*. The quantum volume is a pragmatic performance metric for NISQ devices, affected by software toolchain and selection and fidelity of gates. Improvements on both axes result in the highest volume measured to date.

09:15–10:00
FTh2A • Visionary - Bernard Kress
Presider: To be Announced

FTh2A.1• 09:15 VISIONARY
There Is no Moore's Law in Optics: So How Come AR/VR/MR HMD Optics Still Succeed at Shrinking Over Time?, Bernard Kress[1]; [1]*Microsoft Corp., USA*. Improving wearable and visual comfort are key to delivering next generation MR experiences. At the same time, sensory immersion needs also to be improved (display, audio, touch, gestures…).

Washington 5

LS

08:00–09:00
LTh1E • Nobel Prize Symposium I
Presider: Mark Raizen; University of Texas at Austin, USA

LTh1E.1 • 08:00 Invited
The Atomic Physics Impact of Art Ashkin's Nobel Prize Work on Optical Tweezers, William D. Phillips[1,2]; [1]*National Inst. of Standards & Technology, USA;* [2]*Joint Quantum Inst., USA*. The citation for Ashkin's 2018 Nobel prize emphasizes application of optical tweezers to biological systems. The genesis of optical tweezers, however, was in the trapping of atoms, and their impact on atomic physics is widespread.

LTh1E.2 • 08:45
Investigation of the angular distribution of the generated MIR source by DFG in the tight-focusing limit, Xinyang Su[1,2], Mingjian Lyu[2], Tuyen Hoang[2], Zujun Xu[2], Pin Long[3], Yi Zheng[1], Donna Strickland[2]; [1]*Beijing Jiaotong Univ., China;* [2]*Univ. of Waterloo, Canada;* [3]*O/E Land Inc, Canada*. The angular distribution of the generated MIR source by difference frequency generation under the condition of the tight-focusing limit was measured, showing that there is a dip in the middle of the MIR beam.

09:15–10:00
LTh2A • Visionary - Toshiki Tajima
Presider: Philip Bucksbaum; Stanford University, USA

LTh2A.1 • 09:15 VISIONARY
Laser Wakefields in Plasma, Nanostructures and Blackhole Vicinities, Toshiki Tajima[1]; [1]*Univ. of California Irvine, USA*. Laser wakefield acceleration has been enabled by the CPA laser and has been considered for high energy accelerators, cancer therapy and so on. The recent laser developments further expand its horizon to X-ray wakefields in nanostructures. Meanwhile, we find that Mother Nature had wakefieds emitted from blackhole jets.

Washington 6

FiO

08:00–09:00
FTh1F • Computer-Generated Holography and Digital Holography
Presider: Hiroshi Yoshikawa; Nihon University, Japan

FTh1F.1 • 08:00 Invited
Research on Computer-Generated Holography Based on Polygons, Yaping Zhang[1,2]; [1]*Faculty of Science, Kunming Univ. of Science and Tech., China;* [2]*Dept. of Electrical and Computer Engineering, Virginia Tech, USA*. We first describe the three commonly used methods in polygon-based computer-generated holography. We then discuss our proposed method along with some results and, to some extent, contrast our method to the other existing methods.

FTh1F.2 • 08:30
Effect of Random Phase on Reconstruction Quality for Computer-Generated Holography, Zehao He[1], Xiaomeng Sui[1], Guofan Jin[1], Liangcai Cao[1]; [1]*Tsinghua University, China*. Random phase modulation is an efficient way to render amplitude of the object in the angular-spectrum algorithm for computer-generated holography. A frequency-based adaptive phase modulation method is proposed to enhance the reconstruction quality.

FTh1F.3 • 08:45
Depth Measurement by Optical Scanning Tilt Holography, Jung-Ping Liu[1], Hsuan-Hsuan Wen[1], Ting-Chung Poon[1,2]; [1]*Feng Chia Univ., Taiwan;* [2]*Virginia Tech., USA*. Recently, optical scanning tilt holography (OSTH) has been proposed to record the off-axis object light based on the single-pixel holographic technique. Here we demonstrate that OSTH can enhance the sensitivity of depth measurement.

10:00–10:30 Coffee Break, *Washington Rooms Foyer*

Washington 1

Theme:
Virtual Reality and Augmented Vision

10:30–12:30
FTh3A • Innovation Showcase
Presider: To be Announced

FTh3A.1 • 10:30 Invited
Title to be Determined, Yuta Itoh[1]; [1]*Univ. of Tsukuba, Japan.* Abstract not available.

