

About | FiO+LS

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Technical Conference & Exhibit: 01 – 04 November 2021



Presenting Focused, Deep-dives into the Promising Technologies of Tomorrow

The 2021 Frontiers in Optics+Laser Science (FiO LS) conference and exhibition concluded 04 November with more than 1,500 registrants from 75 countries, almost 80 technical sessions with over 650 technical presentations.

This year's technical program and exhibition leveraged the intersection between science and applications within three conference themes: Autonomous Systems, Machine Learning and Virtual Reality, and Augmented Vision. In addition to these cutting-edge presentations, FiO LS features invited speakers, special events, dynamic poster presentations and two engaging plenary speakers. FiO LS provides attendees from around the world with the opportunity to network, present, learn and connect.

“This four-day conference presented a remarkably insightful view of the recent advancements made in the optical sciences,” said 2021 FiO Co-chair Claudio Mazzali, Corning Inc., USA. “The FiO LS Program Committee, along with the staff from Optica, executed an amazing

event. Aside from being a great production overall, there was a strong sense of community around this event. With insightful speakers, opportunities to network with the speakers and virtual booths — it was the next best thing to being in person."

Forefront Technical Presentations

The Technical Conference is supplemented by three themes that leverage the intersection between science and applications — the result is intended to illustrate the research within the technology. The conference chairs and subcommittee carefully curate a technical program that addresses the breadth and depth of the community. The meeting's structure is influenced by Optica technical divisions such as fabrication, design and instrumentation; optics in biology, medicine, vision and color; and information acquisition, processing and display. A special focus at the 2021 conference was on nanophotonics, plasmonics and metamaterials; quantum science, ultrafast dynamics in complex systems; and XFEL and high-field laser science.

"The high level of talks at FiO LS from global leaders in optical science research and innovation and a large number of PhD students and young professionals make it 'the' place to learn and network with collaborators," said 2021 FiO Co-chair T.-C. Poon, Virginia Tech, USA. "With new programming, special sessions and dynamic visionary speakers, FiO LS, the annual meeting of Optica, is the place where scientific ideas meet industrial interests."

Conference Themes

The Technical Conference is supplemented by three themes that leverage the intersection between science and applications— the end result is intended to illustrate the research within the technology. The themes provide opportunities for focused, deep-dives into the most compelling and promising technologies of tomorrow. Each theme includes an all-invited program of panel discussions and is anchored by a 45-minute talk offered by a visionary speaker.

2021 Themes: Connecting Research and Applications

- Autonomous Systems
- Machine Learning
- Virtual Reality and Augmented Vision

Plenary Speakers

The first plenary presentation of FiO LS, entitled “Fourier Transforms and Fourier Optics with Mathematica™,” was given by Joseph W. Goodman is the author of the books Introduction to Fourier Optics (now in its fourth edition), Statistical Optics (now in its second edition), and Speckle Phenomena in Optics (now in its second edition) and Fourier

Transforms Using Mathematica. Goodman has received numerous awards from Optica, IEEE, ASEE and SPIE. He is a member of the National Academy of Engineering, a Fellow of the American Academy of Arts and Sciences, and an Honorary Member of Optica.

Anne L'Huillier, Professor, Lund University, Sweden, provided a glimpse of ultrafast dynamics of electrons in matter in the conference's second plenary talk titled "From Extreme Nonlinear Optics to Ultrafast Atomic Physics." The interaction of atoms with intense laser radiation leads to the generation of high-order harmonics or, equivalently, trains of attosecond pulses. This presentation will describe the physics and performances of these sources and show how attosecond pulses can be used to investigate fast electron dynamics in atomic photoionization.

Visionary Speakers

These speakers are individuals who come from within and beyond the optics and photonics community – each equipped to provide insight into cutting-edge advances related to the conference themes.

- **Paul Debevec**, Director of Research, Creative Algorithms and Technology, Netflix, USA
- **Ryan McMichael**, Senior Manager, Sensor Engineering, Zoox Inc, USA
- **Keith Nelson**, Haslam and Dewey Professor of Chemistry, Massachusetts Institute of Technology, USA
- **Ana Maria Rey**, NIST and JILA Fellow, Associate Research Professor, University of Colorado at Boulder, USA
- **Eli Yablonovitch**, Professor, University of California Berkeley, USA
- **Jiangying Zhou**, Program Manager, Defense Advanced Research Projects Agency, USA

"FiO LS is one of the most anticipated events in optical sciences and technology. The virtual format has certainly lived up to its reputation of providing unparalleled content and value," said LS Co-chair Richard Averitt, University of California, San Diego, USA. "The Program Committee tapped into fantastic presenters from so many parts of the world, with diverse research backgrounds. We were thrilled to present the program to the community."

"Optics and laser science create an unmatched synergy that pushes technological development," said LS Co-chair Robert Kaindl, Arizona State University, USA. "The attendees at FiO LS were able to take advantage of an international cross-section of thought leaders, optical science experts, and innovative companies who are pushing the boundaries of the industry."

Future Dates

October 2022 - Dates and location to be announced.

[HOME \(/HOME/\)](#) > [ABOUT \(/HOME/ABOUT-FIO-LS/\)](#)

Program Committee

Chairs

Frontiers in Optics



Claudio Mazzali
Corning Inc., USA



Ting-Chung (T.-C.) Poon
Virginia Tech, USA

Laser Science



Richard Averitt
University of California, San Diego, USA



Robert Kaindl
Arizona State University, USA

FiO Program Committees

FiO 1: Fabrication, Design and Instrumentation

Yoshio Hayasaki, *Utsunomiya University, Japan*, **Subcommittee Chair**

Yves Bellouard, *EPFL, Switzerland*

Liangcai Cao, *Tsinghua University, China*

Tomasz Kozacki, *Warsaw University of Technology, Poland*

Yuan Luo, *National Taiwan University, Taiwan*

Sung-Wook Min, *Kyung Hee University, Korea*

Gladys Minguez-Vega, *University Jaume I, Spain*

Mizue Mizoshiri, *Nagaoka University of Technology, Japan*

C. S. Narayanamurthy, *Indian Institute of Space Science and Technology, India*

Maitreyee Roy, *UNSW Sydney, Australia*

Ayano Tanabe, *Citizen Watch, Japan*

Yuzuru Takashima, *University of Arizona, USA*

Jyrki Saarinen, *University of Eastern Finland (UEF), Finland*

FiO 2: Optical Interactions

Judith M. Dawes, *Macquarie University, Australia*, **Subcommittee Chair**

Cord Arnold, *Lund University, Sweden*

Greg Gbur, *UNC, Charlotte, USA*

Igor Jovanovic, *University of Michigan, USA*

Saulius Juodkazis, *Swinburne University Melbourne, Australia*

Howard Lee, *University of California Irvine, USA*

Kaoru Minoshima, *University of Electro Communications, Japan*

Rubén Ramos-García, *Instituto Nacional de Astrofísica, Mexico*

Gabrielle Thomas, *M Squared Lasers, Germany*

Yan Zhang, *Capital Normal University, China*

FiO 3: Quantum Electronics

Mohammad Soltani, *Raytheon BBN Technologies, USA*, **Subcommittee Chair**

Nathalie De Leon, *Princeton University, USA*

Juliet Gopinath, *University of Colorado, USA*

Ryan Hamerly, *Massachusetts Institute of Technology, USA*

Boubacar Kante, *University of California, Berkeley, USA*

Ebrahim Karimi, *University of Ottawa, Canada*

Mercedeh Khajavikhan, *University of Southern California, USA*

Mohammad Mirhosseini, *Caltech, USA*

Andrew Shields, *Toshiba Research, UK*

Kevin Silverman, *NIST, USA*

Josh Silverstone, *University of Bristol, UK*

FiO 4: Fiber Optics and Optical Communications

Alexey Turukhin, *Cisco Systems, Inc., USA*, **Subcommittee Chair**

Mark Feuer, *College of Staten Island, CUNY*

Madeleine Glick, *Columbia University, USA*

Inwoong Kim, *Fujitsu, USA*

Lyuba Kuznetsova, *San Diego State University, USA*

Julia Larikova, *Infinera, USA*

Giovanni Milione, *NEC Labs, USA*

Milen Paskov, *Facebook, UK*

Chuan Qin, *Microsoft, USA*

FiO 5: Integrated Devices for Computing, Sensing, and Other Applications

Po Dong, *II-VI, Inc., USA*, **Subcommittee Chair**

Alvaro Casas-Bedoya, *University of Sydney, Australia*

Tingyi Gu, *University of Delaware, USA*

Zhaoran Huang, *Rensselaer Polytechnic Institute, USA*

Nikolai Klimov, *NIST, USA*

Bart Kuyken, *Ghent University, INTEC, Belgium*

Christopher V. Poulton, *Analog Photonics, USA*

Sudip Shekhar, *University of British Columbia, Canada*

Takuo Tanemura, *University of Tokyo, Japan*

Ke-Yao Wang, *Marvell Technology, Inc., USA*

Linjie Zhou, *Shanghai Jiaotong University, China*

FiO 6: Optics in Biology, Medicine, Vision, and Color

Ireneusz Grulkowski, *Nicolaus Copernicus University, Poland*, **Subcommittee Chair**

Tommaso Alterini, *Mermec, Italy*

Ana Rodríguez Aramendía, *Beamagine, Spain*

Judith Birkenfeld, *Consejo Superior de Investigaciones Científicas (CSIC), Spain*

Miya Ishihara, *National Defense Medical College, Japan*

Thomas Klein, *OptoRes GmbH, Germany*

Michelle Sandler, *Boston University, USA*

Yoav Shechtman, *Technion - Israel Institute of Technology, Israel*

Hakan Urey, *Koç University, Turkey*

Yizheng Zhu, *Virginia Tech, USA*

FiO 7: Information Acquisition, Processing and Display

Yaping Zhang, *Kunming University of Science and Technology, China*, **Subcommittee Chair**

Partha Banerjee, *University of Dayton, USA*

Chau-Jern Cheng, *National Taiwan Normal University, Taiwan*

Guohai Situ, *Shanghai Inst. of Optics and Fine Mechanics Chinese Academy of Science, China*

Pascal Picart, *LeMans Université, France*

Tomoyoshi Shimobaba, *Chiba University, Japan*

Peter Tsang, *City University of Hong Kong, Hong Kong*

Qionghua Wang, *Beihang University, China*

Abbie Watnik, *Naval Research Laboratory, USA*

Siavash Yazdanfar, *Corning Inc, USA*

Laser Science Program Committees

LS 1: Nanophotonics, Plasmonics, and Metamaterials

Willie Padilla, *Duke University, USA*, **Subcommittee Chair**

Studies of subwavelength electromagnetic phenomena in metals, dielectrics, and two-dimensional materials, spanning from THz through visible wavelengths. Topics include light confinement, Purcell effect, strong coupling, enhanced detection, polariton propagation, meta-surfaces, meta-devices, holography, novel imaging, integration with quantum materials.

LS 2: Quantum Science

Steven Cundiff, *University of Michigan, USA*, **Subcommittee Chair**

Investigations of quantum phenomena involving optics and photonics, as well as applications in areas related to quantum information science and other quantum technologies. Topics include quantum interactions of light with matter, characterization and physics of single quantum emitters, generation, detection, and characterization of quantum states of light, quantum optomechanics, novel quantum precision measurements, quantum memories and repeaters, and hybrid quantum systems.

LS 3: Ultrafast Dynamics in Complex Systems

Ryo Shimano, *University of Tokyo, Japan*, **Subcommittee Chair**

Studies of dynamics in complex systems spanning chemistry, biology, materials science, and quantum materials. Ultrafast optical techniques provide powerful approaches to investigate cooperativity and competition between microscopic degrees of freedom that lead to emergent properties. Examples in this theme include light-driven phases and competing orders in quantum materials; spin dynamics and optical control of magnetism; exciton physics in semiconductors, van der Waals coupled layers, and perovskites; optical coupling in light-harvesting complexes and photovoltaics; electronic and vibrational dynamics in complex molecules.

LS 4: XFEL and High-field Laser Science

Arvinder Sandhu, *University of Arizona, USA*, **Subcommittee Chair**

Experimental and theoretical investigations harnessing the perspectives enabled by accelerator-based and table-top short wavelength light sources, including high-harmonic and X-ray free-electron lasers (XFELs), as well as the behavior of matter in strong light fields. Topical examples include coherent imaging and ptychography, structural studies and diffuse scattering, nonlinear X-ray experiments, dynamical studies and field-driven phenomena ranging from the sub-attosecond to picosecond regimes in atoms, molecules, and solids, as well as new source developments.

FiO Themes

Autonomous Systems

Umar Piracha, *University of Central Florida and Zoox, USA*

Machine Learning

Aydogan Ozcan, *University of California, Los Angeles, USA*, Lei Tian, *Boston University, USA*, and Abbie Watnik, *Naval Research Laboratory, USA*

Virtual Reality and Augmented Vision

Douglas Lanman, *Facebook Reality Labs, USA* and Kaan Akşit, *University College London, UK*

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Program & Speakers

Subpages ▾



Join the Visionaries at the All-Virtual FiO LS Conference

The meeting unites [Optica](http://www.osa.org/en-us/home/) (<http://www.osa.org/en-us/home/>) (formerly OSA) and American Physical Society (APS) (<http://www.aps.org/>) communities for quality, cutting-edge presentations, fascinating invited speakers and a variety of special events.

Plenary, Invited and Contributed Talks

The conference chairs and subcommittee carefully curate a technical program that addresses the breadth and depth of the optics and photonics community. The meeting's structure is influenced by Optica technical divisions such as fabrication, design and instrumentation; optics in biology, medicine, vision and color; and information acquisition, processing and display.

Each year, the Laser Science subcommittee selects key topics to address. The focus in 2021 is on nanophotonics, plasmonics and metamaterials; quantum science, ultrafast dynamics in complex systems; and XFEL and high-field laser science.

Plenary (<https://www.frontiersinoptics.com/home/program/plenary-and-visionary-speakers/>), invited (<https://www.frontiersinoptics.com/home/program/invited-speakers/>) and contributed talks are organized based on these topical categories. The result is a comprehensive technical program from some of the world's leading scientists.

2021 Conference Themes

The Technical Conference is supplemented by three themes that leverage the intersection between science and applications— the end result is intended to illustrate the research within the technology.

Each theme operates as a unique workshop within the conference and features an exclusive 45-minute talk from a Visionary Speaker plus sessions and panel discussions comprised of an invited roster of speakers.

Connecting Research and Applications

- Autonomous Systems (<https://www.frontiersinoptics.com/home/program/theme-autonomous-systems/>)
- Machine Learning (<https://www.frontiersinoptics.com/home/program/theme-machine-learning/>)
- Virtual Reality and Augmented Vision (<https://www.frontiersinoptics.com/home/program/theme-virtual-reality/>)
- Quantum Information and Measurement VI (QIM) (<https://www.frontiersinoptics.com/home/program/theme-quantum-information/>) - a separate conference presented with FiO LS (registrants for either meeting have access to programs offered by both).

Visionary Speakers

In a time of technological disruption and evolution, when even things as familiar as vision, computers and automobiles seem to be on the edge of amazing reinvention, FiO LS brings forward true visionaries to speak about discoveries soon to come.

These individuals come from within and beyond the optics and photonics community – each equipped to provide insight into cutting-edge advances related to the conference themes.

Plenary & Visionary Speakers

frontiersinoptics.com/home/program/plenary-and-visionary-speakers

Plenary Speakers



Joseph Goodman

William Ayer Professor Emeritus, Stanford University, USA

About the Speaker

Joseph W. Goodman is the author of the books Introduction to Fourier Optics (now in its fourth edition), Statistical Optics (now in its second edition), and Speckle Phenomena in Optics (now in its second edition) and Fourier Transforms Using Mathematica, published in 2020 by SPIE. He has received numerous awards from IEEE, ASEE, OSA and SPIE, including the highest awards given by the latter two societies. He is a member of the National Academy of Engineering, a Fellow of the American Academy of Arts and Sciences, and an Honorary Member of The Optical Society.

Talk: Fourier Transforms and Fourier Optics with Mathematica™

For the past 18 months, access to laboratories has been difficult or impossible for many. How can one keep actively exploring optical problems under such conditions? The answer is SIMULATION using your favorite software package. In this talk, I explore several different problems in Fourier optics about which I have been curious. These include diffraction by unusual apertures, various approaches to imaging phase objects, speckle in RGB projection displays and the Lyot filter for imaging weak planets orbiting bright stars. Wherever possible, Mathematica's user-manipulable figures illustrate the results of changing parameters.



Anne L'Huillier

Professor, Lund University, Sweden

About the Speaker

Anne L'Huillier, born 1958 in Paris, defended her thesis in 1986 at the Commissariat à l'Energie Atomique, in Saclay, France and was employed there as researcher until 1995. She moved to Lund University, Sweden and became full professor in 1997. Her research has been centered around high-order harmonic generation in gases and its applications, in particular in attosecond science. Her current research deals with attosecond source development and optimization as well as with the study of photoionization dynamics in atomic systems using attosecond pulses.

Talk: From Extreme Nonlinear Optics to Ultrafast Atomic Physics

The interaction of atoms with intense laser radiation leads to the generation of high-order harmonics or, equivalently, trains of attosecond pulses. This presentation will describe the physics and performances of these sources and show how attosecond pulses can be used to investigate fast electron dynamics in atomic photoionization.

Visionary Speakers



Paul Debevec

Director of Research, Creative Algorithms and Technology, Netflix, USA

About the Speaker

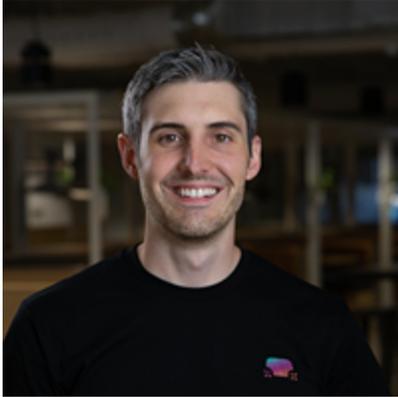
Paul Debevec is Netflix's Director of Research, Creative Algorithms and Technology overseeing the creation of new technologies in computer vision, computer graphics and machine learning for virtual production, visual effects and animation. His 2002 Light Stage 3 system at the USC Institute for Creative Technologies was the first to surround actors with color LED lighting driven by images of virtual locations for virtual production. Techniques from his work have been used to create key visual effects sequences in *The Matrix*, *Spider-Man 2*, *Benjamin Button*, *Avatar*, *Gravity*, *Furious 7*, *Blade Runner: 2049*, *Gemini Man*, *Free Guy*, numerous video games and to record a 3D portrait of US President Barack Obama.

His light stage facial capture technology has helped numerous companies create photoreal digital actors and build machine learning datasets for synthetic avatars. Paul's work in HDR imaging, image-based lighting and light stage facial capture has been recognized with two technical Academy Awards and SMPTE's Progress Medal. Paul is a Fellow of the Visual Effects Society and a member of the Television Academy's Science and Technology Peer Group, and has served on the Motion Picture Academy's Visual Effects Branch Executive Committee and Science and Technology Council, and as Vice President of ACM SIGGRAPH. More information at: www.debevec.org.

Talk: Light Fields, Light Stages and the Future of Virtual Production

I'll describe recent work I've helped lead at Netflix, Google and the USC Institute for Creative Technologies to bridge real and virtual worlds through photography, lighting and machine learning. I'll begin by describing Welcome to Light Fields, the first downloadable Virtual Reality light field experience. I'll then describe DeepView, Google's solution for Light Field Video, providing immersive VR video you can move around in after it's been recorded, with subjects close enough to be within arm's reach.

I'll also present how Google's Light Stage system paired with machine learning techniques is enabling new techniques for lighting estimation from faces for AR and interactive portrait relighting on mobile phone hardware. I will finally talk about how all of these techniques may enable the next generation of virtual production filmmaking, infusing both light fields and relighting into the real-world image-based lighting LED stages now revolutionizing how movies and television are made.



Ryan McMichael

Senior Manager, Sensor Engineering, Zoox Inc, USA

About the Speaker

Ryan McMichael is the Sr. Manager of Sensors and Systems Engineering for Advanced Hardware at Zoox. He's been at Zoox since February 2016; as part of his current role, he enjoys leading engineering teams to specify, design, build and test sensors for Zoox's autonomous vehicle platform.

Prior to joining Zoox, Ryan had the opportunity to work at the Johns Hopkins University Applied Physics Lab where he focused on optical design of space instruments. Although Ryan has left JHUAPL, he continues to teach two courses in the JHU Space Systems Engineering graduate program.

Ryan obtained his BS/MS in Optics from the University of Rochester. He has co-authored two publications and has been listed as an inventor on over 60 patent applications. Outside of work, you can find Ryan singing and songwriting on the piano and guitar.

Talk: Sensors For Autonomous Vehicles: Requirements and Opportunities

This talk will provide an overview of an approach to determine the sensor architecture on an autonomous vehicle platform. Then, the talk will go into details about the pros and cons of specific sensors, as well as opportunities to improve the performance of these sensors in the future.



Keith Nelson

Haslam and Dewey Professor of Chemistry, Massachusetts Institute of Technology, USA

About the Speaker

Keith Nelson joined the MIT Department of Chemistry as an Assistant Professor in 1982 after completing his doctorate in Physical Chemistry at Stanford University in 1981 and a postdoctoral year at UCLA. His research interests are in ultrafast optics, coherent spectroscopy and coherent control over collective dynamics and structure in condensed matter.

Talk: Light, Matter and Their Interactions: The Gift That Keeps on Giving

Advances in THz through x-ray pulse generation have enabled optical control over molecular and collective modes, extending to guided far-from-equilibrium dynamical transformations that are monitored in real time. We celebrate and look ahead!



Ana Maria Rey

NIST and JILA Fellow, Associate Research Professor, University of Colorado at Boulder, USA

About the Speaker

Professor Ana María Rey received her PhD from the University of Maryland. After that she was a postdoctoral fellow at Harvard. Currently, she is a Fellow of JILA, a NIST Fellow and a Professor Adjoint at the Department of Physics at the University of Colorado at Boulder. Rey's research interests are in the scientific interface between AMO, condensed matter physics and quantum information science. She has been the recipient of various awards, including the DAMOP Thesis Prize (2005), a MacArthur Fellowship (2013), the PECASE (2013) and Maria Goeppert Mayer Awards (2014), and the Blavatnik National Awards (2019). Rey is also an APS Fellow.

Talk: Building with Crystals of Light and Quantum Matter: From Clocks to Quantum Computers

Harnessing the behavior of complex systems is at the heart of quantum technologies. Precisely engineered ultracold gases are emerging as a powerful tool for this task. I will present recent developments using alkaline-earth atoms, the basis of the most precise atomic clocks, for the investigation of many-body phenomena and magnetism.



Eli Yablonovitch

Professor, University of California Berkeley, USA

About the Speaker

Eli Yablonovitch introduced the idea that strained semiconductor lasers could have superior performance due to reduced valence band (hole) effective mass. With almost every human interaction with the internet, optical telecommunication occurs by strained semiconductor lasers. He is regarded as a Father of the Photonic BandGap concept, and he coined the term "Photonic Crystal". The geometrical structure of the first experimentally realized Photonic bandgap, is sometimes called "Yablonovite". In his photovoltaic research, Yablonovitch introduced the $4(n^2)$ ("Yablonovitch Limit") light-trapping factor that is in worldwide use, for almost all commercial solar panels. His mantra that "a great solar cell also needs to be a great LED", is the basis of the world record solar cells: single-junction 29.1% efficiency; dual-junction 31.5%; quadruple-junction 38.8% efficiency; all at 1 sun. His cellphone antenna company, Ethertronics Inc., shipped over 2×10^9 antennas.

Talk: Physics Does Digital Optimization—for Machine Learning, Control Theory, Backpropagation, etc.

Optimization is vital to engineering, artificial intelligence, and to many areas of science. Mathematically, we usually employ steepest-descent or other digital algorithms. But, physics itself performs optimizations in the normal course of dynamical evolution.

Nature provides us with the following optimization principles: (1) The Principle of Least Action; (2) The Variational Principle of Quantum Mechanics; (3) The Principle of Minimum Entropy Generation; (4) The First Mode to Threshold method; (5) The Principle of Least Time; (6) The Adiabatic Evolution method; and (7) Quantum Annealing.

In effect, physics provides machines that solve digital optimization problems with faster time-to-solution and lower energy-to-solution than any digital computer. Of these physics principles, “Minimum Entropy Generation” in the form of bistable electrical or optical circuits is particularly adaptable toward offering digital optimization. For example, we provide the electrical circuit that addresses “the traveling salesman problem”, among many other hard-to-solve problems.



Jiangying Zhou

Program Manager, Defense Advanced Research Projects Agency, USA

About the Speaker

Jiangying Zhou became a DARPA program manager in the Defense Sciences Office in 2018, having previously served as a program manager in the Strategic Technology Office (STO). Her areas of research include machine learning, artificial intelligence, data analytics, and intelligence, surveillance and reconnaissance (ISR) exploitation technologies. Prior to joining DARPA, Zhou was a senior engineering manager in the Information Sciences Division at Teledyne Scientific and Imaging, LLC. During her more than 10-year tenure at Teledyne, Zhou worked on many contract R&D programs from US government funding agencies as well as commercial customers in the areas of sensor exploitation, signal and image processing and pattern recognition. Zhou also served as director of R&D of Summus Inc., a small start-up company specializing in contract engineering projects for US Department of Defense and commercial customers in the areas of video and image compression, pattern recognition and computer vision. Zhou began her career as a scientist at Panasonic Technologies, Inc., where she conducted research in the areas of document analysis, handwriting recognition, image analysis and information retrieval. Zhou received a Bachelor of Science and a Master of Science, both in computer science, from Fudan University. She received a doctorate in electrical engineering from the State University of New York at Stony Brook. Zhou is a member of the Institute of Electrical and Electronics Engineers Society and also a member of the Upsilon Pi Epsilon international honor society for the computing and information disciplines.

Talk: Re-thinking Sensing in the Age of AI

The advances of AI and ML present both new opportunities as well as challenges to sensing. Looking at sensing through the lens of information processing will enable us to envision a new design paradigm, leading to potentially brand new sensing concepts

never imagined before. In this talk I will highlight some of the recent research programs at DARPA exploring the implications of this interplay between AI and sensing design, and discuss some potential new opportunities for research.

HOME (/HOME/) > PROGRAM (/HOME/PROGRAM/)

Theme: Autonomous Systems

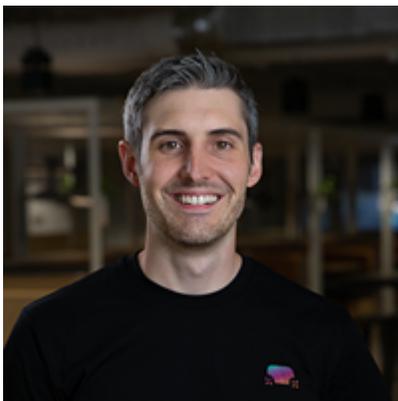


Image courtesy of Zoox

We are at the beginning of a major revolution in human society brought about by sophisticated sensing hardware and artificial intelligence that is going to change how the human society operates in many ways. There are several application areas of autonomous systems such as mobility, transport, drones, industrial robots, agriculture, remote surgery and more. This theme will highlight the latest results, challenges and possible solutions for achieving autonomy in these application areas.

Theme Coordinator

Umar Piracha, UCF CREOL and Zoox, USA



Visionary Speaker

Ryan McMichael

Senior Manager, Sensor Engineering, Zoox Inc, USA

About the Speaker

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Talk: Sensors For Autonomous Vehicles: Requirements and Opportunities

This talk will provide an overview of an approach to determine the sensor architecture on an autonomous vehicle platform. Then, the talk will go into details about the pros and cons of specific sensors, as well as opportunities to improve the performance of these sensors in the future.

Monday, 1 November	
09:00 - 10:00	Tutorial Speaker: Paul McManamon, <i>University of Dayton, USA</i> Optical Technologies for Autonomous Applications
11:00 - 13:00	Autonomous Imaging and Robotic Surgery Emily Charlson, <i>Stanford University, USA</i> Martin Villiger, <i>Wellman Center for Photomedicine, USA</i> Mark Draelos, <i>Duke University, USA</i> Pierre Dupont, <i>Harvard Medical School, USA</i>
14:00 - 15:00	Sensors for Autonomy Ross Uthoff, <i>Lumotive LLC, USA</i> Chris Posch, <i>Teledyne FLIR, USA</i>

16:00 – 18:00	Autonomous Technologies and Applications Akram Benmbarek, <i>AEye Inc., USA</i> Amin Abbasi, <i>imec, Belgium</i> Emil Kadlec, <i>Aurora, USA</i>
Tuesday, 2 November	
11:15 – 12:00	Visionary Speaker: Ryan McMichael, <i>Zoox Inc, USA</i> Sensors For Autonomous Vehicles: Requirements and Opportunities

[HOME \(/HOME/\)](#) > [PROGRAM \(/HOME/PROGRAM/\)](#)

Theme: Machine Learning

We welcome attendees to the Machine learning theme at the Frontiers in Optics (FIO) meeting. The Machine Learning theme provides an interdisciplinary platform to learn about and discuss a wide range of optics/photonics topics that machine learning has recently impacted on. The theme features 1 visionary speaker, 1 tutorial speaker, and 15 invited speakers spanning academia, industry and government institutions.

These exciting speakers will provide both historical retrospectives and state-of-the-art views on emerging machine learning techniques applied to optics/photonics applications. The topics include computational imaging, metaphotonics, optical computing, biophotonics and many more. Through these talks, attendees will learn about the newest machine learning technologies applied to optics and photonics and some of the emerging concepts in embedding optical physics into machine learning designs.

Theme Coordinators

Aydogan Ozcan, *University of California, Los Angeles, USA*

Lei Tian, *Boston University, USA*

Abbie Watnik, *Naval Research Laboratory, USA*



Visionary Speaker

Eli Yablonovitch

Professor, University of California Berkeley, USA

About the Speaker

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29.1% efficiency; dual-junction 31.5%; quadruple-junction 38.8% efficiency; all at 1 sun. His cellphone antenna company, Ethertronics Inc., shipped over 2×10^9 antennas.

Talk: Physics Does Digital Optimization—for Machine Learning, Control Theory, Backpropagation, etc.

Optimization is vital to engineering, artificial intelligence, and to many areas of science. Mathematically, we usually employ steepest-descent or other digital algorithms. But, physics itself performs optimizations in the normal course of dynamical evolution. Nature provides us with the following optimization principles: (1) The Principle of Least Action; (2) The Variational Principle of Quantum Mechanics; (3) The Principle of Minimum Entropy Generation; (4) The First Mode to Threshold method; (5) The Principle of Least Time; (6) The Adiabatic Evolution method; and (7) Quantum Annealing.

In effect, physics provides machines that solve digital optimization problems with faster time-to-solution and lower energy-to-solution than any digital computer. Of these physics principles, “Minimum Entropy Generation” in the form of bistable electrical or optical circuits is particularly adaptable toward offering digital optimization. For example, we provide the electrical circuit that addresses “the traveling salesman problem”, among many other hard-to-solve problems.



Visionary Speaker **Jiangying Zhou**

Program Manager, Defense Advanced Research Projects Agency, USA

About the Speaker

Jiangying Zhou became a DARPA program manager in the Defense Sciences Office in 2018, having previously served as a program manager in the Strategic Technology Office (STO). Her areas of research include machine learning, artificial intelligence, data analytics, and intelligence, surveillance and reconnaissance (ISR) exploitation technologies. Prior to

joining DARPA, Zhou was a senior engineering manager in the Information Sciences Division at Teledyne Scientific and Imaging, LLC. During her more than 10-year tenure at Teledyne, Zhou worked on many contract R&D programs from US government funding agencies as well as commercial customers in the areas of sensor exploitation, signal and image processing and pattern recognition. Zhou also served as director of R&D of Summus Inc., a small start-up company specializing in contract engineering projects for US Department of Defense and commercial customers in the areas of video and image compression, pattern recognition and computer vision. Zhou began her career as a scientist at Panasonic Technologies, Inc., where she conducted research in the areas of document analysis, handwriting recognition, image analysis and information retrieval. Zhou received a Bachelor of Science and a Master of Science, both in computer science, from Fudan University. She received a doctorate in electrical engineering from the State University of New York at Stony Brook. Zhou is a member of the Institute of Electrical and Electronics Engineers Society and also a member of the Upsilon Pi Epsilon international honor society for the computing and information disciplines.

Talk: Re-thinking Sensing in the Age of AI

The advances of AI and ML present both new opportunities as well as challenges to sensing. Looking at sensing through the lens of information processing will enable us to envision a new design paradigm, leading to potentially brand new sensing concepts never imagined before. In this talk I will highlight some of the recent research programs at DARPA exploring the implications of this interplay between AI and sensing design, and discuss some potential new opportunities for research.

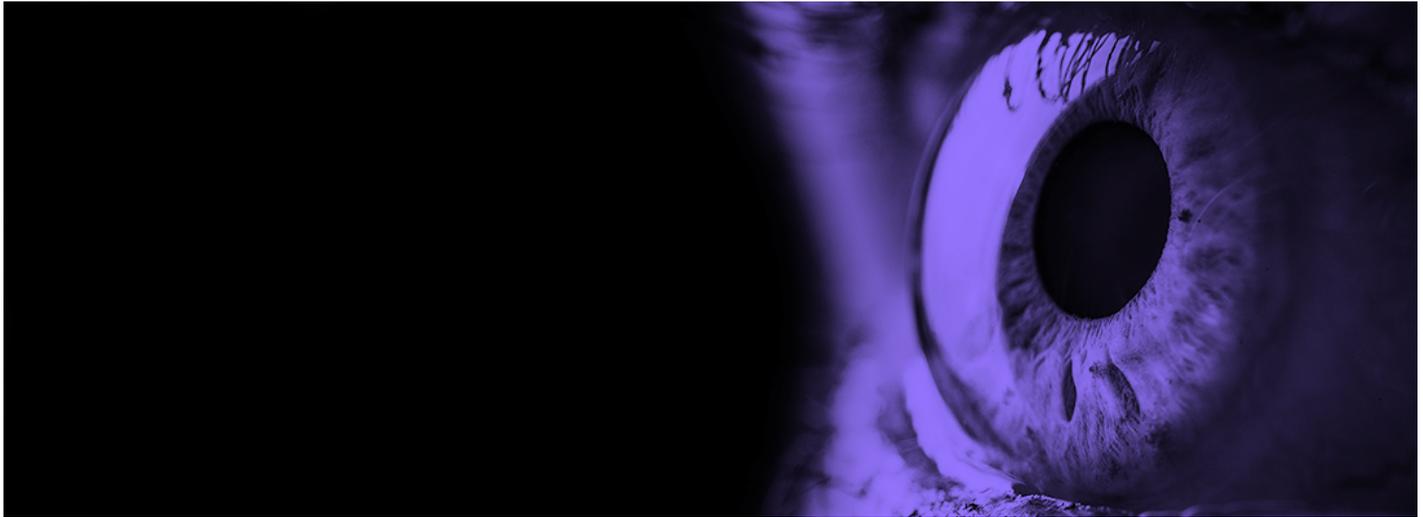
Tuesday, 2 November

09:15 – 10:00	<p>Visionary Speaker: Eli Yablonovitch, <i>University of California Berkeley, USA</i></p> <p>Physics Does Digital Optimization—for Machine Learning, Control Theory, Backpropagation, etc.</p>
15:30 - 17:00	<p>Smart Cameras with Machine Learning</p> <p>David Brady, <i>University of Arizona, USA</i> Achuta Kadambi, <i>Akasha Imaging / University of California, Los Angeles, USA</i> Xin Yuan, <i>Westlake University, China</i></p>
Wednesday, 3 November	
08:00 – 09:00	<p>Tutorial Speaker: George Barbastathis, <i>Massachusetts Institute of Technology, USA</i></p> <p>Incorporating Physics Priors into Machine Learning for Inverse Problems</p>
10:15 – 11:00	<p>Visionary Speaker: Jiangying Zhou, <i>Defense Advanced Research Projects Agency, USA</i></p> <p>Re-thinking Sensing in the Age of AI</p>
15:30 – 17:00	<p>Optical Computing in Machine Learning</p> <p>Shanhui Fan, <i>Stanford University, USA</i> Adrian Stern, <i>Ben-Gurion University of the Negev, Israel</i> Marin Soljačić, <i>Massachusetts Institute of Technology, USA</i></p>
17:30 - 19:00	<p>Machine Learning for Extreme Measurements</p> <p>Peyman Milanfar, <i>Google Research, USA</i> Katie Bouman, <i>California Institute of Technology, USA</i> Alexandra Boltasseva, <i>Purdue University, USA</i></p>
Thursday, 4 November	
10:30 - 12:00	<p>Computational Imaging with Machine learning</p> <p>Gordon Wetzstein, <i>Stanford University, USA</i> Yair Rivenson, <i>Pictor Labs, USA</i> Luat Vuong, <i>University of California, Riverside, USA</i></p>

15:00 - 17:00	Computational Microscopy with Machine learning Sixian You, <i>Massachusetts Institute of Technology, USA</i> Laura Waller, <i>University of California, Berkeley, USA</i> Giovanni Volpe, <i>University of Gothenburg, Sweden</i>
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HOME (/HOME/) > PROGRAM (/HOME/PROGRAM/)

Theme: Virtual Reality + Augmented Reality



We welcome attendees to the Virtual Reality (VR) and Augmented Reality (AR) theme at Frontiers in Optics (FiO) 2021. The AR/VR Theme provides a gateway to learn about the unique and long-standing optical challenges with wearable displays. While impressive, today's devices are only at the beginning of a long journey, with numerous optical innovations still necessary to reach life-like visuals with devices that ultimately appear to be ordinary eyeglasses.

The Theme features 21 invited speakers spanning both academia and industry. These speakers will provide both historical retrospectives and state-of-the-art reports. Hence, both new researchers and established leaders can join together as a worldwide community to turn science fiction into reality. This year, the program will highlight the latest work in analog and digital holography, metamaterials, pupil-steered displays, optical trap displays, eye tracking, medical applications, and many more. Through these talks, attendees will learn about the newest VR/AR technologies, lessons learned in building practical systems, and what specific applications appear the most promising.

Theme Coordinators

Kaan Akşit, *University College London, UK*

Douglas Lanman, *Facebook Reality Labs, USA*

Visionary Speaker



Paul Debevec

Director of Research, Creative Algorithms and Technology, Netflix, USA

About the Speaker

Paul Debevec is Netflix's Director of Research, Creative Algorithms and Technology overseeing the creation of new technologies in computer vision, computer graphics and machine learning for virtual production, visual effects and animation. His 2002 Light Stage 3 system at the USC Institute for Creative Technologies was the first to surround actors with color LED lighting driven by images of virtual locations for virtual production. Techniques from his work have been used to create key visual effects sequences in *The Matrix*, *Spider-Man 2*, *Benjamin Button*, *Avatar*, *Gravity*, *Furious 7*, *Blade Runner: 2049*, *Gemini Man*, *Free Guy*, numerous video games and to record a 3D portrait of US President Barack Obama.

His light stage facial capture technology has helped numerous companies create photoreal digital actors and build machine learning datasets for synthetic avatars. Paul's work in HDR imaging, image-based lighting and light stage facial capture has been recognized with two technical Academy Awards and SMPTE's Progress Medal. Paul is a Fellow of the Visual Effects Society and a member of the Television Academy's Science and Technology Peer Group, and has served on the Motion Picture Academy's Visual Effects Branch Executive Committee and Science and Technology Council, and as Vice President of ACM SIGGRAPH. More information at: www.debevec.org (<http://www.debevec.org>).

Talk: Light Fields, Light Stages and the Future of Virtual Production

I'll describe recent work I've helped lead at Netflix, Google and the USC Institute for Creative Technologies to bridge real and virtual worlds through photography, lighting and machine learning. I'll begin by describing Welcome to Light Fields (<https://augmentedperception.github.io/welcome-to->

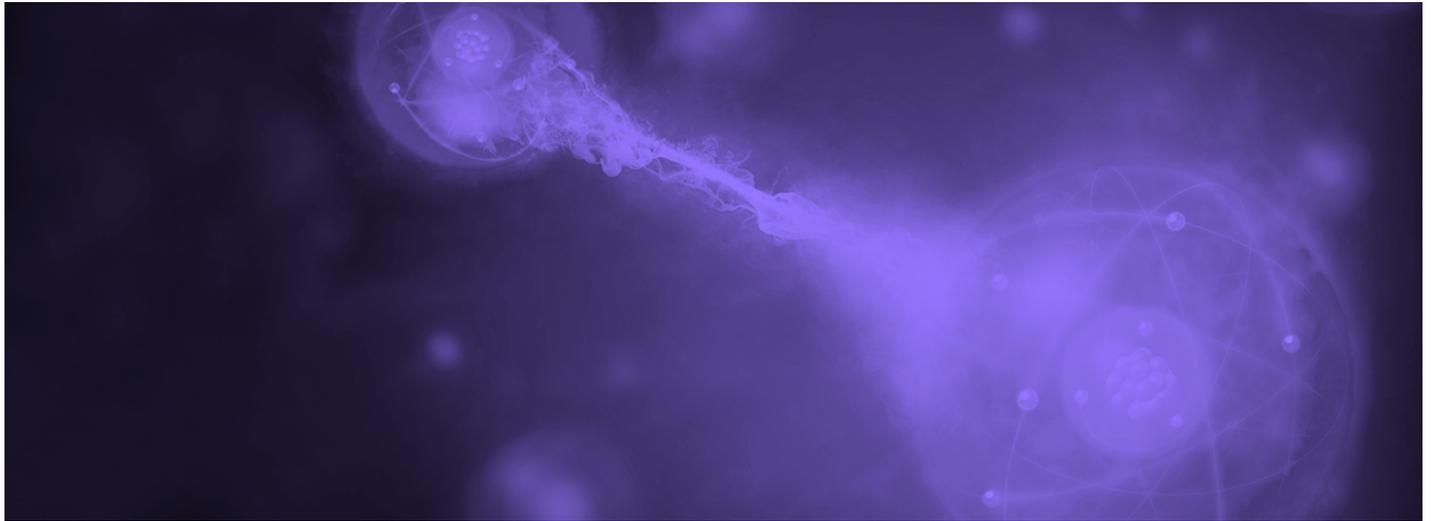
lightfields/), the first downloadable Virtual Reality light field experience. I'll then describe DeepView (<https://augmentedperception.github.io/deepview/>), Google's solution for Light Field Video (<https://augmentedperception.github.io/deepviewvideo/>), providing immersive VR video you can move around in after it's been recorded, with subjects close enough to be within arm's reach. I'll also present how Google's Light Stage (<https://augmentedperception.github.io/therelightables/>) system paired with machine learning techniques is enabling new techniques for lighting estimation from faces (<https://augmentedperception.github.io/facelight/>) for AR and interactive portrait relighting (https://augmentedperception.github.io/total_relighting/) on mobile phone hardware (<https://ai.googleblog.com/2020/12/portrait-light-enhancing-portrait.html>). I will finally talk about how all of these techniques may enable the next generation of virtual production filmmaking, infusing both light fields and relighting into the real-world image-based lighting LED stages now revolutionizing how movies and television are made.

Monday, 1 November	
09:00 - 10:00	<p>Eye Tracking</p> <p>Chiara Giordano, <i>Tobii, Sweden</i> Anastasios Angelopoulos, <i>University of California, Berkeley, USA</i> Emrah Bostan, <i>AMS GmbH, Germany</i></p>
10:30 - 12:30	<p>Analog and Digital Holography</p> <p>Andrzej Kaczorowski, <i>VividQ, UK</i> Suyeon Choi, <i>Stanford University, USA</i> Nicolas Pégard, <i>University of North Carolina, Chapel Hill, USA</i> Changwon Jang, <i>Facebook Reality Labs, USA</i> Paul Christie, <i>Litiholo, USA</i></p>

13:00 - 13:45	<p>Visionary Speaker: Paul Debevec, <i>Director of Research, Creative Algorithms and Technology, Netflix, USA</i></p> <p>Light Fields, Light Stages and the Future of Virtual Production</p>
14:00 - 15:30	<p>New Optical Technologies</p> <p>Jannick Rolland, <i>University of Rochester, USA</i> Boris Greenberg, <i>EyeWay Vision, Israel</i> Barmak Heshmat, <i>Brelyon, USA</i> Sriram Subramanian, <i>University College London, UK</i></p>
16:00 - 18:00	<p>Emerging Technologies</p> <p>Anat Levin, <i>Technion Israel Institute of Technology, Israel</i> Kaan Akşit, <i>University College London, UK</i> Daniel Smalley, <i>Brigham Young University, USA</i> Nathan Matsuda, <i>Facebook Reality Labs, USA</i> Tobias Ritschel, <i>University College London, UK</i></p>
Tuesday, 2 November	
08:00 - 09:00	<p>Medical Applications of AR/VR</p> <p>Katharina Krösl, <i>VRVis Zentrum für Virtual Reality und Visualisierung, Austria</i> Hakan Urey, <i>Koç University, Turkey</i> Eero Peltohaka, <i>OptoFidelity Ltd, Finland</i></p>

HOME (/HOME/) > PROGRAM (/HOME/PROGRAM/)

Quantum Information and Measurement VI



About Quantum Information and Measurement VI

01 - 05 November 2021, Virtual Event - Eastern Daylight Time (EDT, UTC-04:00)

Quantum Information and Measurement VI (QIM)

(https://www.osa.org/meetings/topical_meetings/quantum_information_and_measurement_vi/) is co-presented with Frontiers in Optics + Laser Science in 2021. Individuals can register for either meeting and receive full access to technical programs presented at both plus the FIO LS Virtual Exhibit. (The QIM schedule is one day longer, concluding on Friday.)

QIM

(https://www.osa.org/meetings/topical_meetings/quantum_information_and_measurement_vi/) covers the latest in theoretical developments and experimental implementations of quantum information technology, including the advanced engineering needed to realize such technologies.

In addition to the conference's traditional focus on quantum optics and photonics, QIM also includes other platforms for quantum technologies, broadly construed, including topics such as solid-state systems (superconductors, semi-conductors) atoms and ions (including gravity gradiometers and gyroscopes and computing and simulation engines).

[Learn More]

(https://www.osa.org/meetings/topical_meetings/quantum_information_and_measurement_vi/)

Plenary Speakers

Warwick Bowen, *University of Queensland, Australia*

Talk: Absolute Quantum Advantage in Bioimaging

Akira Furusawa, *University of Tokyo, Japan*

Talk: Large-scale Quantum Computing with Quantum Teleportation

Luis Sanchez-Soto, *Universidad Complutense de Madrid, Spain*

Talk: Achieving the Ultimate Timing Resolution

Lorenza Viola, *Dartmouth College, USA*

Talk: Advances in Quantum Metrology under Correlated Quantum Noise

Philip Walther, *Universitat Wien, Austria*

Talk: Quantum Photonics for Quantum Machine Learning and Secure Computing

Invited Speakers

Ulrik Andersen, *Danmarks Tekniske Universitet, Denmark*

Talk: Optical Quantum Computing Based on Continuous Variable Cluster States

Areeya Chantasri, *Mahidol University, Thailand*

Talk: Unifying Theory of Quantum State Estimation Using Past and Future Information

Sophia Economou, *Virginia Tech, USA*

Talk: Generation of Photonic Graph States from Spin-photon Interfaces

Linran Fan, *University of Arizona, USA*

Talk: Advanced Quantum State Engineering with Pockels Nonlinear Integrated Optics

Alessandro Fedrizzi, *Heriot-Watt University, UK*

Talk: Precision Quantum Photonics in the Time-frequency Domain

Ofer Firstenberg, *Weizmann Institute of Science, Israel*

Talk: Strong Rydberg-mediated Photon-photon Interactions

Sylvain Gigan, *Sorbonne Université, France*

Talk: Programmable Linear Quantum Networks with a Multimode Fibre

Gabriel Hetet, *ENS Departement de Physique, France*

Talk: Spin-mechanics with Trapped Diamonds

Nathan Langford, *University of Technology Sydney, Australia*

Talk: Quantum Chaos and Trotterisation Thresholds in Digital Quantum Simulations

Ben Lanyon, *Institute for Quantum Optics and Quantum Information, Austria*

Talk: A Quantum Repeater Node Made of Trapped Atomic Ions

Radek Lapkiewicz, *Uniwersytet Warszawski, Poland*

Talk: Super-resolution Microscopy and Noise Resistant Phase Imaging with Photon Correlations

Julien Laurat, *Laboratoire Kastler Brossel, France*

Talk: Entangling Highly-efficient Quantum Memories

Virginia Lorenz, *University of Illinois at Urbana-Champaign, USA*

Talk: Engineering Photonic Quantum States for Quantum Applications

Xiongfeng Ma, *Tsinghua University, China*

Talk: Security Assessment of Quantum Networks

Sven Ramelow, *Humboldt Universität zu Berlin, Germany*

Talk: Imaging and Spectroscopy with Mid-IR Undetected Photons

Brian Smith, *University of Oregon, USA*

Talk: Two-photon Time-frequency Entanglement in Quantum Information Science

Robert Stockill, *QphoX, UK*

Talk: Optomechanical Resonators for Quantum-state Transduction and Storage

Rinaldo Trotta, *Univ degli Studi di Roma La Sapienza, Italy*

Talk: Quantum Communication with Entangled Photons from Quantum Dots

Nathan Wiebe, *University of Washington, USA*

Talk: Characterizing Quantum Systems with Classical and Quantum Machine Learning

[HOME \(/HOME/\)](#) > [PROGRAM \(/HOME/PROGRAM/\)](#)

2021 FiO LS Awards Ceremony

Optica (formerly OSA), the Optica Foundation (formerly OSA Foundation) and APS Division of Laser Science are pleased to recognize and celebrate the achievements of several award and honor recipients during FiO. Please enjoy the FiO LS Awards Ceremony.

Ceremony Program

Please use the links below to view specific parts of the Ceremony

[Introduction \(/home/program/2021-fio-ls-awards-ceremony/?videoid=6279966450001\)](/home/program/2021-fio-ls-awards-ceremony/?videoid=6279966450001)

Connie Chang-Hasnain, 2021 Optica President

[Optica Awards and Honors \(/home/program/2021-fio-ls-awards-ceremony/?videoid=6279966450001&t=128\)](/home/program/2021-fio-ls-awards-ceremony/?videoid=6279966450001&t=128)

Optica's Frederic Ives Medal/Jarus W. Quinn Prize

- **Federico Capasso**, Harvard University, USA

Optica Honorary Members

- **Milton M T Chang**, Incubic, LLC, USA
- **Erich P Ippen**, Massachusetts Institute of Technology, USA

Optica Awards & Medals

- Edwin Land Medal, **Joseph A. Izatt**, Duke University, USA
- Adolph Lomb Medal, **Laura Waller**, University of California Berkeley, USA
- C.E.K. Mees Medal, **Halina Rubinsztein-Dunlop**, University of Queensland, Australia
- R. W. Wood Prize, **Tobias Kippenberg**, Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland
- Esther Hoffman Beller Medal, **Nicholas Massa**, Springfield Technical Community College, USA
- Stephen D. Fantone Distinguished Service Award, **Anthony M. Johnson**, University of Maryland Baltimore County (UMBC), USA

- Treasurer's Award, **Kelly Cohen**, Optica Publishing Group, USA
 - Treasurer's Award, **Terence Rooney**, Optica, USA
 - Robert E. Hopkins Leadership Award, **Pierre Chavel**, Institut d'Optique, France
 - Max Born Award, **Anne L'Huillier**, Lund University, Sweden
 - Nick Holonyak Jr. Award, **Martin D. Dawson**, University of Strathclyde and Fraunhofer, UK
 - Emmett N. Leith Medal, **Bahram Javidi**, University of Connecticut, USA
 - Paul F. Forman Team Engineering Excellence Award, **Infinera's Optical Innovation Team**, USA
 - Joseph Fraunhofer Award/Robert M. Burley Prize, **Zeev Zalevsky**, Bar-Ilan University, Israel
 - David Richardson Medal, **Majid Ebrahim-Zadeh**, ICFO-The Institute of Photonic Sciences & ICREA-Catalan Institution for Research and Advanced Studies, Barcelona, Spain
 - Edgar D. Tillyer Award, **David H. Brainard**, University of Pennsylvania, USA
 - Michael S. Feld Biophotonics Award, **Arjun Yodh**, University of Pennsylvania, USA
 - Ellis R. Lippincott Award, **Rohit Bhargava**, University of Illinois at Urbana-Champaign, USA
 - William F. Meggers Award, **Keith Nelson**, Massachusetts Institute of Technology, USA
- Optica Fellows**

Optica Fellows

Optica & Optica Foundation Recognitions (</home/program/2021-fio-ls-awards-ceremony/?videoid=6279966450001&t=1886>)

Introduction

Eric Mazur, Optica Foundation Chair

Diversity & Inclusion Recognition

- **Fujitsu Network Communications**, USA
- **ICFO**, Spain

Optica Foundation Recognitions

- Ivan P. Kamniow Early Career Professional Prize, **Brandon Buscaino**, Stanford University, USA
- Harvey Pollicove Memorial Scholarship, **Tyler Peterson**, University of Arizona, USA
- Milton and Rosalind Chang Pivoting Fellowship, **Madison Rilling**, Optonique, Québec's Photonics Cluster, Canada

APS Division of Laser Science Honors (</home/program/2021-fio-ls-awards-ceremony/?videoid=6279966450001&t=2159>)

Introduction

Randy Bartels, APS DLS Chair

APS Fellows

Carl E. Anderson Division of Laser Science Dissertation Award

Closing Remarks (</home/program/2021-fio-ls-awards-ceremony/?videoid=6279966450001&t=2253>)

Sujatha Ramanujan, 2021 Optica Awards Council Chair

Selection and Review Committee Thank You and Credits (</home/program/2021-fio-ls-awards-ceremony/?videoid=6279966450001&t=2274>)

[HOME \(/HOME/\)](#)

Special Events

Subpages ▾



Pre-Conference Events

Presenting an oral talk or poster at FIO LS? Consider participating in pre-conference sessions on preparing more effective posters and presentations. These web-based events, which are offered at no cost, are scheduled 13 - 19 October. [\[View Schedule\]](#) (</home/special-events/pre-conference-student-and-early-career-profession/>)

FiO LS Awards Ceremony

Join us as we recognize and celebrate the achievements of award and honor recipients from Optica (formerly OSA), the Optica Foundation (formerly OSA Foundation) and APS Division of Laser Science. The ceremony will include the Frederic Ives Medal/Jarus W. Quinn Prize, Honorary Members, society Fellows, and the Milton & Rosalind Chang Pivoting Fellowship.

*View the virtual ceremony (</home/program/2021-fio-ls-awards-ceremony/>)

[\[top\]](#)

The Art of Scientific Presentation

Friday, 15 October, 12:00 - 13:00

Robert Anholt is the author of the acclaimed bestselling book *“Dazzle ‘Em with Style; The Art of Oral Scientific Presentation”* and has given seminars, webinars, or workshops on presentation skills nationally at Michigan State University, Cornell University, the University of Miami, North Carolina State University, Tufts Medical Center, the Environmental Protection Agency and the University of Florida, and internationally at Beijing Forestry University, Cambridge University and the

University of Chile. A Japanese translation of the book is available from Kodansha publishers. The workshop will address how to structure a focused presentation and how to use (and not use) visual images. Dr. Anholt will also provide guidelines for an effective delivery style, including tips for foreign speakers.