FTh3A.2 • 11:00 Invited
Mutual Occlusion in Augmented Reality Displays, Austin Wilson[1]; [1]*Univ. of Arizona, USA.* Development of a mutual occlusion-capable optical see-though HMD (OCOST-HMD) presents numerous complex challenges such as formfactor, mask resolution, light efficiency and pupil matching for correct viewing perspective. These challenges will be addressed as well as some optical solutions and design tradeoffs.

FTh3A.3 • 11:30 Invited
Towards Customized Augmented Reality Displays, Jonghyun Kim[1]; [1]*NVIDIA Corporation, USA.* The concept of customized AR displays and their advantages are presented. A prescription-embedded, fully customized foveated AR display can provide nice AR experiences with an eye-glasses wearable form factor.

Washington 2

FiO

10:30–12:30
FTh3B • Waveguides & Structured Materials
Presider: Xiaojun Wu; Beihang University, China

FTh3B.1 • 10:30 Invited
Comparative Analysis of Planar Optics Technology Alternatives, Nelson V. Tabiryan[1]; [1]*Beam Enginering for Adv. Measurements Co., USA.* Only one of planar optics technologies – diffractive waveplates – has shown capability to match large sizes and low-cost achieved for Fresnel optics, the bandwidth of refractive optics, in thinnest films, and electrically switchable with low-power/voltages.

FTh3B.2 • 11:00
Low Frequency Squeezing using Polarization-Based Truncated SU(1,1) Interferometer, Nikunj Prajapati[1], Irina Novikova[1]; [1]*College of William & Mary, USA.* We present an improvement to the truncated SU (1,1) interferometer. It allows for the generation and measurement of entangled photons and has quantum enhanced phase sensitivity from a range of 200 Hz to 1 MHz.

FTh3B.3 • 11:15
Withdrawn

FTh3B.4 • 11:30
Tunable Optical Frequency Comb Generation Based on a Micro-ring Assisted Fiber Laser with Optical Injection-locking, Po-Hsiu Yen[1], Cheng-Jhih Luo[1], Cheng-Yuan Li[1], Yinchieh Lai[1]; [1]*Department of Photonics, College of Electrical and Computer Engineering, National Chiao Tung Univ., Taiwan.* By using a micro-ring assisted fiber laser with optical injection-locking, a new possibility to generate optical combs with tunable frequency separation is demonstrated. It should be useful for the applications on photonic microwave generation.

Washington 3

FiO

10:30–12:30
FTh3C • Nonlinear Integrated Photonics
Presider: Amy Foster; Johns Hopkins University, USA

FTh3C.1 • 10:30
Inverse-designed silicon photonic circuit for nonreciprocal transmission, Kiyoul Yang[1], Jinhie Skarda[1], Michele Cotrufo[2], Geun Ho Ahn[1], Andrea Alú[2], Jelena Vuckovic[1]; [1]*Stanford Univ., USA;* [2]*City Univ. of New York, USA.* Broadband nonreciprocal transmission is demonstrated in an inverse-designed silicon photonic circuit. Cascaded nonlinear resonators break the single-resonator fundamental bound on forward transmission at wide nonreciprocal intensity span.

FTh3C.2 • 10:45
Resonantly enhanced Brillouin amplification and nonreciprocity in a silicon photonic circuit, Nils T. Otterstrom[1], Eric A. Kittlaus[1], Shai Gertler[1], Ryan Behunin[2], Anthony Lentine[3], Peter Rakich[1]; [1]*Yale Univ., USA;* [2]*Department of Physics and Astronomy, Northern Arizona Univ., USA;* [3]*Applied Photonic Microsystems, Sandia National Laboratory, USA.* Here, we demonstrate record-high Brillouin amplification (>20 dB) and lossless nonreciprocity (28 dB) in an all-silicon device using a resonantly enhanced stimulated inter-modal Brillouin process.

FTh3C.3 • 11:00
Optomechanical cooling in continuous waveguide systems through spontaneous inter-modal Brillouin scattering, Nils T. Otterstrom[1], Ryan Behunin[2], Eric A. Kittlaus[1], Peter Rakich[1]; [1]*Yale University, USA;* [2]*Department of Physics and Astronomy, Northern Arizona Univ., USA.* We demonstrate continuum optomechanical cooling in a multimode optomechanical silicon waveguide. This process yields powerful optomechanical control and offers new strategies for noise mitigation in Brillouin-photonic technologies.