Speaker: Dr. Robert R. H. Anholt

View Event Recording (<https://drive.google.com/file/d/1gbQ53j6DpvfyIJBpKPI01gYzCgzF7aso/view>)

[\[top\]](#)

Presenting Your Scientific Research: Advice for Non-Native Speakers

Tuesday, 19 October, 10:00 – 11:00

Scientific presentations are challenging to make, especially for non-native speakers. This webinar discusses a strategy especially suited for non-native speakers: the assertion-evidence approach (<http://www.assertion-evidence.com>). This approach helps speakers overcome the weak defaults of PowerPoint's defaults that pull down many presentations, especially those by non-native speakers. In this approach, speakers become more focused because they build their talks on succinct messages, not phrase headlines. Moreover, audiences comprehend more of the talk because the speakers support those messages with visual evidence. Also included in this webinar are specific tips for coming up with spoken words and for handling questions. Before attending this webinar, attendees are asked to view the first film on www.assertion-evidence.com: "PowerPoint's defaults are weak" (only 5 minutes). As an optional assignment, participants are encouraged to download a template from <http://www.assertion-evidence.com/templates.html> and create a couple of slides for their next scientific or engineering presentation.

Speaker: Michael Alley

View Event Recording (https://osa.zoom.us/rec/share/_816whFfBI5yMP6all-1350tbEN80GwvqZWNKFGOZd3Sttfv24_NIWrl55U3ARIL.edhZxK3kAMkNZmEI?startTime=1634652095000)

[\[top\]](#)

Dedicated Exhibit Time

Monday, 1 November, 08:00 – 09:00

Visit the Exhibition >>> (/home/virtual-exhibit/?utm_source=OFC&utm_medium=Schedule)

[\[top\]](#)

Optical Sensing and Instrumentation (LM3H)

Monday, 1 November, 11:00 – 12:45

Watch Recorded Session (<https://www.frontiersinoptics.com/home/schedule/?day=Monday#lm3h>)

Presenter: Hong Lin, Bates College, USA

LM3H – 1 Optimization of a laser induced fluorescence platform, Thomas Aumer, Michael Cascio, Theodore Corcovilos, Duquesne University, PA 15282. Laser Induced Fluorescence (LIF) complements mass spectrometry (MS) for protein identification by counting MS mass fragments when run in tandem with MS. Fluorescence allows for quantification: the amount of light re-emitted is proportional to sample concentration. Reactions are run on a polydimethylsiloxane microfluidic chip to minimize needed sample volumes.

LM3H – 2 Novel distance estimates to a variable star via photometric analysis, Kathryn Fagan, Cian Bell, Ben McClure, David Sukow, Washington and Lee University, Lexington, VA 24450. Via extension of photometric methods into the infrared, we generated lightcurves for a star of variable luminosity, and employed their analysis to determine its oscillation period. From formulae linking a star's metallicity to its period-luminosity relation, we derived novel distance estimates in three wavelength bands.

LM3H – 3 Numerical analysis of dynamics of vertical-cavity surface-emitting lasers subject to orthogonal and parallel optical injection, Paul Chapman, Muhammad Abdullah, Hong Lin, Bates College, Lewiston, ME 04240. We demonstrate that polarized optical injection can alter the occurrence of polarization switching and induce various dynamical phenomena (e. g. frequency locking, periodic oscillations) in vertical-cavity surface-emitting lasers, among which period-one dynamics can be used for photonic generation of microwaves. Supported by Bates College.

LM3H – 4 Developing a portable, smartphone-based Schlieren imaging system, Grace N. Riermann, Keith R. Stein, Bethel University, St. Paul, MN 55112. Schlieren imaging is a technique for visualizing fluid flows that are characterized by spatial variations in density or refractive index. Because schlieren imaging is commonly performed with expensive equipment in a lab setting, we sought cost efficiency, accessibility, and ease of fabrication by designing a portable, smartphone-based system. Supported by NSF.

LM3H – 5 Low cost laser beam stabilization and monitoring, Sara Sayer, Disleve Kanku, Cosmin Blaga, Daniel Rolles, Kansas State University, Manhattan, KS 66506. We report a laser beam pointing stabilization and monitoring apparatus designed for university-scale laser systems based on a low-cost RaspberryPi microcomputer, 4K CMOS cameras, and servo mirror mounts. A first prototype has been successfully deployed to continuously stabilize and monitor the beam over several hours. Work supported by NSF.

LM3H – 6 Ray optics invisibility cloaking using axicon lenses, Ava Ianuale¹, Eric Jones², Harold Metcalf² 1) Montclair High School, Montclair NJ 07042 2) Physics and Astronomy, Stony Brook Univ., Stony Brook NY 11794. We employed geometric optics to investigate macroscopic invisibility cloaking methods in the visible spectrum. We expanded on existing methods of cloaking to develop a model of a cloak using axicon lenses with a circular cloaking region.

LM3H – 7 Progress towards single-photon time-of-flight imaging, Kevin Eckrosh, Matthew Brown, Markus Allgaier, Brian J. Smith, Oregon Center for Optical, Molecular and Quantum Science and Department of Physics, University of Oregon, Eugene, OR 97403. The spatial distribution of a pulsed light source at the single-photon level is determined by coupling the field into an array of differing length fibers, which are fused into a single fiber. The output is monitored with a single-photon detector and time-tagging electronics. Results using attenuated laser pulses are presented.

LM3H – 8 Development of a high-speed measurement system for surface enhanced Raman spectroscopy, Sarah Bense¹, Eric Katsma¹, Makayla Schmidt¹, Marit Engevik¹, Tryg Burgau¹, Nathan Lemke¹, Ariadne Bido², Alexandre Brolo², Nathan Lindquist¹, ¹Bethel University, St Paul, MN 55127 USA; ²University of Victoria, Victoria, BC V8P 5C2, Canada. We discuss the development of a system to collect and analyze intensity and spectral data at one million frames per second. This system is then used to study the Surface-Enhanced Raman Spectroscopy (SERS) effect for single molecules in a variety of samples. Supported by NSF.

Download Symposium PDF (/getattachment/Home/Special-Events/Laser-Science-Symposium-on-Undergraduate-Research/Novel-Imaging-Methods-I-(LM4H)/Linked-v2_UG_symposium_program_FiO_LS_2021.pdf.aspx?lang=en-US)

[\[top\]](#)

Quantum Information & Quantum Optics (LM3G)

Monday, 1 November, 11:00 – 12:45

Watch Recorded Session (<https://www.frontiersinoptics.com/home/schedule/?day=Monday#lm3g>)

Presider: Eric Jones, *Stony Brook University, USA*

LM3G – 1 Quantum state tomography of polystyrene beads, *ChanJu (Zoe) You, Enrique Galvez, Colgate University, Hamilton, NY 13346*. Using quantum state tomography, we imaged and analyzed density matrices of entangled photon pairs that were sent through polystyrene microbeads. We used photons of various Bell states and mixed states, as well as different band-pass filters to observe the resulting decoherence. This work was supported by Colgate University.

LM3G – 2 Generation of polarization entangled photons using spontaneous parametric down conversion, *Peter Menart, Gregory Lafyatis, Daniel Gauthier, The Ohio State University, Columbus, OH 43210*. Polarization entangled photons are generated and detected using single photon detectors. An inexpensive Cyclone V FPGA is employed to time photon incidences. The Cyclone V allows photons to be tagged in 5-ns bins and has an integrated hard processing system, eliminating the need for a computer.

LM3G – 3 Quantum entanglement and Bell's inequality, *Otto Nicholson¹, Jianneng Yu², Eric Jones², Harold Metcalfe², 1) Williams College, Williamstown, MA 01267 2) Stony Brook University, Stony Brook, NY 11794*. We used spontaneous parametric down conversion (SPDC) of 405 nm pump laser light by barium borate crystals to create a Bell state to demonstrate quantum entanglement. Looking at the coincidences and calculating the Clauser, Horne, Shimony, and Holt (CHSH) value called S, we see that our results must come from entanglement.

LM3G – 4 Correlation measurements and data acquisition system using field programmable gate array, *Apoorva Bisht, Hiro Nakamura, University of Arkansas, Fayetteville, AR 72701*. We developed a photon correlation measurement setup by utilizing field programmable gate array (FPGA). FPGA will be used to enable advanced photon manipulations such as temporal multiplexing of single photons in the future. Demonstration of coherent and bunched light is demonstrated using an unmodulated and modulated laser light. Supported by Honors College Research Grant and Fui T. Chan and Kaiyuan Chen Endowed Research Scholarship.

LM3G – 5 Optics and opto-mechanics in quantum computing, *Rebeca Reyes Carrión^{1,2}, Jay Esposito², Bryan Spann², Sean Braxton², Tehseen Abidi², 1) University of Puerto Rico at Mayagüez, Mayagüez PR 00681 2) Honeywell Quantum Solutions, Broomfield CO 80021*. Trapped-ion quantum computing relies on laser beam alignment and stability to enable light-matter interactions ranging from atomic state preparation to quantum gate computations. Further, optical detection and measurement of the ions' fluorescence facilitates computational functions. Several techniques were implemented to optimize beam shape and intensity across the ion crystal.

LM3G – 6 Using machine learning to find the adiabatic shortcut, *Livia Guttieres¹, Murray Holland², Liang-Ying Chih², 1) the University of Chicago, Chicago, IL 60637 2) University of Colorado, Boulder, CO 80309*. We use tabular-Q reinforcement learning, to find the optimal evolution trajectory of a particle quantum-state system to a desired target state. We mitigate the issue of incoherent jumps and energy population dispersion due to the structural noise of laser cooling by evolving the system with an optimal path shortcut. Work supported by the NSF through the JILA REU.

LM3G – 7 Identification of quantum jumps in trapped Barium ions, *Akanksha Mishra, Liudmila Zhukas, Boris Blinov, Univ. of Washington, Dept. of Physics, Seattle, WA 98195*. Trapped ions are an approach to quantum computing that proposes to store qubits in the stable electronic states of trapped atomic ions. In this talk we discuss some novel methods to visualize randomly occurring quantum jumps and identify the qubit state of individual ions.

LM3G – 8 Efficient adiabatic rapid passage in the presence of noise, *Kehui Li, David Spierings, Aephraim M. Steinberg, University of Toronto, Toronto, ON M5S 1A1, Canada*. We study ARP in a two-level system under fluctuating perturbations by numerically solving the optical Bloch equations without damping, and find that population transfer is strongly affected by resonances with the noise. Further, we propose a sufficient condition for the population transfer to be above an arbitrary threshold. Supported by the Natural Sciences and Engineering Research Council of Canada.

[Download Symposium PDF \(/getattachment/Home/Special-Events/Laser-Science-Symposium-on-Undergraduate-Research/Entangled-Light-Twisted-Light-Applications-\(LM5G\)/Linked-v2_UG_symposium_program_FIO_LS_2021.pdf.aspx?lang=en-US\)](/getattachment/Home/Special-Events/Laser-Science-Symposium-on-Undergraduate-Research/Entangled-Light-Twisted-Light-Applications-(LM5G)/Linked-v2_UG_symposium_program_FIO_LS_2021.pdf.aspx?lang=en-US)

[\[top\]](#)

Novel Imaging Methods (LM5H)

Monday, 1 November, 14:00 – 15:30

Watch Recorded Session (<https://www.frontiersinoptics.com/home/schedule/?day=Monday#lm5h>)

Presider: Nathan Lindquist, *Bethel University, USA*

LM5H – 1 Applications of electron microscopy in preparation for lensless strain imaging, Landon Schnebly, Richard Sandberg, McKayla Townsend, Hyrum Taylor, Naomi Jensen, Nick Porter, Matt Wilkin, Anastasios Pateras, Anthony Rollett, Yueheng Zhang, Ross Harder, Wonsuk Cha, Barbara Frosik, *Brigham Young University, Provo, UT 84601*. We seek to use x-ray coherent diffraction imaging (CDI) to study how defects in a polycrystalline metal are transmitted under strain. The constraints necessary for 3D image retrieval will be explained. Methods of electron microscopy used to analyze and prepare samples for beamline experiments will also be discussed.

LM5H – 2 Re-focusing detection in a temporal focusing microscope, Sam Yurak, Michael E. Durst, *Middlebury College, Middlebury, VT 05753*. An electrically tunable lens can be used in the detection path of a fluorescence microscope to adjust the depth in focus without changing image magnification. We synchronize this with remote axial scanning in a two-photon temporal focusing microscope to achieve wide-field optical sectioning. Supported by the NIBIB of the NIH (R15EB025585).

LM5H – 3 Using a spatial filter to reduce noise in optical diffraction, Katie Canavan, Raffaella Zanetti, Asia Baker, Jenny Magnes, *Vassar College, NY 12604*. We analyze the locomotion of *C. elegans* through laser diffraction. We use a spatial filter and an assortment of lenses to ensure the laser beam intensity is uniform. As a result, we eliminated unintended noise in the dynamic diffraction pattern of a live nematode.

LM5H – 4 Visualizing mechanical deflection with image-plane digital holographic interferometry, Tristan Noble, Nathan Lindquist, *Bethel University, St Paul, MN 55112*. We use image-plane digital holography to measure mechanical deflections of a beam under various loads. The numerical interference between holograms of a loaded and an unloaded beam directly visualizes the bending contours. We also explore phase shifting techniques to remove uncertainty in deflections of more than one wavelength. Supported by NSF.

LM5H – 5 High-resolution nonlinear pattern formation, Mateo Murillo, Sean Bentley, *Adelphi University Department of Physics, Garden City, NY 11530*. An interferometric optical system for writing arbitrary 2-D patterns on nonlinearly absorbing substrates at a resolution better than normally allowed by the Rayleigh criterion is studied. Both computer simulations and experimental verifications are performed. Details of the system along with preliminary results will be presented. This work was supported by the Horace McDonell Fellowship.

LM5H – 6 Non-linear dynamics of confined Leidenfrost drop, Tianrui Wu¹, Jenny Magnes², Harold Hastings³, 1) *Duke University, Durham, NC 27708*, 2) *Vassar College, Poughkeepsie, NY 12604*, 3) *Bard College at Simon's Rock, Great Barrington, MA 01230*. We constructed and analyzed an experimental non-linear dynamical system utilizing Leidenfrost drops confined in spherical dish with video processing methods, frequency domain analysis, and recurrence methods. We found a combined stochastic relaxation process with an embedding dimension of 3 and positive Lyapunov exponents of magnitude approximately 1 / s, displaying markers of low-dimensional chaos.

LM5H – 7 Observation of coherent backscattering for detection of physical state changes, Claire Yang¹, Eric Jones², Harold Metcalf², Martin Cohen², 1) *Ward Melville High School, East Setauket, NY 11733*, 2) *Dept. of Physics and Astronomy, Stony Brook University, Stony Brook, NY 11794*. Coherent backscattering is an interference phenomenon that produces an

enhanced intensity profile in the backscattering direction. We observed this effect with improved clarity from previous studies and used it in the detection of physical state changes, where the size of and distance between the scattering centers of the medium change.

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[\[top\]](#)

Optical Lattices, Atom Interferometry, Atom Magnetometry (LM5G)

Monday, 1 November, 14:00 – 15:30

Watch Recorded Session (<https://www.frontiersinoptics.com/home/schedule/?day=Monday#lm5g>)

President: Seth Aubin, *College of William and Mary, USA*

LM5G – 1 An atomic magnetometer for charged particle detection based on nonlinear magneto-optical polarization rotation, *Jiahui Li, Irina Novikova, College of William and Mary, VA 23187*. We built a magnetometer using modulated light that induces polarization rotations at a strong magnetic field. We have achieved an operation range at 100mG level with 0.5nT sensitivity. Such a magnetometer is able to measure the trajectory of charged particles.

LM5G – 2 Observation of stochastic resonance and unidirectional ratcheting in an optical lattice, *Casey Scoggins, Daniel Wingert, Jordan Churi, Kefeng Jiang, Ian Dilyard, Samir Bali, Miami University, Oxford, OH 45056*. We illuminate cold atoms diffusing inside an optical lattice with a weak probe and detect directed atomic propagation perpendicular to the probe propagation. The directed propagation is resonantly enhanced by varying the photon scattering rate - a signature of stochastic resonance. Unidirectional ratcheting is achieved by varying the probe's angle of incidence on the lattice. Supported by ARO.

LM5G – 3 Frequency measurement of two optical rubidium atomic clocks, *Kristina Boecker, River Beard, John McCauley, Nathan Lemke, Bethel University, MN 55112*. We developed a system featuring two two-photon rubidium clocks and a measurement of the frequency gap between Rb-87 and Rb-85 transitions. We assessed the effectiveness of an alternating current resistive heater and magnetic field coils used to avoid frequency shifts in the atomic transitions. Work funded by the NASA Minnesota Space Grant Consortium.

LM5G – 4 Polarization-sensitive intensity correlations to probe atomic transport in an optical lattice, *Jordan Churi¹, Angela Noreck², and Samir Bali¹*, *1) Miami University, Oxford, OH 45056 2) Cleveland State University, Cleveland OH 44115*. Following C. Jurczak, et al, Phys. Rev. Lett 77, 1727 (1996) we seek to detect polarization-sensitive intensity correlations in light scattered by atoms confined in an optical lattice. The goal is to directly measure the dwell time of atoms in wells, and the time taken to hop between adjacent wells. Work supported by NSF-REU and ARO.

LM5G – 5 Redevelopment of magneto optical trap, *Paul Russell, Mara Klebonas, and Matthew Wright, Adelphi University, NY 11350*. We have worked on rebuilding a magneto optical trap previously used by our lab group. We have set up an additional laser for the repump frequency which is locked to a sideband on the trap laser which is generated by phase modulation at 6.7 GHz. This apparatus will be used to study the control of ultracold collisions with frequency-chirped light.

LM5G – 6 Enhancing atom interferometry with quantum optimal control, *Garrett Louie and Timothy Kovachy, Northwestern University, Evanston, IL 60208*. Using numerical quantum optimal control, we have developed robust light-pulse atom optics for several techniques in large momentum transfer (LMT) atom interferometry, including multi-photon Bragg diffraction and clock interferometry. Motivations and progress on implementation will be discussed. Supported by Northwestern University.

LM5G – 7 Coaxial cable to microstrip interfacing for a microwave atom chip, Cate Sturmer, Morgan Logsdon, Sindu Shanmugas, Seth Aubin, The College of William and Mary, Williamsburg, VA 23185. Integrating microwaves into an atom chip enables spin specific traps for atom interferometry but requires efficient coupling of microwaves into and out of the chip. Computer simulations are used to design a broadband, low reflection, 50Ω interface from coaxial cable to microstrip via tapered co-planar waveguide. Work supported by NSF, DTRA, and VMEC/ARL-NVESD.

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[\[top\]](#)

Twisted Light and Ultrafast Light (LM6F)

Monday, 1 November, 15:45 – 17:05

Watch Recorded Session (<https://www.frontiersinoptics.com/home/schedule/?day=Monday#lm6f>)

President: Michael Durst, Middlebury College, USA

LM6F – 1 Experimental gravitational lensing by two-body and elliptical systems, Thao Nguyen, Enrique Galvez, Colgate University, Hamilton NY 11346. Using a spatial light modulator, we mimic the effect of gravity and steer the light from a laser such that the phase of the light follows logarithmic dependence with its impact parameter. From symmetric lensing objects, we move onto gravitational lensing by two-body and elliptical systems with orbital angular momentum.

LM6F – 2 Generation of Laguerre-Gauss (LG) beams, Hope Dannar^{1,2}, Reeta Vyas², and Surendra Singh², 1) University of Northern Colorado, Greeley, CO 80639, 2) University of Arkansas, Fayetteville, AR 72701. We describe a mode converter based on a single cylindrical lens instead of two and demonstrate its use to transform Hermite-Gauss beams from a laser into Laguerre-Gauss beams. We also describe the design of a laser cavity for generating LG beams inside the cavity. Supported by NSF Grant # 1851919.

LM6F – 3 Topological stability of stored Bessel beams in Rubidium vapor, Scott Wenner, Jianqiao Li, Reese Tyra, Samir Bali, Miami University, Oxford, OH 45056. We store Bessel beams in warm rubidium vapor via electromagnetically induced transparency, and show that degradation of stored information due to atomic diffusion is suppressed. For comparison, we store an “imposter Bessel” beam generated by passing a Gaussian beam through two dark rings and show that the beam profile degrades rapidly. Supported by ARO.

LM6F – 4 Characterization of femtosecond UV pulses using an autocorrelator, Katya Mikhailova, Zane Phelps, Surjendu Bhattacharyya, Anbu Venkatachala, Daniel Rolles, Kansas State University, Manhattan, KS 66506. The characterization of ultrafast laser pulses is essential for determining the scope and capability of ultrafast experiments. Using an autocorrelator and subsequent data analysis techniques, we developed a robust and wavelength-independent measurement of both pulse duration and chirp for sub-100 fs UV pulses. Supported by NSF & DOE.

LM6F – 5 Supercontinuum generation with tunable dispersion, Ruben Vargas, Michael E. Durst, Middlebury College, Middlebury, VT 05753. We numerically and experimentally investigate the effect of dispersion tuning on supercontinuum generation in a photonic crystal fiber. We tune the dispersion in a 4f grating pair pulse shaper and measure the changes to the output spectrum. We compare our numerical results using split-step Fourier method in Python to spectrometer data. Supported by the NIBIB of the NIH (R15EB025585).

LM6F – 6 Measuring the intensity of a Gaussian beam and converting an extreme ultraviolet beam polarization from linear to circular, Kaylee Radford, Taylor Buckway, William Giforos, Richard Sandberg, Brigham Young University UT 84602. We measured the intensity of an ultra-short pulse titanium-doped sapphire (Ti:Sapph) laser using the knife edge method. We then implemented a MACH-ZEHNDER-LESS for Threefold Optical Virginia spiderwort (MAZEL-TOV) setup to convert the polarization of the beam from linear to circular. This work was supported by NSF grant # 2051129.

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[\[top\]](#)

Optical Spectroscopy (LM6G)

Monday, 1 November, 15:45 – 17:05

Watch Recorded Session (<https://www.frontiersinoptics.com/home/schedule/?day=Monday#lm6g>)

Presider: Jenny Magnes, *Vassar College, USA*

LM6G – 1 Modeling mode shifts in astro-etalons for high precision spectrographic calibration. Molly Kate Kreider^{1, 2}, Scott Diddams², Ryan Terrien³, 1) *Univ. of Richmond, Richmond, VA 23173*, 2) *National Institute of Standards and Technology, Boulder, CO 8035*, 3) *Carleton College, Northfield, MN 55057*. Ultra-stable etalons operating over a 500 nm wavelength range are used for spectrograph calibration in radial velocity exoplanet detection. We use Fresnel analysis and the transfer matrix method to model the multi-layer dielectric etalons to explain the observed wavelength-dependent mode position variations. The impact of temperature and alignment variations was studied. Supported by NIST SURF.

LM6G – 2 Infrared laser spectroscopy of lead: measuring isotope shifts in the electron affinity of Pb, Fabrizio E. Vassallo, N. Daniel Gibson, C. Wesley Walter, *Denison University, Granville, OH 43023*. We measured the electron affinities of the three abundant isotopes of lead using tunable laser negative ion photodetachment spectroscopy, observing s-wave thresholds for ground state detachment. The high precision of our experiment permitted us to resolve a discrepancy between previous studies of the isotope shifts. Supported by NSF and the William G. & Mary Ellen Bowen Research Endowment.

LM6G – 3 Experimental observation of high-speed fluctuations in surface enhanced Raman spectroscopy, Makayla Schmidt¹, Sarah Bense¹, Marit Engevik¹, Tryg Burgau¹, Nathan Lemke¹, Ariadne Bido², Alexandre Brolo², Nathan Lindquist¹, 1) *Bethel Univ., St Paul, MN 55127*, 2) *Univ. of Victoria, Victoria, BC V8P 5C2, Canada*. Surface-Enhanced Raman Spectroscopy (SERS) is an optical effect with single-molecule sensitivity. Because these SERS signals fluctuate at very high speeds, here we use a system that collects fluctuation data at one million frames per second. We outline various SERS samples and experimental conditions to observe these high-speed fluctuations. Supported by NSF.

LM6G – 4 Building an ultra-low frequency Raman spectroscopy system, Mark Whitley, Hiro Nakamura, *University of Arkansas, AR 72701*. We built a Raman spectroscopy system able to detect ultra-low frequency Raman shifts using volume Bragg filters. The system, which includes a refurbished spectrometer, was calibrated using Hg lines, and its low-frequency resolution was demonstrated using sulfur. A capability to measure monolayer WSe₂ is also shown. Supported by National Science Foundation funded Research Experiences for Undergraduate program.

LM6G – 5 Determination of Potassium fine-structure mixing and quenching cross-sections in Helium and Methane buffer gas, Quincy Zawadzky¹, Alina Gearba¹, Randy Knize¹, and Jerry Sell², 1) *US Air Force Academy, CO 80840*, 2) *Energy and Photonics Consulting, Inc., CO 80132*. We implement a method to determine mixing and quenching cross sections for a combination of potassium with different buffer gases. This is accomplished using ultrafast laser excitation and time-correlated single-photon counting. The cross-sections are then determined as a function of buffer gas pressure and temperature.

LM6G – 6 Development of an oceanographic lidar to measure the vertical distribution of particles, Jason Boynewicz, Brian Collister, Richard Zimmerman, Charles Sukenik, Victoria Hill. *Old Dominion University, Norfolk, VA 23529*. We are developing an oceanographic lidar system to measure the vertical distribution of ocean particles to properly model the biogeochemical processes occurring in the upper ocean. In addition, we created models to understand how refraction by ocean surface waves impact the maximum resolution of active remote sensing. Support by NOAA and the Virginia Research Investment Fund.

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[\[top\]](#)

Optics in Biological Systems (LM7A)

Monday, 1 November, 17:20 – 18:40

Watch Recorded Session (<https://www.frontiersinoptics.com/home/schedule/?day=Monday#lm7a>)

Presider: Catherine Herne, State University of New York at New Paltz, USA

LM7A – 1 Toward two-photon absorption spectra of long-wavelength dyes used in fluorescence-guided surgery, Isabel M. Linhares, Michael E. Durst, Middlebury College, VT 05753. We observe two-photon excitation of long-wavelength dyes in the near-infrared region using an optical parametric amplifier. These two-photon absorption spectra determine the optimal wavelengths for the two-photon excitation of these dyes used in fluorescence-guided surgery. Supported by the NIBIB of the NIH (R15EBO25585).

LM7A – 2 Attachment force of B. Bacteriovorus on E. coli over short time scales, Carrie Smithing, Catherine Herne, State University of New York at New Paltz, NY 12561. *Bdellovibrio bacteriovorus* is a predatory bacteria being considered as an alternative to antibiotics. Using an optical tweezer setup, we attach *B. bacteriovorus* to its prey, *Escherichia coli*, and measure the attachment force over short attachment times. The force is a minimum of a few piconewtons and potentially much greater. Support provided by the Kyncl Experiential Scholarship.

LM7A – 3 Using optical trapping and stretching of biological cells to characterize cell health, Sofia Brown¹, Sunday Ajala², Festus Bett², Aotuo Dong², Sacharia Albin², Aylin Marz², Makarand Deo² 1) The College of William and Mary, Williamsburg, VA 23185 2) Norfolk State Univ, Norfolk, VA 23504. We performed non-contact trapping and stretching of biological cells using dual-beam optical tweezer. The extent of cell deformation was higher for higher trapping powers and varied based on the cell types. This technique is useful in cell sorting and disease identification by quantifying cytoskeletal elasticity in cells. Supported by NSF (grant 1954330) and by the Virginia Microelectronics Consortium (VMEC).

LM7A – 4 Analyzing C. elegans locomotion using optical microscopy, Asia Baker, Raffaella Zanetti, Katie Canavan, Jenny Magnes, Vassar College, NY 12604. By using optical microscopy, we can analyze the locomotion of *C. elegans*. Our team determined that the microscope requires a higher numerical aperture to resolve the nematodes. As a result of increasing the aperture, our team produced videos at a higher resolution which enhanced the tracking of the nematode's locomotion.

LM7A – 5 On-demand current pulse activation of rf monopole antenna biosensor arrays with Nitrocellulose membranes, Sindu Shanmugas¹, Jonathan Lundquist², Erdem Topsakal², Umit Ozgur², Vitaliy Avrutin² 1) The College of William & Mary, Williamsburg, VA 23185, 2) Virginia Commonwealth University, Richmond, VA 23284. Continuous biosensors are rendered useless by our body in 14 days. Therefore, we propose a skin-patch with an array of RF quarter-wave monopole antenna biosensors. Combustible nitrocellulose membranes prevent early contact with the interstitial fluid. A current pulse applied to disintegrate a membrane activates a new sensor in the array. Research supported by VMEC.

LM7A – 6 Illuminating C. elegans locomotion with laser diffraction, Raffaella Zanetti, Katie Canavan, Asia Baker, Jenny Magnes, Vassar College, NY 12604. *C. elegans*' locomotion illuminates neuronal dynamics. Observing with high resolution laser diffraction, we recorded dynamic diffraction patterns using optics, analyzed as a pixel's time series of intensity. As indicated by chaotic markers, the sample's movement was accurately represented. Each time series is compared to nematode computer simulations, improving our understanding.

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[\[top\]](#)

Laser Systems Technical Group Campfire Session: Breakthrough Starshot - The Path to the World's Largest Laser for Interstellar Lightsail Propulsion

Monday, 1 November, 18:00 – 19:00

You are invited to join the Optica Technical Group on Laser Systems for a campfire session at Frontiers in Optics. Sending a probe to our neighboring Alpha Centauri system requires speeds of order 20% the speed of light. A laser pushed lightsail has been proposed to meet this goal, requiring a 200 GW, 3 km diameter laser. In this campfire session, Wesley Green will present on the technical and cost challenges associated with Breakthrough Starshot as well as discuss the latest progress in early concept development and research. Following the talk from Wesley, the remainder of the session will be open for discussion so come with your thoughts and questions ready. You will be able to turn your camera and mic on or off to participate as you choose.

[\[top\]](#)

Optica Imaging Optical Design Technical Group Special Talk

Monday, 1 November, 18:00 – 19:00

You are invited to join the Optica Technical Group on Imaging Optical Design for a special talk featuring David Shafer (David Shafer Optical Design). David will share highlights from his work in optical design, including discussing now declassified Cold War projects and designing a novel stereo viewer for Salvador Dali. The talk will be followed by a moderated question and answer session.

[\[top\]](#)

Physicist Random Walk: Careers, Graduate School, & Mental Maintenance (SpE26)

Monday, 1 November, 19:00 – 19:45

Watch Recorded Session (<https://www.frontiersinoptics.com/home/schedule/?day=Monday#spe26>)

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

The Laser Science 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 twenty 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, Optica (formerly OSA), NSF, SPS, and Univ. MD (JQI), along with corporate sponsors Thorlabs, Photonics Industries, and East Coast Optical Technologies.

Speaker: Brad Conrad, *Director, Society of Physics Students & Sigma Pi Sigma*

Presider: Harold Metcalf, *Stony Brook University, USA*

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[\[top\]](#)

Dedicated Exhibit Time

Tuesday, 2 November, 10:00 – 11:00

[Visit the Exhibition >>> \(/home/virtual-exhibit/?utm_source=OFC&utm_medium=Schedule\)](/home/virtual-exhibit/?utm_source=OFC&utm_medium=Schedule)

[\[top\]](#)

Ultra-Intense Laser Science and Technology

Tuesday, 2 November, 10:30 – 11:30

The panel will present the status of international scientific work in ultra-intense lasers and related fields. The discussion will include leaders of the U.S. Brightest Light Initiative (BLI) and the international Multi-Petawatt Physics Prioritization (MP3) workshop. The speakers will make introductory presentations and then address questions from the audience.

Panelists:

Félicie Albert, *Lawrence Livermore National Laboratory, USA*

Antonino Di Piazza, *Max-Planck-Institut für Kernphysik, Germany*

Roger Falcone, *UC Berkeley, USA*

Louise Willingale, *University of Michigan, USA*

Jonathan Zuegel, *University of Rochester, USA*

[\[top\]](#)

Meet the APS Physical Review Editors

Tuesday, 2 November, 11:00 – 12:30

Editor-in-Chief, Michael Thoennessen and several editors for Physical Review journals, including the new journal PRX Energy, will talk about the current and future perspectives of the Physical Review journals portfolio. After the brief presentations by relevant journals there will be time for comments, questions and suggestions.

Moderator:

Stojan Rebic, Co-Managing Editor, *PRX Quantum* and Associate Editor, *PRL*

Panelists:

Katiuscia Cassemiro, Co-Managing Editor, *PRX Quantum*

Jacilynn Brant, Managing Editor, *PRX Energy*

Matt Eager, Managing Editor, *PRApplied*

Sonja Grondalski, Associate Editor, *PRL*

Ling Miao, Managing Editor, *PRX*

Xiangyu Yin, Associate Editor, *PRA*

[\[top\]](#)

Hot Topic Coffee Break: The Time Is Now - Latest Developments from the AIP TEAM-UP Report

Tuesday, 2 November, 14:00 – 14:20

Speaker: Arlene Modeste Knowles, *TEAM-UP Project Manager, AIP, USA*

In 2020, The American Institute of Physics released its groundbreaking report, *The Time is Now: Systemic Changes to Increase African Americans with Bachelor's Degrees in Physics & Astronomy* (<https://www.aip.org/sites/default/files/aipcorp/files/teamup-full-report.pdf>) following a rigorous research study to understand the reasons for the persistent underrepresentation of African American students earning bachelor's degrees in these fields. In this webinar, we will present the findings from this study and discuss current efforts to implement the report's recommendations among a select group of physics and astronomy departments committed to systemic change.

Presented By

AIP | American Institute of Physics

[\[top\]](#)

Technology Showcase: Luminate 2021 Industry-First Technology Winners

Tuesday, 2 November, 14:20 – 14:40

See four emerging technologies that will change capabilities in a wide range of industries, including:

- Intelligent, active sensors from PreAct Technologies (<https://www.preact-tech.com/>) that can anticipate a collision and customize vehicle adjustments to reduce injuries and death;
- Transparent solar technologies from Andluca Technologies (<https://andluca.com/>) that selectively and efficiently convert ultraviolet (UV) light to electricity;
- A new kind of power generator created by Mesodyne (<https://www.mesodyne.com/>) that converts fuel to electricity via light;
- The first cuff-less, wrist-wearable technology to offer direct, beat-to-beat measurement of blood pressure with the accuracy of intra-arterial lines, developed by Dynocardia (<https://www.dynocardia.care/>).

These inventions took top honors in Sept. at Luminate Finals 2021, an international startup accelerator that recognizes the best breakthrough technologies enabled by optics, photonics, and imaging. Attendees will see rapid technology demonstrations followed by a chance to speak with founders about the technologies and their potential.

Speakers:

Kurt Brendley, *COO, PreAct Technologies*

Nick Davy, *CEO/CTO, Andluca*

Dr. Veronika Stelmakh, *Co-Founder & CEO, Mesodyne*

Mohan Thanikachalam, MD; *Co-Founder & CEO, Dynocardia*

Presented By



[\[top\]](#)

Congressional Fellowship Q&A: A Unique Career Opportunity for Scientists and Engineers

Tuesday, 2 November, 15:00 – 16:00

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 policy-making process, and how the experience has impacted their careers.

Moderator:

Brandy Dillingham, *Optica, USA*

Panelists:

Michelle Solomon, *2020-2021 Arthur H. Guenther Congressional Fellow*

Benjamin Isaacoff, *2018-2019 Arthur H. Guenther Congressional Fellow*

Learn more: www.optica.org/congressionalfellows (<http://www.optica.org/congressionalfellows>)

[\[top\]](#)

Optica Annual Business Meeting

Tuesday, 2 November, 17:30 – 18:15

Pre-registration required

Learn more about Optica (formerly OSA) and join the 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.

This event is open to Optica Members only.

[\[top\]](#)

DLS Annual Business Meeting

Tuesday, 2 November, 17:30 – 18:15

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 virtual audience. 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

***Please note:** You may register for FIO/LS under the Events + Exhibits Pass option for access to this meeting and all other special events at no charge. If you intend to access this meeting individually, please [join here](https://osa.zoom.us/j/96014480505) (<https://osa.zoom.us/j/96014480505>).

[\[top\]](#)

Optica Fiber Modeling and Fabrication Technical Group Special Talk

Wednesday, 3 November, 11:00 – 12:00

Join the Fiber Modeling and Fabrication Technical Group for a special talk from Andrey Pryamikov of the Fiber Optics Research Center RAS entitled “The Story of Negative Curvature Fibers: From Its Inventors.” Pryamikov’s talk will address a wide range of problems related to the design and production of new types of hollow core fibers, called hollow core antiresonant fibers or hollow core fibers with negative curvature core - cladding boundary. Following the talk will be a moderated question and answer session.

[\[top\]](#)

Optica NonImaging Optical Design Technical Group Special Talk

Wednesday, 3 November, 11:00 - 12:00

You are invited to join the Optica Technical Group on NonImaging Optical Design for a special talk featuring Locke Spencer from the University of Lethbridge. Our featured presenter will give a talk on their research, which will be followed by a moderated question and answer session.

[\[top\]](#)

Dedicated Exhibit Time

Wednesday, 3 November, 11:00 - 23:00

Visit the Exhibition >>> (/home/virtual-exhibit/?utm_source=OFC&utm_medium=Schedule)

[\[top\]](#)

Women at FIO Coffee Break

Wednesday, 3 November, 14:00 - 14:30

Grab your coffee, soda or beverage of your choice and join other women attending FIO2021 for an informal virtual get together. FIO Committee member Abbie Watnik, *Naval Research Laboratory, USA* will join Marcia Lesky, *Optica Senior Director of Diversity, Inclusion & Volunteer Cultivation* to share information on Optica’s diversity and inclusion efforts. Join us to chat with other women in optics and share your ideas on helping ensure our community and this meeting is as welcoming and inclusive as possible.

[\[top\]](#)

Color Technical Group Coffee Break

Wednesday, 3 November, 19:30 - 20:30

The Color Technical Group invites you to join them for a virtual coffee break. Grab a cup of coffee and join us for a chance to chat with your fellow vision scientists. The coffee break will be held in Wonder.me and you will have the chance to move freely around the virtual space to engage your colleagues in conversation.

[\[top\]](#)

Topological Insulator Lasers

Thursday, 4 November, 11:00 – 11:30

Speaker: Moti Segev, *Technion, Israel Institute of Technology, Israel*

Topological insulator lasers are arrays of semiconductor emitters arranged on a photonic chip in a topological structure that forces the emitters to lock coherently and act as a single laser. The concepts of these lasers will be described, including the recent advances on topological insulator VCSELs.

[\[top\]](#)

Hot Topic Coffee Break: Will Congress provide a windfall for science budgets?

Thursday, 4 November, 12:40 – 13:00

Speaker: Mitch Ambrose, *FYI Director, AIP, USA*

The U.S. Congress is currently debating multiple proposals to channel tens of billions of dollars into new research initiatives, including in fields related to optics and photonics. This webinar will describe the current state of the debate using information from FYI, a science policy news service from the American Institute of Physics. This webinar will also describe FYI's resources for monitoring federal budgets and legislation.

Presented By

AIP | American Institute of Physics

[\[top\]](#)

Optica Fiber Optics Technology & Applications Technical Group Special Talk on Fiber Sensors

Thursday, 4 November, 13:00 – 13:45

Join the Fiber Optics Technology & Applications Technical Group for a special talk from Francesco Poletti, University of Southampton, entitled “Hollow Core Fibers: when less (glass) is more (optical performance).” Hollow core nested antiresonant nodeless fibers (NANFs) have recently bridged the performance gap with (and sometimes outperformed) well-established all-glass fibers. Dr. Poletti's talk will review the technology, its current performance and future potential, and the most recent experiments in data transmission and sensing. Following the talk will be a moderated question and answer session.

[\[top\]](#)

Dedicated Exhibit Time

Thursday, 4 November, 13:00 – 14:00

[Visit the Exhibition >>> \(/home/virtual-exhibit/?utm_source=OFC&utm_medium=Schedule\)](/home/virtual-exhibit/?utm_source=OFC&utm_medium=Schedule)

[\[top\]](#)

Nonlinear Optics Technical Group Coffee Break

Thursday, 4 November, 14:00 - 15:00

Join the Nonlinear Optics Technical Group for a virtual coffee break at FiO. This informal networking session will offer students and junior researchers a chance to connect with senior researchers in the field. Attendees will have the opportunity to move around Zoom breakout rooms to have small group discussions with their fellow nonlinear optics community members.

[\[top\]](#)

[HOME \(/HOME/\)](#) > [SPECIAL EVENTS \(/HOME/SPECIAL-EVENTS/\)](#)

Laser Science Symposium on Undergraduate Research



Monday, 01 November, 11:00 - 19:45

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

The Laser Science 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 twenty years, and has showcased the research of more than 700 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, Optica (formerly OSA), NSF, SPS, and Univ. MD (JQI), along with corporate sponsors Thorlabs, Photonics Industries, and East Coast Optical Technologies.

The Laser Science Symposium on Undergraduate Research will run two parallel sessions at each time frame.

[Symposium PDF and Schedule \(/getattachment/Home/Special-Events/Laser-Science-Symposium-on-Undergraduate-Research/Linked-v2_UG_symposium_program_FiO_LS_2021.pdf.aspx?lang=en-US\)](#)

Expand to view presentations and recorded sessions.

11:00 - 12:45 **Quantum Information & Quantum Optics (LM3G)**

Expand for Presentations »

Watch Recorded Session

(<https://www.frontiersinoptics.com/home/schedule/?day=Monday#lm3g>)

Presider: Eric Jones, *Stony Brook University, USA*

LM3G – 1 Quantum state tomography of polystyrene beads, *ChanJu (Zoe) You, Enrique Galvez, Colgate University, Hamilton, NY 13346.* Using quantum state tomography, we imaged and analyzed density matrices of entangled photon pairs that were sent through polystyrene microbeads. We used photons of various Bell states and mixed states, as well as different band-pass filters to observe the resulting decoherence. This work was supported by Colgate University.

LM3G – 2 Generation of polarization entangled photons using spontaneous parametric down conversion, *Peter Menart, Gregory Lafyatis, Daniel Gauthier, The Ohio State University, Columbus, OH 43210.* Polarization entangled photons are generated and detected using single photon detectors. An inexpensive Cyclone V FPGA is employed to time photon incidences. The Cyclone V allows photons to be tagged in 5-ns bins and has an integrated hard processing system, eliminating the need for a computer.

LM3G – 3 Quantum entanglement and Bell's inequality, *Otto Nicholson¹, Jianneng Yu², Eric Jones², Harold Metcalf², 1) Williams College, Williamstown, MA 01267 2) Stony Brook University, Stony Brook, NY 11794.* We used spontaneous parametric down conversion (SPDC) of 405 nm pump laser light by barium borate crystals to create a Bell state to demonstrate quantum entanglement. Looking at the coincidences and calculating the Clauser, Horne, Shimony, and Holt (CHSH) value called S, we see that our results must come from entanglement.

LM3G – 4 Correlation measurements and data acquisition system using field programmable gate array, *Apoorva Bisht, Hiro Nakamura, University of Arkansas, Fayetteville, AR 72701.* We developed a photon correlation measurement setup by utilizing field programmable gate array (FPGA). FPGA will be used to enable advanced photon manipulations such as temporal multiplexing of single photons in the future. Demonstration of coherent and bunched light is demonstrated using an unmodulated and modulated laser light. Supported by Honors College Research Grant and Fui T. Chan and Kaiyuan Chen Endowed Research Scholarship.

LM3G – 5 Optics and opto-mechanics in quantum computing, *Rebeca Reyes Carrión^{1,2}, Jay Esposito², Bryan Spann², Sean Braxton², Tehseen Abidi², 1) University of Puerto Rico at Mayagüez, Mayagüez PR 00681 2) Honeywell Quantum Solutions, Broomfield CO 80021.* Trapped-ion quantum computing relies on laser beam alignment and stability to enable light-matter interactions ranging from atomic state preparation to quantum gate computations.

Further, optical detection and measurement of the ions' fluorescence facilitates computational functions. Several techniques were implemented to optimize beam shape and intensity across the ion crystal.

LM3G – 6 Using machine learning to find the adiabatic shortcut, *Livia Guttieres¹, Murray Holland², Liang-Ying Chih², 1) the University of Chicago, Chicago, IL 60637 2) University of Colorado, Boulder, CO 80309.* We use tabular-Q reinforcement learning, to find the optimal evolution trajectory of a particle quantum-state system to a desired target state. We mitigate the issue of incoherent jumps and energy population dispersion due to the structural noise of laser cooling by evolving the system with an optimal path shortcut. Work supported by the NSF through the JILA REU.

LM3G – 7 Identification of quantum jumps in trapped Barium ions, *Akanksha Mishra, Liudmila Zhukas, Boris Blinov, Univ. of Washington, Dept. of Physics, Seattle, WA 98195.* Trapped ions are an approach to quantum computing that proposes to store qubits in the stable electronic states of trapped atomic ions. In this talk we discuss some novel methods to visualize randomly occurring quantum jumps and identify the qubit state of individual ions.

LM3G – 8 Efficient adiabatic rapid passage in the presence of noise, *Kehui Li, David Spierings, Aephraim M. Steinberg, University of Toronto, Toronto, ON M5S 1A1, Canada.* We study ARP in a two-level system under fluctuating perturbations by numerically solving the optical Bloch equations without damping, and find that population transfer is strongly affected by resonances with the noise. Further, we propose a sufficient condition for the population transfer to be above an arbitrary threshold. Supported by the Natural Sciences and Engineering Research Council of Canada.

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11:00 - 12:45 **Optical Sensing and Instrumentation (LM3H)**

Expand for Presentations »

Watch Recorded Session

(<https://www.frontiersinoptics.com/home/schedule/?day=Monday#1m3h>)

Presider: Hong Lin, *Bates College, USA*

LM3H – 1 Optimization of a laser induced fluorescence platform, *Thomas Aumer, Michael Cascio, Theodore Corcovilos, Duquesne University, PA 15282.* Laser Induced Fluorescence (LIF) complements mass spectrometry (MS) for protein identification by counting MS mass fragments when run in tandem

with MS. Fluorescence allows for quantification: the amount of light re-emitted is proportional to sample concentration. Reactions are run on a polydimethylsiloxane microfluidic chip to minimize needed sample volumes.

LM3H – 2 Novel distance estimates to a variable star via photometric analysis, Kathryn Fagan, Cian Bell, Ben McClure, David Sukow, Washington and Lee University, Lexington, VA 24450. Via extension of photometric methods into the infrared, we generated lightcurves for a star of variable luminosity, and employed their analysis to determine its oscillation period. From formulae linking a star's metallicity to its period-luminosity relation, we derived novel distance estimates in three wavelength bands.

LM3H – 3 Numerical analysis of dynamics of vertical-cavity surface-emitting lasers subject to orthogonal and parallel optical injection, Paul Chapman, Muhammad Abdullah, Hong Lin, Bates College, Lewiston, ME 04240. We demonstrate that polarized optical injection can alter the occurrence of polarization switching and induce various dynamical phenomena (e. g. frequency locking, periodic oscillations) in vertical-cavity surface-emitting lasers, among which period-one dynamics can be used for photonic generation of microwaves. Supported by Bates College.

LM3H – 4 Developing a portable, smartphone-based Schlieren imaging system, Grace N. Riermann, Keith R. Stein, Bethel University, St. Paul, MN 55112. Schlieren imaging is a technique for visualizing fluid flows that are characterized by spatial variations in density or refractive index. Because schlieren imaging is commonly performed with expensive equipment in a lab setting, we sought cost efficiency, accessibility, and ease of fabrication by designing a portable, smartphone-based system. Supported by NSF.

LM3H – 5 Low cost laser beam stabilization and monitoring, Sara Sayer, Disleve Kanku, Cosmin Blaga, Daniel Rolles, Kansas State University, Manhattan, KS 66506. We report a laser beam pointing stabilization and monitoring apparatus designed for university-scale laser systems based on a low-cost RaspberryPi microcomputer, 4K CMOS cameras, and servo mirror mounts. A first prototype has been successfully deployed to continuously stabilize and monitor the beam over several hours. Work supported by NSF.

LM3H – 6 Ray optics invisibility cloaking using axicon lenses, Ava Ianuale¹, Eric Jones², Harold Metcalf² 1) Montclair High School, Montclair NJ 07042 2) Physics and Astronomy, Stony Brook Univ., Stony Brook NY 11794. We employed geometric optics to investigate macroscopic invisibility cloaking methods in the visible spectrum. We expanded on existing methods of cloaking to develop a model of a cloak using axicon lenses with a circular cloaking region.

LM3H – 7 Progress towards single-photon time-of-flight imaging, Kevin Eckrosh, Matthew Brown, Markus Allgaier, Brian J. Smith, Oregon Center for Optical, Molecular and Quantum Science and Department of Physics, University of Oregon, Eugene, OR 97403. The spatial distribution of a pulsed light source at the single-photon level is determined by coupling the field into an array of differing length fibers, which are fused into a single fiber. The output is monitored with a single-photon detector and time-tagging electronics. Results using attenuated laser pulses are presented.

LM3H – 8 Development of a high-speed measurement system for surface enhanced Raman spectroscopy, Sarah Bense¹, Eric Katsma¹, Makayla Schmidt¹, Marit Engevik¹, Tryg Burgau¹, Nathan Lemke¹, Ariadne Bido², Alexandre Brolo², Nathan Lindquist¹, ¹Bethel University, St Paul, MN 55127 USA; ²University of Victoria, Victoria, BC V8P 5C2, Canada. We discuss the development of a system to collect and analyze intensity and spectral data at one million frames per second. This system is then used to study the Surface-Enhanced Raman Spectroscopy (SERS) effect for single molecules in a variety of samples. Supported by NSF.

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14:00 - 15:30 **Optical Lattices, Atom Interferometry, Atom Magnetometry (LM5G)**

Expand for Presentations »

Watch Recorded Session

(<https://www.frontiersinoptics.com/home/schedule/?day=Monday#lm5g>)

Presider: Seth Aubin, College of William and Mary, USA

LM5G – 1 An atomic magnetometer for charged particle detection based on nonlinear magneto-optical polarization rotation, Jiahui Li, Irina Novikova, College of William and Mary, VA 23187. We built a magnetometer using modulated light that induces polarization rotations at a strong magnetic field. We have achieved an operation range at 100mG level with 0.5nT sensitivity. Such a magnetometer is able to measure the trajectory of charged particles.

LM5G – 2 Observation of stochastic resonance and unidirectional ratcheting in an optical lattice, Casey Scoggins, Daniel Wingert, Jordan Churi, Kefeng Jiang, Ian Dilyard, Samir Bali, Miami University, Oxford, OH 45056. We illuminate cold atoms diffusing inside an optical lattice with a weak probe and detect directed atomic propagation perpendicular to the probe propagation. The directed propagation is resonantly enhanced by varying the

photon scattering rate - a signature of stochastic resonance. Unidirectional ratcheting is achieved by varying the probe's angle of incidence on the lattice. Supported by ARO.

LM5G – 3 Frequency measurement of two optical rubidium atomic clocks,

Kristina Boecker, River Beard, John McCauley, Nathan Lemke, Bethel University, MN 55112. We developed a system featuring two two-photon rubidium clocks and a measurement of the frequency gap between Rb-87 and Rb-85 transitions. We assessed the effectiveness of an alternating current resistive heater and magnetic field coils used to avoid frequency shifts in the atomic transitions. Work funded by the NASA Minnesota Space Grant Consortium.

LM5G – 4 Polarization-sensitive intensity correlations to probe atomic

transport in an optical lattice, *Jordan Churi¹, Angela Noreck², and Samir Bali¹, 1) Miami University, Oxford, OH 45056 2) Cleveland State University, Cleveland OH 44115.* Following C. Jurczak, et al, Phys. Rev. Lett 77, 1727 (1996) we seek to detect polarization-sensitive intensity correlations in light scattered by atoms confined in an optical lattice. The goal is to directly measure the dwell time of atoms in wells, and the time taken to hop between adjacent wells. Work supported by NSF-REU and ARO.

LM5G – 5 Redevelopment of magneto optical trap, *Paul Russell, Mara*

Klebonas, and Matthew Wright, Adelphi University, NY 11350. We have worked on rebuilding a magneto optical trap previously used by our lab group. We have set up an additional laser for the repump frequency which is locked to a sideband on the trap laser which is generated by phase modulation at 6.7 GHz. This apparatus will be used to study the control of ultracold collisions with frequency-chirped light.

LM5G – 6 Enhancing atom interferometry with quantum optimal control,

Garrett Louie and Timothy Kovachy, Northwestern University, Evanston, IL 60208. Using numerical quantum optimal control, we have developed robust light-pulse atom optics for several techniques in large momentum transfer (LMT) atom interferometry, including multi-photon Bragg diffraction and clock interferometry. Motivations and progress on implementation will be discussed. Supported by Northwestern University.

LM5G – 7 Coaxial cable to microstrip interfacing for a microwave atom

chip, *Cate Sturner, Morgan Logsdon, Sindu Shanmugas, Seth Aubin, The College of William and Mary, Williamsburg, VA 23185.* Integrating microwaves into an atom chip enables spin specific traps for atom interferometry but requires efficient coupling of microwaves into and out of the chip. Computer simulations are used to design a broadband, low reflection, 50Ω interface from coaxial cable to microstrip via tapered co-planar waveguide. Work supported by NSF, DTRA, and VMEC/ARL-NVESD.

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14:00 - 15:30 **Novel Imaging Methods (LM5H)**

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(<https://www.frontiersinoptics.com/home/schedule/?day=Monday#lm5h>)

Presider: Nathan Lindquist, *Bethel University, USA*

LM5H – 1 Applications of electron microscopy in preparation for lensless strain imaging, *Landon Schnebly, Richard Sandberg, McKayla Townsend, Hyrum Taylor, Naomi Jensen, Nick Porter, Matt Wilkin, Anastasios Pateras, Anthony Rollett, Yueheng Zhang, Ross Harder, Wonsuk Cha, Barbara Frosik, Brigham Young University, Provo, UT 84601.* We seek to use x-ray coherent diffraction imaging (CDI) to study how defects in a polycrystalline metal are transmitted under strain. The constraints necessary for 3D image retrieval will be explained. Methods of electron microscopy used to analyze and prepare samples for beamline experiments will also be discussed.

LM5H – 2 Re-focusing detection in a temporal focusing microscope, *Sam Yurak, Michael E. Durst, Middlebury College, Middlebury, VT 05753.* An electrically tunable lens can be used in the detection path of a fluorescence microscope to adjust the depth in focus without changing image magnification. We synchronize this with remote axial scanning in a two-photon temporal focusing microscope to achieve wide-field optical sectioning. Supported by the NIBIB of the NIH (R15EB025585).

LM5H – 3 Using a spatial filter to reduce noise in optical diffraction, *Katie Canavan, Raffaella Zanetti, Asia Baker, Jenny Magnes, Vassar College, NY 12604.* We analyze the locomotion of *C. elegans* through laser diffraction. We use a spatial filter and an assortment of lenses to ensure the laser beam intensity is uniform. As a result, we eliminated unintended noise in the dynamic diffraction pattern of a live nematode.