FTh3C.4 • 11:15
System Metrics of Brillouin Integrated RF Photonic Filters, Amol Choudhary[1], Yiwei Xie[2], Yang Liu[2], David Marpaung[3], Khu Vu[4], Duk-Yong Choi[4], Stephen Madden[4], Benjamin Eggleton[2]; [1]*Electrical Engineering, Indian Inst. of Technology Delhi, India;* [2]*Univ. of Sydney, Australia;* [3]*Univ. of Twente, Netherlands;* [4]*Australian National Univ., Australia.* In this paper, we theoretically and experimentally compare and optimize the noise figure and link gain of Brillouin integrated microwave photonic filters synthesized using different modulation schemes and switching between Brillouin loss and gain.

FTh3C.5 • 11:30
High-yield ultra-low losses Si_3N_4 microresonators for energy-efficient nonlinear photonics, Laurène Youssef[1], Houssein El Dirani[2], Camille Petit-Etienne[1], Sébastien Kerdiles[2], Philippe Grosse[2], Corrado Sciancalepore[2], Erwine Pargon[1]; [1]*Univ. Grenoble Alpes, CNRS, LTM, France;* [2]*Univ. Grenoble Alpes, CEA-Leti, France.* High confinement and ultra-low losses are required for Kerr frequency combs at telecom wavelengths, a challenge for thick anomalous-dispersion SiN waveguides. We report ultra-high-Q (>6x10^6) SiN micro-resonators fabrication for nonlinear photonics

Washington 4

Theme: Quantum Technologies

10:30–12:30
FTh3D • Quantum Communications and the Future Quantum Internet II
Presider: To be Announced

FTh3D.1 • 10:30 Invited
On Chip Photonics for Quantum Computing, Communication and Sensing, John G. Rarity[1]; [1]*Univ. of Bristol, UK*. We have made great strides in linear optics quantum information processing in Bristol developing various integrated photonic chips demonstrating quantum communications, sensing, complex quantum information and simulation tasks. The talk will review recent progress.

FTh3D.2 • 11:00 Invited
Title to be Announced, Yaseera Ismail[1]; [1]*Univ. of KwaZulu-Natal, South Africa*. Abstract not available.

Washington 5

LS

10:30–12:30
LTh3E • Nobel Prize Symposium II
Presider: To be Announced

LTh3E.1 • 10:30 Invited
X-rays, Attoseconds, and Boiling the Quantum Vacuum: Frontier Research Made Possible by Chirped-pulse Amplification, Philip H. Bucksbaum[1,2]; [1]*Stanford Univ., USA;* [2]*PULSE, SLAC National Accelerator Laboratory, USA*. CPA lasers form part of the core technology responsible for ultrafast x-ray sources, attosecond pulses, and the most intense light on earth. The science revolution CPA launched 34 years ago is still underway.

LTh3E.2 • 11:00 Invited
Tractor beams and related topological tweezers, David G. Grier[1]; [1]*New York University, USA*. The theory of photokinetic effects clarifies how light's phase and amplitude profiles govern the forces experienced by illuminated objects. When used to create tractor beams, this framework identifies interesting topological modes of light.

LTh3E.3 • 11:30 Invited
Exploring Physics with Optical Levitation, Tongcang Li[1]; [1]*Purdue University, USA*. I will review recent breakthroughs in optical levitation of micro- and nanoparticles in vacuum, and discuss its applications in precision measurements and quantum sensing, nanomechanical rotor, and nonequilibrium thermodynamics.

Washington 6

FiO

10:30–12:30
FTh3F • Information Acquisition and Processing
Presider: Daniel Smalley; Brigham Young University, USA

FTh3F.1 • 10:30 Invited
Digital Holographic Tomography: 3D Label-free Imaging and Processing, C.J Cheng[1]; [1]*National Taiwan Normal Univ., Taiwan*. Abstract to be Provided.

FTh3F.2 • 11:00
Omni-Resonant Image Conservation in a Variable Bandwidth Planar Micro-Cavity, Abbas Shiri[1], Massimo Villinger[1], Soroush Shabahang[2,1], Ali Kazemi Jahromi[1], Kenneth L. Schepler[1], Ayman Abouraddy[1]; [1]*Univ. of Central Florida, USA;* [2]*The Wellman Center for Photomedicine, Massachusetts General Hospital, Harvard Medical School, USA*. Broadband omni-resonant transmission and traditional narrowband resonant transmission are demonstrated with the same planar optical microcavity. Optical imaging is enabled in both the narrowband and broadband omni-resonant filtering configurations.

FTh3F.3 • 11:15
Seeing around corners in the mid-infrared using speckle imaging, Shawn Divitt[1], Dennis F. Gardner[2], Abbie T. Watnik[2]; [1]*KeyW Corporation, USA;* [2]*U.S. Naval Research Laboratory, USA*. Speckle correlation imaging offers the ability to see targets around corners without needing nearby calibration objects. Here, we demonstrate high-resolution recovery of mid-infrared targets around corners using bispectrum methods.

FTh3F.4 • 11:30
Single-shot Fourier ptychographic microscopy via annular monochrome LED array, An Pan[1,2], Cheng Shen[2], Baoli Yao[1], Changhuei Yang[2]; [1]*Xi'an Inst. of Optics and Precision Mechanics, Chinese Academy of Sciences, China;* [2]*Department of Electrical Engineering, California Inst. of Technology, USA*. Single-shot Fourier ptychographic microscopy is realized by slightly defocusing with annular illumination. A 2× resolution quantitative phase map can be recovered by one-step deconvolution and further refined by iterative multiplexing algorithm.

Washington 1

Theme: Virtual Reality and Augmented Vision

FTh3A • Innovation Showcase—Continued

FTh3A.4 • 12:00 Invited

Retinal Image Quality in Pupil-steered Systems, Kavitha Ratnam[1]; [1]*Facebook Reality Labs, USA*. Here we propose broad taxonomy of pupil-steered systems and introduce an end-to-end optical model of a generalized pupil-steered system with a schematic eye. We explore the effects of various design parameters on retinal image quality using relevant metrics from vision science.

Washington 2

FiO

FTh3B • Waveguides & Structured Materials—Continued

FTh3B.5 • 11:45

Demonstration of Dynamical Refraction of Space-Time Wave Packets, Murat Yessenov[1], Ayman Abouraddy[1]; [1]*CREOL, Univ. of Central Florida, USA*. We show that endowing a wave-packet with tight spatio-temporal correlations unveils remarkable refractive phenomena, such as group-velocity invariance for refractive index changes, anomalous group velocity increase in higher-index materials and more.

FTh3B.6 • 12:00

Eruptive Generation of Dark Solitons by Amplified Raman-induced Shock Waves in an Active Highly Nonlinear Photonic Crystal Fiber with All-normal Dispersion, Kyoungyoon Park[1], Hansol Kim[1], Jeongkyun Na[1], Juhwan Kim[1], Yoonchan Jeong[1]; [1]*Seoul National Univ., South Korea*. We numerically study eruptive generation of dark solitons in ytterbium-doped all-normal dispersion fibers and verify that the dark solitons are eruptively generated due to amplified Raman-induced shock waves.

FTh3B.7 • 12:15

Single-Pass Generation of Spatial and Spectral Multimode Squeezed States of Light, Tiphaine Kouadou[1], Luca La Volpe[1], Syamsundar De[1], Claude Fabre[1], Valentina Parigi[1], Nicolas Treps[1]; [1]*Laboratoire Kastler Brossel, France*. We show the single-pass generation of entangled states featuring spatial-spectral quantum correlations via SPDC. They constitute multimode building blocks of dual-rail cluster states, which can be achieved via multiplexing in the time domain.

Washington 3

FiO

FTh3C • Nonlinear Integrated Photonics—Continued

FTh3C.6 • 11:45

Efficient Parametric Source of Non Classical Light, Gabriel Marty[2,1], Sylvain Combrié[1], Fabrice Raineri[2,3], Alfredo De Rossi[1]; [1]*Thales Research & Technology, France;* [2]*Centre de Nanosciences et de Nanotetchnologies, CNRS, Université Paris Saclay, France;* [3]*Université Paris Diderot, Sorbonne Paris Cité, France*. Efficient (-6 dB) parametric conversion is achieved in Photonic Crystal Cavities by compensating disorder-induced spectral misalignement. Spontaneous Four Wave Mixing up to 20 pW is detected with pump power about 0.1 mW.