LM5H – 4 Visualizing mechanical deflection with image-plane digital holographic interferometry, *Tristan Noble, Nathan Lindquist, Bethel University, St Paul, MN 55112.* We use image-plane digital holography to measure mechanical deflections of a beam under various loads. The numerical interference between holograms of a loaded and an unloaded beam directly visualizes the bending contours. We also explore phase shifting techniques to remove uncertainty in deflections of more than one wavelength. Supported by NSF.

LM5H – 5 High-resolution nonlinear pattern formation, Mateo Murillo, Sean Bentley, Adelphi University Department of Physics, Garden City, NY 11530. An interferometric optical system for writing arbitrary 2-D patterns on nonlinearly absorbing substrates at a resolution better than normally allowed by the Rayleigh criterion is studied. Both computer simulations and experimental verifications are performed. Details of the system along with preliminary results will be presented. This work was supported by the Horace McDonnell Fellowship.

LM5H – 6 Non-linear dynamics of confined Leidenfrost drop, Tianrui Wu¹, Jenny Magnes², Harold Hastings³, 1) Duke University, Durham, NC 27708, 2) Vassar College, Poughkeepsie, NY 12604, 3) Bard College at Simon's Rock, Great Barrington, MA 01230. We constructed and analyzed an experimental non-linear dynamical system utilizing Leidenfrost drops confined in spherical dish with video processing methods, frequency domain analysis, and recurrence methods. We found a combined stochastic relaxation process with an embedding dimension of 3 and positive Lyapunov exponents of magnitude approximately 1 / s, displaying markers of low-dimensional chaos.

LM5H – 7 Observation of coherent backscattering for detection of physical state changes, Claire Yang¹, Eric Jones², Harold Metcalf², Martin Cohen², 1) Ward Melville High School, East Setauket, NY 11733, 2) Dept. of Physics and Astronomy, Stony Brook University, Stony Brook, NY 11794. Coherent backscattering is an interference phenomenon that produces an enhanced intensity profile in the backscattering direction. We observed this effect with improved clarity from previous studies and used it in the detection of physical state changes, where the size of and distance between the scattering centers of the medium change.

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15:45 - 17:05 **Optical Spectroscopy (LM6G)**

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Presider: Jenny Magnes, Vassar College, USA

LM6G – 1 Modeling mode shifts in astro-etalons for high precision spectrographic calibration. Molly Kate Kreider^{1, 2}, Scott Diddams², Ryan Terrien³, 1) Univ. of Richmond, Richmond, VA 23173, 2) National Institute of Standards and Technology, Boulder, CO 8035, 3) Carleton College, Northfield, MN 55057. Ultra-

stable etalons operating over a 500 nm wavelength range are used for spectrograph calibration in radial velocity exoplanet detection. We use Fresnel analysis and the transfer matrix method to model the multi-layer dielectric etalons to explain the observed wavelength-dependent mode position variations. The impact of temperature and alignment variations was studied. Supported by NIST SURF.

LM6G – 2 Infrared laser spectroscopy of lead: measuring isotope shifts in the electron affinity of Pb, Fabrizio E. Vassallo, N. Daniel Gibson, C. Wesley Walter, Denison University, Granville, OH 43023. We measured the electron affinities of the three abundant isotopes of lead using tunable laser negative ion photodetachment spectroscopy, observing s-wave thresholds for ground state detachment. The high precision of our experiment permitted us to resolve a discrepancy between previous studies of the isotope shifts. Supported by NSF and the William G. & Mary Ellen Bowen Research Endowment.

LM6G – 3 Experimental observation of high-speed fluctuations in surface enhanced Raman spectroscopy, Makayla Schmidt¹, Sarah Bense¹, Marit Engevik¹, Tryg Burgau¹, Nathan Lemke¹, Ariadne Bido², Alexandre Brolo², Nathan Lindquist¹, 1) Bethel Univ., St Paul, MN 55127, 2) Univ. of Victoria, Victoria, BC V8P 5C2, Canada. Surface-Enhanced Raman Spectroscopy (SERS) is an optical effect with single-molecule sensitivity. Because these SERS signals fluctuate at very high speeds, here we use a system that collects fluctuation data at one million frames per second. We outline various SERS samples and experimental conditions to observe these high-speed fluctuations. Supported by NSF.

LM6G – 4 Building an ultra-low frequency Raman spectroscopy system, Mark Whitledge, Hiro Nakamura, University of Arkansas, AR 72701. We built a Raman spectroscopy system able to detect ultra-low frequency Raman shifts using volume Bragg filters. The system, which includes a refurbished spectrometer, was calibrated using Hg lines, and its low-frequency resolution was demonstrated using sulfur. A capability to measure monolayer WSe₂ is also shown. Supported by National Science Foundation funded Research Experiences for Undergraduate program.

LM6G – 5 Determination of Potassium fine-structure mixing and quenching cross-sections in Helium and Methane buffer gas, Quincy Zawadzky¹, Alina Gearba¹, Randy Knize¹, and Jerry Sell², 1) US Air Force Academy, CO 80840, 2) Energy and Photonics Consulting, Inc., CO 80132. We implement a method to determine mixing and quenching cross sections for a combination of potassium with different buffer gases. This is accomplished using ultrafast laser excitation and time-correlated single-photon counting. The cross-sections are then determined as a function of buffer gas pressure and temperature.

LM6G – 6 Development of an oceanographic lidar to measure the vertical distribution of particles, Jason Boynewicz, Brian Collister, Richard Zimmerman, Charles Sukenik, Victoria Hill. Old Dominion University, Norfolk, VA 23529. We are developing an oceanographic lidar system to measure the vertical distribution of ocean particles to properly model the biogeochemical processes occurring in the upper ocean. In addition, we created models to understand how refraction by ocean surface waves impact the maximum resolution of active remote sensing. Support by NOAA and the Virginia Research Investment Fund.

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15:45 - 17:05 **Twisted Light and Ultrafast Light (LM6F)**

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Presider: Michael Durst, Middlebury College, USA

LM6F – 1 Experimental gravitational lensing by two-body and elliptical systems, Thao Nguyen, Enrique Galvez, Colgate University, Hamilton NY 11346.

Using a spatial light modulator, we mimic the effect of gravity and steer the light from a laser such that the phase of the light follows logarithmic dependence with its impact parameter. From symmetric lensing objects, we move onto gravitational lensing by two-body and elliptical systems with orbital angular momentum.

LM6F – 2 Generation of Laguerre-Gauss (LG) beams, Hope Dannar^{1,2}, Reeta Vyas², and Surendra Singh², 1) University of Northern Colorado, Greeley, CO 80639, 2) University of Arkansas, Fayetteville, AR 72701. We describe a mode converter based on a single cylindrical lens instead of two and demonstrate its use to transform Hermite-Gauss beams from a laser into Laguerre-Gauss beams. We also describe the design of a laser cavity for generating LG beams inside the cavity. Supported by NSF Grant # 1851919.

LM6F – 3 Topological stability of stored Bessel beams in Rubidium vapor, Scott Wenner, Jianqiao Li, Reese Tyra, Samir Bali, Miami University, Oxford, OH 45056.

We store Bessel beams in warm rubidium vapor via electromagnetically induced transparency, and show that degradation of stored information due to atomic diffusion is suppressed. For comparison, we store an “imposter Bessel” beam generated by passing a Gaussian beam through two dark rings and show that the beam profile degrades rapidly. Supported by ARO.

LM6F – 4 Characterization of femtosecond UV pulses using an autocorrelator, Katya Mikhailova, Zane Phelps, Surjendu Bhattacharyya, Anbu Venkatachala, Daniel Rolles, Kansas State University, Manhattan, KS 66506. The characterization of ultrafast laser pulses is essential for determining the scope and capability of ultrafast experiments. Using an autocorrelator and subsequent data analysis techniques, we developed a robust and wavelength-independent measurement of both pulse duration and chirp for sub-100 fs UV pulses. Supported by NSF & DOE.

LM6F – 5 Supercontinuum generation with tunable dispersion, Ruben Vargas, Michael E. Durst, Middlebury College, Middlebury, VT 05753. We numerically and experimentally investigate the effect of dispersion tuning on supercontinuum generation in a photonic crystal fiber. We tune the dispersion in a 4f grating pair pulse shaper and measure the changes to the output spectrum. We compare our numerical results using split-step Fourier method in Python to spectrometer data. Supported by the NIBIB of the NIH (R15EB025585).

LM6F – 6 Measuring the intensity of a Gaussian beam and converting an extreme ultraviolet beam polarization from linear to circular, Kaylee Radford, Taylor Buckway, William Giforos, Richard Sandberg, Brigham Young University UT 84602. We measured the intensity of an ultra-short pulse titanium-doped sapphire (Ti:Sapph) laser using the knife edge method. We then implemented a MAch-ZEHnder-Less for Threefold Optical Virginia spiderwort (MAZEL-TOV) setup to convert the polarization of the beam from linear to circular. This work was supported by NSF grant # 2051129.

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17:20 - 18:40 **Optics in Biological Systems (LM7A)**

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Presider: Catherine Herne, State University of New York at New Paltz, USA

LM7A – 1 Toward two-photon absorption spectra of long-wavelength dyes used in fluorescence-guided surgery, Isabel M. Linhares, Michael E. Durst, Middlebury College, VT 05753. We observe two-photon excitation of long-wavelength dyes in the near-infrared region using an optical parametric amplifier. These two-photon absorption spectra determine the optimal

wavelengths for the two-photon excitation of these dyes used in fluorescence-guided surgery. Supported by the NIBIB of the NIH (R15EB025585).

LM7A – 2 Attachment force of *B. Bacteriovorus* on *E. coli* over short time scales, Carrie Smithing, Catherine Herne, State University of New York at New Paltz, NY 12561. *Bdellovibrio bacteriovorus* is a predatory bacteria being considered as an alternative to antibiotics. Using an optical tweezer setup, we attach *B. bacteriovorus* to its prey, *Escherichia coli*, and measure the attachment force over short attachment times. The force is a minimum of a few piconewtons and potentially much greater. Support provided by the Kyncl Experiential Scholarship.

LM7A – 3 Using optical trapping and stretching of biological cells to characterize cell health, Sofia Brown¹, Sunday Ajala², Festus Bett², Aotuo Dong², Sacharia Albin², Aylin Marz², Makarand Deo² 1) The College of William and Mary, Williamsburg, VA 23185 2) Norfolk State Univ, Norfolk, VA 23504. We performed non-contact trapping and stretching of biological cells using dual-beam optical tweezer. The extent of cell deformation was higher for higher trapping powers and varied based on the cell types. This technique is useful in cell sorting and disease identification by quantifying cytoskeletal elasticity in cells. Supported by NSF (grant 1954330) and by the Virginia Microelectronics Consortium (VMEC).

LM7A – 4 Analyzing *C. elegans* locomotion using optical microscopy, Asia Baker, Raffaella Zanetti, Katie Canavan, Jenny Magnes, Vassar College, NY 12604. By using optical microscopy, we can analyze the locomotion of *C. elegans*. Our team determined that the microscope requires a higher numerical aperture to resolve the nematodes. As a result of increasing the aperture, our team produced videos at a higher resolution which enhanced the tracking of the nematode's locomotion.

LM7A – 5 On-demand current pulse activation of rf monopole antenna biosensor arrays with Nitrocellulose membranes, Sindu Shanmugas¹, Jonathan Lundquist², Erdem Topsakal², Umit Ozgur², Vitaliy Avrutin² 1) The College of William & Mary, Williamsburg, VA 23185, 2) Virginia Commonwealth University, Richmond, VA 23284. Continuous biosensors are rendered useless by our body in 14 days. Therefore, we propose a skin-patch with an array of RF quarter-wave monopole antenna biosensors. Combustible nitrocellulose membranes prevent early contact with the interstitial fluid. A current pulse applied to disintegrate a membrane activates a new sensor in the array. Research supported by VMEC.

LM7A – 6 Illuminating *C. elegans* locomotion with laser diffraction, Raffaella Zanetti, Katie Canavan, Asia Baker, Jenny Magnes, Vassar College, NY 12604. *C. elegans*' locomotion illuminates neuronal dynamics. Observing with high

resolution laser diffraction, we recorded dynamic diffraction patterns using optics, analyzed as a pixel's time series of intensity. As indicated by chaotic markers, the sample's movement was accurately represented. Each time series is compared to nematode computer simulations, improving our understanding.

Download Symposium PDF ([/getattachment/Home/Special-Events/Laser-Science-Symposium-on-Undergraduate-Research/Spectroscopy-\(LM5H\)/Linked-v2_UG_symposium_program_FiO_LS_2021.pdf.aspx?lang=en-US](/getattachment/Home/Special-Events/Laser-Science-Symposium-on-Undergraduate-Research/Spectroscopy-(LM5H)/Linked-v2_UG_symposium_program_FiO_LS_2021.pdf.aspx?lang=en-US))

19:00 - 19:45 **Physicist Random Walk: Careers, Graduate School, & Mental Maintenance (SpE26)**

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Watch Recorded Session

(<https://www.frontiersinoptics.com/home/schedule/?day=Monday#spe26>)

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

The Laser Science 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 twenty 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, Optica (formerly OSA), NSF, SPS, and Univ. MD (JQI), along with corporate sponsors Thorlabs, Photonics Industries, and East Coast Optical Technologies.

Speaker: Brad Conrad, *Director, Society of Physics Students & Sigma Pi Sigma*

Presider: Harold Metcalf, *Stony Brook University, USA*

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Monday, 01 November

6:00 - 7:30 (UTC - 07:00)

FM1C

Photonic Quantum Technologies I

Presenter: Joshua Silverstone , *University of Bristol*

FM1C.1

Recent Progress in Coherent Ising Machines

Invited

Presenter: Yoshihisa Yamamoto , *NTT Research, Inc.*

In this talk we will discuss various recent results on coherent Ising machines (CIM): the quantum principles, new application as heuristic algorithms on current digital platform and energy-to-solution.

Authors:Yoshihisa Yamamoto, NTT Research, Inc. / Yoshitaka Inui, NTT Research, Inc. / Sam Reifenstein, NTT Research, Inc. / Satoshi Kako, NTT Research, Inc. / Frad Khoiratee, NTT Research, Inc. / Timothee Leleu, The University of Tokyo

FM1C.2

Waveguide-integrated Single-photon Detectors with High System Detection Efficiency and Photon Number Resolution

Presenter: Martin Wolff , *University of Münster*

We present waveguide-integrated SNSPDs with high system detection efficiency over extremely broad bandwidth. Exploiting photonic integrated circuit functionalities, we further enable photon number resolution capabilities of up to eight photons.

Authors:Martin Wolff, University of Münster / Fabian Beutel, University of Münster / Jonas Schütte, University of Münster / Helge Gehring, University of Münster / Matthias Häußler, University of Münster / Wolfram Pernice, University of Münster / Carsten Schuck, University of Münster

FM1C.3**Demonstration of a Loop-based Single-mode Photonic Quantum Processor for General-purpose Applications**

Presenter: Yutaro Enomoto , *The University of Tokyo*

We develop a loop-based single-mode photonic quantum processor and demonstrate its gate operations. Showing its programmability, scalability, and potential universality, the results indicate our processor is suitable for general-purpose applications.

Authors:Yutaro Enomoto, The University of Tokyo / Kazuma Yonezu, The University of Tokyo / Yosuke Mitsunashi, The University of Tokyo / Kan Takase, The University of Tokyo / Shuntaro Takeda, The University of Tokyo

FM1C.4**Experimental Repeater-Like Quantum Communications Over 600 km of Optical Fibre With Wavelength-Multiplexed Phase Stabilisation**

Presenter: Mirko Pittaluga , *Toshiba Europe Limited*

We introduce a novel phase stabilisation scheme for phase-sensitive single-photon applications. By applying it to the Twin-Field Quantum Key Distribution protocol, we establish a repeater-like quantum communication over 600km of optical fibre.

Authors:Mirko Pittaluga, Toshiba Europe Limited / Mariella Minder, Toshiba Europe Limited / Marco Lucamarini, Toshiba Europe Limited / Mirko Sanzaro, Toshiba Europe Limited / Robert Woodward, Toshiba Europe Limited / Ming-Jun Li, Corning Incorporated / Zhiliang Yuan, Toshiba Europe Limited / Andrew Shields, Toshiba Europe Limited

FM1C.5**Nonlinear Feedforward enabling Nonlinear Quadrature Measurement toward Fault-tolerant Universal Quantum Computation**

Presenter: Atsushi Sakaguchi , *The University of Tokyo*



We demonstrate nonlinear feedforward combined with non-Gaussian ancillae localized in time, which realizes nonlinear quadrature measurement. Our technology in principle enables fault-tolerant universal quantum computation by improving ancillae.

Authors: Atsushi Sakaguchi, The University of Tokyo / Shunya Konno, The University of Tokyo / Fumiya Hanamura, The University of Tokyo / Hisashi Ogawa, The University of Tokyo / Kan Takase, The University of Tokyo / Warit Asavanant, The University of Tokyo / Petr Marek, Palacky University / Radim Filip, Palacky University / Jun-ichi Yoshikawa, The University of Tokyo / Hidehiro Yonezawa, University of New South Wales / Elanor Huntington, Australian National University / Akira Furusawa, The University of Tokyo

6:00 - 7:45 (UTC - 07:00)

FM1A

Structured Light

Presenter: Igor Jovanovic , *University of Michigan*

FM1A.1

On the Robustness of Structured Light in Noisy Channels

Invited

Presenter: Andrew Forbes , *University of Witwatersrand*

We show what forms of structured light are stable in noisy channels such as atmospheric turbulence, in the process resolve a standing debate on the robustness of orbital angular momentum and vectorial light to perturbations.

Authors: Andrew Forbes, *University of Witwatersrand*

FM1A.2

Triple-Ionization in Strong-Laser Fields

Presenter: Jakub Prauzner-Bechcicki , *Jagiellonian University in Krakow*



The triple-ionization of atoms in a strong laser field is analyzed with use of restricted-space model. The effect of Pauli principle on the dynamics of electrons is illustrated by Dalitz plots representing momentum distributions.

Authors: Jakub Prauzner-Bechcicki, Jagiellonian University in Krakow / Michal Mandrysz, Jagiellonian University in Krakow / Dmitry Efimov, Wroclaw University of Science and Technology / Marcelo Ciappina, The Barcelona Institute of Science and Technology / Maciej Lewenstein, The Barcelona Institute of Science and Technology / Jakub Zakrzewski, Jagiellonian University in Krakow

FM1A.3

Fiber-based Acetylene Frequency Stabilization of a Potassium Laser Cooling System

Presenter: Charbel Cherfan , *Laboratoire de physique des lasers atomes et molécules, université de Lille*

We present a compact laser frequency stabilization system based on saturated absorption spectroscopy of acetylene in the telecommunication domain, and utilise it as the only frequency references for a potassium cold-atom experiment

Authors: Charbel Cherfan, Laboratoire de physique des lasers atomes et molécules, université de Lille / maxime denis, Laboratoire de physique des lasers atomes et molécules, université de Lille / Isam Manai, Laboratoire de physique des lasers atomes et molécules, université de Lille / Samir Zemmouri, Laboratoire de physique des lasers atomes et molécules, université de Lille / Jean-Claude Garreau, Laboratoire de physique des lasers atomes et molécules, université de Lille / Jean-François Clément, Laboratoire de physique des lasers atomes et molécules, université de Lille / Pascal Szriftgiser, Laboratoire de physique des lasers atomes et molécules, université de Lille / radu chicireanu, Laboratoire de physique des lasers atomes et molécules, université de Lille

FM1A.4

(Withdrawn) Tailoring light propagation in inhomogeneous media by mapping wave equations

Presenter: Ivor Kresic , *Vienna University of Technology (TU Wien)*



We present a theoretical methodology for tailoring light propagation in inhomogeneous dielectrics which allows both the design of broadband invisible non-Hermitian media and confining light in engineered Hermitian structures.

Authors:Ivor Kresic, Vienna University of Technology (TU Wien) / Konstantinos Makris, University of Crete / Andre Brandstotter, Vienna University of Technology (TU Wien) / Stefan Rotter, Vienna University of Technology (TU Wien)

FM1A.5

Vortex Airy beam realized by superposition of two Airy beams

Presenter: Masato Suzuki , *Hokkaido University*

We propose a new-type vortex Airy beam with both orbital angular momentum and non-diffraction property as a superposition of laterally-sheared two Airy beams. The propagation characteristics are hugely improved compared with the conventional ones.

Authors:Masato Suzuki, Hokkaido University / Keisaku Yamane, Hokkaido University / Takashige Omatsu, Chiba University / Ryuji Morita, Hokkaido University

FM1A.6

Single-shot Resolving Soliton Interaction

Presenter: Tianhao Xian , *Shanghai Jiao Tong University*

The soliton interaction dynamics in harmonic mode-locked laser is experimentally revealed in time and phase domains for the first time. The mismatch evolutions of long-range inter-soliton time separation and relative phase is unveiled.

Authors:Tianhao Xian, Shanghai Jiao Tong University / Li Zhan, Shanghai Jiao Tong University

6:00 - 8:00 (UTC - 07:00)

FM1B

Comb and Advanced Light Sources

Presenter: Tingyi Gu , *University of Delaware*

FM1B.1**Comparison of microcomb-based light sources for optical data transmission**

Presenter: Soma Kogure , *Keio University*

We performed a transmission experiment to compare microcomb states using a silicon nitride microresonator. A modulation instability comb with the correct amount of detuning can provide a light source almost comparable to a soliton comb.

Authors:Soma Kogure, Keio University / Tamiki Ohtsuka, Keio University / Shun Fujii, Keio University / Hajime Kumazaki, Keio University / Koshiro Wada, Keio University / Yosuke Hashimoto, Japan Aerospace Exploration Agency / Yuta Kobayashi, Japan Aerospace Exploration Agency / Tomohiro Araki, Japan Aerospace Exploration Agency / Kentaro Furusawa, National Institute of Information and Communications Technology / Norihiko Sekine, National Institute of Information and Communications Technology / Takasumi Tanabe, Keio University

FM1B.2**Difference-frequency Generation in an AlGaAs Bragg-reflection Waveguide Using an On-chip Electrically-pumped Quantum Dot Laser**

Presenter: Robert Chapman , *RMIT University*

Nonlinear frequency conversion is ubiquitous in laser engineering and entangled photon generation. Here, we demonstrate nonlinear difference frequency generation in an AlGaAs waveguide that is itself the gain medium for one of the required lasers.

Authors:Robert Chapman, RMIT University / A. Schlager, University of Innsbruck / M. Goetsch, University of Innsbruck / S. Frick, University of Innsbruck / H. Thiel, University of Innsbruck / H. Suchomel, University of Wuerzburg / M. Kamp, University of Wuerzburg / C. Schneider, University of Wuerzburg / S. Hoefling, University of Wuerzburg / G. Weihs, University of Innsbruck

FM1B.3**Dual-Frequency Doppler LiDAR Using Periodic Window with Period-6 Based on External Optical Feedback Effect in a Laser Diode**

Presenter: Yanguang Yu , *University of Wollongong*



A new dual-frequency Doppler lidar (DFDL) system is proposed by using a periodic window with Period-6 of laser dynamics subjected to optical feedback. This method has a good velocity resolution while providing ease of implementation.

Authors:Zhuqiu Chen, University of Wollongong / Bairun Nie, University of Wollongong / Yuxi Ruan, University of Wollongong / Yanguang Yu, University of Wollongong / Qinghua Guo, University of Wollongong / Jiangtao Xi, University of Wollongong / Jun Tong, University of Wollongong

FM1B.4

Differential Absorption Lidar Transmitter based on a Photonic Integrated Circuit for Carbon Dioxide Sensing

Presenter: Antonio Perez-Serrano , *Universidad Politécnica de Madrid (UPM)*

We have designed, fabricated and characterized an indium phosphide photonic integrated circuit to be utilized as the transmitter of a differential absorption lidar for carbon dioxide sensing. We demonstrate its suitability for the application.

Authors:Antonio Perez-Serrano, Universidad Politécnica de Madrid (UPM) / Clara Quevedo-Galan, Universidad Politécnica de Madrid (UPM) / Victor Ricardo Aguilera, Universidad Politécnica de Madrid (UPM) / Pau Castera, SMART Photonics / Jose Manuel G. Tijero, Universidad Politécnica de Madrid (UPM) / Ignacio Esquivias, Universidad Politécnica de Madrid (UPM)

FM1B.5

Picosecond Pulse Shaping via On-Chip Interferometry

Presenter: Mario Chemnitz , *Institut National de la Recherche Scientifique*

We present autonomous pulse shaping based on on-chip temporal coherence synthesis powered by a particle swarm algorithm, which allows for robust, and reconfigurable picosecond pulse shaping with low-bandwidth equipment utilizing all-optical sampling.

Authors:Bennet Fischer, Institut National de la Recherche Scientifique / Mario Chemnitz, Institut National de la Recherche Scientifique / Benjamin MacLellan, Institut National de la Recherche Scientifique / Piotr Roztocky, Institut National de la Recherche Scientifique / Benjamin Wetzel, Université de Limoges / Brent Little, Chinese Academy of Science / Sai Chu, City University of Hong Kong / David Moss, Swinburne University of Technology / Jose Azana, Institut National de la Recherche Scientifique / Roberto Morandotti, Institut National de la Recherche Scientifique

FM1B.6**Generic Heterogeneous Integration Process Flow for Commercial Foundry Low-Index Photonic Platforms**

Presenter: Stijn Poelman , *Ghent University - imec*

We demonstrate a generic heterogeneous integration process flow for low-index photonic platforms, based on a two-step microtransfer printing approach. In this work, a silicon coupler is used for low-loss integration of III/V on silicon nitride.

Authors:Stijn Poelman, Ghent University - imec / Stijn Cuyvers, Ghent University - imec / Jasper De Witte, Ghent University - imec / Artur Hermans, Ghent University - imec / Kasper Van Gasse, Ghent University - imec / Nathalie Picqué, Max-Planck-Institut für Quantenoptik / Gunther Roelkens, Ghent University - imec / Dries Van Thourhout, Ghent University - imec / Bart Kuyken, Ghent University - imec

FM1B.7**Enhanced Light-Matter Interaction in TMDC-Materials by Integration in Resonant Layer Architectures**

Presenter: Heiko Knopf , *Friedrich-Schiller-University*

We demonstrate double-resonantly enhanced SH harmonic generation of encapsulated WS_2 -flakes embedded in monolithic resonator, including quadratic energy dependency and discuss possible generalization schemes.

Authors:Heiko Knopf, Friedrich-Schiller-University / Gia Quyet Ngo, Friedrich-Schiller-University / Abtahi Fatemeh, Friedrich-Schiller-University / Simon Bernet, Friedrich-Schiller-University / Antony George, Friedrich Schiller University / Emad Najafidehaghani, Friedrich Schiller University / Ziyang Gan, Friedrich Schiller University / Lackner Lukas, Universität Würzburg / Christoph Rupprecht, Carl von Ossietzky University / Hangyong Shan, Universität Würzburg / Maximilian Weissflog, Friedrich-Schiller-University / Tobias Vogl, Friedrich-Schiller-University / Andrey Turchanin, Friedrich Schiller University / Ulrike Schulz, Fraunhofer Society / Sven Schröder, Fraunhofer Society / Christian Schneider, Carl von Ossietzky University / Sven Höfling, Universität Würzburg / Falk Eilenberger, Friedrich-Schiller-University

FM1B.8**Triply-Resonant Sum-Frequency Generation in 10 μ m Gallium Phosphide Photonic Ring Resonators**

Presenter: Alan Logan , *University of Washington*

We demonstrate triply-resonant sum-frequency generation from telecom to visible in a gallium phosphide-on-oxide integrated photonic platform. Multi-resonant devices are essential for scalable low-power frequency conversion.

Authors: Alan Logan, University of Washington / Shivangi Shree, University of Washington / Karine Hestroffer, Humboldt-Universität zu Berlin / Fariba Hatami, Humboldt-Universität zu Berlin / Kai-Mei Fu, University of Washington

8:00 - 9:00 (UTC - 07:00)

Exhibit Hall Event - Dedicated Exhibit Time

8:30 - 10:00 (UTC - 07:00)

LM2F

Terahertz Metamaterials and Plasmonics

Presenter: Yan Zhang , *Capital Normal University*

LM2F.1

Meta-atoms for Terahertz Microfluidic Chips

Invited

Presenter: Masayoshi Tonouchi , *Osaka University*

We have proposed and developed a new type of THz microfluidic chip, a nonlinear optical crystal based with a few arrays of meta-atoms, for label-free analysis with an ultra-trace volume of solutions and high sensitivity.

Authors: Masayoshi Tonouchi, Osaka University / Kazunori Serita, Osaka University

LM2F.2

Ultrafast Broadband Tuning of InAs THz Plasmonic Arrays

Presenter: Jingdi Zhang , *Hong Kong University of Science and Technology*

Patterned high mobility semiconductors enable tunable plasmonic devices at terahertz frequencies. We investigate broadband tuning of localized surface plasmon polaritons in InAs arrays from 1 – 8 THz using mid-IR pump-terahertz probe spectroscopy.

Authors:Jingdi Zhang, Hong Kong University of Science and Technology / Xiaoguang Zhao, Boston Unviersity / Sheikh Haque, UC San Diego / Fu Deng, Hong Kong University of Science and Technology / Chunxu Chen, Boston Unviersity / Yuan Zhang, UC San Diego / Stephen March, UT Austin / Scott Maddox, UT Austin / Seth Bank, UT Austin / Xin Zhang, Boston Unviersity / Richard Averitt, UC San Diego

LM2F.3

Broadband THz Near-field Microscopy of Resonant Metasurfaces

Invited

Presenter: Jaime Rivas , *Technische Universiteit Eindhoven*

We demonstrate the broadband excitation and direct measurement of the near-field of bound-states in the continuum in dimer resonators and report their extremely long lifetimes due to the out-of-phase field oscillations in the resonators.

Authors:Jaime Rivas, Technische Universiteit Eindhoven

LM2F.4

Optically Tunable Broadband Terahertz Dielectric Membrane Metasurface Absorber

Presenter: Yuwei Huang , *Boston University*

We utilize a periodic lattice of elliptical holes in a thin silicon membrane to demonstrate an optically tunable broadband terahertz metasurface absorber with a bandwidth of ~500 GHz that achieves >90% absorption.

Authors:Yuwei Huang, Boston University / KELSON KAJ, University of California, San Diego / Chunxu Chen, Boston University / Xiaoguang Zhao, Boston University / Sheikh Haque, University of California, San Diego / Yuan Zhang, University of California, San Diego / Richard Averitt, University of California, San Diego / Xin Zhang, Boston University

9:00 - 10:00 (UTC - 07:00)

FM2C

Volume Holography and Fiber Devices

Presider: Liangcai Cao , *Tsinghua University*

FM2C.1

Volume Holography in Solar Concentration

Invited

Presenter: Su Ping , *Tsinghua University*

Abstract not available.

Authors: Su Ping, *Tsinghua University*

FM2C.2

Sensing with Coupled-core Optical Fiber Bragg Gratings

Presenter: Joel Villatoro , *University of the Basque Country UPV/EHU*

Sensitive bending and vibration sensors based on a coupled-core optical fiber with Bragg gratings are proposed and demonstrated. The interrogation of such sensors is cost effective without comprising the sensors performance.

Authors: J. A. Flores-Bravo, *University of the Basque Country UPV/EHU* / J. Madrigal, *ITEAM Research Institute, Universitat Politecnica de Valencia* / J. Zubia, *University of the Basque Country UPV/EHU* / W. Margulis, *KTH Royal Institute of Technology* / S. Sales, *ITEAM Research Institute, Universitat Politecnica de Valencia* / Joel Villatoro, *University of the Basque Country UPV/EHU*

FM2C.3

Propagation of Partially Coherent Beams in Longitudinally Modulated Graded-index Fibers

Presenter: Sultan Abdul Wadood , *University of Rochester*

We show that the cross-spectral density of Gaussian-Schell model beams undergoes amplification in parametrically modulated graded-index media. The process is an analog of quantum parametric amplification with applications in fiber-based imaging.

Authors: Sultan Abdul Wadood, University of Rochester / Kevin Liang, University of Rochester / Govind Agrawal, University of Rochester / Taco Visser, Vrije Universiteit / Carlos Stroud, University of Rochester / Nick Vamivakas, University of Rochester

FM2E

Nanophotonics and Nanoplasmonics

President: Marcelo Davanco , *National Inst of Standards & Technology*

FM2E.1

Non-Hermitian Temporal Coupled-Mode Theory: Effects of Imaginary Couplings on Exceptional Points

Presenter: Kenta Takata , *NTT Basic Research Laboratories*

We reveal imaginary coupling components in the coupled-mode theory for evanescently coupled cavities with gain and loss. We show how exceptional points are resolved and restored in such systems where their effects are generally inevitable.

Authors: Kenta Takata, NTT Basic Research Laboratories / Nathan Roberts, NTT Basic Research Laboratories / Akihiko Shinya, NTT Basic Research Laboratories / Masaya Notomi, NTT Basic Research Laboratories

FM2E.2

FWM Frequency Generation in Topological Floquet Defect Mode Resonance

Presenter: Tyler Zimmerling , *University of Alberta*

We demonstrate frequency generation by four-wave mixing using novel cavity-less Floquet defect mode resonance in 2D silicon microring Floquet topological lattice, achieving a conversion efficiency enhancement of 12.5 dB over the edge mode alone.

Authors: Tyler Zimmerling, University of Alberta / Shirin Afzal, University of Alberta / Vien Van, University of Alberta

FM2E.3

Fast Scattering Matrix Computation for Complex Media and Metasurfaces

Presenter: Ho-Chun Lin , *University of Southern California*

We use the Schur complement and partial factorization to compute the scattering matrices of large-scale complex systems and metasurfaces, achieving orders-of-magnitude speed-up and reduced memory over existing methods.

Authors:Ho-Chun Lin, University of Southern California / Zeyu Wang, University of Southern California / Chia Wei Hsu, University of Southern California

FM2E.4

Giant Long-Range Dipole-Dipole Interactions in a Plasmonic Lattice

Presenter: Ashwin Boddeti , *Purdue University*

We observe long-range dipole-dipole interactions in a plasmonic lattice. Fluorescence lifetime measurements show density-dependent non-exponential decay dynamics over 800 nm mean separation distance between interacting emitters.

Authors:Ashwin Boddeti, Purdue University / Jun Guan, Northwestern University / Tyler Sentz, Purdue University / Xitali Juarez, Northwestern University / Ward Newman, Intel Corporation / Cristian Cortes, Argonne National Laboratory / Teri Odom, Northwestern University / Zubin Jacob, Purdue University

FM2D

Novel Developments in Optical Interferometric Imaging

Presenter: Ireneusz Grulkowski , *Uniwersytet Mikołaja Kopernika*

FM2D.1

A New Static and Dynamic Full Field Transmission Optical Tomography Approach (FFOTT)

Presenter: Claude Boccara , *ESPCI*

Full Field Optical Transmission Tomography relates to optical tomography, and more precisely to a new type of endogenous cell imaging technique offering structural and metabolic contrasts.

Authors:Claude Boccara, ESPCI / OLIVIER THOUVENIN, ESPCI / MARTINE BOCCARA, ENS

FM2D.2**Spectral Laser Doppler Holography (SLDH) for Human Retinal Blood Flow Visualization and Quantification *in vivo***

Presenter: Dawid Borycki , *Polish Academy of Sciences*

We developed and applied spectral laser doppler holography (SLDH) to Fourier-Domain Full-Field Optical Coherence Tomography for visualization and quantification of the human retinal blood flow at high speeds and high transverse resolution *in vivo*

Authors:Dawid Borycki, Polish Academy of Sciences / Egidijus Aukorius, Center for Physical Sciences and Technology (FTMC) / Piotr Wegrzyn, International Centre for Translational Eye Research / Kamil Lizewski, Polish Academy of Sciences / Slawomir Tomczewski, Polish Academy of Sciences / Maciej Wojtkowski, Polish Academy of Sciences

FM2D.3**Spectral Interferometric Confocal Microscopy Using Interferometry Objectives and Synthetic-phase Modulation**

Presenter: Arturo Canales , *University of Rochester*

We present an implementation for phase-sensitive, coherent-noise-free spectral interferometric confocal microscopy using interferometry objectives in combination with a piezo-based sinusoidal synthetic-phase modulation approach.

Authors:Arturo Canales, University of Rochester / P. Scott Carney, University of Rochester

FM2D.4**Dynamic imaging and characterization of volatile aerosols using deep learning-based holographic microscopy**

Presenter: Yi Luo , *University of California, Los Angeles*

A field-portable device that can directly measure the volatility of particulate matter using holographic microscopy and deep learning is introduced. To demonstrate its proof-of-concept, we quantified the volatility of electronic cigarette emissions.

Authors:Yi Luo, University of California, Los Angeles / Yichen Wu, University of California, Los Angeles / Liqiao Li, University of California, Los Angeles / Yuening Guo, University of California, Los Angeles / Ege Cetintas, University of California, Los Angeles / Yifang Zhu, University of California, Los Angeles / Aydogan Ozcan, University of California, Los Angeles

FM2B

Eye Tracking

Presenter: Kaan Aksit , *University College London*

FM2B.1

What Do Eye Tracking Metrics Tell Us? Common Pitfalls in Measuring and Comparing Trackers Performance

Invited

Presenter: Chiara Giordano , *Tobii AB*

Eye-tracking performance is widely used in development of screen technology. Unfortunately, the lack of common metrics complicates the interpretation of results from different trackers. We discuss potential pitfalls and implications in AR/VR

Authors: Chiara Giordano, Tobii AB / Ylva Björk, Tobii AB

FM2B.3

Event-based, Near-eye Gaze Tracking beyond 10,000 Hz

Invited

Presenter: Anastasios Angelopoulos , *University of California Berkeley*

I will explain how to track the human gaze at extremely high speeds up to 10KHz using event-based cameras and a simple online least squares algorithm.

Authors: Anastasios Angelopoulos, University of California Berkeley / Julien Martel, Stanford University / Amit Kohli, University of California Berkeley / Jorg Conradt, KTH Stockholm / Gordon Wetzstein, Stanford University

FM2B.2

Lensless Cameras: Capturing More Than Meets the Sensor

Invited

Presenter: Emrah Bostan , *AMS Technologies AG*

In this talk, we will review the lensless cameras which perform imaging via computation. We will also discuss the current challenges and potential research directions for such systems.

Authors: Emrah Bostan, AMS Technologies AG

10:30 - 12:30 (UTC - 07:00)

M1A

Opening Remarks and Plenary Session I

Presenter: Marissa Giustina , *Google AI Quantum*

M1A.1

Advances in Quantum Metrology Under Correlated Quantum Noise

Plenary

Presenter: Lorenza Viola , *Dartmouth College*

Realizing the full potential of quantum metrology demands that the impact of realistic noise sources be accounted for. I will address entanglement-assisted frequency estimation in the presence of temporally correlated ("non-Markovian") dephasing noise that is also spatially correlated and non-classical. I will first show how, under this kind of noise, uncontrolled entanglement among the qubit sensors, mediated by the environment, generally introduces additional uncertainty and superclassical precision scaling is precluded. I will then discuss our progress in devising strategies for countering these effects and restoring metrological advantage, by both tailoring the sensors' spatial locations and leveraging active quantum-control techniques.

Authors:Lorenza Viola, Dartmouth College

M1A.2

Achieving the Ultimate Timing Resolution

Plenary

Presenter: Luis Sanchez-Soto , *Complutense University of Madrid*

Accurate time-delay measurement is at the core of many modern technologies. I will show new quantum schemes able to estimate the time offset between ultra-short pulses at the quantum limit.

Authors:Luis Sanchez-Soto, Complutense University of Madrid

11:00 - 11:30 (UTC - 07:00)

SpE1

Special Event - Tech Talk: Spiking Neuron in a Photonic Integrated Circuit

11:00 - 12:45 (UTC - 07:00)

LM3G

Special Symposium - Special Event - Quantum Information & Quantum Optics

LM3H

Special Symposium - Special Event - Optical Sensing and Instrumentation

11:00 - 13:00 (UTC - 07:00)

FM3C

Technologies for Optical Device Developments

Presenter: Jyrki Saarinen , *University of Eastern Finland*

FM3C.1

Holographic Femtosecond Laser Processing with Ferroelectric Liquid Crystal Spatial Light Modulator

Presenter: Satoshi Hasegawa , *Utsumomiya University*

Parallel femtosecond laser processing with a reconfiguration of computer-generated holograms (CGHs) with more than 1kHz using a ferroelectric liquid crystal spatial light modulator (FLCoS-SLM) is demonstrated.

Authors:Satoshi Hasegawa, Utsumomiya University / Kenta Nozaki, Utsumomiya University / Ayano Tanabe, CITIZEN / Yoshio Hayasaki, Utsumomiya University

FM3C.2

QD Hybridized 2D Material-Based Nanoscroll: A New Paradigm for Polarized Photosensing and Ultralow Threshold Random Lasing

Presenter: RAPTI GHOSH , *Academia Sinica*

The spirally rolled QD/2D material-based light-trapping hybrid nanocavity structure achieves an unprecedentedly low lasing threshold ($\sim 0.008 \text{ kW cm}^{-2}$) and a 12 fold brighter parallel-polarized luminescence than that of the perpendicular one.

Authors:RAPTI GHOSH, Academia Sinica / Ya-Ping Hsieh, Academia Sinica / Yang-Fang Chen, National Taiwan University

FM3C.3

Femtosecond Laser Assisted Fabrication of Nanopatterned Fluorescent Quick Response Code for Anti-counterfeiting Application

Presenter: Gaurav Singh , *IIT Bombay*

We demonstrate femtosecond laser based fabrication of unclonable micro-quick response code with fluorescent attributes for anti-counterfeiting applications. 3D nano-features in the codes provides security against duplication.

Authors:Gaurav Singh, IIT Bombay

FM3C.4

Optical soft artificial skin

Presenter: Abhijit Roy , *IISc Bangalore*

We present a 3D printable artificial skin made of a soft material capable of detect touch, load, and bending. The artificial skin (soft-a-skin) comprises a uniquely designed optical waveguide and soft hemispherical structures.

Authors:Abhijit Roy, IISc Bangalore / Navin Kumar, IISc Bangalore / Bangalore Shreyas, IISc Bangalore / Ananya Gupta, IISc Bangalore / Alope Kumar, IISc Bangalore / V Venkataraman, IISc Bangalore

FM3C.5**Rapid Fabrication of Glass Microlens Array Using Laser Assisted 3D Printing**

Presenter: Chunxin Liu , *KTH Royal Institute of Technology*

Rapid manufacturing of silica glass microlens arrays is demonstrated using a novel glass 3D printing technology. A 5×5 array was printed and subsequent characterization showed dense microlenses with uniform focal lengths and good imaging performance.

Authors:Chunxin Liu, KTH Royal Institute of Technology / Taras Oriekhov, KTH Royal Institute of Technology / Michael Fokine, KTH Royal Institute of Technology

FM3C.6**Entirely 3D Printed Spectrometer: Application of Consumer-grade Printing Technologies for Fabrication of Optical and Opto-mechanical Components**

Presenter: Gregory Berglund , *Rice University*

This paper presents a successful demonstration of a spectrometer device fully printed on consumer-grade 3D printers. Optical components were made with SLA technology while FDM printing was applied to fabricate opto-mechanical and casing components.

Authors:Gregory Berglund, Rice University / Tomasz Tkaczyk, Rice University

FM3C.7**Lens Bending with Reinforcement Learning for Reduced Optical Aberrations**

Presenter: Cailing Fu , *RWTH Aachen University*

To automate optical system design, a Reinforcement Learning algorithm using lens improvement methods as parameter optimization or lens adding is developed. A proof of concept using lens bending is demonstrated for different learning strategies.

Authors:Cailing Fu, RWTH Aachen University / Jochen Stollenwerk, RWTH Aachen University / Carlo Holly, RWTH Aachen University

FM3C.8**Reconstructing Arbitrary-Duration Ultrashort Pulses from FROG Traces using Deep Convolutional Neural Network Algorithm**

Presenter: Yiming Gong , *University of Michigan*



Two neural networks--one predicting the duration of ultrashort pulses and another reconstructing pulses using a base model and duration-dependent final layers--are combined in an algorithm to adaptively and efficiently reconstruct pulses

Authors:Yiming Gong, University of Michigan / Nosakhare Edoimioya, University of Michigan

FM3E

Coherent Laser and Light Generation

Presenter: James Leatham , *Raytheon Space and Airborne Systems*

FM3E.1

Ultra-narrow Linewidth Frequency Stabilized Photonic Integrated Lasers

Invited

Presenter: Daniel Blumenthal , *University of California Santa Barbara*

Integrated ultra-narrow linewidth stabilized lasers bring the potential for spectrally-pure lasers at the chip-scale. IR and visible emission Si₃N₄ Brillouin lasers stabilized to ultra-high Q resonators will be described for atom, quantum, microwave and communications.

Authors:Daniel Blumenthal, University of California Santa Barbara

FM3E.2

Optical Microsystem Technology Development at DARPA

Invited

Presenter: Gordon Keeler , *Defense Advanced Res Projects Agency*

Heterogeneous integration is key to enabling new photonics capabilities. This talk describes DARPA programs that seek to advance integrated photonics performance and create transformative optical microsystems for computing, sensing, quantum systems, and precision frequency control.

Authors:Gordon Keeler, Defense Advanced Res Projects Agency

FM3E.3

Optical-Isolator-Free, Sub-kHz VECSEL System at 698 nm

Presenter: Martin Lee , *University of Strathclyde*

We report robust performance against optical feedback in a single frequency visible VECSEL targeted at optical clocks. Sub-kHz linewidth at 698 nm was demonstrated in frequency-stabilized operation, without an isolator in the optical set-up.

Authors: Martin Lee, University of Strathclyde / Paulo Hisao Moriya, University of Strathclyde / Jennifer Hastie, University of Strathclyde

FM3E.4

Stokes and Anti-Stokes Pumped Yb-doped Fiber Lasers

Presenter: Nanjie Yu , *University of Illinois at Urbana-Champaign*

A novel excitation balanced laser is proposed, where introducing a second pump, to the red of the signal wavelength, significantly reduces the quantum defect (QD). Experimental and theoretical results indicate near-zero QD heating is possible.

Authors: Nanjie Yu, University of Illinois at Urbana-Champaign / Kavita Desai, University of Illinois at Urbana-Champaign / Andrey Mironov, University of Illinois at Urbana-Champaign / Mingye Xiong, University of Illinois at Urbana-Champaign / Maxime Cavillon, University of Paris - Saclay / Thomas Hawkins, Clemson University / John Ballato, Clemson University / James Eden, University of Illinois at Urbana-Champaign / Peter Dragic, University of Illinois at Urbana-Champaign

FM3E.5

Chip-scale Light Sources in Visible and Near-infrared

Invited

Presenter: Tin Komljenovic , *Nexus Photonics*

We show recent progress in the field of integrated photonic circuits with a focus on chip-scale sources operating below 1.2 μm wavelength to facilitate system-on-a-chip functionality for emerging applications.

Authors: Tin Komljenovic, Nexus Photonics

FM3D

Machine Learning in Biomedical Applications: Optical Coherence Tomography



Presenter: Judith Birkenfeld , *Instituto de Óptica Daza de Valdés*

FM3D.1

Ultra-Widefield OCT Angiography for Ophthalmic Diagnostics

Invited

Presenter: Tilman Schmoll , *Carl Zeiss Meditec Inc*

We present how MHz SS-OCT enables fields of view, so far only known from ultra-widefield fundus cameras. We discuss technical challenges and highlight how examining the peripheral retina will impact diagnosis and treatment of ophthalmic diseases.

Authors:Tilman Schmoll, Carl Zeiss Meditec Inc / Michael Niederleithner, Medical University of Vienna / Luis de Sisternes, Carl Zeiss Meditec Inc / Heiko Stino, Medical University of Vienna / Aleksandra Sedova, Medical University of Vienna / Sophie Kubach, Carl Zeiss Meditec Inc / Matthew Everett, Carl Zeiss Meditec Inc / Andreas Pollreisz, Medical University of Vienna / Wolfgang Drexler, Medical University of Vienna / Rainer Leitgeb, Medical University of Vienna

FM3D.2

Correction of Image Artifacts Related to High-Speed Motion in Swept-Source OCT

Presenter: Ashish Gupta , *Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University*

High-speed motion detected by OCT results in image artifacts including axial shift and broadening of the signal. The method to correct the artifacts allows retrieving a correct trajectory/velocity of a rapidly moving object.

Authors:Ashish Gupta, Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University / Daniel Ruminski, Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University / Ireneusz Grulkowski, Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University

FM3D.3

Supervised Dimensionality Reduction of Single-cell Features from Label-free Multimodal Images for T Cell Subtype Classification

Presenter: Elizabeth Mei Yin Lee , *Singapore-MIT Alliance for Research and Technology Centre*

Nonlinear dimensionality reduction of features extracted from single T cell images show localization of partial cells, CD4+ and CD8+ T cells in the lower-dimensional space, showing potential T cell subtype classification from label-free imaging.

Authors: Elizabeth Mei Yin Lee, Singapore-MIT Alliance for Research and Technology Centre / Maciej Baranski, Singapore-MIT Alliance for Research and Technology Centre / Marvin Chew, Singapore-MIT Alliance for Research and Technology Centre / Wei-Xiang Sin, Singapore-MIT Alliance for Research and Technology Centre / Ka-Wai Cheung, Singapore-MIT Alliance for Research and Technology Centre / Lisa Tucker-Kellogg, Duke-NUS Medical School / Derrick Yong, Singapore Institute of Manufacturing Technology / Michael Birnbaum, Massachusetts Institute of Technology / George Barbastathis, Massachusetts Institute of Technology

FM3D.4

Label-free imaging flow cytometry for phenotypic analysis of microalgae populations using deep learning

Presenter: Cagatay Isil , *UCLA*

We report a field-portable and high-throughput imaging flow-cytometer to perform label-free phenotypic analysis of microalgae populations by extracting the spatial and spectral features of their reconstructed holographic images using deep learning.

Authors: Cagatay Isil, *UCLA* / Kevin de Haan, *UCLA* / Zoltan Gorocs, *UCLA* / Hatice Ceylan Koydemir, *UCLA* / Spencer Peterman, *UCLA* / David Baum, *UCLA* / Fang Song, *UCLA* / Thamira Skandakumar, *UCLA* / Esin Gumustekin, *UCLA* / Aydogan Ozcan, *UCLA*

FM3D.5

Deep Learning-enabled Computational Microscopy and Sensing

Invited

Presenter: Aydogan Ozcan , *University of California Los Angeles*

In this presentation, I will provide an overview of some of our recent work on the use of deep neural networks in advancing computational microscopy and sensing systems, also covering their biomedical applications.

Authors: Aydogan Ozcan, *University of California Los Angeles*

FM3B

Analog and Digital Holography



Presider: Kaan Aksit , *University College London*

FM3B.1

Advances in Real-time Computer-Generated Holography for Augmented Reality Applications

Invited

Presenter: Andrzej Kaczorowski , *VividQ*

Computer-Generated Holography is a display technology particularly applicable in the emerging Augmented Reality wearables. This talk will give an overview of VividQ's algorithmic and hardware advances, and prototyping activity for AR devices using Computer-Generated Holography.

Authors: Andrzej Kaczorowski, *VividQ*

FM3B.2

Enabling Next-generation Holographic Displays with Artificial Intelligence

Invited

Presenter: Suyeon Choi , *Stanford University*

Holographic displays promise unprecedented capabilities for direct-view displays and VR/AR applications. I will talk about our recent work on neural holography that achieves unprecedented image fidelity and real-time frame rates, using camera-in-the-loop training and partially coherent light sources.

Authors: Suyeon Choi, *Stanford University* / Yifan Peng, *Stanford University* / Jonghyun Kim, *NVIDIA Corporation* / Manu Gopakumar, *Stanford University* / Gordon Wetzstein, *Stanford University*

FM3B.3

Dynamic Computer Generated Holography for Virtual Reality Displays

Invited

Presenter: Nicolas Pégard , *University of North Carolina at Chapel Hill*

We present new virtual reality display technologies that synthesize high-fidelity images with compact, inexpensive digital micromirror devices. Our strategy displays fast sequences of coherent holograms mutually optimized to render realistic images in the human eye.

Authors: Mohammad Eybposh, University of North Carolina at Chapel Hill / Vincent Curtis, University of North Carolina at Chapel Hill / Aram Moossavi, University of North Carolina at Chapel Hill / Nicolas Pégard, University of North Carolina at Chapel Hill

FM3B.4

Freeform Holographic Optical Elements for VR/AR Applications

Invited

Presenter: Changwon Jang , *Facebook Reality Labs Research*

We present a pipeline for the design, optimization, and fabrication of freeform holographic optical elements for virtual reality and augmented reality that enhances imaging performance and enables new applications.

Authors: Changwon Jang, Facebook Reality Labs Research / Olivier Mercier, Facebook Reality Labs Research / Robert Upton, Facebook / Matthieu Leibovici, Facebook Reality Labs Research / Kiseung Bang, Facebook Reality Labs Research / Gang Li, Facebook Reality Labs Research / Yang Zhao, Facebook Reality Labs Research / Douglas Lanman, Facebook Reality Labs Research

FM3B.5

Launch of the First Desktop 3D Hologram Printer

Invited

Presenter: Paul Christie , *Liti Holographics*

The use of hologram technology and holographic optical elements has often been limited. We present a new tool for creating HOEs and holograms, and a step towards having a 3D Hologram Printer in every lab.

Authors: Paul Christie, Liti Holographics

FM3A

Autonomous Imaging and Robotic Surgery

Presenter: Umar Piracha , *Zoox*



FM3A.1**Overview Talk on AR/VR, Optical Technologies and Autonomous Surgeries**

Invited

Presenter: Emily Charlson , *Stanford University*

Abstract not available.

Authors:Emily Charlson, Stanford University

FM3A.2**Optical Technologies and Challenges for Catheter-based Robotic Interventions**

Invited

Presenter: Martin Villiger , *Wellman Center for Photomedicine*

The high resolution of optical imaging would be ideal to assist navigation of endoluminal robotic interventions and motivates the development of new imaging paradigms that integrate into narrow-gauge flexible catheters and provide useful imaging contrast.

Authors:Martin Villiger, Wellman Center for Photomedicine

FM3A.3**Robotics for OCT-Guided Ophthalmic Surgery and Diagnostics**

Invited

Presenter: Mark Draelos , *Duke University*

Robotics is poised to change care delivery in ophthalmology. This presentation will discuss recently developed autonomous robotic systems for optical coherence tomography-guided corneal microsurgery and eye imaging.

Authors:Mark Draelos, Duke University

FM3A.4**Optics for Autonomous Transcatheter Interventions**

Invited

Presenter: Pierre Dupont , *Harvard Medical School*



While optical imaging is used to guide almost every type of surgery, one exception is transcatheter cardiac procedures. This talk will explore how optical imaging can be used to improve and even automate interventions performed inside the blood-filled heart.

Authors: Pierre Dupont, Harvard Medical School

LM3F

Laser Science Dissertation Award Presentations

President: Brian Washburn , *National Institute of Standards and Technology (NIST)*

LM3F.1

Tunable Few- To Many-cycle Source for High-order Harmonic Generation and Timeresolved Spectroscopy

Invited

Presenter: John Beetar , *University of Central Florida*

Nonlinear compression schemes based on solid and gas media are developed for a commercial high average power Yb-doped laser amplifier to perform time-resolved studies based on high-order harmonic generation and time- and angle-resolved-photoemission.

Authors: John Beetar, University of Central Florida

LM3F.2

Applications of Intense Mid-infrared Laser-matter Interactions

Invited

Presenter: Daniel Woodbury , *University of Maryland*

We present experiments and simulations of high energy mid-infrared laser-matter applications, including near-critical density laser wakefield acceleration, detection of ultralow electron densities from radiation or strong-field ionization, and novel mechanisms for nonlinear infrared self-guiding.

Authors: Daniel Woodbury, University of Maryland

LM3F.3

Lattice Atom Interferometry in an Optical Cavity

Invited

Presenter: Victoria Xu , *University of California, Berkeley*

We present an intra-cavity trapped atom interferometer with an unprecedented 20-second coherence time, and discuss how this approach suppresses vibration noise while increasing sensitivity in a compact volume, overcoming the major limitations in quantum gravimetry.

Authors:Victoria Xu, University of California, Berkeley

LM3F.4

Quantum Correlations in Advanced LIGO

Invited

Presenter: Haocun Yu , *MIT*

Abstract not Available.

Authors:Haocun Yu, MIT

12:00 - 12:30 (UTC - 07:00)

SpE2

Special Event - Tech Talk: Industrial Applications of the Monocular Stereo Camera as an Omnidirectional Imaging and Ranging Device

12:30 - 13:00 (UTC - 07:00)

SpE1

Special Event - Meet Plenary Speaker Luis Sánchez-Soto

SpE2

Special Event - Meet Plenary Speaker Lorenza Viola

13:00 - 13:45 (UTC - 07:00)

JM4A

Visionary Session I: Paul Debevec, Netflix, USA

Presenter: Kaan Aksit , *University College London*

JM4A.1

Light Fields, Light Stages and the Future of Virtual Production

Visionary

Presenter: Paul Debevec , *Netflix*

I'll describe recent work I've helped lead at Netflix, Google and the USC Institute for Creative Technologies to bridge real and virtual worlds through photography, lighting and machine learning.

Authors: Paul Debevec, *Netflix*

13:00 - 15:00 (UTC - 07:00)

M2A

Entanglement-enabled Quantum Technologies I

Presenter: Scott Carney , *Optica*

M2A.1



A Quantum Repeater Node Made of Trapped Atomic Ions

Invited

Presenter: Ben Lanyon , IQOQI

The context of the work is achieving entanglement between remote quantum matter and my experimental system is trapped atomic ions.

Authors: Ben Lanyon, IQOQI

M2A.2

Realization of a Multi-Node Quantum Network of Remote Solid-State Qubits

Presenter: Simon Baier , Delft University of Technology

Entanglement-based quantum networks will provide exciting opportunities for science and engineering. Here, we report the realization of a three-node quantum network by generating distributed multi-partite entangled states and performing entanglement swapping through an intermediary node.

Authors: Simon Baier, Delft University of Technology / Matteo Pompili, Delft University of Technology / Sophie Hermans, Delft University of Technology / Hans Beukers, Delft University of Technology / Peter Humphreys, Delft University of Technology / Raymond Schouten, Delft University of Technology / Raymond Vermeulen, Delft University of Technology / Marijn Tiggelman, Delft University of Technology / Laura dos Santos Martins, Delft University of Technology / Bas Dirkse, Delft University of Technology / Stephanie Wehner, Delft University of Technology / Ronald Hanson, Delft University of Technology

M2A.3

Single-Pass Femtosecond Parametric Process Towards Continuous Variables Quantum Networks

Presenter: Francesca Sansavini , Laboratoire Kastler Brossel, Sorbonne Université, CNRS, ENS-PSL Research University, Collège de France

We generate multimode quantum states via single-pass femtosecond parametric down conversion in non-linear waveguides. We measure up to 14 squeezed spectral modes and pulse-by-pulse squeezing. This enables the implementation of large quantum networks.

Authors: Francesca Sansavini, Laboratoire Kastler Brossel, Sorbonne Université, CNRS, ENS-PSL Research University, Collège de France / Matthieu Ansquer, Laboratoire Kastler Brossel, Sorbonne Université, CNRS, ENS-PSL Research University, Collège de France / Tiphaine Kouadou, Laboratoire Kastler Brossel, Sorbonne Université, CNRS, ENS-PSL Research University, Collège de France / Nicolas Treps, Laboratoire Kastler Brossel, Sorbonne Université, CNRS, ENS-PSL Research University, Collège de France / Valentina Parigi, Laboratoire Kastler Brossel, Sorbonne Université, CNRS, ENS-PSL Research University, Collège de France

M2A.4

All-Fiber Source and Sorter for Multimode Correlated Photons

Presenter: Kfir Sulimany , *The Hebrew University of Jerusalem*

We use spontaneous four wave mixing to generate multimode photon pairs in a few mode fiber. We show the photons are correlated in the fiber mode basis using an all-fiber mode sorter.

Authors: Kfir Sulimany, The Hebrew University of Jerusalem / Yaron Bromberg, The Hebrew University of Jerusalem

M2A.5

Two-Rebit Entanglement: Theory and Experiment

Presenter: Jan Sperling , *Paderborn University*

We characterize entanglement over real and complex, composite quantum systems. Methods are formulated and applied to simultaneously certify inseparability and separability for two rebits and two qubits, respectively.

Authors: Jan Sperling, Paderborn University / Nidhin Prasannan, Paderborn University / Syamsundar De, Paderborn University / Sonja Barkhofen, Paderborn University / Benjamin Brecht, Paderborn University / Christine Silberhorn, Paderborn University

M2A.6

Propagation-Induced Spatial Entanglement Revival

Presenter: Abhinandan Bhattacharjee , *Indian Institute of Technology Kanpur*



We report the revival of angle-OAM entanglement through propagation. We find that the entanglement decays within a short distance. However, a further propagation induces revival in entanglement, and this feature remains intact in turbulence.

Authors: Abhinandan Bhattacharjee, Indian Institute of Technology Kanpur / Mritunjay Joshi, Indian Institute of Technology Kanpur / Suman Karan, Indian Institute of Technology Kanpur / Jonathan Leach, Heriot-Watt University / Anand Jha, Indian Institute of Technology Kanpur

M2A.7

Ultimate Accuracy Limit of Quantum Pulse-Compression Ranging

Presenter: Quntao Zhuang, University of Arizona

We establish microwave-radar ranging's ultimate quantum limit, and show that quantum illumination (QI) ranging achieves this limit. Moreover, QI's ranging accuracy can be 10's of dB better than that of its best classical competitor.

Authors: Quntao Zhuang, University of Arizona / Jeffrey Shapiro, Massachusetts Institute of Technology

M2C

Quantum Communication I

Presenter: Rinaldo Trotta, Univ degli Studi di Roma La Sapienza

M2C.1

A Quantum Key Distribution Testbed Using Plug&Play Telecom-Wavelength Single-Photons

Presenter: Lucas Rickert, Technical University Berlin



We report on BB84 quantum key distribution tests employing a benchtop plug&play quantum-dot based single-photon source operating at O-band wavelengths. We perform a detailed characterization and exploit optimized temporal filters to maximize the tolerable losses.

Authors: Lucas Rickert, Technical University Berlin / Timm Gao, Technical University Berlin / Felix Urban, Technical University Berlin / Jan Große, Technical University Berlin / Nicole Srocka, Technical University Berlin / Sven Rodt, Technical University Berlin / Anna Musial, Wrocław University of Science and Technology / Kinga Zolnacz, Wrocław University of Science and Technology / Pawel Mergo, Maria Curie Skłodowska University / Kamil Dybka, Fibrain Sp. z o.o / Waclaw Urbanczyk, Wrocław University of Science and Technology / Grzegorz Sek, Wrocław University of Science and Technology / Sven Burger, Zuse Institute Berlin / Stephan Reitzenstein, Technical University Berlin / Tobias Heindel, Technical University Berlin

M2C.2

Efficient Telecom-Band Quantum Frequency Conversion

Presenter: Mathis Cohen , *Universite Côte d'Azur, CNRS, Institut de Physique de Nice (INPHYNI), UMR 7010*

We achieve a frequency conversion interface to coherently transmit light from a weak coherent source at 925 nm toward telecommunication C-band. We demonstrate coherence preservation and an internal conversion of 62 % efficiency.

Authors: Mathis Cohen, Universite Côte d'Azur, CNRS, Institut de Physique de Nice (INPHYNI), UMR 7010 / Romain Dalidet, Universite Côte d'Azur, CNRS, Institut de Physique de Nice (INPHYNI), UMR 7010 / Florian Pastier, Quandela SAS / Valérien Giesz, Quandela SAS / Niccolo Somaschi, Quandela SAS / Pascale Senellart, Universite Paris-Saclay, CNRS, Centre de Nanosciences et de Nanotechnologies (C2N) / Sarah Thomas, Universite Paris-Saclay, CNRS, Centre de Nanosciences et de Nanotechnologies (C2N) / Anthony Martin, Universite Côte d'Azur, CNRS, Institut de Physique de Nice (INPHYNI), UMR 7010 / Sébastien Tanzilli, Universite Côte d'Azur, CNRS, Institut de Physique de Nice (INPHYNI), UMR 7010 / Laurent Labonté, Universite Côte d'Azur, CNRS, Institut de Physique de Nice (INPHYNI), UMR 7010

M2C.3

Discrete-Variable Quantum Key Distribution Based on Homodyne Detection

Presenter: Ignatius William Primaatmaja , *National University of Singapore*



We propose and analyse a practical quantum key distribution protocol that combines the features of discrete and continuous-variable protocols. Our proposed protocol does not require the honest parties to share a phase reference.

Authors: Ignatius William Primaatmaja, National University of Singapore / Cassey Liang, National University of Singapore / Gong Zhang, National University of Singapore / Jing Yan Haw, National University of Singapore / Chao Wang, National University of Singapore / Charles Lim, National University of Singapore

M2C.4

A Scalable Multi-User QKD Hub for Entanglement-Based Phase-Time Coding

Presenter: Lucas Bialowons , *Technische Universität Darmstadt*

Simultaneous pairwise quantum key distribution between four parties was demonstrated by implementing an entanglement-based phase-time coding protocol with a type-0 SPDC photon source. The star-shaped network is scalable to dozens of users.

Authors: Lucas Bialowons, Technische Universität Darmstadt / Erik Fitzke, Technische Universität Darmstadt / Maximilian Tippmann, Technische Universität Darmstadt / Oleg Nikiforov, Technische Universität Darmstadt / Thomas Walther, Technische Universität Darmstadt

M2C.5

Experimental High-Rate Multiplexed Quantum Communication

Presenter: Martin Bohmann , *Austrian Academy of Sciences*

We introduce a general scheme for increasing secure key rates in entanglement-based cryptography exploiting multiple degrees of freedom. We experimentally exemplify this scheme through spatial and wavelength multiplexing. Scalability of our approach is demonstrated.

Authors: Martin Bohmann, Austrian Academy of Sciences / Evelyn Ortega, Austrian Academy of Sciences / Johannes Pseiner, Austrian Academy of Sciences / Sebastian Neumann, Austrian Academy of Sciences / Lukas Achatz, Austrian Academy of Sciences / Lukas Bulla, Austrian Academy of Sciences / Mirela Selimovic, Austrian Academy of Sciences / Krishna Dovzhik, Austrian Academy of Sciences / Rupert Ursin, Austrian Academy of Sciences

M2C.6

Optical Power Limiters for Securing Practical Quantum Communication Systems

Presenter: Gong Zhang , *National University of Singapore*

We propose and experimentally demonstrate a passive optical power limiter device used to protect practical quantum communication systems. The device is robust against different signal variations and has minimum impact on the quantum signals.

Authors:Gong Zhang, National University of Singapore / Ignatius William Primaatmaja, National University of Singapore / Jing Yan Haw, National University of Singapore / Xiao Gong, National University of Singapore / Chao Wang, National University of Singapore / Charles Lim, National University of Singapore

M2C.7

Experimental Symmetric Private Information Retrieval With Quantum key Distribution

Presenter: Chao Wang , *National University of Singapore*

We report an experiment of a two-database symmetric private information retrieval protocol which incorporates a measurement-device-independent quantum key distribution system. Based on the experimental system, we demonstrate information retrieval from a fingerprint database with 800 entries.

Authors:Chao Wang, National University of Singapore / Wen Yu Kon, National University of Singapore / Hong Jie Ng, National University of Singapore / Charles Lim, National University of Singapore

M2B

Quantum Sensors I

Presenter: Michael Duncan , *Optica*

M2B.1

Two-Photon Time-Frequency Entanglement in Quantum Information Science

Invited

Presenter: Brian Smith , *University of Oregon*



Generation, manipulation and detection of time-frequency entangled photon pairs, along with their application in quantum information science, are presented.

Authors: Brian Smith, University of Oregon

M2B.2

Far-Infrared Sensing by Correlated Photons

Presenter: Anna Paterova , *Institute of Materials Research and Engineering, A*STAR*

We extend a sensing method based on interferometry of correlated photon pairs to the fingerprint infrared region. The technique allows performing infrared sensing by detecting near infrared light, and holds potential for environmental control applications.

Authors: Anna Paterova, Institute of Materials Research and Engineering, A*STAR / Zi Toa, Institute of Materials Research and Engineering, A*STAR / Hongzhi Yang, Institute of Materials Research and Engineering, A*STAR / Leonid Krivitsky, Institute of Materials Research and Engineering, A*STAR

M2B.3

All-Optical Raman-Based Noise Spectroscopy of Solid-State Spin Qubits

Presenter: Demitry Farfurnik , *University of Maryland*

We introduce an all-optical approach for noise spectroscopy of solid-state spin qubits, based on Raman control and the Carr-Purcell-Meiboom-Gill pulse sequences, and use it to extract the noise spectra of self-assembled quantum dots.

Authors: Demitry Farfurnik, University of Maryland / Harjot Singh, University of Maryland / Zhouchen Luo, University of Maryland / Allan S. Bracker, Naval Research Laboratory / Samuel G. Carter, Naval Research Laboratory / Robert M. Pettit, University of Maryland / Edo Waks, University of Maryland

M2B.4

Optimal Quantum Ranging -- Hypothesis Testing for an Unknown Return Signal

Presenter: Lior Cohen , *Louisiana State University*



We use quantum hypothesis testing for unknown coherent-state return signals, deriving the error-probability limits of single-shot ranging experiments. We engineer optimal measurements, independent of the range, contributing to better rangefinders and LIDARS.

Authors:Lior Cohen, Louisiana State University / Mark Wilde, Louisiana State University

M2B.5

High-Efficiency and Fast Photon-Number-Resolving SNSPD

Presenter: Lorenzo Stasi , *ID Quantique SA*

We present a full characterization (efficiency, dark count, recovery time, jitter, POVM matrix) of a photon-number-resolving detector based on parallel SNSPD. We construct a model based only on the pixels efficiencies to compute the POVM.

Authors:Lorenzo Stasi, ID Quantique SA / Gaetan Gras, ID Quantique SA / Riad Berrazouane, ID Quantique SA / Félix Bussi eres, ID Quantique SA

M2B.6

On the Inverse Problem of Photocount Statistics

Presenter: Pavel Gostev , *Lomonosov Moscow State University*

The report considers the features of the inverse problem of photocount statistics. A recurrence solution method for finite photocount distributions and a stability criterion for the problem solution for infinite distributions are proposed and discussed.

Authors:Pavel Gostev, Lomonosov Moscow State University / Sergey Magnitskiy, Lomonosov Moscow State University / Anatoly Chirkin, Lomonosov Moscow State University

M2B.7

Deep Cryogenic Operation of 55 nm CMOS SPADs for Quantum Information and Metrology Applications

Presenter: A Morelle , *EPFL*



We demonstrate the operation and study the performance metrics of advanced CMOS single-photon avalanche diodes from 293K down to 3K. This shows their potential for close integration with quantum devices operating at cryogenic temperatures

Authors: A Morelle, EPFL / Francesco Gramuglia, EPFL / Pouyan Keshavarzian, EPFL / Claudio Bruschini, EPFL / Daniel Chong, GlobalFoundries Singapore Pte. Ltd. / Jason Tan, GlobalFoundries Singapore Pte. Ltd. / Michelle Tng, GlobalFoundries Singapore Pte. Ltd. / Elgin Quek, GlobalFoundries Singapore Pte. Ltd. / Edoardo Charbon, EPFL

14:00 - 14:30 (UTC - 07:00)

SpE3

Special Event - Tech Talk: Multi-milijoule Infrared Pulses from a Laser Wakefield Accelerator

14:00 - 15:30 (UTC - 07:00)

FM5C

High-performance Optical Imaging

Presenter: Yuzuru Takashima , *University of Arizona*

FM5C.1

Digital holographic system of extended angle

Presenter: Rafal Kukolowicz , *Warsaw University of Technology*



The digital holographic system with extended angle is proposed. To achieve large angle the system with single lens, spatial filter and hologram processing is built. This work presents the concept, numerical and experimental validation.

Authors:Rafal Kukolowicz, Warsaw University of Technology / Tomasz Kozacki, Warsaw University of Technology / Jędrzej Szpygiel, Warsaw University of Technology

FM5C.2

Ghost Imaging Counterfactually

Presenter: Jonte Hance , *University of Bristol*

We have developed a protocol for ghost imaging that is always counterfactual - while imaging an object, no light interacts with it. This provides both better visibility/SNR and less absorbed intensity than ghost imaging.

Authors:Jonte Hance, University of Bristol / John Rarity, University of Bristol

FM5C.3

Wavefront Sensing based on a 2D HOBBIT

Presenter: Kunjian Dai , *Clemson University*

In this paper we demonstrate a wavefront sensing technique based on 2D HOBBIT system. By generating perfect vortices with different beam size in real time, the beam can be used for wavefront detection.

Authors:Kunjian Dai, Clemson University / Jerome Miller, Clemson University / Eric Johnson, Clemson University

FM5C.4

Temperature Sensor Based on Parallel Mach-Zehnder Interferometers Using Vernier Effect

Presenter: Sigifredo Marrujo , *Guanajuato University*

A temperature sensor based on two parallel MZIs using the Vernier effect is demonstrated. A sensitivity of 2.1020 nm/ °C was obtained in a range from 20 to 50 °C, which is ~ 70.35 times higher than the sensitivity of the single MZI.

Authors:Sigifredo Marrujo, Guanajuato University / Iván Hernandez-Romano, CONACYT / Daniel May-Arriola, CIO / Vladimir Minkovich, CIO / Miguel Torres-Cisneros, Guanajuato University

FM5C.5**Fifth-order Aberration Coefficients for Plane-symmetric Optical Systems**

Presenter: Yuxuan Liu , *University of Rochester*

We present the analytical form of the fifth-order aberration coefficients for plane-symmetric optical systems expressed as a function of first-order system parameters and the paraxial chief and marginal ray angles and heights.

Authors:Yuxuan Liu, University of Rochester / Jessica Steidle, University of Rochester / Jannick Rolland, University of Rochester

FM5C.6**Blind speckle illumination for aberration correction**

Presenter: Evolene Premillieu , *University of Colorado at Boulder*

We propose a computational optical technique based on speckle-pattern illumination of an object and a gradient descent algorithm, enabling aberration correction without requiring the addition of adaptive optics.

Authors:Evolene Premillieu, University of Colorado at Boulder

FM5D**Optical Interactions and Harmonic Generation**

Presenter: Siavash Yazdanfar , *Corning Inc*

FM5D.1**Cavity Optomechanical Sensors and the Effect of Noise and Drift on Inertial Sensing**

Invited

Presenter: Ying Lia Li , *University College London*

Using noise models and the Allan deviation, cavity enhanced optomechanical measurements can be optimised for applications such as inertial sensing, including the use of optical interferometry for reducing noise, and feedback mechanisms to reduce drift.

Authors:Niko Urriola, Independent researcher / Ying Lia Li, University College London

FM5D.2**A Field-deployable Optical Clockwork Capable of Supporting Instabilities Below 1×10^{-17}**

Presenter: Kevin Knabe , *Vescent Photonics*

A field-deployable optical clockwork with in-loop instabilities below 1×10^{-17} is presented. Individual optical subsystem performance is analyzed, and the potential for integration into next-generation quantum sensors is discussed.

Authors: Henry Timmers, *Vescent Photonics* / Dylan Tooley, *Vescent Photonics* / Bennett Sodergren, *Vescent Photonics* / Kyle Sower, *Vescent Photonics* / Evan Barnes, *Vescent Photonics* / Andrew Attar, *Vescent Photonics* / Kurt Vogel, *Vescent Photonics* / Kevin Knabe, *Vescent Photonics*

FM5D.3**Characterization of Highly Structured High Harmonic Beams through Multiplexed Broadband Ptychography**

Presenter: David Schmidt , *Colorado School of Mines*

We demonstrate multi-modal transmission ptychography on high-order harmonic vector beams. The process retrieves highly structured beam profiles and wavefronts in addition to spectral resolution without grating dispersion.

Authors: David Schmidt, *Colorado School of Mines* / David Goldberger, *Colorado School of Mines* / Alba de las Heras, *University of Salamanca* / Carlos Hernández-García, *University of Salamanca* / Yuhao Lei, *University of Southampton* / Peter Kazansky, *University of Southampton* / Daniel Adams, *Colorado School of Mines* / Charles Durfee, *Colorado School of Mines*

FM5D.4**Arbitrary Dispersion in Free Space Using Space-time Wave Packets**

Presenter: Murat Yessenov , *CREOL, University of Central Florida*

We show versatile control over the magnitude, sign, and order of dispersion of a pulse in free space using space-time wave packets – a class of pulsed beams undergirded by non-differentiable angular dispersion.

Authors: Murat Yessenov, *CREOL, University of Central Florida* / Layton Hall, *CREOL, University of Central Florida* / Ayman Abouraddy, *CREOL, University of Central Florida*

FM5D.5

Universal Behavior of the Scattering Matrix Near Thresholds in Photonics

Presenter: Casey Wojcik , *Stanford University*

We show that unitarity, reciprocity, and time-reversal symmetry strongly constrain the scattering matrix near thresholds. We demonstrate this universality in a photonic crystal slab, a planar interface, and a metallic waveguide junction.

Authors: Casey Wojcik, Stanford University / Haiwen Wang, Stanford University / Meir Orenstein, Technion-Israel Institute of Technology / Shanhui Fan, Stanford University

LM5F

X-ray Spectroscopy and XFELs

Presenter: Hans Wörner , *ETH Zurich*

LM5F.1

Momentum Resolved Measurements of XUV Polaritons by X-ray Parametric Down Conversion

Invited

Presenter: Nina Rohringer , *Deutsches Elektronen Synchrotron*

We present an unequivocal experimental realization of x-ray parametric down conversion into pairs of x-ray and XUV photons. Our ab initio theory links the experimental observables to nonlocal electron density correlation functions of the underlying materials.

Authors: Nina Rohringer, Deutsches Elektronen Synchrotron / Christina Boemer, Deutsches Elektronen Synchrotron / Dietrich Krebs, Universität Hamburg / Simo Huotari, University of Helsinki

LM5F.2

Monitoring Molecular Coherences at Conical Intersections via X-ray Raman Spectroscopy and Diffraction with Stochastic Free-Electron-Laser Pulses

Presenter: Stefano Cavaletto , *University of California, Irvine*



Correlation techniques applied to x-ray Raman spectroscopy and diffraction with stochastic free-electron-laser pulses provide the temporal and spectral resolutions needed to monitor the evolution of molecular coherences at conical intersections.

Authors:Stefano Cavaletto, University of California, Irvine / Daniel Keefer, University of California, Irvine / Shaul Mukamel, University of California, Irvine

LM5F.3

Nondispersing Multi-Electron Trojan-Like Wavepackets on Synchronous Langmuir Type-(1) "Bulb Wire" Regular Polygon Trajectories

Presenter: Matt Kalinski , *Utah State University*

Multi-electron extension of the Trojan-like wave packets on the Langmuir Type-(1) He configurations is discovered with the electrons synchronously falling, accelerating and stopping on regular polygon trajectories and hopping between their vertices.

Authors:Matt Kalinski, Utah State University

LM5F.4

Molecules in Intense XFEL Fields

Invited

Presenter: Daniel Rolles , *Kansas State University*

XFELs produce short-pulse, short-wavelength radiation at unprecedented intensities and enable studies of nonlinear X-ray - matter interactions. This talk reviews X-ray multiphoton ionization of atoms and molecules and discuss applications for ultrafast imaging of gas-phase chemical reaction dynamics.

Authors:Daniel Rolles, Kansas State University

FM5B

New Optical Technologies

Presenter: Kaan Aksit , *University College London*

FM5B.1

AR Technology Drives the Emergence of the Metaform

Invited

Presenter: Jannick Rolland , *University of Rochester*

The demand for compact and ergonomic designs in augmented reality displays drove us to invent the metaform construct that leverages freeform optics and flat optics. How ? - you may ask.

Authors:Jannick Rolland, University of Rochester / Daniel Nikolov, University of Rochester / Aaron Bauer, University of Rochester / Nick Vamivakas, University of Rochester

FM5B.2

(Withdrawn) Title to be Announced

Invited

Presenter: Boris Greenberg , *EyeWay Vision*

Abstract not available.

Authors:Boris Greenberg, EyeWay Vision

FM5B.3

Lightfield Engineering for Headset-free Virtual Reality Emulation: Rethinking 3D in Microradians

Invited

Presenter: Barmak Heshmat , *BRELYON*

This talk covers broad perspectives and principles of engineering the wavefront of the light to optically emulate a headset-like experience, where the viewer experiences depth and panorama from a far-standing aperture without wearing a headset.

Authors:Barmak Heshmat, BRELYON

FM5B.4

Computational Acoustic Wavefront Manipulation for Multimodal Displays

Invited

Presenter: Sriram Subramanian , *University College London*



In this talk we will present our work in manipulation of ultrasonic fields to create multi-sensory display. We use phased-arrays of transducers and phase-only holograms create volumetric displays combined with tactile sensations and directional audio.

Authors: Sriram Subramanian, University College London

FM5A

Sensors for Autonomy

Presenter: Umar Piracha , Zoox

FM5A.1

Solid-state Lidars Based on the Meta-Lidar Platform

Invited

Presenter: Ross Uthoff , Lumotive LLC

Lumotive's Meta-Lidar platform is enabling true solid-state lidar based on patented Light Control Metasurface (LCM) technology. We will discuss the operation principles of LCM technology along with how various LCM-based architectures can address a range of lidar applications.

Authors: Ross Uthoff, Lumotive LLC / Apurva Jain, Lumotive LLC / Gleb Akselrod, Lumotive LLC

FM5A.2

(Withdrawn) How Thermal Cameras Improve Automotive Automatic Emergency Braking Systems using RGBT and AI

Invited

Presenter: Chris Posch , Teledyne FLIR

Abstract not available.

Authors: Chris Posch, Teledyne FLIR

LM5G



Special Symposium - Special Event - Optical Lattices, Atom Interferometry, Atom Magnetometry

LM5H

Special Symposium - Special Event - Novel Imaging Methods

14:00 - 16:00 (UTC - 07:00)

FM5E

Optical Sensing, Monitoring, and Imaging for Biomedicine

Presenter: Yizheng Zhu , *Virginia Tech*

FM5E.1

Ultrafast Voltage Imaging of Single Neurons at Ten Kilohertz in Behaving Mice

Invited

Presenter: Xue Han , *Boston University*

We performed five and ten kilohertz imaging of individual hippocampal neurons expressing SomArchon using a high-speed sCMOS camera. The ultrafast imaging speed allows for detailed characterization of action potential waveforms in hippocampal neurons.

Authors: Eric Lowet, Boston University / Sheng Xiao, Boston University / Jerome Mertz, Boston University / Xue Han, Boston University

FM5E.2

Gold Nanorods for Multimodal Photoacoustic Microscopy and Optical Coherence Tomography Molecular Imaging of Choroidal Neovascularization

Presenter: Phuc Nguyen , *University of Michigan*



Functionalized gold nanorods was used as multimodal contrast agents to enhance visualization of choroidal neovascularization using photoacoustic microscopy (PAM) and optical coherence tomography (OCT) in living rabbits.

Authors: Phuc Nguyen, University of Michigan, / Wei Zhang, University of Michigan / Xueding Wang, University of Michigan / Yannis Paulus, University of Michigan,

FM5E.3

Lighting gel filters as low-cost alternatives for fluorescence imaging and optical system design

Presenter: Alberto Ruiz , *Dartmouth College*

Optical characterization of lighting gel filters demonstrates their viability as low-cost alternatives to dielectric and colored glass filters, with the potential for significant advantage in fluorescence and point-of-care diagnostics applications.

Authors: Alberto Ruiz, Dartmouth College / Brady Hunt, Dartmouth College / Mia Giallorenzi, Dartmouth College / Kimberley Samkoe, Dartmouth College / Brian Pogue, Dartmouth College

FM5E.4

A Quantum Optical Microphone in the Audio Band

Presenter: Raphael Nold , *University of Stuttgart*

We demonstrate a sub-shot noise quantum optical sensor combining path entanglement and standard intensity detection. Exploiting our exceptionally high sampling rates, we implement an optical microphone, allowing humans to hear the quantum advantage.

Authors: Raphael Nold, University of Stuttgart / Charles Babin, University of Stuttgart / Joel Schmidt, University of Stuttgart / Tobias Linkewitz, University of Stuttgart / Mariá Zaballos, University of Cambridge / Rainer Stöhr, University of Stuttgart / Roman Kolesov, University of Stuttgart / Vadim Vorobev, University of Stuttgart / Daniil Lukin, Stanford University / Rüdiger Boppert, Olgahospital / Stefanie Barz, University of Stuttgart / Jelena Vuckovic, Stanford University / Christof Gebhardt, Ulm University / Florian Kaiser, University of Stuttgart / Jörg Wrachtrup, University of Stuttgart

FM5E.5

Comparative Analysis of Optical Compensation Methods for Deblurring of Retinal Image in Cataractous Type Media

Presenter: Spozmai Panezai , *Nicolaus Copernicus University*



A comparative analysis between two optical compensation methods, phase conjugation and amplitude modulation, has been carried out to test the visual improvements in retinal images in cataractous eyes.

Authors: Spozmai Panezai, Nicolaus Copernicus University / Alfonso Jimenez Villar, Nicolaus Copernicus University / Alba Paniagua Diaz, Universidad de Murcia, Campus de Espinardo / Augusto Arias, Universidad de Murcia, Campus de Espinardo / Grzegorz Gondek, Nicolaus Copernicus University / Ireneusz Grulkowski, Nicolaus Copernicus University / Pablo Artal, Universidad de Murcia, Campus de Espinardo

FM5E.6

Cherenkov Light Emission in Molecular Radiation Therapy of Hyperthyroidism

Presenter: Jigar Dubal , University of Surrey

We perform numerical experiments based on Monte Carlo simulations and clinical CT data to investigate Cherenkov light emission in molecular radiation therapy of hyperthyroidism, and demonstrate that Cherenkov light-based dosimetry could be feasible.

Authors: Jigar Dubal, University of Surrey / Lucia Florescu, University of Surrey

FM5E.7

Mueller Polarimetric Imaging of Cervical Tissue For Pregnant Women

Presenter: Junha Park , LPICM, Ecole Polytechnique, CNRS

Mueller polarimetric imaging is suitable for assessing the anisotropic and scattering properties of cervix. The extracellular matrix remodeling of cervical tissue in pregnant women is investigated using a Mueller Polarimetric Colposcope *in vivo*.

Authors: Junha Park, LPICM, Ecole Polytechnique, CNRS / Rehbinder Jean, LPICM, Ecole Polytechnique, CNRS / Vizet Jérémy, LPICM, Ecole Polytechnique, CNRS / Jean-Charles Vanel, LPICM, Ecole Polytechnique, CNRS / André Nazac, University Hospital Brugmann, Université Libre de Bruxelles / Angelo Pierangelo, LPICM, Ecole Polytechnique, CNRS

15:00 - 15:30 (UTC - 07:00)



SpE3

Special Event - Monday Virtual Coffee Break

15:45 - 17:05 (UTC - 07:00)

LM6F

Special Symposium - Special Event - Twisted Light and Ultrafast Light

LM6G

Special Symposium - Special Event - Optical Spectroscopy

16:00 - 18:00 (UTC - 07:00)

FM6C

Interferometry and Camera-based Imaging

Presenter: Yoshio Hayasaki , *Utsunomiya University*

FM6C.1

Volume Acquisition of Optical Coherence Tomography: The New Frontier in 3D Imaging

Invited

Presenter: Steve Frisken , *Cylite*



Snapshot volume acquisition using hyperparallel OCT (HP-OCT) is approaching clinical release in Ophthalmic imaging and metrology. Research including enhanced 3-D resolution, holoscopic digital refocussing and dynamic motion visualisation of macroscopic and microscopic in-vivo samples will be explored.

Authors: Steve Frisken, Cylite

FM6C.2

Soil-Insulated Fiber-Optic Interferometry

Presenter: Nabil Md Rakinul Hoque , *The University of Alabama in Huntsville*

We report experimental evidence that demonstrates normal garden soil as an effective insulation material to provide thermal and acoustic isolations in precision fiber-optic interferometry

Authors: Nabil Md Rakinul Hoque, *The University of Alabama in Huntsville* / Lingze Duan, *The University of Alabama in Huntsville*

FM6C.3

Refractive Index Measured by Common Path Interferometry for Solvents from Visible to Infrared

Presenter: Hao-Jung Chang , *University of Central Florida*

We develop a common path interferometer to measure the refractive index of liquids from the visible to infrared. In this work, we present experimental data and comparison of several organic solvents.

Authors: Hao-Jung Chang, *University of Central Florida* / Natalia Munera, *University of Central Florida* / Christian Keyser, *Air Force Research Laboratory* / Scott Webster, *University of Central Florida* / Eric Van Stryland, *University of Central Florida* / David Hagan, *University of Central Florida*

FM6C.4

Single Shot Birefringence Analysis of Natural Fibers

Presenter: Ipsita Chakraborty , *Muroran Institute of Technology*



Identification of single strand of natural textile fiber from its intrinsic birefringence by electromagnetic nanoprobe comprised of focused surface plasmon in a single shot when subjected to different micro-environment towards forensic applications

Authors: Ipsita Chakraborty, Muroran Institute of Technology / Hiroshi Kano, Muroran Institute of Technology

FM6C.5

A Calibration Method for MEMS Mirror Based Structured Light 3D Modeling System Using Striped Patterns

Presenter: Di Yang , *Northwestern Polytechnical University*

We report a MEMS mirror based structured light 3D modeling system which can only project striped patterns. A calibration method is proposed for this structured light system. Experiment results demonstrate an accuracy of 0.26 mm was achieved.

Authors: Di Yang, Northwestern Polytechnical University / Dayong Qiao, Northwestern Polytechnical University / Changfeng Xia, Northwestern Polytechnical University

FM6C.6

Camera-based omnidirectionally three-dimensional sensing for autonomous driving

Invited

Presenter: Kenichi Shimada , *Hitachi Ltd*

For autonomous driving, we propose an omnidirectional three-dimensional sensing and viewing system employing monocular stereo camera which has both ranging and recognition function. We will report the simulated and experimental results of the ranging performance.

Authors: Kenichi Shimada, Hitachi Ltd

FM6D

Optical Processes in Solids and Nanoscale Light-matter Interaction

Presenter: Kevin Silverman , *National Inst of Standards & Technology*

FM6D.1**Quantum Light Emitting Diodes and their Applications***Invited***Presenter:** Richard Stevenson , *Toshiba Europe Limited*

Quantum light emitting diodes are important for many secure quantum networking applications. Here, we address some remaining practical challenges, and present progress in improving the electrical frequency, fiber compatibility and optical coherence of these devices.

Authors:Richard Stevenson, Toshiba Europe Limited / Jonathan Müller, Toshiba Europe Limited / Ginny Shooter, Toshiba Europe Limited / Matthew Anderson, Toshiba Europe Limited / Joanna Skiba-Szymanska, Toshiba Europe Limited / Tin Müller, Toshiba Europe Limited / Jan Huwer, Toshiba Europe Limited / Andrey Krysa, University of Sheffield / Ian Farrer, University of Cambridge / David Ritchie, University of Cambridge / Jon Heffernan, University of Sheffield / Andrew Shields, Toshiba Europe Limited

FM6D.2**Nanofabricated and Integrated Colour Centres in Silicon Carbide with High-Coherence Spin-Optical Properties****Presenter:** Charles Babin , *University of Stuttgart and IQST*

We demonstrate robust spin-optical properties of silicon vacancy centers in 4H-SiC after Helium-ion implantation and integration in nanophotonic-waveguides. For the latter, we show controlled operations on nuclear spin, with near-unity fidelity.

Authors:Charles Babin, University of Stuttgart and IQST / Rainer Stöhr, University of Stuttgart and IQST / Naoya Morioka, University of Stuttgart and IQST / Tobias Linkewitz, University of Stuttgart and IQST / Timo Steidl, University of Stuttgart and IQST / Raphael Wörnle, University of Stuttgart and IQST / Di Liu, University of Stuttgart and IQST / Vadim Vorobev, University of Stuttgart and IQST / Andrej Denisenko, University of Stuttgart and IQST / Mario Hentschel, University of Stuttgart and IQST / Christian Gobert, Fraunhofer Institute for Integrated Systems and Device Technology IISB / Patrick Berwian, Fraunhofer Institute for Integrated Systems and Device Technology IISB / Georgy Astakhov, Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research / Wolfgang Knolle, Leibniz-Institute of Surface Engineering (IOM) / Sridhar Majety, University of California / Pranta Saha, University of California / Marina Radulaski, University of California / Nguyen Son, Linköping University / Jawad Ul-Hassan, Linköping University / Florian Kaiser, University of Stuttgart and IQST / Jörg Wrachtrup, University of Stuttgart and IQST

FM6D.3**Microsphere-Assisted Microscopy for Defect Qubits**

Presenter: Jehyung Kim , UNIST

We demonstrate high-resolution, high-contrast imaging of defects using microsphere-assisted confocal microscopy. A microsphere enables us to address single photons and spins in closely-spaced multiple defects independently.

Authors:Jong Sung Moon, UNIST / Haneul Lee, UNIST / Jin Hee Lee, UNIST / Woong Bae Jeon, UNIST / Dowon Lee, UNIST / Junghyun Lee, KIST / Seoyoung Paik, KIST / Sang-Wook Han, KIST / Rolf Reuter, Stuttgart University / Andrej Denisenko, Stuttgart University / Jörg Wrachtrup, Stuttgart University / Sang-Yun Lee, GIST / Jehyung Kim, UNIST

FM6D.4**Entanglement protection of non-gaussian two-photon states in photonic topological insulators**

Presenter: Konrad Tschernig , Max Born Institut Berlin

We study the evolution of non-Gaussian two-photon states in disordered topological lattices. We identify a parameter regime of the considered states, where an increase of entanglement can be beneficial for their transport through disordered regions.

Authors:Konrad Tschernig, Max Born Institut Berlin / Kurt Busch, Max Born Institut Berlin / Armando Perez-Leija, Max Born Institut Berlin

FM6D.5**Designing High-Fidelity Optical Rotations for the SiV^- and SnV^- in Diamond**

Presenter: EVANGELIA TAKOU , Virginia Polytechnic Institute and State University

We design novel all-optical control schemes tailored to the silicon and tin vacancy centers in diamond. We leverage their full potential via laser polarization and pulse shaping methods, enabling fast and high-fidelity single qubit operations.

Authors:EVANGELIA TAKOU, Virginia Polytechnic Institute and State University / Sophia Economou, Virginia Polytechnic Institute and State University

FM6D.6**Integrated Nonlinear Photonics: New Opportunities in the Nanometer and Femtosecond Scales**

Invited

Presenter: Alireza Marandi , *California Institute of Technology*

Bringing ultrafast nonlinear optics from table-top setups to the chip-scale promises unprecedented opportunities for integrated photonics. We present recent experimental results in lithium niobate nanophotonics including ultra-high-gain parametric amplification and ultrafast ultra-low-energy all-optical switching.

Authors:Alireza Marandi, California Institute of Technology

LM6E

Quantum Science I

Presenter: Virginia Lorenz , *Univ of Illinois at Urbana-Champaign*

LM6E.1

Single- and Multi-Phonon Subtraction to a Mechanical Thermal State via Brillouin Optomechanics

Presenter: Andreas Svela , *Imperial College London*

We perform single- and multi-phonon subtraction to a mechanical thermal state in a Brillouin optomechanical system. An increase in the mean mechanical occupation and non-Gaussianity in the s-parametrised Wigner phase-space distribution is observed.

Authors:GeorgENZIAN, Imperial College London / Lars Freisem, Imperial College London / John Price, Imperial College London / Andreas Svela, Imperial College London / Jack Clarke, Imperial College London / Biveen Shajilal, Australian National University / Jiri Janousek, Australian National University / Ben Buchler, Australian National University / Ping Lam, Australian National University / Michael Vanner, Imperial College London

LM6E.2

Distinguishability and "which pathway" Information in Quantum Interferometric-Spectroscopy

Invited

Presenter: Shaul Mukamel , *University of California, Irvine*



New class of nonlinear quantum correlators are reported. Novel interferometric schemes, with time variables unbound by uncertainty are introduced. For an exciton model we demonstrate: (a) time-resolved intraband dephasing and (b) pathway selectivity.

Authors: Shaul Mukamel, University of California, Irvine / Shahaf Asban, University of California, Irvine

LM6E.3

Randomized tomography of on-chip biphoton frequency combs

Presenter: Karthik Myilswamy, *Purdue University*

We perform full state tomography of frequency-bin entangled qudits generated from a Si_3N_4 microring, up to record-high frequency-bin dimensions of $d=8$. Our method combines randomized electro-optic modulation and pulse shaping with Bayesian inference.

Authors: Karthik Myilswamy, Purdue University / Hsuan-Hao Lu, Purdue University / Suparna Seshadri, Purdue University / Mohammed Alshaykh, Purdue University / Junqiu Liu, Ecole Polytechnique Federale de Lausanne / Daniel Leaird, Purdue University / Tobias Kippenberg, Ecole Polytechnique Federale de Lausanne / Andrew Weiner, Purdue University / Joseph Lukens, Oak Ridge National Laboratory

LM6E.4

Momentum-comb Tomography of Many-body Processes in Solids

Invited

Presenter: Mackillo Kira, *University of Michigan*

Crystal-momentum combs are shown to emerge in harmonic sideband emission as a means to image electronic bands of quantum materials with super-resolution, including timing delicate many-body dynamics at attosecond timescales.

Authors: Mackillo Kira, University of Michigan

LM6E.5

Spin-photon Interfaces for Quantum Networks

Invited

Presenter: Sophia Economou, *Virginia Tech*



Spin-photon interfaces are critical for the realization of quantum networks. This talk will discuss the coherent control of such spin systems, including color centers in solids, and protocols for the generation of entangled multi-photon states.

Authors: Sophia Economou, Virginia Tech

FM6B

Emerging Technologies

Presenter: Douglas Lanman , *Facebook Reality Labs Research*

FM6B.1

ConeTilt: Toward Occlusion Aware Multifocal Displays

Invited

Presenter: Anat Levin , *Technion Israel Institute of Technology*

Abstract not available.

Authors: Anat Levin, Technion Israel Institute of Technology

FM6B.2

Beaming Displays

Invited

Presenter: Kaan Aksit , *University College London*

In this talk, I will be focusing on a new near-eye display concept called "beaming displays", which promises to remove all the active components from the body of an augmented reality near-eye display.

Authors: Kaan Aksit, University College London

FM6B.3

Optical Trap Displays: Considerations for Augmented Reality

Invited

Presenter: Daniel Smalley , *Brigham Young University*



Optical trap displays are unique in that they materially augment the world around us. In this presentation, I discuss the operation and potential of this new display platform for augmented reality.

Authors: Daniel Smalley, Brigham Young University / Dylan Barton, Brigham Young University / Riley Kuttler, Brigham Young University / Madeline Egan, Abbey School

FM6B.4

Reverse Passthrough VR

Invited

Presenter: Nathan Matsuda , *Facebook Reality Labs*

We present a system that shows a three-dimensional view of a VR headset wearer's eyes to multiple outside viewers in a perspective-correct manner, using light field displays, to facilitate in-person interactions.

Authors: Nathan Matsuda, Facebook Reality Labs

FM6B.5

Metameric image synthesis and display

Invited

Presenter: Tobias Ritschel , *University College London*

Different physical stimuli might lead to the same human perception. I will here discuss a special case of such ambiguity of images (metamers) that in the human visual fovea match a target exactly, but in the peripheral vision only match the targets statistics. This opens up new options for bandwidth and compute saving in image generation and display. Specifically, I will discuss three applications: cloud-based real-time rendering, where metameric images are transmitted, latency compensation in VR, where metamers are used for completing missing information, and finally applying metamers to holographic displays.

Authors: Tobias Ritschel, University College London

FM6A

Autonomous Technologies and Applications

Presenter: Umar Piracha , *Zoox*



FM6A.1**(Withdrawn) New Applications of Lidar in the Autonomous Industry***Invited***Presenter:** Akram Benmbarek , *AEye Inc.*

Abstract not available.

Authors:Akram Benmbarek, *AEye Inc.*

FM6A.2**Silicon Photonic Technologies for the Future of Autonomous Mobility***Invited***Presenter:** Amin Abbasi , *Ghent University, INTEC*

Abstract not available.

Authors:Amin Abbasi, *Ghent University, INTEC*

FM6A.3**LiDAR, AV, Trucking Sensors***Invited***Presenter:** Emil Kadlec , *Aurora Innovations Inc.*

Aurora's FirstLight lidar has been designed to provide long-range performance, high point density and radial velocity on every point. We will discuss the FirstLight lidar and how it enables safe AV operation at highway speeds.

Authors:Emil Kadlec, *Aurora Innovations Inc.*

17:20 - 18:40 (UTC - 07:00)

LM7A

Special Symposium - Special Event - Optics in Biological Systems

18:00 - 19:00 (UTC - 07:00)

SpE21

Special Event - Imaging Optical Design Technical Group
Special Talk

SpE24

Special Event - Laser Systems Technical Group Campfire
Session: Breakthrough Starshot - The Path to the World's
Largest Laser for Interstellar Lightsail Propulsion

19:00 - 19:45 (UTC - 07:00)

SpE26

Special Symposium - Special Event - Physicist Random
Walk: Careers, Graduate School, & Mental Maintenance



Tuesday, 02 November

6:00 - 8:00 (UTC - 07:00)

Tu1A

Plenary Session II

Presenter: Nicolas Treps , *Sorbonne Université*

Tu1A.1

Absolute Quantum Advantage in Bioimaging

Plenary

Presenter: Warwick Bowen , *University of Queensland*

The clarity of state-of-the-art microscopes is constrained by intensity limits imposed by biological photodamage. We use quantum correlations to overcome these otherwise absolute limits. This allows imaging of biological structures inaccessible using classical light.

Co-authors: C A Casacio, L S Madsen, A Terrasson, M Waleed, K Barnscheidt, B Hage, M A Taylor and W P Bowen

Authors: Warwick Bowen, University of Queensland

Tu1A.2

Large-Scale Quantum Computing With Quantum Teleportation

Plenary

Presenter: Akira Furusawa , *The University of Tokyo*

Time-domain multiplexed one-way quantum computation is a method to overcome the problem of scalability of quantum computers. I will talk about the recent progress toward the realization of large-scale fault-tolerant universal quantum computers.

Authors: Akira Furusawa, The University of Tokyo

7:00 - 8:00 (UTC - 07:00)

JTu1A

Joint Poster Session I

JTu1A.1

Multi-mJ Pulse Self-compression to 10 fs in a 2 cm Kr Filled Compact Hollow Core Waveguide

Presenter: Qiandong Ran , *Nanyang Technological University*

Broad spectrum supporting sub-10 fs pulses was generated from a 2 cm Kr filled hollow core waveguide. Multi-mJ pulses were compressed to 10.5 fs by self-compression without using any phase compensation optics.

Authors: Qiandong Ran, Nanyang Technological University / Hao Li, Singapore Institute of Manufacturing Technology / Qi Jie Wang, Nanyang Technological University / Ying Zhang, Singapore Institute of Manufacturing Technology

JTu1A.2

Terahertz Transverse Magnetism in Subwavelength Grating-Coupled Hybrid Plasmonic Systems

Presenter: Subhajit Karmakar , *Indian Institute of Technology Delhi*

We propose an effective mechanism to induce transverse magnetic moment in plasmonic gratings coupled with subwavelength dipole rods. Artificial magnetism in plasmonic wire gratings may lead to efficient hybrid system for THz magnetic applications.

Authors: Subhajit Karmakar, Indian Institute of Technology Delhi / Ravendra K. Varshney, Indian Institute of Technology Delhi / Dibakar Roy Chowdhury, Ecole Centrale School of Engineering - Mahindra University

JTu1A.3

Active Control of Picosecond Pulse Pumped Supercontinuum Generation in Silicon-nanocrystal-based Slot Waveguide

Presenter: Kaibin Lin , *Peking University*



We numerically demonstrate the active control of the picosecond pulse pumped supercontinuum generation in silicon-nanocrystal-based slot waveguide.

Authors: Kaibin Lin, Peking University / Qian Li, Peking University

JTu1A.4

Non-equilibrium carrier transport and dynamics of type-II quantum wells

Presenter: Herath Piyathilaka , *West Virginia University*

Non-equilibrium carrier transport and dynamics were investigated using AC photoconductivity in type-II quantum wells. Low carrier mobilities are observed in the system when the hot-carriers at the metastability time span.

Authors: Herath Piyathilaka, West Virginia University / Rishmali Sooriyagoda, West Virginia University / Hamidreza Esmailpour, University of Oklahoma / Vincent Whiteside, University of Oklahoma / Tetsuya Mishima, University of Oklahoma / Michael Santos, University of Oklahoma / Ian Sellers, University of Oklahoma / Alan Bristow, West Virginia University

JTu1A.5

Demonstration of a Multi-channel Dynamic Interrogation System Based on Matched Filters for Elastic Wave Sensing

Presenter: Aananth K , *Indian Institute of Technology Madras*

We experimentally demonstrate a dual-channel dynamic interrogator for elastic waves sensing using matched fiber Bragg gratings, with noise floor closer to theoretical limit using hardware filtering and computationally inexpensive signal conditioning.

Authors: Aananth K, Indian Institute of Technology Madras / Jagadeeshwar Tabjula, Indian Institute of Technology Madras / Balaji Srinivasan, Indian Institute of Technology Madras

JTu1A.6

Utilizing Object Asymmetry in the Phase Retrieval Algorithm

Presenter: Surya Gautam , *Indian Institute of Space Science and Technology*



Object autocorrelation obtained from the far field intensity pattern of the asymmetric object contains the object features. This fact is utilized here in the phase retrieval algorithm to remove the twin image problem.

Authors:Surya Gautam, Indian Institute of Space Science and Technology / Dinesh Naik, Indian Institute of Space Science and Technology

JTu1A.7

Practical Considerations for 1x4 All-Fiber MMI Based Power Splitter Using Square Core Fiber

Presenter: Kritarth Srivastava , *Indian Institute of Technology, Jodhpur*

We investigate the practical issues such as fiber offset and operational bandwidth for 1x4 all-fiber square core multimode interference based optical power splitter.

Authors:Kritarth Srivastava, Indian Institute of Technology, Jodhpur / Nitin Bhatia, Indian Institute of Technology, Jodhpur

JTu1A.8

Random Verses Improved Initial Guess on the Reconstruction from Phase Retrieval Algorithm

Presenter: Surya Gautam , *Indian Institute of Space Science and Technology*

a comparison study is presented to show the effect on the reconstruction of the phase retrieval algorithm using random initial guess and a region filtered from the autocorrelation as an initial guess (improved guess).

Authors:Surya Gautam, Indian Institute of Space Science and Technology / Dinesh Naik, Indian Institute of Space Science and Technology

JTu1A.9

Vortex laser generation with controllable topological charges in a spiral phase defect resonator

Presenter: YuanYao Lin , *National Sun Yat-Sen University*

We propose an optical cavity with spiral phase defect for vortex laser generation. Utilizing a reflective spatial light modulator that creates variable spiral phase defect, vortex beams with controllable topological charges are demonstrated.

Authors:YuanYao Lin, National Sun Yat-Sen University / Yu-Wei Lee, National Sun Yat-Sen University

JTu1A.10**Feedback Phase Sensitivity of a Semiconductor Laser Subject to Distributed Optical Feedback From a Fiber Bragg Grating.**

Presenter: Martin Skänderas , *Brussels Photonics (B-PHOT), Vrije Universiteit Brussel*

We demonstrate that the feedback phase from a wavelength-detuned fiber Bragg grating affects the laser behavior. Highly detailed maps of the dynamics indicate that the border between dynamical states fluctuates in the same manner as the phase change.

Authors: Martin Skänderas, Brussels Photonics (B-PHOT), Vrije Universiteit Brussel / Nitish Gupta, Brussels Photonics (B-PHOT), Vrije Universiteit Brussel / Spencer Jolly, Brussels Photonics (B-PHOT), Vrije Universiteit Brussel / Thomas Geernaert, Brussels Photonics (B-PHOT), Vrije Universiteit Brussel / Martin Virte, Brussels Photonics (B-PHOT), Vrije Universiteit Brussel

JTu1A.11**Impact of Feedback Phases on the Dynamics of a Laser with Double Optical Feedback**

Presenter: Robbe de Mey , *Vrije Universiteit Brussel*

In simulating a semiconductor laser subject to two feedback loops, we observed the dynamics to be dependent on both feedback phases. Even for very low second feedback strength, the second phase has a visible influence.

Authors: Robbe de Mey, Vrije Universiteit Brussel / Spencer Jolly, Vrije Universiteit Brussel / Martin Virte, Vrije Universiteit Brussel

JTu1A.12**Mutli-variable Optimization of Cooling of Mechanical Mode Assisted by Three-level System**

Presenter: Neelesh Vij , *IIT Kanpur*

We develop, both analytically and numerically, an optimization scheme for ground-state cooling of a mechanical mode, over a broad range of system parameters using master equation approach, by coupling to a general three-level system.

Authors: Neelesh Vij, IIT Kanpur / Meenakshi Khosla, Cornell University / Shilpi Gupta, IIT Kanpur

JTu1A.13

Experimental Investigation of Visible Light Communication using PPM Modulated 532nm DPSS Laser

Presenter: SIVA SUBRAMANIYAM C N , *Indian Institute of Technology Madras*

We experimentally demonstrate visible light communication (VLC) with PPM modulated 532 nm DPSS laser for link loss upto ~78 dB while supporting bit rates up to 120 kbps and BER better than $1e-6$.

Authors: SIVA SUBRAMANIYAM C N, *Indian Institute of Technology Madras* / Awakash Dixit, *Indian Institute of Technology Madras* / Kanhaiya Mishra, *Indian Institute of Technology Madras* / Deepa Venkitesh, *Indian Institute of Technology Madras* / Balaji Srinivasan, *Indian Institute of Technology Madras*

JTu1A.14

Photoinduced Dynamics of V_4O_7

Presenter: Alexander Bartenev , *University of Puerto Rico*

Ultrafast dynamics of V_4O_7 reveal complex nonlinearity upon laser excitation across a broad range of temperatures. The formation of the nonequilibrium metal-like phase within several picoseconds is accompanied by the generation of coherent phonons.