FTh3C.7 • 12:00 Invited

Simple and Robust Design of Photonic Crystal Cavities and Applications, Gabriel Marty[2,1], Inès Ghorbel[1,2], Sylvain Combrié[1], Rémy Braive[2,3], Fabrice Raineri[2,3], Alfredo De Rossi[1]; [1]*Thales Research & Technology, France;* [2]*Centre de Nanosciences et de Nanotetchnologies, CNRS, Université Paris Saclay, France;* [3]*Université Paris Diderot, Sorbonne Paris Cité, France*. I will show that quasi-periodic photonic structures governed by a minimal set of parameters are endowed with the necessary features a variety of applications: optical parametric oscillators, optomechanical crystals and silicon photonics.

Washington 4

Theme: Quantum Technologies

FTh3D • Quantum Communications and the Future Quantum Internet II—Continued

Washington 5

LS

LTh3E • Nobel Prize Symposium II—Continued

LTh3E.4 • 12:00
Machine Learning Design of Plasmonic Apertures for Optical Nanotweezers, Neuton Li[1], Vivek R. Shrestha[1], Jasper Cadusch[1], Zhe Xu[1], Kenneth B. Crozier[1]; [1]*University of Melbourne, Australia*. We present a new approach to design plasmonic structures for optical trapping. Using a simulated annealing algorithm, the shape of a nanoaperture is optimized. An order of magnitude increase in trapping potential is predicted.

LTh3E.5 • 12:15
On-chip Trapping of Protein and Nanoparticles Using Thermoplasmonic Nanohole Metasurface, Justus C. Ndukaife[1], Chuchuan Hong[1], Sen Yang[1]; [1]*Vanderbilt Univ.; Science of Engineering, USA*. We experimentally demonstrate thermoplasmonic nanohole metasurfaces for low optical power trapping of small protein molecules and nanoparticles. This device platform could enable new possibilities in nanobiosensing and nanoscale optofluidic cytometry.

Washington 6

FiO

FTh3F • Information Acquisition and Processing—Continued

FTh3F.5 • 11:45
Neural Network for Optical Pathlength Demodulation in Wavelength Shifting Interferometry, Jacob Black[1], Shichao Chen[1], Yizheng Zhu[1]; [1]*Virginia Tech., USA*. Current demodulation algorithms in wavelength shifting interferometry fail to reach the theoretical sensitivity limit set by the Cramér-Rao bound. Simulations show that neural networks improve upon existing techniques and approach this limit.

FTh3F.6 • 12:00
Fourier-Transform Spectral Imaging Using Optical Diffraction Tomography, Seth D. Smith-Dryden[1], Shengli Fan[1], Guifang Li[1], Bahaa E. Saleh[1]; [1]*Univ. of Central Florida, CREOL, USA*. Fourier-transform spectroscopy is combined with optical diffraction tomography to reconstruct spatio-spectral distributions of the complex refractive index. We validate this technique by measuring spectral images of a dye-filled hollow-core fiber.

FTh3F.7 • 12:15
Optical Reservoir Computing for Lung Tumor Movement Prediction in Radiation Therapy Applications, Alexander Hollingsworth[1], Nathan McDonald[2], Wei Ji[1], Chengyu Shi[3], Steven Beninati[1], Zhaoran R. Huang[1]; [1]*Rensselaer Polytechnic Inst., USA;* [2]*Air Force Research Lab, USA;* [3]*Memorial Sloan Kettering Cancer Center, USA*. An optical reservoir computer (ORC) is used to predict the motion of lung tumors during radiation therapy procedures. The ORC shows comparable accuracy to traditional neural networks with vastly increased computation speed and training time.

Key to Authors and Presiders

A

Aaberg, Michael - FM5F.5, JTu3A.98, JTu4A.94
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Barclay, Paul E.- FM4E.1
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Boyd, Robert W.- FM3C.7, FTu1B.2, JW3A.21, JW4A.82
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Carew, Adam - JTu3A.45, JTu4A.43
Carletti, Luca - LM3E.6
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Carmichael Martins, Alessandra M.- JTu3A.1
Carnes, Kevin D. - FM1F.3
Carr, Adra - LM1E.3
Carter, Sam - FM5E.3, FTu5F.4
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