Authors: Alexander Bartenev, *University of Puerto Rico* / Armando Rua, *University of Puerto Rico* / Camilo Verbel, *University of Puerto Rico* / Felix Fernandez, *University of Puerto Rico* / Sergiy Lysenko, *University of Puerto Rico*

JTu1A.15

Femtosecond Laser Ferroelectric Domains Reversal in Monodomain Calcium Barium Niobate Crystal

Presenter: Leszek Mazur , *Wroclaw University of Science and Technology*

Femtosecond pulses are used for the first time to invert spontaneous polarization in the monodomain calcium barium niobate crystal. The resulting domain patterns allow transverse SHG without the nonlinear noise encountered in multidomain crystals.

Authors: Leszek Mazur, *Wroclaw University of Science and Technology* / Shan Liu, *The Australian National University* / Xin Chen, *Xidian University* / Wieslaw Krolikowski, *Texas A&M University at Qatar* / Yan Sheng, *The Australian National University*

JTu1A.16

Deep Learning Assisted Classification of Noisy Laguerre Gaussian Modes

Presenter: Venugopal Raskatla , *National Institute of Technology, Warangal*

A deep learning assisted scheme for classification of noisy LG modes is proposed. This model is noise and alignment independent and will increase the accuracy and fidelity of OAM mode detection systems.

Authors: Venugopal Raskatla, National Institute of Technology, Warangal / Vijay Kumar, National Institute of Technology, Warangal

JTu1A.17

Integrated Silicon Resonator with Bragg Grating Reflectors for Passive Reservoir Computing

Presenter: Younus Mandalawi , *THz-Photonics Group*

We design a novel integrated silicon photonic resonator with Bragg grating reflectors for passive reservoir computing. It provides chaotic signal mixing and fading memory feature, which are imperative to solve time-dependent heavy computational tasks

Authors: Younus Mandalawi, THz-Photonics Group / Ranjan Das, THz-Photonics Group / Thomas Schneider, THz-Photonics Group

JTu1A.18

Quantum Differential Interference Contrast microscopy

Presenter: Daniel Urrego , *ICFO*

We present here the experimental demonstration of a Differential Interference Contrast microscope that makes use of the Hong-Ou-Mandel effect, a phenomenon genuinely quantum, for phase retrieval of phase objects

Authors: Daniel Urrego, ICFO / Marcello Passos, ICFO / Juan Torres, ICFO

JTu1A.19

Discretized X-Wave in a Multimode Optical Fiber

Presenter: Karolina Stefanska , *Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR6303 CNRS-UBFC*

We numerically and experimentally demonstrate the spontaneous emergence of conical waves when an ultrashort pulse propagates nonlinearly in a multimode fiber, i.e. a discretization of conical emission phenomenon (e.g., X-wave) in bulk media.

Authors:Karolina Stefanska, Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR6303 CNRS-UBFC / Pierre B ejot, Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR6303 CNRS-UBFC / Karol Tarnowski, Department of Optics and Photonics, Faculty of Fundamental Problems of Technology, Wroclaw University of Science and Technology / Bertrand Kibler, Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR6303 CNRS-UBFC

JTu1A.20

Ultrafast Probing of Plasmonic Hot Electron Occupancies

Presenter: Zsuzsanna P apa , *Wigner RCP*

We discuss in-depth distribution and time evolution of hot electrons generated upon the excitation of surface plasmon polaritons. Dielectric function of plasmonic systems was measured with ellipsometric methods to reveal the electron distribution.

Authors:Zsuzsanna P apa, Wigner RCP / Judit Budai, ELI-ALPS / Shirly Espinoza, ELI Beamlines / Mateusz Rebarz, ELI Beamlines / Martin Zahradnik, ELI Beamlines / P eter Dombi, Wigner RCP

JTu1A.22

Interaction of Twisted Light with Metal Tips

Presenter: Abhisek Sinha , *Indian Institute of Technology*

A study of the interaction of Laguerre-Gaussian (LG) beams with Tungsten tips. A change in the order of the interaction for LG beams compared to Gaussian beams is reported.

Authors:Abhisek Sinha, Indian Institute of Technology / Debobrata Rajak, Tata Institute of Fundamental Research / Shilpa Rani, Indian Institute of Technology / Ram Gopal, Tata Institute of Fundamental Research / Vandana Sharma, Indian Institute of Technology

JTu1A.23

Whispering gallery modes excitation in microresonators of crystalline silicon at 8.6 μm wavelength.

Presenter: Artem Shitikov , *Russian Quantum Center*



We demonstrated an excitation of whispering gallery modes in microresonators made of crystalline silicon at 8.6 μm . The Q-factor of 3×10^5 was measured experimentally and compared it with measured at 1.5 and 2.6 μm .

Authors: Artem Shitikov, Russian Quantum Center / Oleg Benderov, Moscow Institute of Physics and Technology / Nikita Kondratyev, Russian Quantum Center / Valery Lobanov, Russian Quantum Center / Dmitry Mylnikov, Moscow Institute of Physics and Technology / Igor Bilenko, Russian Quantum Center

JTu1A.24

Spectral Modulations of High Harmonic Generation in Extreme High-power Chirped Pulses

Presenter: Raz Halifa-levi , *Tel Aviv University*

We demonstrate the spectral splitting of high-harmonics generated from gas, when an extreme amount of temporal chirp is applied to a 20 TW peak power driving laser pulse

Authors: Raz Halifa-levi, Tel Aviv University / Ori Ildis, Tel Aviv University / Assaf Levanon, Tel Aviv University / Ishay Pomerantz, Tel Aviv University

JTu1A.25

Micro-hole drilling of transparent materials with ultra-fast Bessel beam

Presenter: Belloni Valeria Viviana , *Università dell'Insubria*

We study micro-hole drilling in transparent materials with ultra-fast Bessel beam in single pulse mode and burst mode. We apply this technique to samples with thickness up to 500 μm and of different materials.

Authors: Belloni Valeria Viviana, Università dell'Insubria / Vytautas Sabonis, UAB Altechna Rnd / Shane M. Eaton, Istituto di Fotonica e Nanotecnologie, CNR / Monica Bollani, Istituto di Fotonica e Nanotecnologie, CNR, L-NESS / Paolo Di Trapani, Università dell'Insubria / Ottavia Jedrkiewicz, Istituto di Fotonica e Nanotecnologie, CNR, Udr di Como

JTu1A.26

CEP-stable Infrared OPCPA Sources

Presenter: Nicolas Forget , *FASTLITE*



We review several OPCPA systems designed to achieve extreme CEP stability in the infrared. We demonstrate the compatibility of the "self-seeded DFG" scheme with a set of high-power Ytterbium pump lasers (bulk, rod-type, thin-disk, InnoSlab).

Authors:Nicolas Thiré, FASTLITE / Raman Maksimenka, FASTLITE / Yoann Pertot, FASTLITE / José Villanueva, FASTLITE / Thomas Pinoteau, FASTLITE / Nicolas Forget, FASTLITE

JTu1A.27

Generation of Extremely High Cone Angle Bessel Beam

Presenter: Belloni Valeria Viviana , *FEMTO-ST Institute*

We present a new method for the generation of extremely high angle Bessel beams. We report the simulations and experimental results where we reach 43 degrees cone angle at a wavelength of 980 nm.

Authors:Belloni Valeria Viviana, FEMTO-ST Institute / Luc Froehly, FEMTO-ST Institute / Cyril Billet, FEMTO-ST Institute / Luca Furfaro, FEMTO-ST Institute / Francois Courvoisier, FEMTO-ST Institute

JTu1A.28

Control and Optimization of Precise Colour in Thin-Film Stacks

Presenter: Riley Shurvinton , *Institut Fresnel*

Thin films present a versatile and powerful alternative for surface colour generation. We present a demonstration of colour coating design and control via the description of three strongly saturated RGB primaries.

Authors:Riley Shurvinton, Institut Fresnel / Antonin Moreau, Institut Fresnel / Fabien Lemarchand, Institut Fresnel / Julien Lumeau, Institut Fresnel

JTu1A.29

Femtosecond Nonlinear Energy Losses Reduction for Enhanced Nanoparticle Production by Laser Ablation in Liquids

Presenter: Carlos Doñate Buendía , *Universitat Jaume I*



Pulsed laser ablation in liquids is an eco-friendly alternative to high pureness nanoparticle synthesis. Simultaneous spatio-temporal focusing technique improves femtosecond laser productivity in a factor of two compared to conventional setups.

Authors: Carlos Doñate Buendía, Universitat Jaume I / Mercedes Fernández-Alonso, Universitat Jaume I / Jesus Lancis, Universitat Jaume I / Gladys Mínguez-Vega, Universitat Jaume I

JTu1A.31

Stimulated Brillouin Scattering-Induced All-Optical Spectrum Sensing

Presenter: Jaffar Kadum , *Technical University of Braunschweig*

We report a spectrum sensing technique for RF signals. A multi-channel signal discrimination is illustrated based on the group delay by Brillouin scattering-induced transparency. The technique is reconfigurable and feasible for broad spectrum bands

Authors: Jaffar Kadum, Technical University of Braunschweig / Ranjan Das, Technical University of Braunschweig / Arijit Misra, Technical University of Braunschweig / Thomas Schneider, Technical University of Braunschweig

JTu1A.32

Machine Learning-based Fiber-Wireless Channel Estimation

Presenter: Arismar Cerqueira Sodre Junior , *National Institute of Telecommunications*

This work reports a fiber-wireless (FiWi) channel estimation, using machine learning (ML). Numerical results demonstrate the ML potential for channel estimation considering a flat optical channel response and a fast-fading wireless channel.

Authors: Luiz Pereira, National Institute of Telecommunications / Luciano Mendes, National Institute of Telecommunications / Arismar Cerqueira Sodre Junior, National Institute of Telecommunications

JTu1A.33

A Coupled-mode Theory Approach for Consolidating Nonlinearities with Quasinormal Modes

Presenter: Thomas Christopoulos , *Aristotle University of Thessaloniki*



A rigorous nonlinear framework for modeling resonant cavities is presented, reconciling perturbation theory/coupled-mode theory approach with quasinormal modes. The framework is tested in characteristic guided and free-space resonant cavities.

Authors: Thomas Christopoulos, Aristotle University of Thessaloniki / Odysseas Tsilipakos, Foundation for Research and Technology-Hellas / Emmanouil Kriezis, Aristotle University of Thessaloniki

JTu1A.34

Design and Simulation of Double Quantum Well Vertical Cavity Tunneling Injection Transistor Laser for Technical Characteristics Improvement

Presenter: Ghazaleh Noorbakhsh , *Photonics Research Laboratory*

Here, we proposed a Tunnel-Injection graded-base Transistor Laser with double quantum well. We achieved 50% reduction in threshold current, 13.6GHz optical bandwidth enhancement, 0.9 increment in DC-current gain compared to previous reported results.

Authors: Ghazaleh Noorbakhsh, Photonics Research Laboratory / Hassan Kaatuzian, Photonics Research Laboratory / Behzad Namvar, Photonics Research Laboratory

JTu1A.35

3D-printed Mounts for Microdroplet Resonators

Presenter: Parker Averkamp , *Brigham Young University*

We present a 3D printed structure utilizing quick fabrication and modular designs, enabling the easy creation of microdroplet resonators of varying shapes, sizes, and liquids.

Authors: Parker Averkamp, Brigham Young University / Davin Fish, Brigham Young University / Madison King, Northern Arizona University / David Hill, Brigham Young University / Greg Nordin, Brigham Young University / Ryan Camacho, Brigham Young University

JTu1A.37

Ultrashort Pulse Measurement at 1.9 μm Using GRENOUILLE Technique

Presenter: Daniil Batov , *Bauman Moscow State Technical University*



We demonstrate the features of the GRENOUILLE technique for measuring the amplitude-phase characteristics of ultrashort pulses at a wavelength of 1.9 μm for pulses with a duration of 330 fs and about 70 fs.

Authors: Dmitriy Vlasov, Bauman Moscow State Technical University / Vasiliy Voropaev, Bauman Moscow State Technical University / Daniil Batov, Bauman Moscow State Technical University / Selçuk Akturk, Georgia Institute of Technology / Rana Jafari, Georgia Institute of Technology / Mikhail Tarabrin, Bauman Moscow State Technical University / Rick Trebino, Georgia Institute of Technology / Vladimir Lazarev, Bauman Moscow State Technical University

JTu1A.38

How Fast Can NV and SiV Centers in Diamond Be Electrically Triggered?

Presenter: Igor Khramtsov , *Moscow Institute of Physics and Technology*

We present a rigorous study of the temporal dynamics of electrically driven single-photon sources based on NV and SiV centers in diamond

Authors: Igor Khramtsov, Moscow Institute of Physics and Technology / Dmitry Fedyanin, Moscow Institute of Physics and Technology

JTu1A.39

Quantitative characterization of trapping force properties of 2D Airy beam superpositions

Presenter: Fuxi Lu , *Guangxi university*

We have experimentally and theoretically investigated the gradient force and trap stiffness of 2D Airy beam superpositions, quantitatively demonstrating the beams can show better optical trapping ability than circular Airy beam.

Authors: Fuxi Lu, Guangxi university / Liu Tan, Guangxi university / Huahao Wu, Guangxi university / Zhifu Tan, Guangxi university / Yi Liang, Guangxi university

JTu1A.42

Raman Path for Generation of Singlet Oxygen in Aqueous Environments

Presenter: Aristides Marcano Olaizola , *Delaware State University*



We propose that Raman excitation can generate singlet oxygen in water environments without the intervention of photosensitizers. Preliminary Raman experiments using continuous-wave laser light at 405 nm validate the hypothesis.

Authors:Aristides Marcano Olaizola, Delaware State University / David Kingsley, USDA / Robinson Kuis, University of Maryland Baltimore County / Anthony Johnson, University of Maryland Baltimore County

JTu1A.43

Optical design, optimization and validation of an extended-depth-of-field optical coherence tomography probe based on mirror-tunneling

Presenter: Chukwuemeka Okoro , *Harvard Medical School*

We present results from optimizing mirror-tunnel based optical coherence tomography probes, achieving extended depth of field at high resolution. We achieved 6 μm spot diameter over 1 mm depth in simulations and validated experimentally.

Authors:Chukwuemeka Okoro, Harvard Medical School / Charles Cunningham, Harvard Medical School / Aaron Baillargeon, Harvard Medical School / Andreas Wartak, Harvard Medical School / Guillermo Tearney, Harvard Medical School

JTu1A.44

New Space-Time Spermodes in Highly Multi-Mode Planar Waveguides

Presenter: Abbas Shiri , *University of Central Florida*

The field distributions in highly multi-moded waveguides vary axially in a complicated fashion. We show that propagation-invariant space-time wave packets are impervious to mode-beating in 168- μm -thick and 9.1-mm-long multi-mode planar waveguide.

Authors:Abbas Shiri, University of Central Florida / Scott Webster, University of Central Florida / Kenneth Schepler, University of Central Florida / Ayman Abouraddy, University of Central Florida

JTu1A.45

Optimum Pattern Depth for Diffraction in Phase Gratings

Presenter: Arpita Haldar , *Indian Institute of Technology Kanpur*



In 1-D step grating, the diffraction intensity is a monotonic function of the refractive index. But in a 2-D arrangement, an optimum pattern depth is possible and this is a function of the refractive index.

Authors: Arpita Haldar, Indian Institute of Technology Kanpur / Dhananjay De, Indian Institute of Technology Kanpur / Vijaya Ramarao, Indian Institute of Technology Kanpur

JTu1A.46

Near-maximal Polarization Entanglement for Quantum Communications at 2.1 μm

Presenter: Adetunmise Dada , *University of Glasgow*

We demonstrate for the first time a positive secure-key rate at 2.1 μm (0.417 bits/pair, with a quantum bit error rate of 5.43%), using near-maximally entangled photons in a proof-of-principle device-independent quantum-key-distribution scenario.

Authors: Adetunmise Dada, University of Glasgow / Jędrzej Kaniewski, University of Warsaw / Corin Gawith, Covesion Ltd. / Martin Lavery, University of Glasgow / Robert Hadfield, University of Glasgow / Daniele Faccio, University of Glasgow / Matteo Clerici, University of Glasgow

JTu1A.47

Low-loss Hollow Core Silica Fiber with Anti-resonant Tubes for Quantum State Transmission in the Visible Regime

Presenter: Sudip Chatterjee , *Indian Institute of Science*

We report an optimized design of six-ring antiresonant nodeless fiber possessing low, wideband confinement loss of 1 dB/km across 600-700 nm with minimum of 0.092 dB/km at 650 nm. The bend robustness is also investigated.

Authors: Sudip Chatterjee, Indian Institute of Science / Suchita Suchita, Indian Institute of Science / Asha Bhardwaj, Indian Institute of Science

JTu1A.48

Dynamic Laser Speckle as a Technique for the Characterization of Diatomite-Based Ceramic Foams Hygroscopicity

Presenter: Myrian Tebaldi , *Centro de Investigaciones Opticas*



Hygroscopicity of diatomite based ceramic foams with heterogeneous surfaces is studied using dynamic speckle. Results are analyzed comparatively with those obtained from nitrogen adsorption technique used for the surface textural properties study.

Authors:Ruth Dary Mojica -Sepúlveda, Centro de Investigaciones Opticas / Barbara Galzerano, Applied Chemistry Labs-Department of Chemical, Materials and Industrial Engineering, University of Naples Federico II, Naples, Italy / Luis Joaquin Mendoza Herrera, Centro de Investigaciones Opticas / Carmen I Cabello, Centro de Investigación y Desarrollo en Ciencias Aplicadas, Dr. J. J. Ronco (CINDECA-CONICET-CIC-UNLP) / Eduardo Grumel, Centro de Investigaciones Opticas / Myrian Tebaldi, Centro de Investigaciones Opticas / Marcelo Trivi, Centro de Investigaciones Opticas

JTu1A.49

Wave Propagation and Imaging using Thin Lens under Effect of Chirality and Dielectric Loss

Presenter: Monish Chatterjee , *University of Dayton*

In this paper, we study the propagation of p -polarized electromagnetic waves across a chiral thin lens using ABCD matrix to examine the propagation and imaging of a transverse object under dielectric loss and variable chirality.

Authors:Akram Muntaser, University of Dayton / Monish Chatterjee, University of Dayton

JTu1A.50

Ring currents in high harmonic generation driven by bicircular intense laser pulses

Presenter: Agnieszka Jaron-Becker , *University of Colorado*

The bicircular setup is used to both drive the ring current and high harmonic generation.

We discuss how the set up can be used to follow the ultrafast nonadiabatic electron dynamics of ring currents.

Authors:Agnieszka Jaron-Becker, University of Colorado

JTu1A.51

Surface Deposition of YAG Phosphor on Borosilicate Glass Using a CO₂ Laser

Presenter: Javed Ali , *Texas A&M University*

A novel method for surface deposition for YAG-Ce phosphor using a CO₂ laser is presented. This versatile method reduces the process time multifold and can deposit thick phosphor films for white light applications.

Authors:Javed Ali, Texas A&M University / Christi Madsen, Texas A&M University

JTu1A.53

Non-diffractive Beam Cleaving of Fibers for Optical Connectivity

Presenter: Lei Yuan , *Corning Incorporated*

We present our recent progress on non-diffractive beam cleaved fibers for optical connectivity applications. Fiber/ribbon can be cleaved at flexible locations with no swelling, flat end face, controlled surface roughness, and high process throughput.

Authors:Lei Yuan, Corning Incorporated / Randy McClure, Corning Incorporated / Joel Carberry, Corning Incorporated / Chad Terwilliger, Corning Incorporated / Craig Ungaro, Corning Incorporated / David Meek, Corning Incorporated / Scott Bickham, Corning Incorporated / Hanzheng Wang, Corning Incorporated / Jie Liu, Corning Incorporated / Qi Wu, Corning Incorporated

JTu1A.54

V-point Polarization Singularity in Cylindrical Vector Beams

Presenter: Elforjani Jera , *University of Dayton*

We will investigate the optical polarization singularities in cylindrical vector beams. Theoretically using 4Pi microscopic setup and experimentally using spatial light modulators. The results show that V-point polarization singularities are observed

Authors:Elforjani Jera, University of Dayton

JTu1A.55

Graphene-based Photonic C-H bond activation

Presenter: Erick Ulin-Avila , *CIDESI*

C-H bond activation is critical for the realization of photosynthesis. We present a graphene-based spectroscopic technique that controls the C-H bond Raman modes allowing for the study of thermodynamic changes at the molecular level.

Authors:Erick Ulin-Avila, CIDESI / Akhilesh Mishra, Indian Institute of Technology Roorkee

JTu1A.56**Effects of nonlinear absorptions on Airy pulses supercontinuum in a cubic-quintic AsSe₂/As₂S₅ rib optical waveguide**

Presenter: Lucien Mandeng Mandeng , *National Advanced School of Engineering of the University of Yaoundé I*

The nonlinear absorptions reduce the appearance of Airy dispersive waves. The three-photon absorption is found to be a good tool to control two-photon absorption in the interaction between cubic and quintic nonlinearities for long wavelengths.

Authors: Lucien Mandeng Mandeng, National Advanced School of Engineering of the University of Yaoundé I / crépin heuteu, Laboratory of Mechanics, Materials and Structures, Faculty of Science, University of Yaoundé I / Souang Kemedane Boukar, University of Adam Barka / Clément Tchawoua, Laboratory of Mechanics, Materials and Structures, Faculty of Science, University of Yaoundé I

JTu1A.57**Experimental Results on the Effect of OAM State on the Scintillation Index for an Asymmetric Perfect Vortex Beam**

Presenter: Michael Cox , *Clemson University*

We present experimental results of scintillation of an Asymmetric Perfect Vortex beam using a turbulence generator. These results seem to support that scintillation does not vary with OAM state in the weak to moderate regime.

Authors: Michael Cox, Clemson University / Matthew Panipinto, Clemson University / Jaxon Wiley, Clemson University / Liam Vanderschaaf, Clemson University / Jerome Miller, Clemson University / Eric Johnson, Clemson University / Joseph Watkins, Clemson University

JTu1A.58**Impact of Spontaneous Brillouin Scattering in Cascaded Fiber Brillouin Amplification for Fiber-Based Optical Frequency Dissemination**

Presenter: Jaffar Kadum , *Physikalisch-Technische Bundesanstalt*

We investigate the Brillouin scattering noise in two-cascaded Brillouin amplifiers. Steady-state analysis shows that the noise initiated from the first stage is enhanced by the second stage leading to a degradation of the signal-to-noise ratio

Authors: Jaffar Kadum, Physikalisch-Technische Bundesanstalt / Sebastian Koke, Physikalisch-Technische Bundesanstalt

JTu1A.59**Seeded Intermodal Four-Wave Mixing in a Few Moded Fiber**

Presenter: Denis Bolotov , *Technical University of Denmark*

We demonstrate seeded intermodal four-wave mixing pumped at 1064 nm and enabling frequency conversion from 965-nm to 1187-nm. The spontaneously generated pulses have pulse durations of 150 ps and kilowatts of peak powers.

Authors: Denis Bolotov, Technical University of Denmark / Mads Holmark Vandborg, Technical University of Denmark / Karsten Rottwitt, Technical University of Denmark / Lars Rishoj, Technical University of Denmark

JTu1A.60**Measuring the Nonlinear Refractive Index of Methylene Blue in the Femtosecond Regimen**

Presenter: Sebastian Vergara Palacio , *Universidad Nacional de Colombia - Medellin*

The Z-scan technique was used to experimentally study the behavior of the non-linear refractive index n_2 of methylene blue by using a laser source at 780nm nm and at different pulse widths in the femtosecond regime.

Authors: Sebastian Vergara Palacio, Universidad Nacional de Colombia - Medellin / Carlos Alvarez, Universidad Nacional de Colombia - Medellin / Rodrigo Acuna Herrera, Universidad Nacional de Colombia - Medellin / Pedro Torres, Universidad Nacional de Colombia - Medellin

JTu1A.62**Photoconductivity Mechanism in Monolayer MoS₂**

Presenter: Mykyta Redkin , *Taras Shevchenko National University of Kyiv*

Photoconductivity (PC) mechanisms in two-dimensional materials are essential for optoelectronic applications. Through the PC experiments in the temperature range of 10-300 K, we probe the mechanisms of lateral PC in monolayer MoS₂

Authors: Mykyta Redkin, Taras Shevchenko National University of Kyiv / Olexandr Datsenko, Taras Shevchenko National University of Kyiv / Danylo Babich, Taras Shevchenko National University of Kyiv / Serhiy Kondratenko, Taras Shevchenko National University of Kyiv

JTu1A.63

Nanocomposites Synthesis from a Biogenic Material: Optical and Spectroscopic Properties.

Presenter: Michelina Arcuri , *Universidad Central de Venezuela*

This work describes two methods of synthesis of nanocomposites from biogenic material and their spectroscopy and optical properties, quantitative analysis by LIBS and SPR response in order to determine the variations in energy bandgap.

Authors: Michelina Arcuri, Universidad Central de Venezuela / Jimmy Castillo, Universidad Central de Venezuela / Vincent Piscitelli, Universidad Central de Venezuela

JTu1A.64

ABCD Matrix Approach to Dual-image Formation from a Chiral Fresnel Lens

Presenter: Monish Chatterjee , *University of Dayton*

Optical ray path analyses are applied to a planar lossy *chiral* Fresnel lens (CFL) configuration, leading to relevant ABCD parameters and dual-image formation. Preliminary results are discussed relative to tunability and other imaging properties.

Authors: Nagi buaossa, University of Dayton / Monish Chatterjee, University of Dayton

JTu1A.65

A Hyperbola Based Analysis of Wave Interference

Presenter: Joseph Thomas , *National Institute of Advanced Studies*

In this paper, the conventional analysis of optical wave interference is reformulated using a highly versatile hyperbola theorem. The new analysis so developed is shown to have some remarkable theoretical advantages and practical applications.

Authors: Joseph Thomas, National Institute of Advanced Studies

JTu1A.67

Analysing the Oxidation Status of Mustard Oils Using Spectroscopic Methods: A Preliminary Study

Presenter: Soumyabrata Banik , *Manipal School of Life Sciences, Manipal Academy of Higher Education*

In this study, various spectroscopic methods such as UV-Vis absorbance, Fluorescence and Raman spectroscopy were employed to understand how the storage condition and time effects the oxidation of oil.

Authors: Soumyabrata Banik, Manipal School of Life Sciences, Manipal Academy of Higher Education / Aditi Sengupta, Manipal School of Life Sciences, Manipal Academy of Higher Education / Sindhoora K. M., Manipal School of Life Sciences, Manipal Academy of Higher Education / Ishita Chakraborty, Manipal School of Life Sciences, Manipal Academy of Higher Education / K. K. Mahato, Manipal School of Life Sciences, Manipal Academy of Higher Education / Nirmal Mazumder, Manipal School of Life Sciences, Manipal Academy of Higher Education

JTu1A.68

Analytical Polygon Hologram Calculation Using Look-up Tables and Band-limited Spectra

Presenter: Wang Fan , *Chiba University*

In this study, a new polygon-based hologram generation method is proposed by combining the table look-up method, principal component analysis method, and frequency-limited band calculation method.

Authors: Wang Fan, Chiba University / Tomoyoshi Shimobaba, Chiba University / Tomoyoshi Ito, Chiba University / Takashi Kakue, Chiba University

JTu1A.69

3D-printed Autofocus Custom-built Microscope for Extended Field-of-view Imaging of Large Biological Samples

Presenter: Alejandro Silva , *Universidad de la República*

We propose a low-cost 3D-printed microscope with an electrically focus-tunable lens (ETL) and a motorized XY stage driven by a microcontroller board capable of autofocusing and extending the field-of-view (FOV) for large biological sample imaging.

Authors: Alejandro Silva, Universidad de la República / Julia Alonso, Universidad de la República

JTu1A.70

Mode Structure and Orbital Angular Momentum of Spatio-temporal Optical Vortex (STOV) Pulses

Presenter: Scott Hancock , *Institute for Research in Electronics and Applied Physics*

We find modal solutions for spatio-temporal optical vortex (STOV) pulses propagating in dispersive media. We find that STOVs can support half integer orbital angular momentum and can excite a polariton-like quasiparticle.

Authors: Scott Hancock, Institute for Research in Electronics and Applied Physics / Sina Zahedpour Anaraki, Institute for Research in Electronics and Applied Physics / Howard Milchberg, Institute for Research in Electronics and Applied Physics

JTu1A.72

Visible and NIR Tunable Light Source with High In-band Fluxes

Presenter: Xiaohua Ye , *Energetiq*

A visible and NIR tunable light source with fiber coupled output is presented. Highest in-band fluxes as reported reach 3.6mW in average from 400nm to 1000nm, with a narrow FWHM average of 5.9nm.

Authors: Xiaohua Ye, *Energetiq* / Huiling Zhu, *Energetiq*

JTu1A.73

Towards Noncritical Phasematching in Thin-film Lithium Niobate Frequency Converters

Presenter: Paulina Kuo , *NIST*

We present a study of noncritical phasematching in thin-film, periodically poled lithium niobate waveguides. Noncritical phasematching relaxes fabrication tolerances and is needed for long devices or when ideal tuning curves are required.

Authors: Paulina Kuo, *NIST*

JTu1A.74

Determining and Structuring Ultrafast Laser Pulses: From Direct Optical Tailoring to Optomechanical Coupling through Engineering Microfibers

Presenter: Junqing Zhao , *Jiangsu Normal University*



We demonstrate that ultrafast laser pulses can be efficiently determined and structured either by direct optical tailoring or optomechanical coupling in fiber lasers through engineering microfibers.

Authors:Junqing Zhao, Jiangsu Normal University / Jian Zhou, Jiangsu Normal University / Zikai Chen, Jiangsu Normal University / Yuyuan Jiang, Jiangsu Normal University / Jing Liu, Jiangsu Normal University

JTu1A.76

Coherence-driven Resonances in PT-Symmetric Structures

Presenter: João Pedro Mendonça , *Universidade Federal de Alagoas*

The interaction of partially coherent light with a PT-symmetric heterostructure is investigated according to the classical coherence theory. Low spatial coherence degree sources induce resonant peaks in both transmitted and reflectance amplitudes.

Authors:Paulo Brandão, Universidade Federal de Alagoas / João Pedro Mendonça, Universidade Federal de Alagoas / Solange Cavalcanti, Universidade Federal de Alagoas

JTu1A.77

Lasing from GaAs Nanowires on Fe Films

Presenter: Gyanan Aman , *University of Cincinnati*

We demonstrate optically pumped nearly photonic lasing from highly Zn-doped GaAs nanowires (NWs) on Fe films at 77 K. High Zn-doping enhances the radiative recombination rate and the material gain to overcome the plasmonic losses of Fe.

Authors:Gyanan Aman, University of Cincinnati / Martin Fränzl, University of Leipzig / Mykhaylo Lysevych, The Australian National University / Hark Hoe Tan, The Australian National University / Chennupati Jagadish, The Australian National University / Heidrun Schmitzer, Xavier University / Marc Cahay, University of Cincinnati / Hans Peter Wagner, University of Cincinnati

JTu1A.79

Optical Combs Generation Using a Graphene-based Source in Comparison with MZM Configurations

Presenter: Karen Arroyave Giraldo , *Universidad de Antioquia*



We propose a multiwavelength graphene-based source and compare with two configurations of Mach-Zehnder-modulator comb generators for WDM-PON application. The performance showed penalties less than 0.2 dB for transmission over 20 km of optical fiber.

Authors: Karen Arroyave Giraldo, Universidad de Antioquia / Jhon Anderson Lopera Cortes, Universidad de Antioquia / Jhon James Granada Torres, Universidad de Antioquia / Juan Diego Zapata Caro, Universidad de Antioquia

JTu1A.80

Cavity-enhanced Photon-phonon Coupling Using a Quantum Emitter and Surface Acoustic Waves

Presenter: Poolad Imany , *National Institute of Standards and Technology*

We demonstrate modulation of scattered light from a quantum dot embedded in a surface acoustic wave cavity, and show coupling of red-detuned photons and the quantum dot mediated by phonons.

Authors: Poolad Imany, National Institute of Standards and Technology / Zixuan Wang, National Institute of Standards and Technology / Robert Boutelle, National Institute of Standards and Technology / Corey McDonald, National Institute of Standards and Technology / Travis Autry, National Institute of Standards and Technology / Ryan DeCrescent, National Institute of Standards and Technology / Samuel Berweger, National Institute of Standards and Technology / Pavel Kabos, National Institute of Standards and Technology / Richard Mirin, National Institute of Standards and Technology / Kevin Silverman, National Institute of Standards and Technology

JTu1A.81

Extrinsic Fabry-Perot Interferometer With Supermode Interference

Presenter: Joel Villatoro , *University of the Basque Country*

We propose and demonstrate an extrinsic Fabry-Perot interferometer build with a strongly coupled multicore fiber. The interferometer can be used for measuring distances or any other parameter that induces changes in the cavity length.

Authors: Monserrat Alonso Murias, Centro de Investigaciones en Óptica A. C / David Monzón-Hernández, Centro de Investigaciones en Óptica A. C / Enrique Antonio-Lopez, University of Central Florida / Axel Schülzgen, University of Central Florida / Rodrigo Amezcua-Correa, University of Central Florida / Joel Villatoro, University of the Basque Country

JTu1A.82**Ray Tracing Reflection Analysis in Anti-spoofing Face Recognition Using Infrared Structure Light**

Presenter: Yang Qi , Rowan University

We demonstrate an analysis method that use ray tracing for anti-spoofing face recognition which discriminate face anomalies. Face images captured in infrared structure light provide spatial structure and reflection pattern for this analysis.

Authors: Shengtao Sun, Rowan University / Yue Tian, NEC Laboratories America, INC / Ying Tang, Rowan University / Yang Qi, Rowan University / Ben Wu, Rowan University

JTu1A.83**Steady-state Squeezing Transfer in Hybridoptomechanics**

Presenter: Hugo Molinares , Universidad Mayor

A hybrid scheme proves the transfer of squeezed states (TSS) from the mechanical part to an optical cavity. Here a three-level atom acts as an intermediate and TSS is achieved with a high fidelity.

Authors: Vitalie Eremeev, Universidad Diego Portales / Hugo Molinares, Universidad Mayor / Miguel Orszag, Universidad Mayor

JTu1A.84**Bernstein-Greene-Kruskal States in Nonlinear Optics**

Presenter: Xiaohang Sun , Princeton University

We introduce and experimentally demonstrate photonic Bernstein-Greene-Kruskal states using statistical light in a nonlinear crystal. The results reveal coherence dynamics in phase space that cannot be observed in position or momentum space alone.

Authors: Xiaohang Sun, Princeton University / Yaotian Wang, Princeton University / Jason Fleischer, Princeton University

JTu1A.85**A Specialty Multicore Optical Fiber Using Aubry-Andre-Harper Model Based Localization Phase Transition**

Presenter: Suman Dey , University of Calcutta



We present a quasi-periodically modulated coupled multicore fiber based on Aubry-Andre-Harper model to exhibit a sharp localization phase transition that is explicitly dependent on modulation strength and core arrangement radius of the geometry.

Authors:Suman Dey, University of Calcutta / Madhusudan Mishra, University of Calcutta / Piyali Biswas, Indian Institute of Technology Jodhpur / Nikhil Ranjan Das, University of Calcutta / Somnath Ghosh, Indian Institute of Technology Jodhpur

JTu1A.86

Near-Perfect Noisy NOON State Transfer in a Chain of Coupled Three-Level Atoms

Presenter: Abunameh Aiejina , *The University of the West Indies*

We demonstrate the high-fidelity transfer of a noisy two-excitation NOON state between the ends of a chain of 5 dipole-coupled three level atoms by engineering the values of the couplings between atoms.

Authors:Abunameh Aiejina, The University of the West Indies / Ethan Wyke, The University of the West Indies / Roger Andrews, The University of the West Indies

JTu1A.87

Ultrafast Optical Analog of Gas-Plasma Marcuse Effect Induced by Ultrashort Laser Pulses in Semiconductors

Presenter: Vitaly Gruzdev , *University of New Mexico*

We theoretically show feasibility of generating low-collision-rate free-carrier plasma by intense ultrashort infrared laser pulses in semiconductors that coherently amplifies low-power laser pulses by stimulated inverse bremsstrahlung.

Authors:Vitaly Gruzdev, University of New Mexico

JTu1A.89

Erbium-doped Chirped Pulse All-fiber Laser for Raman Distributed Temperature Sensor

Presenter: Aleksander Fedorenko , *Bauman Moscow State Technical University*

We present a chirped pulse erbium-doped all-fiber hybrid mode-locked laser as a source of high-energy probe pulses in a Raman distributed temperature sensor with high spatial resolution.

Authors:Aleksander Fedorenko, Bauman Moscow State Technical University

JTu1A.91**Formation of Multiple Bubbles and their Interactions During Pulsed Laser Ablation of a Solid Immersed in Liquid**

Presenter: Kavil Mehta , *Pandit Deendayal Energy University*

Investigation of tight focusing of a pulsed laser onto a solid target submerged in distilled water is undertaken in the present study. The study uncovers the formation of multiple bubbles in liquid and its interaction.

Authors:Kavil Mehta, Pandit Deendayal Energy University / Kaushik Patel, Pandit Deendayal Energy University / Ashwini Sharma, Indian Institute of Technology Guwahati / Alike Khare, Indian Institute of Technology Guwahati / Prahlad Baruah, Pandit Deendayal Energy University

JTu1A.92**Narrow-linewidth Tunable Er-doped Fiber Laser Based on Fs-pulse-inscribed Artificial Rayleigh Reflector**

Presenter: Sergey Babin , *Institute of Automation and Electrometry SB RAS*

We present a narrow-linewidth random Er-doped fiber laser based on fs-pulse-inscribed artificial Rayleigh reflector. A single-frequency regime with 500 Hz linewidth was observed at 1.5 mW output power, and few-mode regime at 12 mW.

Authors:Mikhail Skvortsov, Institute of Automation and Electrometry SB RAS / Alexey Wolf, Institute of Automation and Electrometry SB RAS / Olga Egorova, Prokhorov General Physics Institute of the RAS / Sergey Semjonov, Dianov Fiber Optic Research Center / Kseniya Proskurina, Institute of Automation and Electrometry SB RAS / Alexander Dostovalov, Institute of Automation and Electrometry SB RAS / Alexander Vlasov, Institute of Automation and Electrometry SB RAS / Alexey Churin, Institute of Automation and Electrometry SB RAS / Sergey Babin, Institute of Automation and Electrometry SB RAS

JTu1A.93**Machine Learning-Aided At-Line Detection of Bacterial Biomarker for Cell Manufacturing**

Presenter: Elizabeth Mei Yin Lee , *Singapore-MIT Alliance for Research and Technology Centre*

We show a machine learning-aided UV spectroscopy-based method using aseptic instrumentation to detect nicotinic acid, a marker of microbial contamination. This potentially enables rapid, at-line microbial contamination detection in cell manufacturing

Authors: Jiayi Huang, Singapore-MIT Alliance for Research and Technology Centre / Thiara Sana Ahmed, Singapore-MIT Alliance for Research and Technology Centre / Maciej Baranski, Singapore-MIT Alliance for Research and Technology Centre / Elizabeth Mei Yin Lee, Singapore-MIT Alliance for Research and Technology Centre / Shruthi Pandi Chelvam, Singapore-MIT Alliance for Research and Technology Centre / Ying Ying Wu, Bioprocessing Technology Institute / Rajeev Ram, Singapore-MIT Alliance for Research and Technology Centre / Scott Rice, Singapore-MIT Alliance for Research and Technology Centre / Derrick Yong, Singapore-MIT Alliance for Research and Technology Centre / Stacy Springs, Singapore-MIT Alliance for Research and Technology Centre

JTu1A.94

Experimental Generation of Dispersion Curve of Photonic Crystal Cavity using two Laser Sources

Presenter: Naresh Sharma , IIT Kanpur

We demonstrate a technique to generate dispersion curve of a one-dimensional photonic crystal cavity, which relates the cavity resonance wavelength to resonance angle by measuring transmitted annular beams for two known laser wavelengths.

Authors: Naresh Sharma, IIT Kanpur / Govind Kumar, IIT Kanpur / Shilpi Gupta, IIT Kanpur

JTu1A.95

Computational Spectrometer based on Photonic Crystal Cavity and Reconstruction Algorithm

Presenter: Naresh Sharma , IIT Kanpur

We propose a miniaturized and portable reconstructive spectrometer that uses a planar one-dimensional photonic crystal cavity as a dispersive element and a reconstructive computational algorithm to extract spectral information from spatial patterns.

Authors: Naresh Sharma, IIT Kanpur / Govind Kumar, IIT Kanpur / Shilpi Gupta, IIT Kanpur

JTu1A.96**Higher harmonic and supercontinuum generated by electronic self-phase modulation under extreme ultrafast laser pulses for various states of matter**

Presenter: Shah Faisal Mazhar , *IUSL*

A classical electrodynamics theoretical model is presented to explain the Odd Higher Harmonic Generation (HHG) from the electronic response n_2 SPM effects in rare gases and condensed matter in contrast to the quantum mechanical model.

Authors: Robert Alfano, *IUSL* / Shah Faisal Mazhar, *IUSL* / Lingyan Shi, *Shi Lab*

JTu1A.97**Nonlinear Spectrum Transformation in Semiconductor Optical Amplifiers**

Presenter: Anastasia Bednyakova , *Novosibirsk State University*

We demonstrated both through numerical modeling and experimentally that optical pulses with appropriate initial chirp can undergo a nonlinear spectral blueshift, opposite to the Raman-induced redshift, when they are amplified by the SOA.

Authors: Anastasia Bednyakova, *Novosibirsk State University* / Darya Khudozhitkova, *Novosibirsk State University* / Alexey Kokhanovskiy, *Novosibirsk State University* / Sergei Turitsyn, *Novosibirsk State University*

JTu1A.98**3D Depth Camera Based Face Mask Recognition Using Spatial and Frequency Features**

Presenter: Xiaoyan Wang , *Institute of Modern Optics, Nankai University*

A novel method for face mask recognition is demonstrated using spatial and frequency features from the captured 3D information by depth camera. Mask types can be further classified, and the average recognition accuracy is 82.11%.

Authors: Xiaoyan Wang, *Institute of Modern Optics, Nankai University* / Tianxu Xu, *Institute of Modern Optics, Nankai University* / Lei Sun, *Shphotronics, LTD* / Qiang Wang, *Angle AI (Tianjin) Technology co. LTD* / Zhongqi Pan, *Department of Electrical & Computer Engineering, University of Louisiana at Lafayette* / Yang Yue, *Institute of Modern Optics, Nankai University*

JTu1A.99

Understanding the Photothermal Response of CBNP Nanofluids Using Thermal Lens Spectroscopic Techniques

Presenter: Subhajit Chakraborty , IIT Kanpur

We performed a dual beam Z-scan experiment to examine the thermal lensing effects in CBNP nanofluids. The photothermal characteristics and heat dissipation dynamics were observed for these nanofluids at different levels of their linear absorption.

Authors:Subhajit Chakraborty, IIT Kanpur / Amit Mishra, IIT Kanpur / Ashwini Rawat, IIT Kanpur / Debabrata Goswami, IIT Kanpur

JTu1A.100

Along-the-side Pump Concept for Rod Laser Amplifiers with High Average Power

Presenter: Ivan Kuznetsov , Institute of Applied Physics of the Russian Academy of Science

A new approach for developing laser amplifiers is proposed based on the use of standard rod active elements with bright diode pumping, the beam of which is shifted maximum close to the cooled side surface.

Authors:Ivan Kuznetsov, Institute of Applied Physics of the Russian Academy of Science / Nikolay Emelyanov, Institute of Applied Physics of the Russian Academy of Science / Sergey Chizhov, Institute of Applied Physics of the Russian Academy of Science / Oleg Palashov, Institute of Applied Physics of the Russian Academy of Science

JTu1A.101

Towards All-Integrated Optical Nanometrology

Presenter: Paul Beck , Friedrich-Alexander-Universität Erlangen-Nürnberg

We discuss an all-integrated photonic chip for high-precision localization and other nanometrological tasks. The proposed photonic device drastically reduces the footprint of previous techniques and involves bespoke components and detection schemes.

Authors:Paul Beck, Friedrich-Alexander-Universität Erlangen-Nürnberg / Sebastian Schulz, University of St Andrews / Ankan Bag, Friedrich-Alexander-Universität Erlangen-Nürnberg / Francesco Morichetti, Politecnico di Milano / Peter Banzer, Max Planck institute for the science of light

JTu1A.102

Fabrication of High-Q Crystalline Whispering Gallery Mode Microcavities Using Single-point Diamond Turning

Presenter: Kirill Minkov , *Russian Quantum Center, Skolkovo, 143026, Russia*

An efficient algorithm for fabrication of high-Q crystalline whispering-gallery-mode optical microcavities using diamond turning is developed. This method allows fabrication of microcavities with predefined geometry and Q-factor higher than 10^7 .

Authors: Kirill Minkov, Russian Quantum Center, Skolkovo, 143026, Russia / Artem Shitikov, Russian Quantum Center, Skolkovo, 143026, Russia / Andrei Danilin, Russian Quantum Center, Skolkovo, 143026, Russia / Valery Lobanov, Russian Quantum Center, Skolkovo, 143026, Russia / Igor Bilenko, Russian Quantum Center, Skolkovo, 143026, Russia

JTu1A.103

DFMO: Deep features mining of material's optical constant

Presenter: An Qing Jiang , *Waseda University*

This paper presents an innovative approach to the characterization of optical constants. These features extracted by this method can be used significantly efficiently in the reverse design of nanophotonics devices.

Authors: An Qing Jiang, Waseda University / Liangyao Chen, Fudan University / Osamu Yoshie, Waseda University

JTu1A.105

Tunable between 3 to 4 μm mid-infrared optical frequency comb by difference frequency generation

Presenter: Tianyu Lin , *Tsinghua University*

We describe a difference frequency generation based mid-infrared frequency comb by near-infrared frequency comb. The output DFG source can be continuously tuned between 3-4 μm , generating an ideal source for gas sensing in fingerprint area.

Authors: Tianyu Lin, Tsinghua University / MINJIAN LU, Tsinghua University / Bocheng Tang, Tsinghua University / XINYI CHEN, Tsinghua University / HAORYUN WEI, Tsinghua University / YAN LI, Tsinghua University

JTu1A.106

Texture analysis of optic nerve images from patients with glaucoma using wavelet transform and gray-level co-occurrence matrix (GLCM)

Presenter: Ouafa Sijilmassi , *Complutense University of Madrid*

This paper uses a method based on the texture features computed from the wavelet transform and GLCM to discriminate between healthy and glaucomatous optic nerves. This work analyses various statistical features like contrast, energy, etc.

Authors: Ouafa Sijilmassi, Complutense University of Madrid

JTu1A.107

High-Q As₂S₃ and GaAs Whispering Gallery Mode Microresonators

Presenter: Artem Shitikov , *Russian Quantum Center*

Methods for manufacture of high-Q bulk microresonators from As₂S₃ and GaAs are elaborated. Obtained Q-factor at 1550 nm are shown to be comparable with record values for these materials: 7×10^6 for GaAs and 8×10^6 for As₂S₃.

Authors: Tatiana Tebeneva, Moscow Institute of Physics and Technology / Artem Shitikov, Russian Quantum Center / Oleg Benderov, Moscow Institute of Physics and Technology / Valery Lobanov, Russian Quantum Center / Kirill Minkov, Russian Quantum Center / Igor Bilenko, Russian Quantum Center / Alexander Rodin, Moscow Institute of Physics and Technology / Igor Skripachev, Institute of Chemistry of High-Purity Substances of the Russian Academy of Sciences

JTu1A.108

Investigation of High-Precision Laser Instrument for Distance and Displacement Measurements

Presenter: Iurii Minin , *Skolkovo Institute of Science and Technology*

The novel high-precision measurement method was proposed. The considered method possesses laser-interferometric precision, does not require to move any external mirrors over full measuring basis, and can be applied to measure distances of 10^{-2} – 10^5 m.

Authors: Iurii Minin, Skolkovo Institute of Science and Technology / Igor Bulatov, Moscow Institute of Physics and Technology / Nikita Korobov, Moscow Institute of Physics and Technology / Mstislav Dubrov, Fryazino Branch of Kotelnikov Institute of Radio-Engineering and Electronics of RAS / Maxim Fedorov, Skolkovo Institute of Science and Technology

JTu1A.109



Stabilization of the Gain-Switched Laser via Self-Injection Locking Regime to a WGM Microresonator

Presenter: Artem Shitikov , *Russian Quantum Center*

We demonstrated experimentally a distillation of a spectrum of a gain-switched laser in self-injection locking regime. The linewidth remains sub-kHz for up to 1 ms averaging intervals.

Authors:Artem Shitikov, Russian Quantum Center / Nikita Kondratyev, Russian Quantum Center / Valery Lobanov, Russian Quantum Center / Evgeny Lonshakov, Russian Quantum Center / Igor Bilenko, Russian Quantum Center

JTu1A.110

High-Q Whispering-gallery-mode Optical Cavity Manufactured from Terbium Gallium Garnet

Presenter: Andrey Danilin , *Russian Quantum Center*

We manufactured a magneto-optical optical cavity from Terbium Gallium Garnet with the quality factor of $Q=1.45 \times 10^8$. To the best of our knowledge, this is the highest result for such material so far.

Authors:Andrey Danilin, Russian Quantum Center / Kirill Minkov, Russian Quantum Center / Grigorii Slinkov, Lomonosov Moscow State University / Valery Lobanov, Russian Quantum Center / Igor Bilenko, Russian Quantum Center

JTu1A.111

Simulation of Mid Infrared Supercontinuum Generation in Silicon Germanium Photonic Waveguide

Presenter: Proficiency Munsaka , *National University of Science and Technology*

We report simulations of pulse evolution along a silicon germanium photonic waveguide. Simulations were made by solving the generalised nonlinear Schrödinger equation for the femtosecond pump pulse evolution along the length of photonic waveguide.

Authors:Proficiency Munsaka, National University of Science and Technology / Peter Baricholo, National University of Science and Technology / Erich Rohwer, Stellenbosch University / Gurthwin Bosman, Stellenbosch University

JTu1A.112

Photon Wave Function Associated to a Wave Packet of Coherent States



Presenter: Daniel Borrero Landazabal , *Aix-Marseille Université*

We show an extraction rule to get the photon wave function that includes a generalized phase for a quantized field state in the basis of coherent states with expectation value of a single quanta.

Authors: Daniel Borrero Landazabal, *Aix-Marseille Université* / Rafael Torres Amaris, *Universidad Industrial de Santander*

JTu1A.114

Numerical Aperture for Photon Detection within Shifted Position-Diffuse Reflectance Imaging

Presenter: Moritz Späth , *Institute of Photonic Technologies*

Shifted position-diffuse reflectance imaging is used to non-invasively assess microcirculation. In this study, it is investigated whether a cut-off angle in the detection of the reflected photons is obligatory for the success of the technique.

Authors: Moritz Späth, *Institute of Photonic Technologies* / Martin Hohmann, *Institute of Photonic Technologies* / Maximilian Rohde, *University Hospital Erlangen* / Florian Klämpfl, *Institute of Photonic Technologies*

JTu1A.115

Effect of Al₂O₃ Content on Laser Writing of Form Birefringence in Sodium Aluminoborate Glass

Presenter: Alexey Lipatiev , *Mendeleev University of Chemical Technology*

Nanogratings formation inside sodium aluminoborate glass is demonstrated. The structure of nanogratings is similar to that obtained in sodium borate glass, which has a main feature as a large period of 0.5-0.6 μm between nanoplanes.

Authors: Alexey Lipatiev, *Mendeleev University of Chemical Technology* / Sergey Fedotov, *Mendeleev University of Chemical Technology* / Sergey Lotarev, *Mendeleev University of Chemical Technology* / Tatiana Lipateva, *Mendeleev University of Chemical Technology* / Vladimir Sigaev, *Mendeleev University of Chemical Technology*

JTu1A.116

Spectral Shaping in a Multimode Fiber by Transmission Matrix Engineering

Presenter: zohar finkelstein , *The Hebrew University Of Jerusalem*



We experimentally demonstrate spectral shaping in a multimode fiber by macro-bend based transmission matrix engineering. We implement an all-fiber spectral filter and demonstrate a tunable bandpass filter with spectral resolution of 0.4nm.

Authors:zohar finkelstein, The Hebrew University Of Jerusalem / Kfir Sulimany, The Hebrew University Of Jerusalem / Shachar Resisi, The Hebrew University Of Jerusalem / Yaron Bromberg, The Hebrew University Of Jerusalem

JTu1A.117

Universal Approach for Accurate Measurement of Dispersive Characteristics of Optical Microresonators

Presenter: Nikita Dmitriev , *Russian Quantum Center*

Novel approach for measuring the dispersive characteristics of optical microresonators is developed. Considered method is based on application of Mach-Zehnder interferometer and can be used for any wavelength range.

Authors:Nikita Dmitriev, Russian Quantum Center / Kirill Minkov, Russian Quantum Center / Valery Lobanov, Russian Quantum Center / Andrey Danilin, Russian Quantum Center / Igor Bilenko, Russian Quantum Center / Nikita Kondratyev, Russian Quantum Center

JTu1A.118

Suppressing the Non-linear Fiber Background in Multimode Fiber Endoscopy

Presenter: Johanna Trägårdh , *Institute of Scientific Instruments, CAS*

We demonstrate a composite probe, based on a GRIN multimode fiber, where the non-linear fiber background, apparent in non-linear Raman imaging, is suppressed, while the GRIN fiber bandwidth is retained.

Authors:Johanna Trägårdh, Institute of Scientific Instruments, CAS / Tomáš Pikálek, Institute of Scientific Instruments, CAS / Mirek Stiburek, Institute of Scientific Instruments, CAS / Rodrigo Amezcua-Correa, CREOL, The College of Optics and Photonics, University of Central Florida / Enrique Antonio-Lopez, CREOL, The College of Optics and Photonics, University of Central Florida / Tomáš Čizmár, Institute of Scientific Instruments, CAS

JTu1A.119

Multimode Laser Diode Self-Injection Locking to a Whispering Gallery Mode Microresonator Modeling

Presenter: Nikita Kondratyev , RQC

A numerical model of multi-frequency self-injection locking is developed. We perform the simulation of the system dynamics and reveal important features and parameter ranges of the process.

Authors: Nikita Kondratyev, RQC / Ramzil Galiev, RQC / Valery Lobanov, RQC / Igor Bilenko, Lomonosov Moscow State University

JTu1A.120

A Wearable Photoacoustic Microscopy and Electroencephalograph for Brain Imaging in Anesthetized and Behavioral Rats

Presenter: Qian Chen , *University of Electronic Science and Technology of China*

Studying neurovascular coupling is significant to brain science. Here, we report a wearable device for observing neurovascular dynamics and studying their interplay in anesthesia and behavioral rats by establishing localized seizure models

Authors: Qian Chen, University of Electronic Science and Technology of China / Weizhi Qi, Southern University of Science and Technology / Lei Xi, Southern University of Science and Technology

JTu1A.122

Numerical modeling of light-tip interaction for near-field laser ablation application

Presenter: Hung-Ju LIN , *Université Paris-Saclay, CEA*

We developed a model based on Boundary-Element-Method to describe the tip-assisted electric field enhancement under laser illumination. The nanometric-enhanced field is at the basis for an interpretation of near-field laser ablation applications.

Authors: Hung-Ju LIN, Université Paris-Saclay, CEA / Ludovic Douillard, Université Paris-Saclay, CNRS CEA / Jean-Luc Lacour, Université Paris-Saclay, CEA / Alexandre Semerok, Université Paris-Saclay, CEA / Frédéric Chartier, Université Paris-Saclay, CEA

JTu1A.123

Evaluation of Laser-irradiated Tissue Ablation and Thermal Effects by Optical Detection

Presenter: Felix Fanjul-Velez , *University of Cantabria*



The use of optical sources on biological tissues can provoke ablation or thermal effects, whose appropriate evaluation is critical to avoid harmful collateral effects. Optical detection based on optical properties is employed to this aim.

Authors: Lucía Santamaría-Bustamante, University of Cantabria / Sofia Perez-Rivas, University of Cantabria / Jose Luis Arce-Diego, University of Cantabria / Felix Fanjul-Velez, University of Cantabria

JTu1A.124

Efficient and Ultra-Compact Nanoplasmonic Mach-Zehnder Interferometer Design Using Air-Gap Couplers

Presenter: Rami Wahsheh , *Princess Sumaya University for Technology*

We introduce a novel design and analysis of an ultra-compact nanoplasmonic Mach-Zehnder interferometer with high coupling efficiency and wide spectrum range. Our results indicate that the proposed design can be used in biosensor applications.

Authors: Rami Wahsheh, Princess Sumaya University for Technology

JTu1A.125

Design of Concave-Microstructured Colour Filter Bio-inspired from *Papilio Blumei*

Presenter: Uttam Pal , *COMSOL Multiphysics Pvt. Ltd.*

The dielectric concave microstructure mimicking the colour filtering ability of the wings of *Papilio Blumei* butterfly is designed and analyzed. The effect of cuticle thickness and inter-cuticle spacing over the reflection spectrum is studied.

Authors: Uttam Pal, COMSOL Multiphysics Pvt. Ltd. / Vaibhav Adhikar, COMSOL Multiphysics Pvt. Ltd. / Prajakta Sabnis, COMSOL Multiphysics Pvt. Ltd.

JTu1A.127

A Novel Nanolaser Using Gain Metamaterial Waveguide

Presenter: Ehab Awad , *King Saud University*

A Nanolaser is demonstrated using novel silicon-compatible gain metamaterial waveguide. It has periodic gain stripes and air gaps. It allows efficient pump absorption and lasing with almost ideal internal quantum efficiency and low lasing threshold.

Authors: Ehab Awad, King Saud University



JTu1A.129**Spectral reshaping of partial-width Bragg-grating inside SOI core waveguide****Presenter:** Ehab Awad , *King Saud University*

Novel partial-width entrenched core in few-mode silicon-on-insulator planar waveguide is demonstrated. Core is entrenched with partially filling nano air-gaps. Spectrum is tuned within 1-2 μ m range. Double-hump spectrum is reshaped in various spectra

Authors:Ehab Awad, King Saud University**JTu1A.130****0.5 Mbps photonic logic gates based on a pair of micro-ring resonators****Presenter:** Nazym Alipbayeva , *Nazarbayev University*

We propose the design of micro-ring resonator-based logic gates. Employment of Silicon-on-insulator (SOI) formation and thermo-optic effect for modulation reduces fabrication cost and complexity. Static and dynamic response spectra are provided.

Authors:Dias Azhigulov, Nazarbayev University / Nazym Alipbayeva, Nazarbayev University / Bikash Nakarmi, Nanjing University of Aeronautics and Astronautics / Ikechi Ukaegbu, Nazarbayev University**JTu1A.131****An Optical Tactile Sensor with Liquid Lens Mechanism****Presenter:** Lihui Wang , *Institute of Semiconductors, Guangdong Academy of Sciences*

We proposed a liquid lens-based optical sensor with a liquid-membrane variable-focus optical lens structure, and its focal length is changed with the contact force, thereby affecting the perceived light intensity of the photosensitive element.

Authors:Hui Yang, Institute of Semiconductors, Guangdong Academy of Sciences / Jian Fu, Institute of Semiconductors, Guangdong Academy of Sciences / Ruimin Cao, Institute of Semiconductors, Guangdong Academy of Sciences / Jiaqi Liu, Beihang University / Lihui Wang, Institute of Semiconductors, Guangdong Academy of Sciences**JTu1A.132****Simulating Satellite Quantum Key Distribution Links: Analytical Model and Software Tool**

Presenter: Andrea Stanco , *University of Padova*

We present a software tool able to simulate a given satellite-to-ground Quantum Key Distribution link. The software was designed according to a custom developed analytical model able to compute the secret key rate.

Authors:Andrea Stanco, University of Padova / Giulio Foletto, University of Padova / Alessia Scriminich, University of Padova / Lorenzo Dal Corso, Qascom S.r.l. / Luca Canzian, Qascom S.r.l. / Francesco Petroni, Sitael S.p.A. / Giuseppe Piscopiello, Sitael S.p.A. / Gilles Mariotti, Sitael S.p.A. / Luca De Filippis, Sitael S.p.A. / Giuseppe Vallone, University of Padova / Paolo Villoresi, University of Padova

JTu1A.138

Usability of 3D Models Generated Using Optic Historical Images in Cultural Heritage Documentation Studies

Presenter: Irem Yakar , *Istanbul Technical University*

In this study, historical Tophane Fountain has been 3D modelled by historical optic images and evaluated in terms of closeness to reality.

Authors:Irem Yakar, Istanbul Technical University / Mahmut Oguz Selbesoglu, Istanbul Technical University / Serdar Bilgi, Istanbul Technical University

JTu1A.140

Surface Plasmon Polaritons in Lanthanum Nickelate and Barium Titanate at telecommunication Frequencies

Presenter: Shayla Breedlove , *University of Florida*

Results of 2D FDTD simulation of the Lanthanum Nickelate (LNO) and Barium Titanate (BTO) interface show support of surface plasmon polaritons (SPPs) at telecommunication wavelengths to implement a nonvolatile compact LNO/BTO SPP switch.

Authors:Shayla Breedlove, University of Florida / Daniel Shahar, University of Florida / Yong-Kyu "Yk" Yoon, University of Florida / Henry Zmuda, University of Florida

JTu1A.141

Effects of Lossy Chiral Interface on Power Coefficients for Electromagnetic Plane Wave Propagation across an Achiral/Chiral Boundary

Presenter: Monish Chatterjee , *University of Dayton*

In this paper, propagation of an EM wave across an achiral/chiral boundary with dielectric loss within specific chirality bands are examined specific to Fresnel power coefficients. loss impact on both propagation and evanescence is investigated.

Authors:Rajab Ataai, University of Dayton / Monish Chatterjee, University of Dayton / Elforjani Jera, University of Dayton

JTu1A.142

QPSK-pilot Aided DSP for Single-carrier High-order Modulation Formats

Presenter: Liang Junpeng , *ZTE Company*

The complexity of DSP algorithms are generally increasing with modulation order. In this work, we propose a QPSK-pilot aided DSP for single-carrier transmission with high order modulation formats in order to reduce the complexity

Authors:Liang Junpeng, ZTE Company

JTu1A.143

A Highly-Efficiency NIR Plasmonic Long-Wavelength Cut-Off Filter based on Stepped Impedance Resonators

Presenter: Seyed Morteza Ebadi , *Mid Sweden University*

We report design and simulation results of a high-efficiency long-wavelength cut-off filter realized by stepped impedance resonators. Moreover, numerical results confirm by modulating the length of resonator, cut-off wavelength can be easily tuned.

Authors:Seyed Morteza Ebadi, Mid Sweden University / Jonas Örtégren, Mid Sweden University / Max Yan, KTH Royal Institute of Technology

8:00 - 8:30 (UTC - 07:00)

SpE4

Special Event - Meet Plenary Speakers Warwick Bowen and Akira Furusawa

8:00 - 9:00 (UTC - 07:00)

FTu2C

Light - Matter Interactions

Presenter: Cord Arnold , *Lunds Universitet*

FTu2C.1

Nonlinear Optical Processes in Epsilon-near-zero Materials

Invited

Presenter: Robert Boyd , *University of Ottawa*

Abstract not available.

Authors: Robert Boyd, University of Ottawa

FTu2C.2

Imaging Light-Matter Interactions Following Ultrafast Processing of Transparent Materials

Presenter: Matthew Ross , *Corning Research & Development*

Ultrafast laser processing of brittle transparent materials involves a chain of physical processes on timescales from femtoseconds to milliseconds. Using time-resolved imaging, this paper reports on several of these processes and relevant timescales.

Authors: Matthew Ross, Corning Research & Development / Christian Rothenbach, Corning Optical Communications

FTu2C.3

Mechanisms of Nonlinear Refractive Index in Organic Ultrastrongly Coupled Polaritons

Presenter: Samuel Schwab , *Case Western Reserve University*

We use the z-scan technique to measure the intensity dependent complex refractive index in organic ultrastrongly coupled polaritons. We find an enhanced response arising from an induced blue-shift described by a three-level quantum optical model.

Authors: Samuel Schwab, Case Western Reserve University / William Christopherson, Case Western Reserve University / Robert Twieg, Kent State University / Michael Crescimanno, Youngstown State University / Kenneth Singer, Case Western Reserve University

FTu2D

Fiber Optics and Quantum Communications

Presenter: Giovanni Milione , *NEC Laboratories America Inc*

FTu2D.1

In Search of the Optimum Information Rate and Symbol Rate in PS-QAM Systems to Enable Highly Efficient Optical Transport Networks

Invited

Presenter: Olga Vassilieva , *Fujitsu Network Communications Inc.*

We demonstrate how optimization of information rates and symbol rates in flexible transponders utilizing Probabilistic Constellation Shaping (PCS) can maximize transmission reach and SE x reach product for high speed optical transmission networks.

Authors: Olga Vassilieva, Fujitsu Network Communications Inc. / Inwoong Kim, Fujitsu Network Communications Inc. / Paparao Palacharla, Fujitsu Network Communications Inc.

FTu2D.2

Optical Hybrid-based Optimal Receiver Design for Entanglement-Assisted Communication

Presenter: Rahul Kumar Bhadani , *The University of Arizona*

We propose optical hybrid (OH) receivers to discriminate PSK modulated signals that is sent using entanglement-assisted communication. OH receivers perform 10% better in error-probability and ~50% in Shannon's capacity compared to older receivers.

Authors:Rahul Kumar Bhadani, The University of Arizona / Ivan Djordjevic, The University of Arizona

FTu2D.3

Measurement angular error in continuous-variable quantum key distribution

Presenter: shen tao , State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications

We propose a theoretical model of the measurement angular error in the CV-QKD using homodyne detection, and corresponding simulation results are depicted to show its impacts on system performance.

Authors:shen tao, State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications / Yundi Huang, State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications / Xiangyu Wang, State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications / Huiping Tian, State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications / Ziyang Chen, State Key Laboratory of Advanced Optical Communication Systems and Networks, Department of Electronics, and Center for Quantum Information Technology, Peking University / Song Yu, State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications

FTu2E

Integrated Photonics for Quantum Applications

Presenter: Ke-Yao Wang , Inphi Corporation

FTu2E.1

Tunable Source of Quantum-Correlated Photons with Integrated Pump Rejection in a Silicon CMOS Platform

Presenter: Josep Fargas Cabanillas , Boston University

A wavelength-tunable, silicon photon-pair source based on spontaneous four-wave mixing, integrated with a pump rejection filter in a single, flip-chip packaged CMOS chip, is demonstrated with a CAR of 9.1 with no off-chip pump filtering.

Authors: Josep Fargas Cabanillas, Boston University / Danielius Kramnik, University of California Berkeley / Anirudh Ramesh, Northwestern University / Cale Gentry, University of Colorado Boulder / Vladimir Stojanović, University of California Berkeley / Prem Kumar, Northwestern University / Milos Popovic, Boston University

FTu2E.2

Microwave Photonic Crystals for Electro-Optic Quantum Transduction

Presenter: Mihir Khanna , *University of Pittsburgh*

We are performing electro-optic quantum transduction by developing dielectric, centimeter-scale microwave photonic crystal cavities with high Q/V coupled to LiNbO₃ nonlinear optical resonators at room temperature.

Authors: Mihir Khanna, University of Pittsburgh / Yang Hu, University of Pittsburgh / Chris Ligato, University of Pittsburgh / Thomas Purdy, University of Pittsburgh

FTu2E.3

Squeezed Optical Frequency Combs in a Microresonator

Presenter: Zijiao Yang , *University of Virginia*

We report a demonstration of optical microresonator-based frequency comb (microcomb) in the deterministic quantum regime, where 20 pairs of two-mode squeezed comb mode pairs are generated in a silica microresonator on a silicon chip.

Authors: Zijiao Yang, University of Virginia / Mandana Jahanbozorgi, University of Virginia / Dongin Jeong, Korea Advanced Institute of Science and Technology / Shuman Sun, University of Virginia / Olivier Pfister, University of Virginia / Hansuek Lee, Korea Advanced Institute of Science and Technology / Xu Yi, University of Virginia

FTu2E.4

Waveguide-Based Spontaneous Parametric Downconversion Sources of Polarization-Entangled Photon Pairs

Presenter: Kristina Meier , *Los Alamos National Laboratory*



We present waveguide-based SPDC sources for producing both degenerate and highly nondegenerate polarization-entangled photon pairs. We measure entanglement metrics of up to 99% through optimization of both temporal and spectral overlap.

Authors: Kristina Meier, Los Alamos National Laboratory / Spencer Johnson, University of Illinois Urbana-Champaign / Josh Aller, Advr, Inc. / Brad Slezak, Advr, Inc. / Tony Roberts, Advr, Inc. / Phil Battle, Advr, Inc. / Paul Kwiat, University of Illinois Urbana-Champaign

FTu2B

Medical Applications of AR/VR

Presenter: Kaan Aksit , *University College London*

FTu2B.1

Simulating Vision Impairments in XR

Invited

Presenter: Katharina Krösl , *VRVis Zentrum für Virtual Reality und Visualisierung*

This talk will present a methodology to simulate various vision impairments, which allows us to conduct user studies in XR, with people with healthy eyesight and graphically simulated vision impairments.

Authors: Katharina Krösl, *VRVis Zentrum für Virtual Reality und Visualisierung*

FTu2B.2

Computational Holographic Display Based Vision Simulator for Cataracts

Invited

Presenter: Hakan Urey , *Koç University*

CGH displays can shape and steer light beams in a programmable manner across the user's eye lens. We performed holographic visual acuity tests with cataract patients before surgery and the results well-predicted the post-operative visual acuity.

Authors: Hakan Urey, *Koç University*

FTu2B.3

Testing of Head-mounted Displays for Medical Applications

Invited

Presenter: Eero Peltohaka , *OptoFidelity Ltd*

Medical applications place unique requirements for AR/VR headset characterization. We describe our key calibration and characterization methods through two example use cases: surgery assistance with see-through AR headset and low-vision aid via video-see-through VR headset.

Authors:Eero Peltohaka, OptoFidelity Ltd

FTu2A

Tutorial: Optical Technologies for Autonomous Applicatio

Presenter: Umar Piracha , *Zoox*

FM2A.1

Optical Technologies for Autonomous Applications

Tutorial

Presenter: Paul McManamon , *University of Dayton*

Abstract not available.

Authors:Paul McManamon, University of Dayton

8:00 - 9:15 (UTC - 07:00)

LTu2F

Ultrafast Dynamics in Complex Systems I

Presenter: Jingdi Zhang , *Hong Kong Univ. of Science & Technology*

LTu2F.1

Generalized Collective Mode Spectroscopy and Quantum Probes of Quantum Matter from a Theory Perspective

Invited

Presenter: Prineha Narang , *Harvard University*

Abstract not available.

Authors:Prineha Narang, Harvard University

LTu2F.2

Ultrafast Modulations and Detection of a Ferro-rotational Charge Density Wave Using Time-resolved Electric Quadrupole Second Harmonic Generation

Invited

Presenter: Liuyan Zhao , *University of Michigan*

We show the ferro-rotational nature of the commensurate charge density wave (CCDW) in 1T-TaS₂ and track its dynamic modulations by temperature-dependent and time-resolved electric quadrupole rotation anisotropy-second harmonic generation (EQ RA-SHG), respectively.

Authors:Liuyan Zhao, University of Michigan

LTu2F.3

Terahertz Pulse-induced Melting of Charge Density Wave through the Coherent Excitation of Amplitude Mode in 3R-Ta_{1+x}Se₂

Presenter: Naotaka Yoshikawa , *The University of Tokyo*

We investigated the nonlinear dynamics of the amplitude mode of the charge density wave in 3R-Ta_{1+x}Se₂. Intense terahertz pulse excites the amplitude mode with the anharmonic coupling regime and suppresses the charge density wave order.

Authors:Naotaka Yoshikawa, The University of Tokyo / Ushio Narusaka, The University of Tokyo / Kunio Nishizawa, The University of Tokyo / Hideki Matsuoka, The University of Tokyo / Yuki Tanaka, The University of Tokyo / Masaki Nakano, The University of Tokyo / Yoshihiro Iwasa, The University of Tokyo / Ryo Shimano, The University of Tokyo

9:15 - 10:00 (UTC - 07:00)

JTu3A

Visionary Session II: Eli Yablonovitch, University of California, Berkeley, USA

Presider: Willie Padilla , *Duke University*

JTu3A.1

Physics Does Digital Optimization—for Machine Learning, Control Theory, Backpropagation, etc.

Visionary

Presenter: Eli Yablonovitch , *University of California Berkeley*

In effect, physics provides machines that solve digital optimization problems with faster time-to-solution and lower energy-to-solution than any digital computer. Of these physics principles, “Minimum Entropy Generation” in the form of bistable electrical or optical circuits is particularly adaptable toward offering digital optimization.

Authors: Eli Yablonovitch, University of California Berkeley

10:00 - 11:00 (UTC - 07:00)

Exhibit Hall Event - Dedicated Exhibit Time

10:30 - 11:30 (UTC - 07:00)

SpE5



Special Event - Ultra-Intense Laser Science and Technology

11:00 - 12:30 (UTC - 07:00)

SpE4

Special Event - APS Meet the Physical Review Editors

Tu2B

Nonclassical Light Sources and Detectors I

Presenter: Brian Smith , *University of Oregon*

Tu2B.1

Generation of Photonic Graph States From Spin-Photon Interfaces

Invited

Presenter: Sophia Economou , *Virginia Tech*

Photonic graph states are of interest for applications in one-way quantum computing, in quantum networks, and in quantum sensing. The lack of photon-photon interactions makes the generation of entangled photonic states challenging: it is either based on resource-intensive probabilistic processes using linear optics, or it requires nonlinear interactions through a matter system. Here we will consider the direct generation of photonic entangled graph states from controlled quantum emitters. I will discuss the protocols developed in my group for the generation of states for quantum computing and quantum networks, along with a general procedure to generate any photonic graph state using minimal resources.

Authors: Sophia Economou, Virginia Tech

Tu2B.2

Precision Quantum Photonics in the Time-Frequency Domain

Invited

Presenter: Alessandro Fedrizzi , *Heriot-Watt University*

Time-frequency encoding is attractive for quantum photonics due to telecom compatibility and access to higher dimensions. This talk will explore the precision tailoring and characterisation of time-frequency quantum states of light generated in domain-engineered nonlinear crystals.

Authors:Alessandro Fedrizzi, Heriot-Watt University

Tu2B.3

Organic Dye Molecules as Single Photon Sources for Optical Quantum Technologies

Presenter: *pietro lombardi , CNR-INO*

We present Hong–Ou–Mandel (HOM) experiments with photons emitted by a single molecule of Dibenzoterrylene in an Anthracene nanocrystal under pulsed excitation, and preliminary results for photons emitted by two spatially-separated molecules on the same sample.

Authors:*pietro lombardi, CNR-INO / Ramin Emadi, CNR-INO / Rocco Duquennoy, Università di Firenze / Ghulam Murtaza, CNR-INO / Maja Colautti, CNR-INO / Costanza Toninelli, CNR-INO*

Tu2B.4

Two-Photon Interference With Bright Remote Quantum Dot Sources

Presenter: *Mathias PONT , Centre for Nanosciences and Nanotechnology, CNRS, Universite Paris-Saclay, UMR 9001*

Fabricating multiple identical bright single-photon sources is critical for scalable quantum technologies. We demonstrate Hong–Ou–Mandel interference of photons from two distinct quantum dot sources in micropillar cavities with a visibility of $(67\pm 4)\%$.

Authors:*Mathias PONT, Centre for Nanosciences and Nanotechnology, CNRS, Universite Paris-Saclay, UMR 9001 / Sarah Thomas, Centre for Nanosciences and Nanotechnology, CNRS, Universite Paris-Saclay, UMR 9001 / Ilse Maillette de Buy Wenniger, Centre for Nanosciences and Nanotechnology, CNRS, Universite Paris-Saclay, UMR 9001 / Abdelmounaim Harouri, Centre for Nanosciences and Nanotechnology, CNRS, Universite Paris-Saclay, UMR 9001 / Aristide Lemaitre, Centre for Nanosciences and Nanotechnology, CNRS, Universite Paris-Saclay, UMR 9001 / Isabelle Sagnes, Centre for Nanosciences and Nanotechnology, CNRS, Universite Paris-Saclay, UMR 9001 / Niccolo Somaschi, Quandela SAS / Pascale Senellart, Centre for Nanosciences and Nanotechnology, CNRS, Universite Paris-Saclay, UMR 9001*

Tu2C

Quantum Optics of Light-atom Interactions I

Presenter: Ofer Firstenberg , *Weizmann Institute of Science*

Tu2C.1

Engineering Photonic Quantum States for Quantum Applications

Invited

Presenter: Virginia Lorenz , *Univ of Illinois at Urbana-Champaign*

I will present our experimental and theoretical work on generating photonic quantum states in optical fiber, characterizing them efficiently, engineering their quantum properties, and controlling their free space storage and retrieval for quantum applications.

Authors: Virginia Lorenz, Univ of Illinois at Urbana-Champaign

Tu2C.2

Submegahertz Spectral Width Photon-Pair Source Based on Fused Silica Microspheres

Presenter: Erasto Ortiz Ricardo , *Instituto de ciencias nucleares UNAM*

We demonstrate, and characterize, a photon-pair source based on the process of spontaneous four wave mixing in fused-silica microspheres, with single heralded photon bandwidths down to 366kHz.

Authors: Erasto Ortiz Ricardo, Instituto de ciencias nucleares UNAM / Cesar Bertoni-Ocampo, Instituto de ciencias nucleares UNAM / Mónica Maldonado-Terrón, Instituto de ciencias nucleares UNAM / Arturo Sanchez-Zurita, Instituto de ciencias nucleares UNAM / Roberto Ramirez Alarcón, Centro de investigacion en optica / Hector Cruz Ramirez, Instituto de ciencias nucleares UNAM / Rigoberto Castro Beltran, Universidad de Guanajuato / Alfred B. U'Ren, Instituto de ciencias nucleares UNAM

Tu2C.3

Observing the Modification of Quantum Statistics of Plasmonic Systems

Presenter: Mingyuan Hong , *Louisiana State University*



We demonstrate that quantum statistics are not always preserved in plasmonic systems and report the observation of their modification. We show the potential of optical near fields to modify the statistics of multiparticle systems.

Authors: Chenglong You, Louisiana State University / Mingyuan Hong, Louisiana State University / Narayan Bhusal, Louisiana State University / Jinnan Chen, University of Alabama in Huntsville / Mario Quiroz-Juarez, Universidad Autónoma Metropolitana Unidad Iztapalapa / Joshua Fabre, Louisiana State University / Fatemeh Mostafavi, Louisiana State University / Junpeng Guo, University of Alabama in Huntsville / Israel De Leon, Tecnológico de Monterrey / Roberto Leon-Montiel, Universidad Nacional Autónoma de México / Omar Magana-Loaiza, Louisiana State University

Tu2C.4

Cavity Protected Multifrequency Polaritons in a Cold Atomic System

Presenter: Romain Long , ENS-PSL University, CNRS, Sorbonne Université, Collège de France

We generate multifrequency polaritons in a cold atom optical cavity interface by modulating the emitters frequency. The polaritons coherence time is protected by the cavity which prevents the mixing with dark states.

Authors: Pierre-Antoine Bourdel, ENS-PSL University, CNRS, Sorbonne Université, Collège de France / Mohamed Baghdad, ENS-PSL University, CNRS, Sorbonne Université, Collège de France / Sylvain Schwartz, ENS-PSL University, CNRS, Sorbonne Université, Collège de France / Constance Poulain, ENS-PSL University, CNRS, Sorbonne Université, Collège de France / Jakob Reichel, ENS-PSL University, CNRS, Sorbonne Université, Collège de France / Romain Long, ENS-PSL University, CNRS, Sorbonne Université, Collège de France

Tu2A

Precision Measurements and Quantum Metrology I

Presenter: Nicolas Treps , Sorbonne Université

Tu2A.1

Sensing With few Photons: the Power of Correlations in Lossy SU(1,1) Interferometers.

Presenter: Matteo Santandrea , Paderborn University, Department of Physics, Integrated Quantum Optics, Institute for Photonic Quantum Systems (PhoQS)

This work explores the phase uncertainty of lossy SU(1,1) interferometers in the low gain regime. We show that coincidence measurement can reach the lowest phase uncertainty possible in the system, regardless of the internal losses.

Authors: Matteo Santandrea, Paderborn University, Department of Physics, Integrated Quantum Optics, Institute for Photonic Quantum Systems (PhoQS) / Kai Hong Luo, Paderborn University, Department of Physics, Integrated Quantum Optics, Institute for Photonic Quantum Systems (PhoQS) / Michael Stefszky, Paderborn University, Department of Physics, Integrated Quantum Optics, Institute for Photonic Quantum Systems (PhoQS) / Jan Sperling, Paderborn University, Department of Physics, Integrated Quantum Optics, Institute for Photonic Quantum Systems (PhoQS) / Harald Herrmann, Paderborn University, Department of Physics, Integrated Quantum Optics, Institute for Photonic Quantum Systems (PhoQS) / Benjamin Brecht, Paderborn University, Department of Physics, Integrated Quantum Optics, Institute for Photonic Quantum Systems (PhoQS) / Christine Silberhorn, Paderborn University, Department of Physics, Integrated Quantum Optics, Institute for Photonic Quantum Systems (PhoQS)

Tu2A.2

Measurement-Dependent Erasure of Distinguishability for the Observation of Interference in an Unbalanced SU(1,1) Interferometer

Presenter: Zhe-Yu Ou , *City University of Hong Kong*

We report a method of homodyne detection that can recover otherwise lost interference effect in an unbalanced SU(1,1) interferometer. The indistinguishability due to amplitude measurement and slow detection is responsible for the recovery of interference.

Authors: Zhe-Yu Ou, City University of Hong Kong / Nan Huo, Tianjin University / Liang Cui, Tianjin University / Xueshi Guo, Tianjin University / Xiaoying Li, Tianjin University

Tu2A.3

Optimal Detection of Ultra-Broadband bi-Photons With Quantum Nonlinear SU(1,1) Interference

Presenter: Nir Nechushtan , *Bar-Ilan University*



<div style="direction: ltr;">SU(1,1) interference is a major tool for quantum detection of squeezed light. We optimize the interference visibility experimentally based on the phase matching and beam parameters. We demonstrate near-ideal visibility (loss-limited) over an octave bandwidth.</div>

Authors: Nir Nechushtan, Bar-Ilan University / Hanzhong Zhang, Bar-Ilan University / Avi Pe'er, Bar-Ilan University

Tu2A.4

(Withdrawn) Robust Interferometric Sensing of a Mirror Tilting Using Two-Photon Interference

Presenter: Pablo Saldanha , *Universidade Federal de Minas Gerais*

We theoretically and experimentally investigate how two-photon interference can be used to measure a mirror tilting with metrological advantages compared to direct beam displacement measurements and with greater stability compared to a classical interferometric method.

Authors: Gabriel Aguilar, Universidade Federal do Rio de Janeiro / Rodrigo Piera, Universidade Federal do Rio de Janeiro / Pablo Saldanha, Universidade Federal de Minas Gerais / Luiz Davidovich, Universidade Federal do Rio de Janeiro / Ruinet Matos Filho, Universidade Federal do Rio de Janeiro / Stephen Walborn, Universidade Federal do Rio de Janeiro

Tu2A.5

Adaptive two-Phase Estimation on a Photonic Integrated Device

Presenter: Mauro Valeri , *università di Roma La Sapienza*

Efficient adaptive multiphase estimation has been demonstrated experimentally on an integrated three-arm interferometer injected by single photons. Bayesian learning and Sequential Monte Carlo approximation have been employed as machine learning tools to achieve this goal.

Authors: Mauro Valeri, università di Roma La Sapienza / Emanuele Polino, università di Roma La Sapienza / Davide Poderini, università di Roma La Sapienza / Ilaria Gianani, Università degli Studi Roma Tre / Giacomo Corrielli, Istituto di Fotonica e Nanotecnologie - CNR / Andrea Crespi, Istituto di Fotonica e Nanotecnologie - CNR / Roberto Osellame, Istituto di Fotonica e Nanotecnologie - CNR / Nicolò Spagnolo, università di Roma La Sapienza / Fabio Sciarrino, università di Roma La Sapienza

Tu2A.6

Time-Frequency Randomized Compressive Tomography Using a Quantum Pulse Gate

Presenter: Benjamin Brecht , *Paderborn University*

We demonstrate randomized compressive tomography of few-photon states that comprise of different temporal modes. We require no a-priori knowledge and reconstruct states using only few measurement settings. Our approach is naturally compatible with integrated architectures.

Authors: Benjamin Brecht, Paderborn University / Jano Gil-Lopez, Paderborn University / Syamsundar De, Paderborn University / Yong Siah Teo, Seoul National University / Hyunseok Jeong, Seoul National University / Luis Sanchez-Soto, Universidad Complutense / Christine Silberhorn, Paderborn University

11:15 - 12:00 (UTC - 07:00)

JTu4A

Visionary Session III: Ryan McMichael, Zoox Inc., USA

Presenter: Umar Piracha , *Zoox*

JTu4A.1

The State and Future of the Autonomous Industry

Visionary

Presenter: Ryan McMichael , *Zoox Inc.*

Abstract not available.

Authors: Ryan McMichael, Zoox Inc.

12:00 - 12:30 (UTC - 07:00)



SpE6

Special Event - Tech Talk: Computational 3D/4D holographic Imaging

12:30 - 13:00 (UTC - 07:00)

SpE6

Special Event - Tuesday Virtual Coffee Break I

12:30 - 13:45 (UTC - 07:00)

JTu5A

Plenary Session I: Joseph Goodman, Stanford University, USA

Presenter: Ting-Chung Poon , *Virginia Tech*

JTu5A.1

Fourier Transforms and Fourier Optics with Mathematica™

Plenary

Presenter: Joseph Goodman , *Stanford University (Emeritus)*

In this talk, I explore several different problems in Fourier optics about which I have been curious.

Authors: Joseph Goodman, Stanford University (Emeritus)

13:00 - 14:30 (UTC - 07:00)



Tu3A

Entanglement-enabled Quantum Technologies II

Presider: Michael Duncan , *Optica*

Tu3A.1

(Withdrawn) Observation of the Einstein-Podolsky-Rosen Paradox Between two Bose-Einstein Condensates

Presenter: Tilman Zibold , *University of Basel*

In our experiment we show the realization of the Einstein-Podolsky-Rosen paradox between two macroscopic many-body systems: two Bose-Einstein condensates.

Authors: Paolo Colciaghi, University of Basel / Yifan Li, University of Basel / Philipp Treutlein, University of Basel / Tilman Zibold, University of Basel

Tu3A.2

Witnessing Quantum Correlations in a Nuclear Spin Ensemble via a Proxy Qubit

Presenter: Dorian Gangloff , *University of Cambridge*

A resident electron spin in a semiconductor nanostructure is an interface to an ensemble of nuclear spins, and witnesses the creation of entanglement within the ensemble in the form of dark-state coherences.

Authors: Dorian Gangloff, University of Cambridge / Leon Zaporski, University of Cambridge / Jonathan Bodey, University of Cambridge / Clara Bachorz, University of Cambridge / Daniel Jackson, University of Cambridge / Gabriel Éthier-Majcher, University of Cambridge / Constantin Lang, University of Cambridge / Edmund Clarke, University of Sheffield / Maxime Hugues, Université Côte d'Azur / Claire Le Gall, University of Cambridge / Mete Atatüre, University of Cambridge

Tu3A.3

Measurement of Near-Maximal Polarization Entanglement at 2.1 μ m

Presenter: Adetunmise Dada , *University of Glasgow*

We present a device-independent certification of near-maximal polarization entanglement at 2.1 μ m. The 2–2.5- μ m waveband offers reduced solar background, low-loss propagation in the atmosphere, and low-loss, low-dispersion transmission in hollow-core fibers and silicon waveguides.

Authors: Adetunmise Dada, University of Glasgow / Jędrzej Kaniewski, University of Warsaw / Corin Gawith, Covision Ltd. / Martin Lavery, University of Glasgow / Robert Hadfield, University of Glasgow / Daniele Faccio, University of Glasgow / Matteo Clerici, University of Glasgow

Tu3A.4

Experimental Estimation of Causal Influences in the Presence of Quantum Common Cause

Presenter: Davide Poderini, *Sapienza University of Rome*

The incompatibility between the quantum and classical notion of causality is a well known result in quantum theory. Using a photonic platform we show that, going beyond Bell's scenario, we can detect nonclassicality even when no violation is possible, by intervening in our experimental apparatus.

Authors: Iris Agresti, Sapienza University of Rome / Davide Poderini, Sapienza University of Rome / Beatrice Polacchi, Sapienza University of Rome / Nikolai Miklin, International Centre for Theory of Quantum Technologies (ICTQT), University of Gdansk / Mariami Gachechiladze, Institute for Theoretical Physics, University of Cologne / Alessia Suprano, Sapienza University of Rome / Emanuele Polino, Sapienza University of Rome / Giorgio Milani, Sapienza University of Rome / Gonzalo Carvacho, Sapienza University of Rome / Rafael Chaves, International Institute of Physics, Federal University of Rio Grande do Norte / Fabio Sciarrino, Sapienza University of Rome

Tu3A.5

Self-Testing of Qubit Graph States Based on Temporal Noncontextuality Inequalities

Presenter: Jebarathinam Chellasamy, *Polish Academy of Sciences*

We propose robust self-testing protocols based on temporal noncontextual inequalities to certify qubit graph states for quantum computation purposes.

Authors: Rafael Freitas dos Santos, Polish Academy of Sciences / Jebarathinam Chellasamy, Polish Academy of Sciences / Remigiusz Augusiak, Polish Academy of Sciences

Tu3A.6**Using Coherent Multimode Photon Addition for Sensing a Remote Phase**

Presenter: Marco Bellini , *Istituto Nazionale di Ottica (CNR-INO)*

We demonstrate a remote phase estimation technique based on delocalized single-photon addition onto distinct field modes and characterized by a sensitivity scaling with the intensity of light that never interacted with a distant sample.

Authors: Nicola Biagi, Istituto Nazionale di Ottica (CNR-INO) / Saverio Francesconi, Istituto Nazionale di Ottica (CNR-INO) / Manuel Gessner, Laboratoire Kastler Brossel, ENS-Université PSL / Alessandro Zavatta, Istituto Nazionale di Ottica (CNR-INO) / Marco Bellini, Istituto Nazionale di Ottica (CNR-INO)

Tu3B**Quantum Communication II**

Presenter: Robert Stockill , *Delft University of Technology*

Tu3B.1**Quantum Communication With Entangled Photons From Quantum Dots**

Invited

Presenter: Rinaldo Trotta , *Univ degli Studi di Roma La Sapienza*

I will discuss how entangled photons generated by a quantum dot can be used to implement quantum communication protocols. A discussion on future challenges and perspectives will conclude the seminar.

Authors: Rinaldo Trotta, Univ degli Studi di Roma La Sapienza

Tu3B.2**Telecom-Heralded Entanglement Distribution Between Remote Multimode Solid-State Quantum Memories**

Presenter: Samuele Grandi , *ICFO-The Institute of Photonic Sciences*

We demonstrate entanglement between two quantum nodes. The entanglement is generated by parametric down conversion, heralded by telecom photons and stored in multimode rare-earth based quantum memories. The memories share a delocalized excitation.

Authors:Samuele Grandi, ICFO-The Institute of Photonic Sciences / Dario Lago-Rivera, ICFO-The Institute of Photonic Sciences / Jelena Rakonjac, ICFO-The Institute of Photonic Sciences / Alessandro Seri, ICFO-The Institute of Photonic Sciences / Hugues de Riedmatten, ICFO-The Institute of Photonic Sciences

Tu3B.3

Entanglement Between a Telecom Photon and a Spin-Wave Solid-State Multimode Quantum Memory

Presenter: Samuele Grandi , *ICFO-The Institute of Photonic Sciences*

We demonstrate entanglement between a telecom photon and a solid-state multimode quantum memory. The entanglement is maintained for an optical excitation (with a fidelity high enough to violate a Bell inequality) and a spin-wave excitation.

Authors:Jelena Rakonjac, ICFO-The Institute of Photonic Sciences / Dario Lago-Rivera, ICFO-The Institute of Photonic Sciences / Alessandro Seri, ICFO-The Institute of Photonic Sciences / Margherita Mazzera, Heriot-Watt University / Samuele Grandi, ICFO-The Institute of Photonic Sciences / Hugues de Riedmatten, ICFO-The Institute of Photonic Sciences

Tu3B.4

Entanglement-Assisted Communication Surpassing the Ultimate Classical Capacity

Presenter: Shuhong Hao , *University of Arizona*

We report experimental entanglement-assisted communication above the ultimate classical capacity set by the Holevo-Schumacher-Westmorel bound. A high-efficiency entanglement source and a phase-conjugate quantum receiver reap the benefit of pre-shared entanglement over lossy and noisy channels.

Authors:Shuhong Hao, University of Arizona / Haowei Shi, University of Arizona / Wei Li, University of Arizona / Jeffrey Shapiro, Massachusetts Institute of Technology / Quntao Zhuang, University of Arizona / Zheshen Zhang, University of Arizona

Tu3B.5

Entanglement-Assisted Multiple-Access Channels: Capacity Regions and Protocol Designs

Presenter: Haowei Shi , *University of Arizona*

We solve the entanglement-assisted rate region of multiple-access channels, applicable to thermal-loss optical networks. Practical protocols based on spontaneous parametric down-conversion source, phase modulation and optical parametric amplifiers are presented to benefit from entanglement.

Authors: Haowei Shi, University of Arizona / Min-Hsiu Hsieh, Hon Hai Research Institute / Saikat Guha, University of Arizona / Zheshen Zhang, University of Arizona / Quntao Zhuang, University of Arizona

14:00 - 14:20 (UTC - 07:00)

HT1

Exhibit Hall Event - Hot Topic Coffee Break: The Time Is Now - Latest Developments from the AIP TEAM-UP Report

14:20 - 14:40 (UTC - 07:00)

TS1

Exhibit Hall Event - Technology Showcase: Luminare 2021 Industry-first Technology Winners

14:30 - 15:00 (UTC - 07:00)



SpE7

Special Event - Tuesday Virtual Coffee Break II

15:00 - 15:30 (UTC - 07:00)

SpE8

Special Event - Tech Talk: The Power of Label Free Holographic 3D Imaging in Flow-cytometry

15:00 - 16:00 (UTC - 07:00)

SpE7

Special Event - Congressional Fellowship Q&A: A Unique Career Opportunity for Scientists and Engineers

15:00 - 16:30 (UTC - 07:00)

LTu6E

Attosecond Spectroscopy and High Harmonic Generation

Presenter: Arvinder Sandhu , *University of Arizona*

LTu6E.1

Selection Rules by Multi-scale Dynamical Symmetries and Symmetries in Synthetic Dimensions

Invited



Presenter: Oren Cohen , *Technion Israel Institute of Technology*

I will present (i) a theory describing the microscopic-macroscopic dynamical symmetries of electromagnetic fields, revealing new symmetries and selection rules in light-matter interactions, and (ii) selection rules in symmetry-broken systems by symmetries in synthetic dimensions.

Authors:Oren Cohen, Technion Israel Institute of Technology

LTu6E.2

Attosecond Soft-X-ray Spectroscopy in the Gas and Liquid Phases

Invited

Presenter: Hans Jakob Woerner , *ETH Zurich*

Abstract not available.

Authors:Hans Jakob Woerner, ETH Zurich

LTu6E.3

Autoionizing States in Attosecond Spectroscopy

Invited

Presenter: Luca Argenti , *University of Central Florida*

Autoionizing states are pervasive features of atomic and molecular ionization processes. We illustrate how the evolution of autoionizing states in polyelectronic atoms can be monitored and controlled with attosecond pump-probe photoelectron and transient-absorption spectroscopy.

Authors:Luca Argenti, University of Central Florida

15:30 - 17:00 (UTC - 07:00)

FTu6D

Frequency Combs

Presenter: Tara Fortier , *National Inst of Standards & Technology*



FTu6D.1**Phase-locked Short Pulses in a Driven Laser Cavity**

Presenter: Nicolas Englebert , *Université libre de Bruxelles*

We show the existence of temporal solitons in a driven laser pumped below its oscillation threshold, theoretically and experimentally. The cavity detuning offers a new degree of freedom, allowing the generation of ultra-short high-power pulses.

Authors:Nicolas Englebert, Université libre de Bruxelles / Carlos Mas Arabí, Université libre de Bruxelles / Pedro Parra-Rivas, Université libre de Bruxelles / Simon-Pierre Gorza, Université libre de Bruxelles / François Leo, Université libre de Bruxelles

FTu6D.2**Ultrafast Optical Rotation in Chiral Molecules with Ultrashort and Tightly Focused Beams**

Presenter: David Ayuso , *Imperial College London*

We introduce ultrafast optical rotation: a highly efficient method for chiral discrimination using ultrashort pulses. Sub-cycle optical control enables full control over the enantio-sensitive response of matter in a molecule-specific manner.

Authors:David Ayuso, Imperial College London / Andres Ordonez, Max-Born-Institut / Misha Ivanov, Max-Born-Institut / Olga Smirnova, Max-Born-Institut

FTu6D.3**Optical Frequency Combs for Precision Metrology of Atomic Clocks**

Invited

Presenter: Tara Fortier , *National Inst of Standards & Technology*

Optical frequency combs act as precise and frequency-traceable synthesizers permitting the comparison of atomic standards across the optical and microwave domains for characterization of next generation time standards and test of fundamental physics.

Authors:Tara Fortier, National Inst of Standards & Technology

FTu6D.4**Cavity-Enhanced Spectroscopy with Interband Cascade Optical Frequency Combs in the CH Stretching Region**

Presenter: Charles Markus , *California Institute of Technology*

Interband cascade lasers are convenient sources for generating optical frequency combs that cover 1 THz within the 3-6 μm region. We apply these monolithic devices towards trace gas detection with enhancement cavities using Vernier spectroscopy.

Authors: Charles Markus, California Institute of Technology / Lukasz Sterczewski, California Institute of Technology / Tzu-Ling Chen, California Institute of Technology / Douglas Ober, California Institute of Technology / Mahmood Bagheri, California Institute of Technology / Mitchio Okumura, California Institute of Technology

FTu6D.5

Accurate Accelerometry Using Cavity Optomechanics and Electro-optic Frequency Combs

Presenter: Benjamin Reschovsky , *National Institute of Standards and Technology*

We demonstrate an optomechanical accelerometer that is capable of intrinsically accurate measurements without an external calibration. We use an electrooptic frequency comb to measure the cavity displacement in terms of optical and radio frequencies.

Authors: Benjamin Reschovsky, National Institute of Standards and Technology / David Long, National Institute of Standards and Technology / Feng Zhou, National Institute of Standards and Technology / Yiliang Bao, National Institute of Standards and Technology / Richard Allen, National Institute of Standards and Technology / Thomas LeBrun, National Institute of Standards and Technology / Jason Gorman, National Institute of Standards and Technology

FTu6C

Advanced Techniques for Fiber Optics Communications

Presenter: Mark Feuer , *College of Staten Island*

FTu6C.1

SDM, Power Efficiency and Current Submarine Systems

Invited

Presenter: Jin-Xing Cai , *TE SubCom*



We review the most recent achievements in undersea transmission with high optical power efficiency and the associated enabling technologies.

Authors:Jin-Xing Cai, TE SubCom

FTu6C.2

High-dimensional Stokes-space Spatial Beam Analyzer

Presenter: Daniel Dahl , *University of Queensland*

We demonstrate a device for measuring the generalized Stokes parameters of a six spatial mode beam. The device is a single-shot wavefront sensor measuring spatial complex amplitude and coherence without an external phase reference.

Authors:Daniel Dahl, University of Queensland / Martin Plöschner, University of Queensland / Nicolas Fontaine, Nokia Bell Labs / Joel Carpenter, University of Queensland

FTu6C.3

Benchmarking an Ultra-lightweight Deep Learning Architecture for Laser-based Underwater Communication

Presenter: Joel Esposito , *US Naval Academy*

We communicate underwater via laser by transmitting an alphabet of images. A light-weight deep neural network decodes the distorted images with ~99% accuracy, in a fraction of the time used by larger deep networks.

Authors:Joel Esposito, US Naval Academy / Svetlana Avramov-Zamurovic, US Naval Academy / Charles Nelson, US Naval Academy

FTu6C.4

Photodetector Performance Prediction with Machine Learning

Presenter: Ergun Simsek , *University of Maryland Baltimore County*

Four machine learning algorithms are tested to predict the performance metrics of modified uni-traveling carrier photodetectors from their design parameters. The highest accuracy (>94%) is achieved with artificial neural networks.

Authors:Ergun Simsek, University of Maryland Baltimore County / Seyed Mahabadi, University of Maryland Baltimore County / Thomas Carruthers, University of Maryland Baltimore County / Curits Menyuk, University of Maryland Baltimore County

FTu6C.5**Sub-Nyquist Sampling with Optical Pulses for Photonic Blind Source Separation**

Presenter: Taichu Shi , *Rowan Univeristy*

We proposed and demonstrated an optical pulse sampling method for photonic blind source separation. It can separate large bandwidth of mixed signals by small sampling frequency, which can reduce the workload of digital signal processing.

Authors: Taichu Shi, Rowan Univeristy / Yang Qi, Rowan Univeristy / Weipeng Zhang, Princeton University / Paul Prucnal, Princeton University / Ben Wu, Rowan Univeristy

FTu6B**Silicon Photonics**

Presenter: Nikolai Klimov , *National Inst of Standards & Technology*

FTu6B.1**Silicon Photonics for the Visible Spectrum**

Invited

Presenter: Joyce Poon , *Max-Planck-Inst fur Mikrostrukturphysik*

I will discuss the opportunities and challenges in taking silicon photonics technology to the visible spectrum, where it can address new applications, such as neural implants, fluorescence imaging, and quantum computing.

Authors: Joyce Poon, Max-Planck-Inst fur Mikrostrukturphysik

FTu6B.2**Rapid Adiabatic 3 dB Coupler with 50±1% Splitting Over 200 nm Including S, C and L Bands in 45 nm CMOS Platform**

Presenter: Josep Fargas Cabanillas , *Boston Univeristy*

We demonstrate a 70 um-long silicon rapid adiabatic coupler (RAC) with <0.07 dB insertion loss over 50 nm and power splitting ratio 50±1% over 200 nm bandwidth fabricated in the commercial 45RF 'zero change' CMOS electronics-photonics platform.

Authors: Josep Fargas Cabanillas, Boston Univeristy / Deniz Onural, Boston Univeristy / Milos Popovic, Boston Univeristy

FTu6B.3**Forward Stimulated Brillouin Scattering in Free-Standing Waveguides on a Silicon Photonics Platform**

Presenter: Khannan Rajendran , *UGent-imec*

Stimulated Brillouin Scattering (SBS) is demonstrated on a standard active silicon photonics platform, the forward SBS gain and opto-mechanical coupling rates are calculated for two different rib waveguide geometries.

Authors: Khannan Rajendran, UGent-imec / Awanish Pandey, UGent-imec / Alain Takabayashi, EPFL / Umar Khan, UGent-imec / Niels Quack, EPFL / Wim Bogaerts, UGent-imec / Dries Van Thourhout, UGent-imec

FTu6B.4**Frequency Translating Add/Drop Filters based on Electro-Optically Modulated Photonic Molecules**

Presenter: Hayk Gevorgyan , *Boston University*

We demonstrate a new category of optical add-drop filters, with a frequency-translated drop-port response. Comprising modulated coupled resonators, they support Butterworth, Chebyshev and other passband shapes typical to linear high-order filters.

Authors: Hayk Gevorgyan, Boston University / Milos Popovic, Boston University

FTu6B.5**Compact, Pull-in-Free Electrostatic MEMS Actuated Tunable Ring Resonator for Optical Multiplexing**

Presenter: Alexander Ruyack , *Sandia National Laboratories*

We present an optical wavelength division multiplexer enabled by a ring resonator tuned by MEMS electrostatic actuation. Analytical analysis, simulation and fabrication are discussed leading to results showing controlled tuning greater than one FSR.

Authors: Alexander Ruyack, Sandia National Laboratories / Alejandro Grine, Sandia National Laboratories / Patrick Finnegan, Sandia National Laboratories / Darwin Serkland, Sandia National Laboratories / Samuel Robinson, Sandia National Laboratories / Scott Weatherred, Sandia National Laboratories / Megan Frost, Sandia National Laboratories / Christopher Nordquist, Sandia National Laboratories / Michael Wood, Sandia National Laboratories

FTu6A**Smart Cameras with Machine Learning****Presenter:** Onur Kulce , *Bilkent Universitesi***FTu6A.1****Neural Processing for Array Cameras***Invited***Presenter:** David Brady , *University of Arizona*

We review the emerging data processing pipeline for array cameras and present recent results on neural image generation from compressed features. We consider physical neural architectures in optics and electronics for large scale camera systems.

Authors:David Brady, University of Arizona**FTu6A.3****Deep Learning for Snapshot Compressive Imaging***Invited***Presenter:** Xin Yuan , *Nokia Bell Labs*

We consider deep learning methods for snapshot compressive imaging (SCI), where a single 2D detector is used to capture the high-dimensional data-cube. This work reviews the recent advances of deep learning based inversion algorithms for SCI.

Authors:Xin Yuan, Nokia Bell Labs**FTu6A.2****On the Physics behind Computer Vision***Invited***Presenter:** Achuta Kadambi , *University of California Los Angeles*

Abstract not available.

Authors:Achuta Kadambi, University of California Los Angeles

16:00 - 16:30 (UTC - 07:00)

SpE9

Special Event - Tech Talk: Molecules in Intense XFEL Fields

17:30 - 18:15 (UTC - 07:00)

SpE10

Special Event - DLS Business Meeting

SpE12

Special Event - Optica Annual Business Meeting

17:30 - 18:45 (UTC - 07:00)

JTU7A

Joint Postdeadline Session I

President: Judith Dawes , *Macquarie University*

JTU7A.2

Cryogenic Optical Transitions of T Centers in Bulk Silicon and Silicon-on-insulator for Cavity Quantum Electrodynamics**Presenter:** Jiahui Huang , *University of California, Los Angeles*

We examine the 1325 nm T center transitions and an unknown color center with 1312 nm transitions in ion-implanted bulk Silicon and Silicon-on-insulator. We aim to use it for strong coupling via photonic crystal cavities.

Authors:Jiahui Huang, University of California, Los Angeles / Murat Sarihan, University of California, Los Angeles / Jin Ho Kang, University of California, Los Angeles / Baolai Liang, University of California, Los Angeles / Wei Liu, University of California, Los Angeles / Chee Wei Wong, University of California, Los Angeles

JTu7A.3

Dielectric metasurfaces with asymmetric generation of nonlinear images

Presenter: Sergey Kruk , *Australian National University*

We design, fabricate, and demonstrate translucent metasurfaces that generate images in transmission at third-harmonic frequency. Such metasurfaces create different and completely independent images for the opposite directions of illumination.

Authors:Sergey Kruk, Australian National University / Lei Wang, Australian National University / Basudeb Sain, Paderborn University / Zhaogang Dong, A*STAR / Joel Yang, A*STAR / Thomas Zentgraf, Paderborn University / Yuri Kivshar, Australian National University

JTu7A.4

Demonstration of Nanoscale Patterning of Thin-Layer Beta-Barium Borate Through Anhydrous Fabrication

Presenter: Mohamed Mohamed , *Jet Propulsion Laboratory, California Institute of Technology*

We demonstrate sub-micron lithographic patterning of nonlinear β -barium borate layers, obtaining features below 100 nm through a novel anhydrous fabrication process. This paves the way for visible- and ultraviolet-range chip-scale photonic devices.

Authors:Mohamed Mohamed, Jet Propulsion Laboratory, California Institute of Technology / Siamak Forouhar, Jet Propulsion Laboratory, California Institute of Technology

JTu7A.5

Observation of Spatiotemporal Optical Vortices in Subcycle Terahertz Pulses

Presenter: George Hine , *Oak Ridge National Laboratory*

Linear phase shear of subcycle terahertz pulsed beams is shown to directly lead to spatiotemporal optical vortex generation. This is corroborated by spatiotemporal measurements of subcycle terahertz radiation under linear phase shear.

Authors:George Hine, Oak Ridge National Laboratory

JTu7A.1

Localization-Assisted Stimulated Brillouin Scattering Spectroscopy

Presenter: Giulia Zanini , *University of Maryland*

Localization theory is here extended to the spectral domain for the design of a stimulated Brillouin scattering spectrometer with 10-fold improved acquisition speed and an order of magnitude improved precision.

Authors:Giulia Zanini, University of Maryland / Giuliano Scarcelli, University of Maryland



Wednesday, 03 November

7:00 - 9:00 (UTC - 07:00)

FW1D

Lithium Niobate Integrated Photonics

Presenter: Linjie Zhou , *Shanghai Jiao Tong University*

FW1D.1

Lithium Niobate Thin Films for Integrated Photonics

Invited

Presenter: Hui Hu , *Shandong University*

Single-crystal lithium niobate (LN) thin film retains the excellent physical properties of LN crystal and has large refractive index contrast. This paper introduces the fabrications and applications of LN thin films.

Authors:Hui Hu, Shandong University

FW1D.2

Integration of Electro-Optic Modulators and Single-Photon Detectors in LNOI Photonic Circuits

Presenter: Emma Lomonte , *University of Münster*

We demonstrate electro-optic modulators and superconducting nanowire single-photon detectors (SNSPDs) monolithically integrated in a single Lithium-Niobate-On-Insulator (LNOI) device, featuring ultra-low propagation loss and a compact footprint.

Authors:Emma Lomonte, University of Münster / Martin Wolff, University of Münster / Fabian Beutel, University of Münster / Simone Ferrari, University of Münster / Carsten Schuck, University of Münster / Wolfram Pernice, University of Münster / Francesco Lenzini, University of Münster

FW1D.3

Integrated LNOI Single-mode Lasers by Vernier Effect

Presenter: Ru Zhang , Nankai University

C-band single-mode lasers with ~200 μ W threshold and exceeding 26 dB side-mode suppression ratio were realized in two coupled erbium-doped LNOI microrings with different radii by Vernier effect.

Authors:Ru Zhang, Nankai University / Chen Yang, Nankai University / Zhenzhong Hao, Nankai University / Di Jia, Nankai University / Qiang Luo, Nankai University / Dahuai Zheng, Nankai University / Hongde Liu, Nankai University / Xuanyi Yu, Nankai University / Feng Gao, Nankai University / Fang Bo, Nankai University / Yongfa Kong, Nankai University / Zhang Guoquan, Nankai University / Jingjun Xu, Nankai University

FW1D.4

Low Loss Wavelength-agnostic Optical Isolators Through Acoustic Pumping in a Lithium Niobate Platform

Presenter: Ogulcan Orsel , University of Illinois at Urbana-Champaign

We experimentally demonstrate linear optical isolators on-chip through acoustic pumping. Our devices achieve 39 dB contrast with 0.65 dB insertion loss at 1550 nm, and comparable performance at 780 nm.

Authors:Ogulcan Orsel, University of Illinois at Urbana-Champaign

FW1D.5

Tunable Dual-channel Integrated Filters on Thin-film Lithium Niobate with Ultranarrow Linewidth

Presenter: Milad Vazimali , University of Central Florida

We present a tunable dual-channel phase-shifted Bragg-grating filter on thin-film lithium niobate with an extinction ratio of 27 dB and channel linewidth of 19 pm and spacing of 19 GHz.

Authors:Kamal Abdelsalam, University of Central Florida / Ehsan Ordouie, University of Central Florida / Milad Vazimali, University of Central Florida / Farzaneh Juneghani, University of Central Florida / Prem Kumar, Northwestern University / Gregory Kanter, Northwestern University / Sasan Fathpour, University of Central Florida

FW1E

Photonic Quantum Technologies II



Presider: Qing Li , *Carnegie Mellon University*

FW1E.1

Quantum Sensing of Photonic Spin Density Using a Single Spin Qubit

Presenter: Farid Kalhor , *Purdue University*

We demonstrate that a nitrogen-vacancy (NV) center in diamond can be used as a nanoscale quantum sensor for detecting photonic spin density (PSD). This opens a new frontier for studying exotic phases of photons as well as future on-chip applications.

Authors:Farid Kalhor, Purdue University / Li-Ping Yang, Northeast Normal University / Leif Bauer, Purdue University / Noah Opondo, Purdue University / Shoaib Mahmud, Purdue University / Sunil Bhave, Purdue University / Zubin Jacob, Purdue University

FW1E.2

1.5-THz-Bandwidth Digital Photonic Quantum Memory

Presenter: Nathan Arnold , *Univ. of Illinois Urbana-Champaign*

Quantum optical memories are a key component of quantum information applications. Here we develop a system with multiplexed free-space storage cavities, able to efficiently store single photons for up to 12.5 μ s over several nanometers of bandwidth.

Authors:Nathan Arnold, Univ. of Illinois Urbana-Champaign / Michelle Victora, RightHand Robotics, Inc / Michael Goggin, Truman State University / Paul Kwiat, Univ. of Illinois Urbana-Champaign

FW1E.3

Fast and Simple One Way High-Dimensional Quantum Key Distribution

Presenter: Kfir Sulimany , *The Hebrew University of Jerusalem*



We propose and analyze a novel high-dimensional quantum key distribution protocol. We implement the protocol using a software update in a standard two-dimensional system and observe a twofold enhancement in the secure key rate.

Authors: Kfir Sulimany, The Hebrew University of Jerusalem / Rom Dudkiewicz, The Hebrew University of Jerusalem / Simcha Korenblit, The Hebrew University of Jerusalem / Hagai S. Eisenberg, The Hebrew University of Jerusalem / Yaron Bromberg, The Hebrew University of Jerusalem / Michael Ben-Or, The Hebrew University of Jerusalem

FW1E.4

Multi-qubit Production in Spontaneous Parametric Down Conversion

Presenter: Finn Buldt, *Rensselaer Polytechnic Institute*

We have designed Gaussian masks for SPDC to subdivide the pump beam before passing it through a nonlinear medium. We are able to observe simultaneous separate down converted emission cones with spatial overlap.

Authors: Phillip Heitert, Rensselaer Polytechnic Institute / Finn Buldt, Rensselaer Polytechnic Institute / Pascal Bassene, Rensselaer Polytechnic Institute / Moussa N'gom, Rensselaer Polytechnic Institute

FW1E.5

Experimental Demonstration of Polarization Entanglement from a Spatiotemporally Incoherent Source

Presenter: Cheng Li, *University of Ottawa*

We experimentally demonstrate the generation of polarization entanglement from SPDC pumped by a spatiotemporally incoherent pump. The produced two-photon state is found to have a concurrence of 0.562 and purity of 0.647.

Authors: Cheng Li, University of Ottawa / Boris Braverman, University of Ottawa / Girish Kulkarni, University of Ottawa / Robert Boyd, University of Ottawa

FW1E.6

Wave-function-based State Generator Using Quantum Teleportation with Non-Gaussian Entangled State

Presenter: Warit Asavanant, *The University of Tokyo*



We present a methodology to generate various non-Gaussian states via wave-function engineering. Our method uses the conditional quantum teleportation with non-Gaussian resource states, making it compatible with the time-domain multiplexing scheme.

Authors: Warit Asavanant, The University of Tokyo / Kan Takase, The University of Tokyo / Kosuke Fukui, The University of Tokyo / Mamoru Endo, The University of Tokyo / Jun-ichi Yoshikawa, The University of Tokyo / Akira Furusawa, The University of Tokyo

FW1E.7

Co-existence of Entangled and Classical Light Over 45 km of Installed Fiber

Presenter: Jordan Thomas , *Northwestern University*

We show coexistence of quantum entangled and classical light over 45.6 km of installed optical fiber. Wavelength engineering/filtering allows milliwatts copropagating power with quantum light from a photon-pair source with broad entangled spectrum.

Authors: Jordan Thomas, Northwestern University / Gregory Kanter, Northwestern University / Kim Lee, Northwestern University / Prem Kumar, Northwestern University

FW1E.8

(Withdrawn) Entangled Photons Generation in Broken Symmetry GaAs Metasurfaces

Presenter: Tomas Santiago , *Max Planck Institute for the Science of Light*

We report on entangled photons generation via spontaneous parametric down-conversion in GaAs metasurfaces featuring Fano-like resonances, where we obtained a considerable enhancement of the generation rate in comparison to an unpatterned GaAs film.

Authors: Tomas Santiago, Max Planck Institute for the Science of Light / Sylvain D. Gennaro, Sandia National Laboratories / Michael Poloczek, Max Planck Institute for the Science of Light / Vitaliy Sultanov, Max Planck Institute for the Science of Light / Sadhvikas Addamane, Sandia National Laboratories / John Reno, Sandia National Laboratories / Igal Brener, Sandia National Laboratories / Maria V. Chekhova, Max Planck Institute for the Science of Light

8:00 - 9:00 (UTC - 07:00)

FW1B

Complex Light I

Presenter: Andrew Forbes , *University of Witwatersrand*

FW1B.1

Light Emission by atoms and by free electrons in photonic time-crystals

Invited

Presenter: Mordechai Segev , *Technion Israel Institute of Technology*

We present our studies on the emission of light in Photonic Time-Crystals: materials whose refractive index varies periodically in time, giving rise to time-reflections and refractions, which form Floquet bands separated by momentum gap.

Authors: Mordechai Segev, Technion Israel Institute of Technology / Alex Dikopoltsev, Technion Israel Institute of Technology / Mark Lyubarov, Technion Israel Institute of Technology / Yaakov Lumer, Technion Israel Institute of Technology / Eran Lustig, Technion Israel Institute of Technology / Yonatan Sharabi, Technion Israel Institute of Technology / Ohad Segal, Technion Israel Institute of Technology / Ido Kaminer, Technion Israel Institute of Technology

FW1B.2

Structuring Harmonic Vector-Vortex Beams in the Extreme Ultraviolet

Presenter: Alba de las Heras , *Universidad de Salamanca*

The synchronous control of spin and orbital angular momentum in high-harmonic generation allows us to introduce a novel XUV structured beam with spatially-varying polarization and phase, high topological charge, and robust propagation.

Authors:Alba de las Heras, Universidad de Salamanca / Alok Kumar Pandey, Université Paris-Saclay / Julio San Román, Universidad de Salamanca / Javier Serrano, Universidad de Salamanca / Elsa Baynard, Université Paris-Saclay / Guillaume Dovillaire, Imagine Optic / Moana Pittman, Université Paris-Saclay / Charles Durfee, Colorado School of Mines / Luis Plaja, Universidad de Salamanca / Sophie Kazamias, Université Paris-Saclay / Olivier Guilbaud, Université Paris-Saclay / Carlos Hernández-García, Universidad de Salamanca

FW1C

Fiber Fabrication and Test

Presenter: Alexey Turukhin , Cisco Systems Inc

FW1C.2

Low-loss Silicon-core Optical Fibre Fabrication Using a Co Laser-based Furnace without an Interface Layer

Presenter: Clarissa Harvey , KTH Royal Institute of Technology

Silicon core optical fibres have been fabricated using an experimental draw tower based on a CO laser furnace. Fabricated fibres have achieved a submicron core size and shown a record low loss of 0.1 dB/cm.

Authors:Clarissa Harvey, KTH Royal Institute of Technology / Korbinian Mühlberger, KTH Royal Institute of Technology / Taras Oriekhov, KTH Royal Institute of Technology / Michael Fokine, KTH Royal Institute of Technology

FW1C.3

Exploring Fabrication Limits for UV Guiding Hollow Core Anti-Resonant Fiber

Presenter: Greg Jackson , University of Southampton



We report a preform scaling technique to fabricate hollow-core Nested Antiresonant Nodeless Fiber (NANF) for guiding ultraviolet wavelengths. We demonstrate that fabrication of NANFs with membrane thicknesses of ~100nm and yields of 1km are possible.

Authors: Greg Jackson, University of Southampton / Thomas Bradley, University of Southampton / Gregory Jasion, University of Southampton / Francesco Poletti, University of Southampton

FW1C.1

(Withdrawn) Guided Acoustic Brillouin Scattering Measurements in Communication Fibers

Invited

Presenter: Fatih Yaman , *NEC Laboratories America Inc*

Abstract not available.

Authors: Fatih Yaman, *NEC Laboratories America Inc*

LW1F

Ultrafast Dynamics in Complex Systems II

Presenter: Prineha Narang , *Harvard University*

LW1F.1

Excitation Dynamics and Dielectric Resonance Energy Transfer in Cu₂O Nanocubes

Presenter: Sunil Gyawali , *West Virginia University*

Transient absorption captures dynamics of nanocubes, showing negative delay-time signals associated with perturbed free induction. This validates dielectric-resonance energy transfer between electromagnetic modes for light-harvesting applications.

Authors: Sunil Gyawali, *West Virginia University* / Rishmali Sooriyagoda, *West Virginia University* / Aaron Wheeler, *Oklahoma State University* / Ravi Teja A. Tirumala, *Oklahoma State University* / Sundaram Ramakrishnan, *Oklahoma State University* / Farshid Mohammadparast, *Oklahoma State University* / Susheng Tan, *University of Pittsburgh* / A. Kaan Kalkan, *Oklahoma State University* / Marimuthu Andiappan, *Oklahoma State University* / Alan Bristow, *West Virginia University*

LW1F.2**Lightwave Control of Topological Properties in 2D Materials for Sub-Cycle and Non-Resonant Valley Manipulation**

Presenter: Alvaro Jimenez-Galan , *Max-Born-Institut*

Using light fields tailored on a sub-cycle timescale to the symmetry of graphene-like materials, we show selective minimization of the bandgap at one of the valleys, introducing a new method for valleytronics and light-induced topology.

Authors: Alvaro Jimenez-Galan, Max-Born-Institut / Rui Silva, Universidad Autonoma de Madrid / Olga Smirnova, Max-Born-Institut / Misha Ivanov, Max-Born-Institut

LW1F.3**Subcycle Nonlinearities of Light-matter Hybrid Modes in the Deep-strong Coupling Regime**

Invited

Presenter: Christoph Lange , *Technische Universität Dortmund*

We investigate novel regimes of cavity quantum electrodynamics by non-perturbative THz excitation or even non-adiabatic femtosecond switch-off of deep-strong light-matter coupling, where the subcycle response reveals previously inaccessible quantum dynamics of strongly squeezed quantum vacua.

Authors: Christoph Lange, Technische Universität Dortmund / Joshua Mornhinweg, Universität Regensburg / Maike Halbhuber, Universität Regensburg / Viola Zeller, Universität Regensburg / Cristiano Ciuti, Université de Paris / Dominique Bougeard, Universität Regensburg / Rupert Huber, Universität Regensburg

FW1A**Tutorial: Incorporating Physics Priors into Machine Learning for Inverse Problems**

Presenter: Xin Yuan , *Westlake University*

FW1A.1**Incorporating Physics Priors into Machine Learning for Inverse Problems**

Tutorial

Presenter: George Barbastathis , *Massachusetts Institute of Technology*

Abstract not available.

Authors:George Barbastathis, *Massachusetts Institute of Technology*

9:30 - 10:00 (UTC - 07:00)

SpE22

Special Event - Tech Talk: Cavity Optomechanical Sensors and the Effect of Noise and Drift on Inertial Sensing

10:00 - 10:45 (UTC - 07:00)

W1A

Plenary Session III

Presenter: Christine Silberhorn , *Universität Paderborn*

W1A.1

Quantum Photonics for Quantum Machine Learning and Secure Computing

Plenary

Presenter: Philip Walther , *University of Vienna*



This talk presents recent experimental demonstrations that use integrated nanophotonic processors for various quantum computations such as quantum machine learning and in particular reinforcement learning, where agents interact with environments by exchanging signals via a communication channel. We show that this exchange allows boosting the learning of the agent. We show that this exchange allows boosting the learning of the agent. Another experiment underlines the feasibility of photonic quantum system for secure quantum computing by enabling homomorphic encryption and probabilistic one-time programs for classical computing. As outlook I will discuss technological challenges for the scale up of photonic quantum computers, and our group's current work for addressing some of those.

Authors: Philip Walther, University of Vienna

10:15 - 11:00 (UTC - 07:00)

JW2A

Visionary Session IV: Jiangying Zhou, Defense Advanced Research Projects Agency, USA

Presenter: Lei Tian , *Boston University*

JW2A.1

Re-thinking Sensing in the Age of AI

Visionary

Presenter: Jiangying Zhou , *Defense Advanced Research Projects Agency*

In this talk I will highlight some of the recent research programs at DARPA exploring the implications of this interplay between AI and sensing design, and discuss some potential new opportunities for research.

Authors: Jiangying Zhou, Defense Advanced Research Projects Agency

11:00 - 11:30 (UTC - 07:00)

SpE8

Special Event - Meet Plenary Speaker Philip Walther

11:00 - 12:00 (UTC - 07:00)

SpE17

Special Event - NonImaging Optical Design Technical Group
Special Talk

SpE23

Special Event - Fiber Modeling and Fabrication Technical
Group Special Talk

Exhibit Hall Event - Dedicated Exhibit Time

11:30 - 13:00 (UTC - 07:00)

W2B

Nonclassical Light Sources and Detectors II

Presenter: Giuseppe Vallone , *Universita degli Studi di Padova***W2B.1****Hierarchy of Quantum non-Gaussian States: Theory and Experiment****Presenter:** Radim Filip , *Palacky University*

The talk will present recent theoretical and experimental activities in optically controlled quantum non-Gaussian states with single-atom and massive atomic systems and their applications in force sensing and thermometry.

Authors:Radim Filip, Palacky University

W2B.2

Nonclassical Phase-Space Correlations in Theory and Experiment

Presenter: Martin Bohmann , *Austrian Academy of Sciences*

We derive phase-space-inequality conditions for the verification of nonclassicality and implement them experimentally. We certify quantum correlations even if the phase-space distributions are nonnegative and demonstrate noise and loss robustness.

Authors:Martin Bohmann, Austrian Academy of Sciences / Nicolas Biagi, Istituto Nazionale di Ottica (CNR-INO) / Jan Sperling, Paderborn University / Alessandro Zavatta, Istituto Nazionale di Ottica (CNR-INO) / Marco Bellini, Istituto Nazionale di Ottica (CNR-INO) / Elizabeth Agudelo, Austrian Academy of Sciences

W2B.3

The Role of Two-Photon Entanglement in Sum-Frequency Generation

Presenter: Sofiane Merkouche , *University of Oregon*

The theory of sum-frequency generation (SFG) as a two-photon measurement process is used to infer the role of two-photon entanglement in this process, and an experimental setup and preliminary data are presented as a way towards quantifying the dependence of SFG on entanglement.

Authors:Sofiane Merkouche, University of Oregon / Amy Soudachanh, University of Oregon / Tiemo Landes, University of Oregon / Markus Allgaier, University of Oregon / Valerian Thiel, University of Oregon / Brian Smith, University of Oregon / Michael Raymer, University of Oregon

W2B.4

Reducing $g^{(2)}(0)$ of a Parametric Down-Conversion Source via Photon-Number Resolution With Superconducting Nanowire Detectors

Presenter: Santiago Sempere-Llagostera , *Imperial College London*



We demonstrate a 13 ± 0.4 % reduction of the second-order correlation function $g^{(2)}(0)$ by harnessing the photon-number resolving capabilities of *commercial* superconducting nanowire single-photon detectors, improving the quality of a heralded single-photon source.

Authors: Santiago Sempere-Llagostera, Imperial College London / Guillaume Thekkadath, Imperial College London / Raj Patel, Imperial College London / Steven Kolthammer, Imperial College London / Ian Walmsley, Imperial College London

W2B.5

Sub-Shot Noise Absorption Measurements Using a Skipper-CCD and Twin-Beams: a Work in Progress

Presenter: Agustina Magnoni , *Laboratorio de Óptica Cuántica, DEILAP UNIDEF (CITEDEF-CONICET)*

We present the work in progress of a proposed scheme for a transmission measurement that combines quantum light with sub-Poissonian statistics with novel Skipper-CCD sensors to obtain a quantum advantage in ultra-low light regimes.

Authors: Agustina Magnoni, Laboratorio de Óptica Cuántica, DEILAP UNIDEF (CITEDEF-CONICET) / Muriel Bonetto, Department of Physics, FCEN, University of Buenos Aires / Javier Tiffenberg, Fermi National Accelerator Laboratory / Juan Estrada, Fermi National Accelerator Laboratory / Miguel Larotonda, Laboratorio de Óptica Cuántica, DEILAP UNIDEF (CITEDEF-CONICET) / Darío Rodrigues, Department of Physics, FCEN, University of Buenos Aires

W2B.6

Steady-State Wigner-Negative Light From a Cavity Coupled to a Driven Multilevel Atom

Presenter: Alexander Elliott , *The University of Auckland*

We investigate temporal modes in continuous output light from a cavity QED system in which a single atom undergoes cavity- and laser-assisted, multistep Raman transitions along a ground hyperfine state. Wigner function negativity is predicted.

Authors: Alexander Elliott, The University of Auckland / Scott Parkins, The University of Auckland

W2A

Precision Measurements and Quantum Metrology II

Presider: Marco Barbieri , *Universita degli Studi Roma Tre*

W2A.1

Probe Incompatibility in Multiparameter Noisy Quantum Channel Estimation

Presenter: Rafal Demkowicz-Dobrzanski , *University of Warsaw*

We derive fundamental bounds on the maximal achievable precision in multiparameter noisy quantum channel estimation, valid under the most general entanglement-assisted adaptive strategy, which are tighter than the bounds obtained by a direct use of single-parameter bounds.

Authors:Rafal Demkowicz-Dobrzanski, University of Warsaw / Francesco Albarelli, University of Warsaw

W2A.2

Efficient Computation of the Nagaoka-Hayashi Bound for Multi-Parameter Estimation With Separable Measurements

Presenter: Lorcan Conlon , *Australian National University*

We introduce a tight bound for quantum metrology for estimating multiple parameters simultaneously when performing separable measurements; relevant for experimental accessibility. We show that this bound can be efficiently computed as a semidefinite program.

Authors:Lorcan Conlon, Australian National University / Jun Suzuki, The University of Electro-Communications / Ping Koy Lam, Australian National University / Syed Assad, Australian National University

W2A.3

Time-Energy Uncertainty Relation for Noisy Quantum Metrology

Presenter: Philippe Faist , *Freie Universität Berlin, Germany*



We derive a fundamental trade-off relating the accuracy loss of a quantum clock due to a noise channel to the information about the energy of the clock that leaks to the environment.

Authors: Philippe Faist, Freie Universität Berlin, Germany / Mischa Woods, ETH Zurich / Victor Albert, NIST / Joseph Renes, ETH Zurich / Jens Eisert, Freie Universität Berlin, Germany / John Preskill, Caltech

W2A.4

(Withdrawn) Quantum-Limited Estimation of Range and Velocity

Presenter: Zixin Huang , *University of Sheffield*

The energy-time uncertainty relation puts a fundamental limit on the lidar precision for estimating an object's range and velocity. We characterise how this tradeoff is relaxed in the presence of entanglement.

Authors: Zixin Huang, University of Sheffield / Cosmo Lupo, University of Sheffield / Pieter Kok, University of Sheffield

W2A.5

Identification of the Cirel'son Bound Using Uncertainty Limited Joint Measurement of Photon Polarization

Presenter: Kengo Matsuyama , *Hiroshima University*

Joint measurements of complementary polarizations are performed on entangled photon pairs, clarifying the relation between measurement uncertainties and quantum non-locality. Extremely low probabilities indicate that the non-local correlations are close to the Cirel'son bound.

Authors: Kengo Matsuyama, Hiroshima University / Holger Hofmann, Hiroshima University / Masataka Inuma, Hiroshima University

W2A.6

Quantum Conformance Test

Presenter: Pauline Boucher , *INRIM*



We introduce a protocol addressing the conformance test problem. We demonstrate theoretically and experimentally that a simple quantum strategy, using available resources and measurement schemes (two-mode squeezed vacuum, photon-counting) can outperform classical strategies.

Authors:Giuseppe Ortolano, INRIM / Pauline Boucher, INRIM / Ivo Pietro Degiovann, INRIM / Elena Losero, Ecole Polytechnique Fédérale de Lausanne / Marco Genovese, INRIM / Ivano Ruo Berchera, INRIM

11:30 - 13:15 (UTC - 07:00)

W2C

Quantum Sensors II

Presenter: Scott Carney , *Optica*

W2C.1

Building Quantum ion Sensors Based on Solid-State Defects in Nanodiamond

Presenter: Changhao Li , *MIT*

In this work we propose and are experimentally demonstrating a novel quantum sensor that can detect alkali metal ions specifically. The technique is based on the charge state conversion of nitrogen-vacancy (NV) centers in nanodiamond.

Authors:Changhao Li, MIT / Lennon Shao-Xiong Luo, MIT / Daniel Kim, MIT / Guoqing Wang, MIT / Paola cappellaro, MIT

W2C.2

Development of a Wide-Field Quantum Diamond Microscope for Imaging Dynamics of Cell Adhesion

Presenter: Feng Xu , *The University of Hong Kong*



A wide-field quantum diamond microscope was established to investigate the dynamics of cell adhesive ligands. The cells deform the ligands labeled with molecular magnets, which could be quantitatively readout through NV spin relaxometry.

Authors:Feng Xu, The University of Hong Kong / Yong Hou, The University of Hong Kong / Shuxiang Zhang, Sichuan University / Zhiqin Chu, The University of Hong Kong

W2C.3

Cross-Validated Optical Thermometry Using Diamond Containing Dual-Defect Centers

Presenter: Madhav Gupta , *The University of Hong Kong*

By measuring ODMR spectrum of NV centers and PL spectrum of SiV centers simultaneously, we demonstrate high-precision optical thermometry using two independent mechanisms cross-validating each other in a diamond sample with dual-defect centers.

Authors:Madhav Gupta, The University of Hong Kong / Zhang Tongtong, The University of Hong Kong / Zhiqin Chu, The University of Hong Kong

W2C.4

Quantum Sensing Enhanced Fiber Optic Sensors

Presenter: Scott Shepard , *University of Missouri*

Quantum sensing techniques can greatly enhance imaging but most of these require nonclassical light sources which are inappropriate for use in an optical fiber. One exception which uses low intensity laser light is explored herein.

Authors:Scott Shepard, University of Missouri

W2C.5

Noisy Magnetometry in Real Time

Presenter: Julia Amoros-Binefa , *Centre for Quantum Optical Technologies, Centre of New Technologies, University of Warsaw*



We study the effect of noise on continuously-monitored atomic sensors for magnetometry of a fluctuating field. We prove that noise disallows the error to follow a super-classical scaling in number of atoms and measurement time.

Authors: Julia Amoros-Binefa, Centre for Quantum Optical Technologies, Centre of New Technologies, University of Warsaw / Jan Kolodynski, Centre for Quantum Optical Technologies, Centre of New Technologies, University of Warsaw

W2C.6

Population Repumping for Enhanced Rydberg Electrometry

Presenter: Nikunj Prajapati , *National Institute of Standards and Technology*

We demonstrate improved sensitivity in Rydberg electrometry using electromagnetically induced transparency with a ground state repumping laser. This doubles the interaction strength while avoiding Doppler or power broadening and improves the sensitivity by nearly 2.

Authors: Nikunj Prajapati, National Institute of Standards and Technology / Amy Robinson, University of Colorado / Samuel Berweger, National Institute of Standards and Technology / Matthew Simons, National Institute of Standards and Technology / Alexandra Artusio-Glimpse, National Institute of Standards and Technology / Christopher Holloway, National Institute of Standards and Technology

W2C.7

Experimental Detection of BPSK Signals With a Qubit Sensor

Presenter: Kevin Schultz , *Johns Hopkins University Applied Physics Laboratory*



We experimentally execute recently developed quantum signal detection protocols and show that they remain effective when applied to real-world communications signals that do not meet the assumptions of the original formulation of the protocol.

Authors: Kevin Schultz, Johns Hopkins University Applied Physics Laboratory / Andrew Murphy, Johns Hopkins University Applied Physics Laboratory / Helena Yoest, Johns Hopkins University Applied Physics Laboratory / Gregory Quiroz, Johns Hopkins University Applied Physics Laboratory / Leigh Norris, Johns Hopkins University Applied Physics Laboratory / Colin Trout, Johns Hopkins University Applied Physics Laboratory / Mayra Amezcua, Johns Hopkins University Applied Physics Laboratory / Brian Tien-Street, Johns Hopkins University Applied Physics Laboratory / Samuel Bibelhauser, Johns Hopkins University Applied Physics Laboratory / Tom Gilliss, Johns Hopkins University Applied Physics Laboratory / Eric Curtis, Johns Hopkins University Applied Physics Laboratory / Christopher Watson, Johns Hopkins University Applied Physics Laboratory / Paraj Titum, Johns Hopkins University Applied Physics Laboratory / Timothy Sweeney, Johns Hopkins University Applied Physics Laboratory

12:00 - 12:30 (UTC - 07:00)

SpE11

Special Event - Tech Talk: The Search for the Optimum Information Rate and Symbol Rate of PS-QAM Systems to Enable Highly Efficient Optical Transmission

12:30 - 13:30 (UTC - 07:00)

JW3A

Plenary Session II: Anne L'Huillier, Lund University, Sweden

President: Richard Averitt, *University of California San Diego*



JW3A.1**From Extreme Nonlinear Optics to Ultrafast Atomic Physics***Plenary***Presenter:** Anne L'Huillier , *Lunds Universitet*

The interaction of atoms with intense laser radiation leads to the generation of high-order harmonics or, equivalently, trains of attosecond pulses. This presentation will describe the physics and performances of these sources and show how attosecond pulses can be used to investigate fast electron dynamics in atomic photoionization.

Authors: Anne L'Huillier, *Lunds Universitet***13:00 - 13:30 (UTC - 07:00)**

SpE9

Special Event - Wednesday Virtual Coffee Break I**13:30 - 15:00 (UTC - 07:00)**

W3A

Quantum Simulation**Presenter:** Ben Lanyon , *University of Queensland***W3A.1****Quantum Chaos and Trotterisation Thresholds in Digital Quantum Simulations***Invited***Presenter:** Nathan Langford , *University of Technology Sydney*

Maximising the power of digital quantum simulators requires careful optimisation of experimental resources. We conclusively demonstrate a direct connection between quantum chaos and the breakdown of Trotterisation exhibiting surprisingly universal behaviour across diverse simulator systems.

Authors: Nathan Langford, University of Technology Sydney

W3A.2

Spectral Density and non Markovianity Measurements via Graph State Simulation

Presenter: Paul Renault, *Laboratoire Kastler Brossel*

Multimode optical parametric processes can be tailored and arranged as complex quantum networks. Here we show experimental results for the simulation of structured environments and the probing of their spectral density and non-Markovianity

Authors: Paul Renault, Laboratoire Kastler Brossel / Johannes Nokkala, Turku Center for Quantum Physics / Nicolas Treps, Laboratoire Kastler Brossel / Jyrki Piilo, Turku Center for Quantum Physics / Valentina Parigi, Laboratoire Kastler Brossel

W3A.3

Holographic Dynamics Simulations With a Trapped Ion Quantum Computer

Presenter: Eli Chertkov, *Honeywell Quantum Solutions*

Using a trapped ion quantum computer, we experimentally demonstrate a tensor-network-based algorithm that simulates the dynamics of infinite-size quantum systems by re-using qubits in the middle of the calculation.

Authors: Eli Chertkov, Honeywell Quantum Solutions / Justin Bohnet, Honeywell Quantum Solutions / David Francois, Honeywell Quantum Solutions / John Gaebler, Honeywell Quantum Solutions / Dan Gresh, Honeywell Quantum Solutions / Aaron Hankin, Honeywell Quantum Solutions / Kenny Lee, Honeywell Quantum Solutions / David Hayes, Honeywell Quantum Solutions / Brian Neyenhuis, Honeywell Quantum Solutions / Russell Stutz, Honeywell Quantum Solutions / Andrew Potter, University of Texas at Austin / Michael Foss-Feig, Honeywell Quantum Solutions

W3A.4

Simulation of Quantum Jump in Three-Level Atoms Using Photons

Presenter: Sebastiao de Padua, *Universidade Federal de Minas Gerais*

We simulate experimentally a three-level system (cascade, Λ , V) under quantum jump using a three-mode photonic system. A spatial light modulator is programmed for implementing the Kraus operators for quantum jumps.

Authors: Sebastiao de Padua, Universidade Federal de Minas Gerais / Arthur Cardoso, Universidade Federal de Minas Gerais / João Condé, Universidade Federal de Minas Gerais / Breno Marques, Universidade Federal do ABC / Jader Cabral, Universidade Federal de Uberlândia

W3A.5

The Coherent Dynamics of Coupled Non-Degenerate Parametric Oscillators

Presenter: Shay Ben Ami , Bar Ilan University

We explore experimentally synchronization and persistent beating dynamics in coupled non-degenerate parametric oscillators. We demonstrate that synchronization is completely prevented due to mode competition, which is unique to non-degenerate oscillators.

Authors: Shay Ben Ami, Bar Ilan University / Igal Aharonovich, Bar Ilan University / Avi Pe'er, Bar Ilan University

W3B

Quantum Communication III

Presenter: Luis Sanchez-Soto , Universidad Complutense de Madrid

W3B.1

Security Assessment of Quantum Networks

Invited

Presenter: Xiongfeng Ma , Tsinghua University

I shall introduce the recent exciting development on quantum networks, including the 46-node Hefei network, Beijing-Shanghai backbone, and intercontinental link. We design a routing scheme and delayed privacy amplification to reduce the trustworthiness requirement on the intermediate relays.

Authors: Xiongfeng Ma, Tsinghua University

W3B.2**Cost and Routing of Continuous Variable Quantum Networks**

Presenter: Federico Centrone , *Sorbonne University*

We investigate the capabilities provided by highly multimode entangled quantum systems with arbitrary shapes, evaluate the cost of their experimental realization and devise an entanglement routing protocol to allow quantum communications between arbitrary nodes.

Authors:Federico Centrone, Sorbonne University / Frederic Grosshans, Sorbonne University / Valentina Parigi, Sorbonne University

W3B.3**Security Analysis of Continuous-Variable Quantum key Distribution Using m-PSK Classical Modulation Schemes**

Presenter: Yupeng Gong , *University of Cambridge*

We theoretically prove the security of using classical m-psk modulation protocol for the transmission of continuous-variable quantum key distribution and discuss the performance of classical digital communication protocols for CVQKD

Authors:Yupeng Gong, University of Cambridge / Anran Jin, University of Cambridge / He Li, University of Cambridge / Adrian Wonfor, University of Cambridge / Richard Penty, University of Cambridge

W3B.4**Quantum-Enabled Communication Without a Phase Reference**

Presenter: Quntao Zhuang , *University of Arizona*

A phase reference has been a standard requirement in quantum sensing and communication protocols. We show that quantum communication and entanglement-assisted communication without a phase reference are possible, when a short-time memory effect is present.

Authors:Quntao Zhuang, University of Arizona

W3B.5**Benchmarking a Quantum Random Number Generator With Machine Learning**

Presenter: Jing Yan Haw , *National University of Singapore*



We develop a predictive machine learning (ML) analysis to examine the uniformity and unpredictability aspects of a random number generator. We show that our tool is capable of uncovering hidden correlations and experimental imperfections.

Authors:Jing Yan Haw, National University of Singapore / Nhan Duy Truong, The University of Sydney / Hong Jie Ng, National University of Singapore / Raymond Ho, National University of Singapore / Syed Assad, The Australian National University / Chao Wang, National University of Singapore / Ping Koy Lam, The Australian National University / omid Kavehei, The University of Sydney

14:00 - 14:30 (UTC - 07:00)

SpE25

Special Event - Women at FIO Coffee Break

14:30 - 15:15 (UTC - 07:00)

JW4A

Visionary Session V: Ana Maria Rey, University of Colorado at Boulder, USA

Presider: Steven Cundiff , *University of Michigan*

JW4A.1

Building with Crystals of Light and Quantum Matter: From Clocks to Quantum Computers

Visionary

Presenter: Ana Maria Rey , *University of Colorado at Boulder JILA*



I will present recent developments using alkaline-earth atoms, the basis of the most precise atomic clocks, for the investigation of many-body phenomena and magnetism.

Authors: Ana Maria Rey, University of Colorado at Boulder JILA

15:00 - 15:30 (UTC - 07:00)

SpE10

Special Event - Wednesday Virtual Coffee Break II

15:30 - 17:00 (UTC - 07:00)

FW5C

Complex Light II

Presenter: Amina Hussein , *University of Alberta*

FW5C.1

Experimental Generation of Near-Diffraction-Free OAM Pulses Having a Controllable Group Velocity from $1.0069c$ - $0.9933c$ by Coherently Combining Different Beams of Multiple Correlated Bessel Modes and Frequencies

Presenter: Kai Pang , *University of Southern California*



We experimentally demonstrate the generation of near-diffraction-free OAM +1 and +3 pulses having a controllable group velocity from $1.0069c$ - $0.9933c$. The diffraction of such OAM pulses and the effects of transmitter aperture size are also explored.

Authors:Kai Pang, University of Southern California / Kaiheng Zou, University of Southern California / Hao Song, University of Southern California / Maxim Karpov, École Polytechnique Fédérale de Lausanne / Murat Yessenov, University of Central Florida / Zhe Zhao, University of Southern California / Amir Minoofar, University of Southern California / Runzhou Zhang, University of Southern California / Haoqian Song, University of Southern California / Huibin Zhou, University of Southern California / Xinzhou Su, University of Southern California / Nanzhe Hu, University of Southern California / Tobias Kippenberg, École Polytechnique Fédérale de Lausanne / Ayman Abouraddy, University of Central Florida / Moshe Tur, Tel Aviv University / Alan Willner, University of Southern California

FW5C.2

Conservation of Spatiotemporal Orbital Angular Momentum of Light in Nonlinear Frequency Conversion

Presenter: Guan Gui , *University of Colorado*

The conservation of spatiotemporal orbital angular momentum (ST-OAM) of light is observed in second-harmonic generation for the first time. The space-time topological charge of the fundamental ST-OAM field is doubled along with the optical frequency.

Authors:Guan Gui, University of Colorado / Nathan Brooks, University of Colorado / Margaret Murnane, University of Colorado / Henry Kapteyn, University of Colorado / Chen-Ting Liao, University of Colorado

FW5C.3

Higher-Order Fractal Laser Modes in Fabry-Pérot Resonators Containing Microspheres

Presenter: Austin Steinforth , *University of Illinois*

Higher-order fractal modes of laser resonators are demonstrated experimentally for the first time. Simulations characterize the fractal behavior of the lowest-loss and higher-order modes of these Fabry-Pérot cavities containing microsphere arrays.

Authors:Austin Steinforth, University of Illinois / Gary Eden, University of Illinois

FW5C.4

(Withdrawn) From Orbital Angular Momentum to Speckle Light Field

Presenter: Juan Staforelli , *Universidad de Concepcion*

A Laguerre gaussian beam is propagated through different samples with variable optical densities. Partial component of helical wave-front produce speckles. Simulation and analysis show that the orbital angular momentum (OAM) does not vanish entirely.

Authors: Igor Meglinsky, Aston University / Alexander Doronin, Victoria University of Wellington / Nicolas Vera, Universidad de Concepcion / Tatiana Novikova, Institut Polytechnique de Paris / Juan Staforelli, Universidad de Concepcion

FW5C.5

Experimental Generation of OAM +1 and +3 Spatiotemporal Beams with a Time-Dependent Beam Radius of ~0.24-to~0.68 mm Using a Coherent Combination of Multiple Frequencies Each Containing Multiple LG Modes

Presenter: Kaiheng Zou , *University of Southern California*

We experimentally generate OAM +1 and +3 spatiotemporal beams with a time-dependent beam radius oscillating from ~0.24 to ~0.68 mm. The measured OAM modal purity of the generated beam is >~64%.

Authors: Kaiheng Zou, University of Southern California / Kai Pang, University of Southern California / Amir Minoofar, University of Southern California / Hao Song, University of Southern California / Maxim Karpov, École Polytechnique Fédérale de Lausanne / Murat Yessenov, University of Central Florida / Zhe Zhao, University of Southern California / Xinzhou Su, University of Southern California / Huibin Zhou, University of Southern California / Runzhou Zhang, University of Southern California / Haoqian Song, University of Southern California / Nanzhe Hu, University of Southern California / Tobias Kippenberg, École Polytechnique Fédérale de Lausanne / Ayman Abouraddy, University of Central Florida / Moshe Tur, Tel Aviv University / Alan Willner, University of Southern California

FW5C.6

Coherent and incoherent contribution of population dynamics of semiconductor exciton-polaritons

Presenter: Jagannath Paul , *National Institute of Standards and Technology*



Population/mixing-time-dependent two-dimensional coherent spectra are presented for exciton-polaritons in a microcavity. Theory based on dynamically-controlled truncation reveals coherent and incoherent contributions to the decay dynamics.

Authors:Jagannath Paul, National Institute of Standards and Technology / Hendrik Rose, Paderborn University / Jared Wahlstrand, National Institute of Standards and Technology / Torsten Meier, Paderborn University / Alan Bristow, West Virginia University

FW5D

Novel Fiber Optics Devices and Components

Presenter: Lyuba Kuznetsova , *San Diego State University*

FW5D.1

Advanced Digital Formats for Directly Modulated Lasers Beyond 200 Gb/s

Invited

Presenter: Di Che , *Nokia Bell Labs*

We review our recent research on the 200G directly modulated laser (DML) applicable to the next-gen 800GbE, and share our consideration on the advanced digital formats suitable for future high-speed intensity modulations.

Authors:Di Che, Nokia Bell Labs

FW5D.2

Large Extinction (> 70 dB) RF Notch filter Using Low Brillouin Loss (< 20 dB) With Single Sideband Modulation

Presenter: VARUN K , *Indian Institute of Science Education and Research*

Thiruvananthapuram, Indian Institute of Science Education and Research

Thiruvananthapuram, Thiruvananthapuram, Kerala, IN, academic

We present a RF notch filter with >70 dB extinction using single sideband modulation and a small Brillouin loss of <20 dB. A resolution study also performed to demonstrate the effectiveness of the filter.

Authors:VARUN K, Indian Institute of Science Education and Research Thiruvananthapuram, Indian Institute of Science Education and Research Thiruvananthapuram, Thiruvananthapuram, Kerala, IN, academic / Ravi Pant, Indian Institute of Science Education and Research Thiruvananthapuram, Indian Institute of Science Education and Research Thiruvananthapuram, Thiruvananthapuram, Kerala, IN, academic

FW5D.3

Feedback Control Circuit Implementation in a Fiber Loop SOA-Optical Frequency Comb Generator

Presenter: Danierick Vinicius Nascimento , UNICAMP

A feedback control circuit was designed for amplitude and phase stabilization in a SOA-based recirculating fiber loop optical frequency comb generator. Amplitude and wavelength stabilities were achieved for an OFCG with increased comb line number.

Authors:Danierick Vinicius Nascimento, UNICAMP / Aldário Bordonalli, UNICAMP

FW5D.4

Demonstration of an Orbital Angular Momentum Multiplexer for Ring Core Fiber

Presenter: Bilas Chowdhury , University of Maryland

We report the design, fabrication, and measurement of a crossed-fork Dammann grating that can spatially multiplex modes from 10 fibers into separate, high topological charge OAM modes of a ring-core fiber.

Authors:Bilas Chowdhury, University of Maryland / Thomas Murphy, University of Maryland / Kenneth Ritter, Laboratory for Physical Sciences

FW5D.5

Efficient Holographic Excitation of Modes in Hollow-Core Photonic Crystal Fibre

Presenter: Ralf Mouthaan , University of Cambridge



We present a rigorous method for the efficient holographic excitation of high-purity modes in arbitrary geometry waveguides. The technique is demonstrated using a simplified antiresonant hollow-core photonic crystal fibre.

Authors:Ralf Mouthaan, University of Cambridge / Peter Christopher, University of Cambridge / Michael Frosz, Max Planck Institute for the Science of Light / George Gordon, University of Nottingham / Timothy Wilkinson, University of Cambridge / Tijmen Euser, University of Cambridge

FW5E

Neuromorphic Photonics

Presenter: Sudip Shekhar , *University of British Columbia*

FW5E.1

Spiking Neuron in a Photonic Integrated Circuit

Invited

Presenter: Hsuan-Tung Peng , *Princeton University*

Photonic spiking neurons represent an important class of optical computing. We have fabricated a laser neuron that uses excitable laser dynamics to achieve biologically-inspired spiking behavior, and demonstrated its compatibility for larger scale system integration.

Authors:Hsuan-Tung Peng, Princeton University / Thomas Ferreira de Lima, Princeton University / Mitchell Nahmias, Luminous Computing / Alexander Tait, Queen's University / Chaoran Huang, The Chinese University of Hong Kong / Bhavin Shastri, Queen's University

FW5E.2

Phase-Retrieval Coherent Detection with On-Chip Photonic Linear Processing

Presenter: Mitsumasa Nakajima , *NTT Corp.*



We propose phase-retrieval coherent detection with hybrid optical and digital signal processing. By using an on-chip photonic convolutional processor and digital postprocessing, 20-GBaud QPSK signals were recovered from intensity-only measurement.

Authors: Mitsumasa Nakajima, NTT Corp. / Toshikazu Hashimoto, NTT Corp.

FW5E.3

Universal Optics with Programmable Multimode Interference

Presenter: Hugo Larocque , *Massachusetts Institute of Technology*

We show that multimode interference programmable optics benefit from the simple algorithmic construction and length scaling of state-of-the-art programmable photonic circuits, while featuring orders of magnitude reductions in width and losses.

Authors: Hugo Larocque, Massachusetts Institute of Technology / Dirk Englund, Massachusetts Institute of Technology

FW5B

Information Acquisition and Processing

Presenter: Partha Banerjee , *University of Dayton*

FW5B.1

The Power of Label Free Holographic 3D Imaging in Flow-cytometry

Invited

Presenter: Pietro Ferraro , *Institute of Intelligent Systems CNR*

Coherent-light microscopy based on label-free holographic imaging has opened an extraordinary avenue in life-science through 3D quantitative phase-contrast-tomography. The vast opportunities offered by in-flow 3D tomographic imaging and measurement at single-cell-level are presented and discussed.

Authors: Pietro Ferraro, Institute of Intelligent Systems CNR

FW5B.2

Robust Dual Polarization Encryption Scheme based on a Tailored Pixelated Polarizer

Presenter: Marwan Dhiya Eddine Chachoua , *Université 8 mai 1945 Guelma*

We propose a Tailored DPES based on a tailored pixelated polarizer to encrypt target images into a predefined uniformly distributed noisy image. Relying on Mueller-Stokes formalism, it provides more robustness and flexibility than DPES

Authors:Marwan Dhiya Eddine Chachoua, Université 8 mai 1945 Guelma / Rachid Hamdi, Université 8 mai 1945 Guelma / Ayman Alfalou, L@bISEN / Abderezzaq halassi, Université 8 mai 1945 Guelma

FW5B.3

Analysis of the Reconstructed Images of Light-in-flight Recording by Holographic Microscopy when Recording Condition is Changed

Presenter: Tomoyoshi Inoue , *Kyoto Institute of Technology*

We investigated reconstructed images of light-in-flight recording by holographic microscopy when recording conditions are changed. As the conditions, we focused on incident angle of the reference light pulse and that of the object light pulse.

Authors:Tomoyoshi Inoue, Kyoto Institute of Technology / Mika Sasaki, Kyoto Institute of Technology / Kenzo Nishio, Kyoto Institute of Technology / Toshihiro Kubota, Kubota Holography Laboratory Corporation / Yasuhiro Awatsuji, Kyoto Institute of Technology

FW5B.4

Information Processing Capacity of Diffractive Optical Processors

Presenter: Onur Kulce , *University of California Los Angeles*

We show that the input-output transformation capacity of diffractive processors increases linearly with the number of their diffractive features and is upper-bounded by the areas of the input and output fields-of-view

Authors:Onur Kulce, University of California Los Angeles / Deniz Mengu, University of California Los Angeles / Yair Rivenson, University of California Los Angeles / Aydogan Ozcan, University of California Los Angeles

FW5B.5

Shift Invariant Correlation using the Hybrid Optoelectronic Correlator with a PQ:PMMA Holographic Memory Device

Presenter: Julian Gamboa , *Northwestern University*



We demonstrate the incorporation of a PQ:PMMA holographic memory device into the hybrid optoelectronic correlator architecture. This will serve as a high-speed optical storage medium, allowing us to improve the correlation speed.

Authors: Julian Gamboa, Northwestern University / Tabassom Hamidfar, Northwestern University / Selim Shahriar, Northwestern University

LW5F

Quantum Science II

Presenter: Sophia Economou , *Virginia Tech*

LW5F.1

Bright Single-Photon Emitting Diodes Based on the Silicon-Vacancy Center in AlN/Diamond Heterostructures

Presenter: Dmitry Fedyanin , *Moscow Institute of Physics and Technology*

We propose and numerically demonstrate a concept of a single-photon emitting diode based on a color center in a nanoscale AlN/diamond heterojunction device, which gives the possibility to generate up to 4×10^7 photons per second at room temperature.

Authors: Igor Khramtsov, Moscow Institute of Physics and Technology / Dmitry Fedyanin, Moscow Institute of Physics and Technology

LW5F.2

Spin Coherence and Control of Shallow Donors in Bulk ZnO and Single ZnO Nanowires

Invited

Presenter: Kai-Mei Fu , *University of Washington*

In direct band-gap semiconductors, the donor-bound exciton links the donor electron spin and photon. Here we demonstrate high optical homogeneity and coherent population trapping of donor spins in bulk and single ZnO nanowires.

Authors: Kai-Mei Fu, University of Washington

LW5F.3

Genuine High-Dimensional Quantum Steering

Presenter: Vatshal Srivastav , *Heriot-Watt University*



We theoretically formalise and experimentally demonstrate a notion of genuine high-dimensional quantum nonlocal steering. We demonstrate steering with a record local dimension of 15 in a 31-dimensional space.

Authors: Vatshal Srivastav, Heriot-Watt University / Natalia Valencia, Heriot-Watt University / Will McCutcheon, Heriot-Watt University / Sébastien Designolle, University of Geneva / Roope Uola, University of Geneva / Nicolas Brunner, University of Geneva / Mehul Malik, Heriot-Watt University

LW5F.4

Advances in Trapped Ion Quantum Computing

Invited

Presenter: Jungsang Kim , *IonQ Inc*

In this talk, I will discuss the advances in commercial quantum computing enabled by trapped ion technology, and the technological prospect of scaling the performance of these systems for commercially viable applications.

Authors: Jungsang Kim, *IonQ Inc*

FW5A

Optical Computing in Machine Learning

Presenter: Achuta Kadambi , *University of California Los Angeles*

FW5A.1

Optical Computing in Synthetic Dimensions

Invited

Presenter: Shanhui Fan , *Stanford University*

Abstract not available.

Authors: Shanhui Fan, *Stanford University*

FW5A.2

Optical Firewall for Defending Deep Neural Networks from Adversarial Attacks

Invited



Presenter: Adrian Stern , *Ben Gurion University of the Negev*

We overview approaches that we have recently introduced that employ optical encrypted acquisition to defend against adversarial attacks on deep learning algorithms.

Authors:Adrian Stern, Ben Gurion University of the Negev / Vladislav Kravets, Ben Gurion University of the Negev / Bahram Javidi, University of Connecticut

FW5A.3

Novel Deep Learning Techniques for Photonics

Invited

Presenter: Marin Soljacic , *Massachusetts Institute of Technology*

We present a few novel deep learning techniques for applications in photonics. Of particular interest are few-shot techniques which minimize the amount of needed training data.

Authors:Marin Soljacic, Massachusetts Institute of Technology

17:00 - 17:30 (UTC - 07:00)

SpE13

Special Event - Tech Talk: Interactive Generation of Full Color 4K Image Hologram

17:30 - 19:00 (UTC - 07:00)

FW6B

Advanced SiN Photonics

Presenter: Chris Poulton , *Analog Photonics*



FW6B.1**Heterogeneous integration with SiN_x***Invited***Presenter:** Amy Foster , *Johns Hopkins University*

Exploiting the heterogeneous multilayer SiN_x/a-Si:H platform, high nonlinearity a-Si:H microring resonators and waveguides are tightly integrated with low-loss SiN_x waveguides and filters for applications including wavelength converters and quantum sources.

Authors:Amy Foster, Johns Hopkins University**FW6B.2****Low Loss, Low Power, Silicon Nitride PZT Stress-optic Microresonator Modulator for Control Functions****Presenter:** Jiawei Wang , *University of California Santa Barbara*

We demonstrate a PZT Si₃N₄ ring-modulator with 0.03 dB/cm loss, 7.1 million Q and 20 nW power consumption. For feedback control, ER = 14 dB, $\sqrt{\pi}\alpha = 1.3$ VdB, 1.6 pm/V tuning, DC-20 MHz bandwidth is measured.

Authors:Jiawei Wang, University of California Santa Barbara / Qiancheng Zhao, University of California Santa Barbara / Ryan Rudy, U.S. Army Research Laboratory / Daniel Blumenthal, University of California Santa Barbara**FW6B.3****High-Speed, Cryogenically Compatible, and Visible-Wavelength Photonic Circuits in a 200 mm CMOS Architecture****Presenter:** Mark Dong , *The MITRE Corporation*

We introduce a 200 mm CMOS-compatible integrated photonics platform that uses aluminum nitride piezo-actuators coupled to silicon nitride waveguides, enabling strain-based phase modulation rates greater than 100 MHz in the visible-NIR wavelengths.

Authors:Mark Dong, The MITRE Corporation / Genevieve Clark, The MITRE Corporation / Andrew Leenheer, Sandia National Laboratories / Matthew Zimmermann, The MITRE Corporation / Daniel Dominguez, Sandia National Laboratories / Adrian Menssen, MIT / David Heim, The MITRE Corporation / Gerald Gilbert, The MITRE Corporation / Dirk Englund, MIT / Matt Eichenfield, Sandia National Laboratories

FW6B.4**8x8 Programmable Many-mode Interferometer Operating with Visible-wavelength Piezo-Cantilever Modulators**

Presenter: Mark Dong , *The MITRE Corporation*

We report a visible-wavelength, programmable 8x8 many-mode interferometer based on silicon nitride waveguides and piezo-cantilever optical phase-shifters with sub 1- μ s response times to address applications in photonics and quantum technologies.

Authors:Mark Dong, The MITRE Corporation / Andrew Leenheer, Sandia National Laboratories / Matthew Zimmermann, The MITRE Corporation / Genevieve Clark, The MITRE Corporation / David Heim, The MITRE Corporation / Daniel Dominguez, Sandia National Laboratories / Gerald Gilbert, The MITRE Corporation / Dirk Englund, MIT / Matt Eichenfield, Sandia National Laboratories

FW6B.5**III-V Photodiode Illumination with Bi-layer Silicon Nitride Grating Coupler**

Presenter: Peichuan Yin , *Rochester Institute of Technology*

We present a III-V detector illuminated with a bi-layer silicon nitride grating coupler. A responsivity of 0.233 A/W was obtained, corresponding to a measured fiber-to-detector efficiency of 40%.

Authors:Peichuan Yin, Rochester Institute of Technology / Victoria Carey, Phase Sensitive Innovations / Timothy Creazzo, Phase Sensitive Innovations / Peng Yao, Phase Sensitive Innovations / Dennis Prather, Phase Sensitive Innovations / Stefan Preble, Rochester Institute of Technology

FW6A**Machine Learning for Extreme Measurements**

Presenter: Luat Vuong , *University of California at Riverside*

FW6A.1**Denosing as a Building Block: Theory and Applications**

Invited

Presenter: Peyman Milanfar , *Google Research*

Abstract not available.

Authors: Peyman Milanfar, Google Research

FW6A.2

Beyond the First Portrait of a Black Hole

Invited

Presenter: Katie Bouman , *California Institute of Technology*

This talk will discuss how we are building upon recent advances in ML to achieve more efficient uncertainty quantification as well as to develop techniques to extract the evolving structure of a black hole.

Authors: Katie Bouman, California Institute of Technology

FW6A.3

Advancing Photonic Design and Quantum Measurements with Machine Learning

Invited

Presenter: Alexandra Boltasseva , *Purdue University*

In this talk, photonic design approaches will be discussed showcasing machine-learning-assisted topology optimization for thermophotovoltaic metasurface designs and machine-learning-enabled quantum optical measurements.

Authors: Alexandra Boltasseva, Purdue University

19:00 - 20:00 (UTC - 07:00)

JW7A

Joint Poster Session II

JW7A.1



Angular Coding Evaluation for Pixelated Holographic Near-Eye Display

Presenter: Christophe Martinez , *CEA Leti*

We describe our first results on the angular coding of images in pixelated holograms for potential retinal projection devices. We present the set-ups used to record and recover the holograms together with first coding strategies.

Authors: Christophe Martinez, CEA Leti / Matthias Colard, CEA Leti / gentet Marie-Claude, CEA Leti / Yann Lee, CEA Leti / Paul Legentil, CEA Leti / Sylvia Meunier-Della-Gatta, CEA Leti

JW7A.2

High-Q Floquet Defect Mode Resonance in a Microring Floquet Topological Insulator

Presenter: Shirin Afzal , *University of Alberta*

We report a new defect-mode resonance phenomenon in a Floquet topological insulator by tuning the cyclic phase of a Floquet bulk mode. The resonance is cavity-less, tunable and can be formed anywhere in the bulk.

Authors: Shirin Afzal, University of Alberta / Vien Van, University of Alberta

JW7A.3

Experimental Observation of Self-Focusing in Ferrofluid-Based Hyperbolic Metamaterials

Presenter: Vera Smolyaninova , *Towson University*

We report experimental observation of the self-focusing effect in ferrofluid-based self-assembled hyperbolic metamaterials, which is predicted to exhibit gravity-like nonlinear optical interactions.

Authors: Vera Smolyaninova, Towson University / Jonathon Cartelli, Towson University / Bryan Augstein, Towson University / Stephanie Spickard, Towson University / Mary Devadas, Towson University / Igor Smolyaninov, University of Maryland

JW7A.4

DLCNN: A High-Resolution Computer-Generated Hologram Technology Based on Deep Learning

Presenter: Xinwei Wang , *College of Science, China University of Petroleum (East China)*

We proposed a new network structure *DLCNN* for optical image reconstruction. And applying this structure to the computationally generated holographic problem. This method can obtain higher quality image reconstruction accuracy.

Authors:Xianfeng Xu, College of Science, China University of Petroleum (East China) / Xinwei Wang, College of Science, China University of Petroleum (East China) / Tianyu Ma, College of Science, China University of Petroleum (East China)

JW7A.5

Dynamic Speckle Metrology with Normalized Processing of Compressed Data

Presenter: Elena Stoykova , *Institute of Optical Materials and Technologies - Bulgarian Academy of Sciences*

Monitoring of processes by dynamic speckle needs storage of speckle images, and data compression becomes mandatory. For images with spatially varying speckle statistics, normalized processing is applied. We proved its feasibility for compressed data.

Authors:Elena Stoykova, Institute of Optical Materials and Technologies - Bulgarian Academy of Sciences / Dimana Nazarova, Institute of Optical Materials and Technologies - Bulgarian Academy of Sciences / Lian Nedelchev, Institute of Optical Materials and Technologies - Bulgarian Academy of Sciences / Branimir Ivanov, Institute of Optical Materials and Technologies - Bulgarian Academy of Sciences / Alexander Machikhin, Scientific and Technological Center of Unique Instrumentation

JW7A.6

Suppression of the Transfer Efficiency for a Noisy Path-Entangled Single Photon in the LH1-RC Unit

Presenter: Ethan Wyke , *University of the West Indies*

The transfer efficiency of the LH1-RC is determined for an incident path-entangled photon with dephasing noise. We have found transfer efficiency suppression due to dephasing noise and the phase difference between the entangled photon states.

Authors:Ethan Wyke, University of the West Indies / Abunameh Aiyejina, University of the West Indies / Roger Andrews, University of the West Indies

JW7A.7

Super-resolution of two unbalanced sources

Presenter: Xiao-Feng Qian , *Stevens Institute of Technology*

Estimation of arbitrary separations between two unbalanced point sources is studied by including the spatial property's entangled partner. Super-resolution is shown to be achievable with high accuracy through finite values of Fisher information.

Authors: Abdelali Sajia, Stevens Institute of Technology / Xiao-Feng Qian, Stevens Institute of Technology

JW7A.8

Learning framework for unsupervised cellular refractive index and thickness measurement

Presenter: Maxim Makarenko , *KAUST*

In this work, we develop a framework to experimentally extract thickness and refractive index maps from biological cells using AI-driven inverse search from RGB photographs.

Authors: Maxim Makarenko, KAUST / Arturo Burguete-Lopez, KAUST / Fedor Getman, KAUST / Andrea Fratalocchi, KAUST

JW7A.9

One-dimensional Space-time Vector Light Sheet

Presenter: Mbaye Diouf , *Brown University*

We experimentally demonstrate classically, double entangled, space-time vector beams. These beams exhibit in-parallel correlation between two degrees of freedom, namely, spatial-temporal frequency and polarization-space.

Authors: Mbaye Diouf, Brown University / Mitchell Harling, Brown University / Murat Yessenov, University of Central Florida / Ayman Abouraddy, University of Central Florida / Kimani Toussaint, Jr., Brown University

JW7A.10

Detecting Breast Tumor by Photoacoustic Spectroscopy Integrated Machine Learning: A Comparison of Statistical and Algorithm Based Features

Presenter: JACKSON RODRIGUES , *Manipal School of Life Sciences*



We compared the performance of feature selection over feature extraction on wavelet packet decomposed photoacoustic spectra belonging to control and different time-points of breast tumor progression *ex vivo*, in machine learning based classification.

Authors:JACKSON RODRIGUES, Manipal School of Life Sciences / Ashwini Amin, Manipal Institute of Technology / Subhash Chandra, Manipal School of Life Sciences / Subramanya Nayak, Manipal Institute of Technology / Satadru Ray, Kasturba Medical College / Satyamoorthy K, Manipal School of Life Sciences / Krishna Mahato, Manipal School of Life Sciences

JW7A.11

Motion-insensitive Lossy-mode-resonances Optical Fiber Sensor for Relative Humidity and Moisture Contents

Presenter: Mucheng Li , *Worcester Polytechnic Insititute*

A moisture sensor was developed based on lossy-mode resonances and polarization-maintaining optical fibers. Due to the motion insensitivity, the sensor has a high potential for RH and moisture contents measurements in various industrial applications.

Authors:Mucheng Li, Worcester Polytechnic Insititute / Mackenzie Damon, Worcester Polytechnic Insititute / Yuxiang Liu, Worcester Polytechnic Insititute

JW7A.12

Optical fiber strain sensor for real-time food deformation measurements in drying

Presenter: Hamed Jafarishad , *Worcester Polytechnic Institute*

An optical fiber strain sensor was developed for food samples. We demonstrated up to 20% strain measurements of fresh banana slices during drying. The sensor can help understand the deformation of foods and biomedical samples.

Authors:Hamed Jafarishad, Worcester Polytechnic Institute / Mucheng Li, Worcester Polytechnic Institute / Yuxiang Liu, Worcester Polytechnic Institute

JW7A.13

Ultra-high Reflectivity Photonic Crystal Reflectors for Cavity Optomechanics

Presenter: Feng Zhou , *National Institute of Standards and Thechnology*



We demonstrate a silicon nitride membrane incorporating two-dimensional photonic crystal structure. A Fabry-Perot (FP) cavity with a finesse as high as 26500 is constructed using the photonic crystal mirror.

Authors:Feng Zhou, National Institute of Standards and Thechnology

JW7A.15

Low power thresholds of sideband generation in the high-finesse χ^2 resonators with a large walk-off

Presenter: Danila Puzyrev , *University Of Bath*

We report the nano-watt thresholds of the sideband generation in the χ^2 microresonators. The practical and hence large difference of the repetition rates, i.e., walk-off parameter, between the pump and harmonic plays a pivotal role in our results.

Authors:Danila Puzyrev, University Of Bath / Vladislav Pankratov, University Of Bath / Dmitry Skryabin, University Of Bath

JW7A.16

Demonstration of Plasmonic Multilayer Coating for Passive Heating

Presenter: Muhammad Asad , *Queen's University*

We investigated planar multilayer architecture for design of transparent solar energy harvesting coatings for passive heating applications. The coating increased surface temperature by 7°C and demonstrated maximum visible transparency of 32.5%.

Authors:Muhammad Asad, Queen's University / Muhammad Alam, Queen's University

JW7A.17

Angle dependent optical performance of light trapping metallic electrodes

Presenter: Mengdi Sun , *University of Central Florida*

The angle response of triangular transparent electrodes was investigated. We found that higher index improves light trapping at all angles. Up to 85% shadowing loss reduction is achieved over a large angular range of 120°.

Authors:Mengdi Sun, University of Central Florida / Pieter Kik, University of Central Florida

JW7A.18

Spatial Coherence Measurement via Spatiotemporal Light Modulation Using a Digital Micromirror Device

Presenter: Tomohiro Shirai , *National Institute of Advanced Industrial Science and Technology (AIST)*

A method is proposed for spatial coherence measurement by means of temporal modulation of a double slit on a digital micromirror device. Some advantageous features including immunity to background light are shown theoretically and experimentally.

Authors: Tomohiro Shirai, National Institute of Advanced Industrial Science and Technology (AIST) / Ari Friberg, University of Eastern Finland

JW7A.19

U-net Based Isotropic Phase Retrieval with Quantitative Differential Phase contrast Microscopy

Presenter: Ying-Ju Chen , *Biomedical Engineering*

IDPC imaging with a half-circle pupil faces the problem of multiple measurements for isotropic phase. Deep learning method is applied to deal with the slow data acquisition process and generate accurate phases from the least number of measurements.

Authors: ANCIN LI, Medical Device and Imaging / Ying-Ju Chen, Biomedical Engineering / Hsuan-Ming Huang, Medical Device and Imaging / Yuan Luo, Medical Device and Imaging

JW7A.20

The Effects of Detector Efficiency when Heralding on the Detection of Zero Photons

Presenter: Cory Nunn , *UMBC*

Reliable detection of zero photons is important for quantum information applications but presents unique experimental challenges. We demonstrate the role of detector efficiency when "heralding on zero" using a modified Hong-Ou-Mandel interferometer.

Authors: Cory Nunn, UMBC / James Franson, UMBC / Todd Pittman, UMBC

JW7A.21

Fabrication of graphene oxide conformally coated fiber Bragg grating

Presenter: Wenbo Liu , *Swinburne university of technology*

We demonstrate the fabrication of graphene oxide coated fiber Bragg grating for potential applications. The fabrication technique involves the femtosecond laser fabrication of FBG and layer-by-layer conformal coating of the graphene oxide materials.

Authors:Wenbo Liu, Swinburne university of technology / Han Lin, Swinburne university of technology / Tao Yao, Swinburne university of technology / Jinchuan zheng, Swinburne university of technology / baohua Jia, Swinburne university of technology

JW7A.22

The Influence of Membrane Thickness on the Dynamic Response of Liquid Lens

Presenter: Lihui Wang , *GIDIT*

Liquid-filled variable focus lens is capable of dynamically changing its focal lengths. In this work, we investigated the thickness of the elastic membrane that affected the dynamic response of liquid lens.

Authors:Jian Fu, *GIDIT* / Hui Yang, *GIDIT* / Ruimin Cao, *GIDIT* / Lihui Wang, *GIDIT*

JW7A.23

Semiclassical Theory of Photon Echoes with Application to Pr:YSO

Presenter: Zachary Levine , *National Institute of Standards and Technology*

Coherent states are used to prepare a crystal using the Atomic Frequency Comb protocol for quantum memory. Here, semiclassical theory is developed and compared to experimental photon echoes of a coherent pulse.

Authors:Zachary Levine, *National Institute of Standards and Technology*

JW7A.24

Study of Single and Double Tilted Fiber Bragg Gratings Under Pull-induced Strain

Presenter: Pedro Esquivia , *Universidad Nacional de Colombia*



We report the spectral behavior of a single Tilted Fiber Bragg Grating (TFBG) at 5 degrees under pull-induced strain and compared it to a setup of two cascaded TFBGs, with one tensioned. Modal overlapping is observed and measured.

Authors:Rodrigo Acuna Herrera, Universidad Nacional de Colombia / Juan Arango, Universidad Nacional de Colombia / Pedro Esquivia, Universidad Nacional de Colombia / Jose Montoya, Universidad Nacional de Colombia / Jonathan Pinzon, Universidad Nacional de Colombia / Pedro Torres, Universidad Nacional de Colombia / Sebastian Vergara Palacio, Universidad Nacional de Colombia / Donovan Ramirez, Universidad Nacional de Colombia

JW7A.26

Absorption Reduction of Large Purcell Enhancement Enabled by Topological State-led Mode Coupling

Presenter: Zhiyuan Qian , *Peking University*

Based on edge state-led mode coupling mechanism, absorption reduction of spontaneous emission spectra appears in topological structure containing nanoantenna, providing Purcell enhancement over $10^4\gamma_0$ with all scattering light guided into edge state.

Authors:Zhiyuan Qian, Peking University / Zhichao Li, Peking University / He Hao, Peking University / Lingxiao Shan, Peking University / Qi Zhang, Peking University / Jianwen Dong, Sun Yat-sen University / Qihuang Gong, Peking University / Ying Gu, Peking University

JW7A.27

Optical Training Framework for Optical Diffractive Deep Neural Network via Direct Feedback Alignment

Presenter: Tao Fang , *Huawei Technologies Co., Ltd.*

We propose a novel optical training framework for Optical Diffractive Deep Neural Network based on Direct Feedback Alignment. The proposed method can accelerate the training process enormously without significant loss of accuracy.

Authors:Tao Fang, Huawei Technologies Co., Ltd. / Jingwei Li, Huawei Technologies Co., Ltd. / Biao Zhang, Huawei Technologies Co., Ltd. / Tongyu Wu, Huawei Technologies Co., Ltd. / Xiaowen Dong, Huawei Technologies Co., Ltd.

JW7A.28

Coherent Octave-spanning Comb-like Supercontinuum Generation in a Cascaded Structure

Presenter: Kangzhu Zhou , *Peking University*

We propose a structure containing the micro-resonator and a silicon-rich nitride waveguide to obtain the coherent octave-spanning comb-like supercontinuum, which is excited in the micro-resonator firstly and then broadened in the waveguide.

Authors:Kangzhu Zhou, Peking University / Qian Li, Peking University

JW7A.29

Plasma Temperature Evolution with Varying Compositions in an Alloy Using Laser Induced Breakdown Spectroscopy

Presenter: lingamurthy Narlagiri , *University of Hyderabad*

Time-resolved, nanosecond LIBS spectra were collected from Au-Ag target of different compositions. The corresponding spectral data was used for Boltzmann plots providing information on evolution of plasma temperature as function of composition.

Authors:lingamurthy Narlagiri, University of Hyderabad / Venugopal Rao Soma, University of Hyderabad

JW7A.30

Manufacture Protocol for the Control of Epsilon-Near-Zero Properties in Indium Tin Oxide Nanolayer at Telecommunication Wavelength

Presenter: Yanhua Sha , *School of Electronic and Computer Engineering, Peking University*

We experimentally demonstrate the tuning of the epsilon-near-zero (ENZ) properties in indium tin oxide (ITO) film by direct-current magnetron sputtering and present a stable method to produce ITO films with ENZ point at telecommunication wavelength.

Authors:Yanhua Sha, School of Electronic and Computer Engineering, Peking University / Jiaye Wu, School of Electronic and Computer Engineering, Peking University / Jie Chen, School of Electronic and Computer Engineering, Peking University / Shengdong Zhang, School of Electronic and Computer Engineering, Peking University / Qian Li, School of Electronic and Computer Engineering, Peking University

JW7A.31

3.4 GHz Passively Harmonic Mode Locking in a Nonlinearity Managed Er-doped Fiber Laser with Carbon Nanotubes Film

Presenter: Qianqian Huang , *Shanghai University*



We demonstrate a nonlinearity managed passively harmonic mode-locked Er-doped fiber laser using carbon nanotubes film. Lowering the pulse energy via careful nonlinearity management results in 3.4GHz pulse generation with only 250mW pump power.

Authors: Qianqian Huang, Shanghai University / Lilong Dai, Shanghai University / Aleksey Rozhin, Aston University / Mohammed Araiimi, University of Technology and Applied Sciences / Chengbo Mou, Shanghai University

JW7A.32

A Design of Single Photon and Squeezing Light Source in a Nanoscale Photonic-crystal-plasmonic System

Presenter: Lingxiao Shan , *Peking University*

Squeezing light sources need exploring for on-chip devices. A PhC-plasmonic system with a band-edge mode can establish strong coupling. $g(2)(0) < 0.1$ and 0.53 dB degree of squeezing are obtained. Besides, 70% emission can be channeled in PhC waveguide.

Authors: Lingxiao Shan, Peking University / Juanjuan Ren, Peking University / Qi Zhang, Peking University / Yun Ma, Peking University / Qihuang Gong, Peking University / Ying Gu, Peking University

JW7A.33

Raman Sideband Cooling $^{171}\text{Yb}^+$ Across Zeeman Sub-levels

Presenter: Jordan Scarabel , *Griffith University*

We implemented Raman sideband cooling in $^{171}\text{Yb}^+$ between weakly split Zeeman states rather than across the typical 12.6 GHz hyperfine splitting and infer sub-Doppler cooling from $\langle n \rangle_{x,y,z} = [29(2), 36(16), 16.2(5)]$ to $[0.07(7), 2.0(1.2), 5.6(2)]$.

Authors: Jordan Scarabel, Griffith University / Kenji Shimizu, Griffith University / Moji Ghadimi, Griffith University / Mirko Lobino, Griffith University / Erik Streed, Griffith University

JW7A.34

3D Human Joints Extraction Using Part Segmentation

Presenter: Tianxu Xu , *Nankai University*



We propose an approach of human joints extraction using part segmentation. Six human segmentations obtained by PointNet++ are further utilized to extract the 3D joints. The average error of 14 joints is < 4.2 cm.

Authors:Tianxu Xu, Nankai University / Dong An, Nankai University / Yuetong Jia, Nankai University / Jiaqing Chen, Nankai University / Hongkun Zhong, Nankai University / Yishen Ji, Nankai University / Yushi Wang, Nankai University / Zhonghan Wang, Nankai University / Qiang Wang, Angle AI (Tianjin) Technology co. LTD / Zhongqi Pan, University of Louisiana at Lafayette / Yang Yue, Nankai University

JW7A.35

High-speed Optical 3D Active Sensing Method for High-dynamic Targets in the Large-Field Scene

Presenter: Lihui Wang , *Institute of Semiconductors, Guangdong Academy of Sciences*

This method proposed a mapping relationship between mirror-angles and target position. It employed two galvano-mirrors to quickly control the optical path, improved the sensing field-of-view and the real-time performance for highly dynamic targets.

Authors:Ruimin Cao, Institute of Semiconductors, Guangdong Academy of Sciences / Hui Yang, Institute of Semiconductors, Guangdong Academy of Sciences / Jian Fu, Institute of Semiconductors, Guangdong Academy of Sciences / Lihui Wang, Institute of Semiconductors, Guangdong Academy of Sciences

JW7A.36

Quantitative Differential Phase Contrast Imaging Assisted with U-net++ Model

Presenter: Ying-Ju Chen , *National Taiwan University*

Using asymmetric color gradient illumination, an isotropic differential phase contrast microscopy technique for thin transparent samples is proposed. To further improve imaging performance, U-net++ is adapted to obtain quantitative phase information.

Authors:Ying-Ju Chen, National Taiwan University / Yuan Luo, National Taiwan University

JW7A.37

An Investigation on the Perception of Diagnostic X-ray by the Human Eye under Brain CT-scan

Presenter: Mohammad Fathi , *Kharazmi University*

We employ brain CT-scan to show that the human eye can be capable to see the portions outside the well-known visible area, especially X-rays. Its color relies within the blue area.

Authors: Mohammad Fathi, Kharazmi University

JW7A.39

Detour Phase Design of Graphene Metalens with Ultrahigh 3D Resolution

Presenter: Guiyuan Cao , *Shenzhen University*

We propose a new design method based on the detour phase theory for designing graphene metalenses. The designed graphene metalens shows an ultrahigh 3D resolution compared with conventional Fresnel design.

Authors: Guiyuan Cao, Shenzhen University / Han Lin, Swinburne University of Technology / Shibiao Wei, Shenzhen University / baohua Jia, Swinburne University of Technology

JW7A.40

Propagation Characteristics of Optical Beam in a Diffraction Managed Highly Nonlocal Media

Presenter: Sandeep Kajala , *Mody University of Science and Technology, Lakshmanagarh*

This article discusses the dynamics of optical beam propagation through diffraction-managed highly nonlocal nonlinear media. The dynamical system has been modeled by MNLSE and MNLSE has been investigated by variational method.

Authors: Mohit Sharma, Mody University of Science and Technology, Lakshmanagarh / Sandeep Kajala, Mody University of Science and Technology, Lakshmanagarh / Brajraj Singh, Mody University of Science and Technology, Lakshmanagarh / Manoj Mishra, Mody University of Science and Technology, Lakshmanagarh

JW7A.41

Dynamical Charge Inversion of Polarization Correlation Vortex Propagating through a Cylindrical Lens

Presenter: Himangi Bahen Pandit , *National Institute of Technology Warangal*



Polarization correlations are analyzed in propagating vector speckle field generated by scattering of Poincaré beam. Dynamical charge inversion of the correlation vortex is observed when the speckles propagate through a cylindrical lens.

Authors:HimangiBahen Pandit, National Institute of Technology Warangal / Vijay Kumar, National Institute of Technology Warangal / R. Singh, Physical Research Laboratory

JW7A.42

Characterizing Gain Properties of a Yb-doped Silica Transverse Anderson Localizing Fiber

Presenter: Cody Bassett , *University of New Mexico*

A detailed analysis of a novel Yb-doped silica transverse Anderson localizing optical fiber is performed. Comparisons between measurements and theory determine the parasitic attenuation, gain, saturation power, and the number of modes.

Authors:Cody Bassett, University of New Mexico / Matthew Tuggle, Clemson University / John Ballato, Clemson University / Arash Mafi, University of New Mexico

JW7A.43

Optical Cooling of a Large Core Diameter Yb:SiO₂ Fiber to 18K Below Ambient Temperature

Presenter: Brian Topper , *University of New Mexico*

We present record cooling of Yb:silica by 18.4(3)K in vacuum and 3.57(7)K in air in an optical fiber. The success is attributed to increased Yb concentration and decreased thermal load from a smaller cladding thickness.

Authors:Brian Topper, University of New Mexico / Mostafa Peysokhan, University of New Mexico / Alexander Albrecht, University of New Mexico / Angel Flores, Air Force Research Laboratory / Stefan Kuhn, Fraunhofer Institute for Applied Optics and Precision Engineering / Denny Häßner, Fraunhofer Institute for Applied Optics and Precision Engineering / Sigrun Hein, Fraunhofer Institute for Applied Optics and Precision Engineering / Christian Hupel, Fraunhofer Institute for Applied Optics and Precision Engineering / Johannes Nold, Fraunhofer Institute for Applied Optics and Precision Engineering / Nicoletta Haarlammert, Fraunhofer Institute for Applied Optics and Precision Engineering / Thomas Schreiber, Fraunhofer Institute for Applied Optics and Precision Engineering / Mansoor Sheik-Bahae, University of New Mexico / Arash Mafi, University of New Mexico

JW7A.44**Nesting and Degeneracy of Mie Resonances of Dielectric Cavities embedded in Zero-Index Materials**

Presenter: Yun Ma , *Peking University*

Using analytical methods and numerical simulations, we discovered the novel nesting and degeneracy of Mie resonances of dielectric cavities within zero-index materials.

Authors: Yun Ma, Peking University / Xueke Duan, Peking University / Haoxiang Chen, Peking University / Zhiyuan Qian, Peking University / Qi Zhang, Peking University / Yun Lai, Nanjing University / Ruwen Peng, Nanjing University / Qihuang Gong, Peking University / Ying Gu, Peking University

JW7A.45**Expanding the Field of View in Off-Axis Digital Holography by Using A Holographic Optical Element**

Presenter: Lavlesh Prajapati , *CSIR-Central Scientific Instruments Organisation*

We have developed a novel single shot, triple field of view, off-axis digital holographic method by using a multiplexed holographic optical element in front of the image sensor organized as a matrix of pixels.

Authors: Lavlesh Prajapati, CSIR-Central Scientific Instruments Organisation / Raj Kumar, CSIR-Central Scientific Instruments Organisation

JW7A.46**Theoretical Study of Vacuum Ultraviolet Pulse Characterization from Autocorrelation Signals**

Presenter: Spencer Walker , *JILA and Department of Physics, University of Colorado, Boulder, Colorado 80309-0440, USA*

We present results of a theoretical study on how one can infer the time-dependent amplitude and phase variation of the electric field of a vacuum ultraviolet pulse from autocorrelation ionization measurements.

Authors: Spencer Walker, JILA and Department of Physics, University of Colorado, Boulder, Colorado 80309-0440, USA / Ran Reiff, JILA and Department of Physics, University of Colorado, Boulder, Colorado 80309-0440, USA / Agnieszka Jaron-Becker, JILA and Department of Physics, University of Colorado, Boulder, Colorado 80309-0440, USA / Andreas Becker, JILA and Department of Physics, University of Colorado, Boulder, Colorado 80309-0440, USA

JW7A.47**Investigation on ring resonator based plasmonic optical filter**

Presenter: Somya Mahtani , *Mody University of Science and Technology, Lakshmangarh*

This article investigates a plasmonic ring resonator-based optical filter numerically, to find the impact of the radius of ring resonator and width of the channel on transmission characteristics.

Authors: Mohit Sharma, Mody University of Science and Technology, Lakshmangarh / Somya Mahtani, Mody University of Science and Technology, Lakshmangarh / Brajraj Singh, Mody University of Science and Technology, Lakshmangarh / Manoj Mishra, Mody University of Science and Technology, Lakshmangarh

JW7A.48**Estimation and Correction of Gaussian Random Displacement Error Using Simple Non-Gaussian States**

Presenter: Fumiya Hanamura , *The University of Tokyo*

We analyse estimation and error correction of Gaussian random displacement using experimentally feasible non-Gaussian states. We show that even simple states such as single-photon state is superior to Gaussian states in both settings.

Authors: Fumiya Hanamura, The University of Tokyo / Warit Asavanant, The University of Tokyo / Kosuke Fukui, The University of Tokyo / Shunya Konno, The University of Tokyo / Akira Furusawa, The University of Tokyo

JW7A.49**Modeling of a Hybrid Planar-channel Waveguide Configuration for Ultra-wideband Parametric Amplification**

Presenter: Pragati Aashna , *IIT Delhi*

We propose a novel hybrid planar-channel waveguide configuration in lithium niobate (LiNbO₃) for quasi phase matched adiabatic parametric amplification exhibiting ultra wide bandwidth and complete conversion of pump into signal and idler pair.

Authors: Pragati Aashna, IIT Delhi / k Thyagarajan, IIT Delhi

JW7A.50**Hosting an Exceptional Point in a Gain-Loss Assisted DualCore Optical Fiber Segment**

Presenter: Arpan Roy , *University of Calcutta*

We report a dual-core gain-loss assisted optical fiber-segment to host an exceptional point between two quasi-guided hybrid-modes, and study the adiabatic mode conversion phenomenon by a stroboscopic gain-loss variation around the identified EP.

Authors:Arpan Roy, University of Calcutta / Sibnath Dey, Indian Insitute of Technology, Jodhpur / Arnab Laha, Indian Insitute of Technology, Jodhpur / Abhijit Biswas, University of Calcutta / Somnath Ghosh, Indian Insitute of Technology, Jodhpur

JW7A.51

Determination of the Photoelastic Constants of Silicon Nitride Using Piezo-optomechanical Photonic Integrated Circuits and Laser Doppler Vibrometry

Presenter: Matthew Koppa , *Sandia National Laboratories*

We measure the photoelastic constants of piezo-optomechanical photonic integrated circuits incorporating a silicon-depleted silicon nitride thin films using a laser doppler vibrometer to calibrate the strain produced by the piezoelectric actuators.

Authors:Matthew Koppa, Sandia National Laboratories / Matthew Storey, Sandia National Laboratories / Mark Dong, The MITRE Corporation / David Heim, The MITRE Corporation / Andrew Leenheer, Sandia National Laboratories / Matthew Zimmermann, The MITRE Corporation / Daniel Dominguez, Sandia National Laboratories / Gerald Gilbert, The MITRE Corporation / Dirk Englund, Massachusetts Institute of Technology / Matt Eichenfield, Sandia National Laboratories

JW7A.53

Cross Polarization in Gaussian Light Beams

Presenter: Sameen Khan , *Dhofar University*

A formalism of beam optics and polarization is presented using an exact matrix-representation of Maxwell's equations, using quantum methodologies. The paraxial limit of the formalism explains the experimentally seen cross-polarization in laser beams.

Authors:Sameen Khan, Dhofar University

JW7A.55



Photon Funnel Design Based on Spatially Variant Self-Collimating Photonic Crystals

Presenter: Noel Martinez , *University of Texas at El Paso*

We present a device that flows a beam incident at any position and angle along the input side of a lattice to a single zone at the output. We report the performance of the device.

Authors:Noel Martinez, University of Texas at El Paso / Chun Xia, University of Central Florida / Stephen Kuebler, University of Central Florida / Raymond Rumpf, University of Texas at El Paso

JW7A.56

Diffraction of Laguerre-Gauss Vortex Beams from Cantor Set and Sierpinski Carpet

Presenter: Reeta Vyas , *University of Arkansas*

Far-field diffraction of LG vortex beams from 2-D Cantor Set and Sierpinski Carpet is studied and its dependence on iteration order, topological charge, and aperture size and location relative to the beam-waist is investigated.

Authors:Sean Nomoto, University of Arkansas / Reeta Vyas, University of Arkansas / Surendra Singh, University of Arkansas

JW7A.58

Measurement of Refractive index and Absorption coefficient of 3, 4, 5 -Trinitro 1-H Pyrazole using Terahertz Time-domain Spectroscopy

Presenter: Rajesh Koalla , *University of Hyderabad*

The paper reports the terahertz time-domain spectroscopy of 3, 4, 5 -Trinitro 1-H Pyrazole (explosive) between 0.1-1.5 THz range. We ascertained the values of refractive index and absorption coefficients in solid powder form

Authors:Rajesh Koalla, University of Hyderabad / Anil Kumar Chaudhary, University of Hyderabad

JW7A.59

THz- TDS As a Diagnostic Tool for Monitoring the Water Content in Different Coloured Indian Almond Leaves

Presenter: Nagaraju Menchu , *University of Hyderabad*



We report the significant changes in terms of the refractive index and absorption coefficients of different colored almond leaves between 0.1-3.5 THz range and attributed to water and chlorophyll (peak at 0.34 THz) concentration

Authors: Nagaraju Menchu, University of Hyderabad

JW7A.60

Relativistic Mollow spectrum

Presenter: Octavian Postavaru , *Center for Research and Training in Innovative Techniques of Applied Mathematics in Engineering, University Politehnica of Bucharest, Bucharest, 060042, Romania*

We present the relativistic power spectrum for the interaction of an x-ray field with an highly charged ion, obtained by solving the time-dependent Dirac equation in a two-level approximation.

Authors: Octavian Postavaru, *Center for Research and Training in Innovative Techniques of Applied Mathematics in Engineering, University Politehnica of Bucharest, Bucharest, 060042, Romania* / Antonela Toma, *Center for Research and Training in Innovative Techniques of Applied Mathematics in Engineering, University Politehnica of Bucharest, Bucharest, 060042, Romania*

JW7A.61

Simultaneous dual-scale subwavelength gratings formation over a broad wavelength range

Presenter: Md Taher , *University of Hyderabad*

Dual-scale laser induced nanogratings on stainless steel surface of periodicity 45-100 nm (for secondary ripples), and 230-800 nm (primary ripples) are fabricated via femtosecond laser micromachining with a broad incident wavelength from 400-2200 nm.

Authors: Md Taher, *University of Hyderabad* / D Narayana Rao, *University of Hyderabad* / N Sri Ram Gopal, *University of Hyderabad*

JW7A.62

Theoretical Framework for Analysing Statistical Properties of Partially Coherent V-point Beams

Presenter: Stuti Joshi , *Indian Institute of Technology Delhi*



A generalized theoretical model for coherence-induced changes in the intensity, degree-of-polarization, degree-of-coherence, and state-of-polarization is developed theoretically and verified experimentally for V-point polarization singular beams.

Authors: Stuti Joshi, Indian Institute of Technology Delhi / Saba Khan, Indian Institute of Technology Delhi / P Senthilkumaran, Indian Institute of Technology Delhi

JW7A.63

Realization of Switchable Half-Wave Plate for Superposition of Orbital Angular Momentum Modes

Presenter: SRINIVASU SAPIREDDY , *Indian Institute of Technology, Kanpur*

We propose an electro-optic angular phase grating using angularly polled LiNbO₃ (APLN) to manipulate the superposition of Orbital Angular Momentum (OAM) states of light. This versatile device can act as an HWP for OAM modes of opposite chirality.

Authors: SRINIVASU SAPIREDDY, Indian Institute of Technology, Kanpur / Harshawardhan Wanare, Indian Institute of Technology, Kanpur

JW7A.64

Saturation Effect of THz Emission from Laser Induced Plasma in Liquid Water Line

Presenter: Yuxuan Chen , *Tianjin University*

Saturation effect of THz emission from laser induced plasma in liquid water line due to intensity clamping is observed under high pump intensity. This phenomenon is verified by an independent measurement of pulse spectrum broadening.

Authors: Yuxuan Chen, Tianjin University / Yuhang He, Tianjin University / Yifan Zhang, Tianjin University / Zhen Tian, Tianjin University / Jianming Dai, Tianjin University

JW7A.65

Generation of Vector Platicons and Hybrid Soliton-Platicon Complexes in Optical Microresonators via Modulated Pump

Presenter: Valery Lobanov , *Russian Quantum Center*



We demonstrate numerical excitation of vector platons with orthogonally polarized components by modulated pump in optical microresonators at normal GVD. Generation conditions are found. We also show excitation of soliton-platonic complexes.

Authors:Valery Lobanov, Russian Quantum Center / Artem Shitikov, Russian Quantum Center / Ramzil Galiev, Russian Quantum Center / Kirill Minkov, Russian Quantum Center / Olga Borovkova, Faculty of Physics, Lomonosov Moscow State University / Nikita Kondratyev, Russian Quantum Center

JW7A.66

Coherent Mid-Infrared Dispersive Wave in the Dispersion Engineering Side-slotted Silicon Waveguide

Presenter: Feng Ye , *Peking University*

We numerically demonstrate that using the dispersion engineered side-slotted silicon waveguide contributes much to coherent mid-infrared dispersive wave generation in terms of a higher peak power, wider bandwidth and better coherence property.

Authors:Feng Ye, Peking University / Jiayao Huang, Peking University / Qian Li, Peking University

JW7A.67

Modeling Methods and Pulse Interactions in Epsilon-Near-Zero Multilayer

Presenter: Chen Xingyu Huang , *Peking University*

We have investigated the epsilon-near-zero optical properties of alternating silver-silica stacked multilayer structure and numerically demonstrated the light-matter interactions of an ultrashort 20-fs pulse at epsilon-near-zero wavelength.

Authors:Chen Xingyu Huang, Peking University / Jiaye Wu, Peking University / Yuqing Wang, Peking University / H. Y. Fu, Tsinghua University / Qian Li, Peking University

JW7A.68

Finite Element Analysis to Design an Ultra-stable Fabry-Pérot Cavity

Presenter: Sankalpa Banerjee , *The Inter-University Centre for Astronomy and Astrophysics*



Instability of Fabry-Pérot cavity is investigated for different combinations of dimensions, materials, and support structures by using Finite Element Analysis. Salient results are presented and details will be expanded in the full paper.

Authors:Sankalpa Banerjee, The Inter-University Centre for Astronomy and Astrophysics / Subhadeep De, The Inter-University Centre for Astronomy and Astrophysics / Stanley Johnson, The Inter-University Centre for Astronomy and Astrophysics / Sandip Haldar, Indian Institute of Technology Goa / Yutiben Vaghasia, Indian Institute of Technology Goa / Darshay Naik, Indian Institute of Technology Goa

JW7A.69

Optimization for Dispersive Wave Conversion Efficiency in LiNbO₃ Waveguide Using Genetic Algorithm

Presenter: Zimiao Wang , Peking University

We present a genetic algorithm that maximizes the conversion efficiency of mid-infrared dispersive wave in a 5-mm-long LiNbO₃ waveguide. The optimal dispersive wave will benefit trace gas sensing and Fourier transform infrared spectromicroscopy.

Authors:Zimiao Wang, Peking University / Feng Ye, Peking University / Qian Li, Peking University

JW7A.70

Separating Ultrafast Ground and Excited State Vibrations

Presenter: Shaina Dhamija , Indian Institute of Science Education and Research (IISER) Mohali

Using 'spectrally dispersed' impulsive stimulated Raman spectroscopy, vibrational spectra arising from motion of nuclear wavepackets in ground and excited electronic states of iodine in carbon tetrachloride are recorded isolating from solvent modes.

Authors:Shaina Dhamija, Indian Institute of Science Education and Research (IISER) Mohali / Garima Bhutani, Indian Institute of Science Education and Research (IISER) Mohali / Arijit De, Indian Institute of Science Education and Research (IISER) Mohali

JW7A.71

Superresolution Writing Assisted by Up-conversion Nanoparticles for Next Generation Optical Data Storage

Presenter: Le Gao , University of Shanghai for Science and Technology



A sub-diffraction writing technique assisted by up-conversion nanoparticles is devised for fabricating nanoscale features with low power consumption. This new method is of significant potential in low-power ultra-high-capacity optical data storage.

Authors:Le Gao, University of Shanghai for Science and Technology / Qiming Zhang, University of Shanghai for Science and Technology / Min Gu, University of Shanghai for Science and Technology

JW7A.72

Advanced Microscopic Visualization for Structural Characterization of Cellulose Extracted from *Saccharum Spontaneum* (Kohua Bon) of Assam, India

Presenter: Ishita Chakraborty , *Manipal Academy of Higher Education*

Alpha, microcrystalline and nanocrystalline cellulose were extracted from stems and leaves of *Saccharum spontaneum* and were subjected to morphological and structural characterization using advanced microscopy techniques, including SEM and NLOM

Authors:Ishita Chakraborty, Manipal Academy of Higher Education / Ranjan Kalita, Royal Global University / Pinki Singh, Royal Global University / Soumyabrata Banik, Manipal Academy of Higher Education / Indira Govindaraju, Manipal Academy of Higher Education / Sib Mal, National Institute of Technology, Karnataka / Guan Zhuo, China Medical University / Krishna Mahato, Manipal Academy of Higher Education / Nirmal Mazumder, Manipal Academy of Higher Education

JW7A.73

Morphological and Thermal Characterization of Starch-Based Elastomers

Presenter: Pooja N , *Manipal Academy of Higher Education*

Novel elastomers are synthesized from corn and potato starch with potential application in the fabrication of biodegradable microfluidic devices. The developed elastomers were subjected to morphological and thermal characterization.

Authors:Pooja N, Manipal Academy of Higher Education / Soumyabrata Banik, Manipal Academy of Higher Education / Ishita Chakraborty, Manipal Academy of Higher Education / Sib Mal, National Institute of Technology Karnataka / K. K. Mahato, Manipal Academy of Higher Education / Pornsak Srisungsitthisunti, King Mongkut's University of Technology, North Bangkok / Nirmal Mazumder, Manipal Academy of Higher Education

JW7A.74**Filter-free, Telecom-band, Heralded Single Photons from SOI Waveguides.**

Presenter: Shivani Sharma , *Indian Institute of Technology Delhi*

We present SOI waveguide designs for generating filter-free single photons with high spectral purity (>98%) at telecom wavelengths via SFWM. The proposed designs could be useful for integrated LOQC networks and long-distance fiber-based QKD.

Authors: Shivani Sharma, Indian Institute of Technology Delhi / Vivek Venkataraman, Indian Institute of Technology Delhi / Joyee Ghosh, Indian Institute of Technology Delhi

JW7A.75**Femtosecond Excited State Dynamics of Phenanthroimidazole Derivative Molecules Through Excited State Intramolecular Proton Transfer**

Presenter: Chinmoy Biswas , *Indian Institute of Technology Hyderabad*

Dual emission induced by addition of water in pure solution in a novel phenanthroimidazole derivative molecule was observed. Transient absorption measurements elucidated excited state proton transfer as the primary process in the observed emission.

Authors: Chinmoy Biswas, Indian Institute of Technology Hyderabad / Kathirvelan Devarajan, Indian Institute of Technology Hyderabad / Pritha Dey, Indian Institute of Technology Madras / Tarun K Panda, Indian Institute of Technology Hyderabad / Sivarama Krishnan, Indian Institute of Technology Madras / Sai Santosh Kumar Raavi, Indian Institute of Technology Hyderabad

JW7A.76**Enhanced broadband emission of co-doped (Nd-Er)TiO₂**

Presenter: Venkata Katta , *Indian Institute of Technology, Hyderabad*

Enhancement NIR emission from co-doped (Er-Nd)TiO₂ samples is investigated. Analysis revealed interesting bi-direction energy transfer from both Rare-Earth (RE) sites, the interplay of which results in enhanced NIR emission.

Authors: Venkata Katta, Indian Institute of Technology, Hyderabad / Chinmoy Biswas, Indian Institute of Technology, Hyderabad / Sai Santosh Kumar Raavi, Indian Institute of Technology, Hyderabad

JW7A.78**Soliton Molecules in a Dispersion-managed Tm-doped Fiber Laser Utilizing Black Phosphorus at Near Zero Dispersion**

Presenter: Qian Zhang , *Beihang University*

We report, for the first time to the best of our knowledge, the observation of various soliton molecules in a dispersion-managed thulium-doped fiber laser mode-locked by a black phosphorus saturable absorber at near zero dispersion

Authors:Qian Zhang, Beihang University / Meng Zhang, Beihang University / Xin Jin, Beihang University / zheng zheng, Beihang University / Tawfique Hasan, University of Cambridge

JW7A.80**Analysis of Voxel of Integral Imaging Display Using Self-interference Incoherent Digital Holography**

Presenter: Youngrok Kim , *Kyung Hee University*

A voxel analysis technique of integral imaging system using self-interference incoherent digital holography is proposed, which can acquire the hologram in a condition of the incoherent light source.

Authors:Youngrok Kim, Kyung Hee University / Sungwoong Park, Kyung Hee University / Sung-Wook Min, Kyung Hee University

JW7A.81**Decoherence of Light Due to Non-Paraxial Propagation in an Inhomogeneous Medium**

Presenter: Nikolai Petrov , *Scientific and Technological Centre of Unique Instrumentation of the Russian Academy of Science*

Nonparaxial evolution of partially-coherent beams in a graded-index medium is investigated. It is shown that the degree of spatial coherence of the beam decreases with distance due to the effect of nonparaxiality.

Authors:Nikolai Petrov, Scientific and Technological Centre of Unique Instrumentation of the Russian Academy of Science

JW7A.82**Large Pulse Delay in Acousto-Optic Crystals**

Presenter: Nikolai Petrov , *Scientific and Technological Centre of Unique Instrumentation of the Russian Academy of Science*

The diffraction of a pulse in a resonator formed by two spatially distributed “mirrors” created by an acoustic wave is considered. A significant increase in the pulse delay in acousto-optic crystals near the Bragg resonance is shown.

Authors: Nikolai Petrov, *Scientific and Technological Centre of Unique Instrumentation of the Russian Academy of Science* / Vladislav Pustovoit, *Scientific and Technological Centre of Unique Instrumentation of the Russian Academy of Science*

JW7A.84

Design of Micro-Lens Arrays for Display Illumination

Presenter: Nikolai Petrov , *Scientific and Technological Centre of Unique Instrumentation of the Russian Academy of Sciences*

Wave-optics and ray-field tracing methods for simulation of micro-lens arrays taking into account the coherence and polarization effects of light source are implemented. The ray-field approach based on the coherent states representation is developed.

Authors: Galina Petrova, *Scientific and Technological Centre of Unique Instrumentation of the Russian Academy of Sciences* / Nikolai Petrov, *Scientific and Technological Centre of Unique Instrumentation of the Russian Academy of Sciences*

JW7A.85

Tailoring the Photo Thermal Properties of Natural Curcumin Dye with Laser Generated Silver Nanoparticles

Presenter: Fathima R , *Cochin University of Science and Technology*

The thermo optical properties of Curcumin dye with Ag nanoparticles were investigated using thermal lens spectroscopy. An enhancement in Thermal lens signal amplitude and reduction in diffusivity was observed with concentration of Ag nanoparticles.

Authors: Fathima R, *Cochin University of Science and Technology* / A Mujeeb, *Cochin University of Science and Technology*

JW7A.86

Experimental Investigation of the Nature of Chiral Light Emission at the K/K' Valleys of Monolayer Molybdenum Disulfide Using its Interaction with Gold Nanoparticles

Presenter: Mostafa Abasifard , *Institute of Applied Physics*

Valley polarized chiral light emission of monolayer molybdenum disulfide interacting with gold nanoparticles was studied at 4 K. Its behavior is consistent with the emission of a chiral point dipole of well-defined helicity.

Authors:Mostafa Abasifard, Institute of Applied Physics / Tobias Bucher, Institute of Applied Physics / Rajeshkumar Mupparapu, Institute of Applied Physics / Emad Najafidehghani, Institute of Physical Chemistry / Heiko Knopf, Institute of Applied Physics / Antony George, Institute of Physical Chemistry / Falk Eilenberger, Institute of Applied Physics / Thomas Pertsch, Institute of Applied Physics / Andrey Turchanin, Institute of Physical Chemistry / Isabelle Staude, Institute of Applied Physics

JW7A.87

Chaotic Lidar Sensing Performance Analysis Based on Laser Diode with Optical Feedback

Presenter: Yanguang Yu , *University of Wollongong*

Based on a laser diode with optical feedback, the influence of system controllable parameters on chaotic lidar sensing performance is analyzed. Then, guidance on parameter selection rule for generating high-quality chaotic signals is provided.

Authors:Bairun Nie, University of Wollongong / Zhuqiu Chen, University of Wollongong / Yuxi Ruan, University of Wollongong / Yanguang Yu, University of Wollongong / Qinghua Guo, University of Wollongong / Jiangtao Xi, University of Wollongong / Jun Tong, University of Wollongong

JW7A.89

Soliton Switching in PT -symmetric Directional Coupler with Saturable Cubic Nonlinear Response

Presenter: PRIYANKA CHAUDHARY , *Indian Institute of Technology Roorkee*

We present a numerical study on the effect of PT -symmetry in switching characteristics of soliton pulse in the directional coupler with saturable cubic nonlinear response.

Authors:PRIYANKA CHAUDHARY, Indian Institute of Technology Roorkee / Akhilesh Mishra, Indian Institute of Technology Roorkee

JW7A.90

Quartic Solitons from Airy Pulses



Presenter: Deependra Gaur , *Indian Institute of Technology Roorkee*

We numerically investigate Airy pulse propagation in a medium comprising only fourth-order dispersion and Kerr nonlinearity. For low power input pulse quartic soliton shedding is observed.

Authors:Deependra Gaur, Indian Institute of Technology Roorkee / Ankit Purohit, Indian Institute of Technology Roorkee / Akhilesh Mishra, Indian Institute of Technology Roorkee

JW7A.91

Inverse design of a broadband silicon nitride polarization rotor

Presenter: Rômulo Aparecido de Paula Junior , *CPQD*

In this work, we present the design for a broadband, compact and efficient silicon nitride polarization rotor. This work uses the inverse design method and the results show the polarization rotor with a footprint of $15 \times 3 \mu\text{m}^2$.

Authors:Yesica Rumaldo Bustamante, CPQD / Rômulo Aparecido de Paula Junior, CPQD / Ivan Aritz Aldaya Garde, Universidade Estadual Paulista Julio de Mesquita Filho-UNESP

JW7A.92

Simulation and Design of Receiver Array for Light Carrying Orbital Angular Momentum

Presenter: Marco McGavick , *U.S. Naval Academy*

Received light intensity is captured by a sensor array that generates images for machine learning recognition software. Results indicate that a binary 12×12 sensor array could decode light carrying orbital angular momentum with 93% accuracy.

Authors:Marco McGavick, U.S. Naval Academy / Svetlana Avramov-Zamurovic, U.S. Naval Academy

JW7A.93

Comparison of Coherent and Incoherent Drive in SPASER

Presenter: Ankit Purohit , *Indian Institute of Technology Roorkee*



This article theoretically demonstrates the superiority of coherent control over the incoherent pump drive in exciting the localized surface plasmon (LSP) modes of a silver nanosphere adjacent to a three-level gain medium.

Authors: Ankit Purohit, Indian Institute of Technology Roorkee / Akhilesh Mishra, Indian Institute of Technology Roorkee

JW7A.94

Temporal Properties and Schmidt Decomposition of the Biphoton State in a ppLN Ridge Waveguide

Presenter: Ramesh Kumar , *Indian Institute of Technology Delhi*

We study the temporal properties and Schmidt decomposition of the biphotons generated through spontaneous parametric down-conversion in a type-II lithium niobate ridge waveguide, deriving an explicit expression of the mode function for a waveguide.

Authors: Ramesh Kumar, Indian Institute of Technology Delhi / Vikash Yadav, Indian Institute of Technology Delhi / Vivek Venkataraman, Indian Institute of Technology Delhi / Joyee Ghosh, Indian Institute of Technology Delhi

JW7A.95

All-optical Control of High-harmonic Photon Energy

Presenter: LÉNÁRD GULYÁS OLDAL , *ELI-ALPS*

We propose a technique to control the spectral characteristics of high-harmonic sources. The method is easily implementable in any attosecond-pulse generation beamline, regardless of the driving laser, thereby satisfying different experimental needs.

Authors: LÉNÁRD GULYÁS OLDAL, ELI-ALPS / Ye Peng, ELI-ALPS / Zoltán Filus, ELI-ALPS / Tamás Csizmadia, ELI-ALPS / Tímea Grósz, ELI-ALPS / Massimo De Marco, ELI-ALPS / Zsolt Bengery, ELI-ALPS / Imre Seres, ELI-ALPS / Barnabás Gilicze, ELI-ALPS / Péter Jójárt, ELI-ALPS / Katalin Varjú, ELI-ALPS / Subhendu Kahaly, ELI-ALPS / Balazs Major, ELI-ALPS

JW7A.96

Estimation of Intralipid 20% Dilutions Using Machine Learning Enabled Diffuse Reflectance Spectroscopy

Presenter: Saloni Jain , *Indian Institute of Technology, Madras*



Intralipid widely used synthetic ingredient for mimicking tissue scattering for invitro light tissue interaction studies. We present machine learning-enabled diffuse reflectance spectroscopy to estimate scatterer concentration in intralipid solution.

Authors:Saloni Jain, Indian Institute of Technology, Madras / Sujatha N. Unni, Indian Institute of Technology, Madras

JW7A.98

Femtosecond laser post-processing mechanisms for refractive index tuning of fiber Bragg gratings

Presenter: Timothy Imogore , *institute of Applied Physics*

We present an in-depth study on the evolution of the average refractive index profile of an inscribed fiber Bragg grating with respect to the femtosecond laser post-processing parameters.

Authors:Timothy Imogore, institute of Applied Physics

JW7A.100

Dark Dissipative Soliton Resonance in a Mode-locked Double-clad Er/Yb Fiber Laser

Presenter: Baldemar Ibarra-Escamilla , *INAOE*

We demonstrate the formation of dark rectangular pulses from an EYDCF laser operating in a large net-anomalous dispersion regime. The dynamics of dark rectangular formation and the spectral evolution with pump power are experimentally investigated.

Authors:Baldemar Ibarra-Escamilla, INAOE / Manuel Duran-Sanchez, INAOE / Ricardo I. Alvarez-Tamayo, UPAEP / Miguel Bello-Jimenez, UASLP

JW7A.103

3D Optical Components Made by Additive Manufacturing for Casting Complex Patterns of Light

Presenter: Francesca D elia , *Scuola Normale Superiore*



We report on the design, fabrication by 3D printing and soft molding, and characterization of *magic windows*, which are 3D optical components capable of generating structured light patterns by refraction of an incident beam.

Authors: Francesca Delia, Scuola Normale Superiore / Francesco Pisani, Università di Pisa / Alessandro Tredicucci, Università di Pisa / Dario Pisignano, Università di Pisa / Andrea Camposeo, Istituto Nanoscienze - CNR

JW7A.104

Temporal Coupled-Mode Theory for the Line Shape of the Optical Force Spectrum

Presenter: Lingling Fan, *Stanford University*

We theoretically investigate the general optical force line shape as determined by resonances, based on temporal coupled-mode theory analysis. As an application of the theory, we discuss a novel particle sorting scheme.

Authors: Lingling Fan, Stanford University / Zhexin Zhao, Stanford University / Rituraj Mr, Stanford University / Weiliang Jin, Stanford University / Meir Orenstein, Technion / Shanhui Fan, Stanford University

JW7A.105

Self-cooling Laser without Inversion

Presenter: Laura Andre, *University of Michigan*

In a 3-level system modeled after $\text{Ce}^{3+}:\text{LiCaF}$ a single pump wave tuned near the ground state transition produces lasing without population inversion together with radiative cooling.

Authors: Laura Andre, University of Michigan / Long Cheng, University of Michigan / Stephen Rand, University of Michigan

JW7A.106

Nanosecond-Time Domain Molecular Spectroscopy to Measure the Lifetime of Rovibrational Level of Sodium Diatomic Molecules in the $6^1 \Sigma_g^+$ State

Presenter: Sanjib Thapa, *Miami University*



The lifetime of sodium molecules in the rovibrational state was measured using the molecular spectroscopic technique. The excitation was done by two counter-propagating dye lasers and detection was done using Spectrometer-CCD combination.

Authors:Sanjib Thapa, Miami University / Lok Pant, Miami University / MD Shakil Bin Kashem, Miami University / S.Burcin Bayram, Miami University

JW7A.107

Fiber-Based Transceiver Design for Improved Reception in Free-Space Optical Communication Systems

Presenter: Julijanas Zeludevicius , *Center for Physical Sciences and Technology*

We investigate transceiver design in which fused-fiber combiners are used for routing incident optical signals. Significantly higher total coupling efficiency was registered when using 6-port combiners (70 %) compared to 2-port combiners (20 %)

Authors:Julijanas Zeludevicius, *Center for Physical Sciences and Technology* / Giedrius Dubosas, *Center for Physical Sciences and Technology* / Kestutis Regelskis, *Center for Physical Sciences and Technology*

JW7A.108

Plasmonic Band Shift in Gold Nanoparticles During the Phase Separation in Glass

Presenter: Georgiy Shakhgildyan , *Mendeleev University of Chemical Technology of Russia*

100-nm plasmonic redshift in gold nanoparticles dispersed in glass was studied. Computer simulations revealed that phenomenon is driven by the increase of the local refractive index due to the liquid-phase separation in glass.

Authors:Georgiy Shakhgildyan, *Mendeleev University of Chemical Technology of Russia* / Leon Avakyan, *Southern Federal University* / Mariam Ziatdinova, *Mendeleev University of Chemical Technology of Russia* / Vladimir Sigaev, *Mendeleev University of Chemical Technology of Russia*

JW7A.109

Soliton Solutions for the Nonlinear Schrodinger Equation with Kerr Nonlinearity

Presenter: Angela Jia , *The Harker School*



The nonlinear Schrödinger equation with Kerr nonlinearity is studied by using the hyperbolic function series expansion method. The method appears to be simple and efficient and can be used for other nonlinear equations.

Authors:Angela Jia, The Harker School / Karen Lei, Saratoga High School / Kelin Wang, University of Science and Technology of China / Juhao Wu, Stanford University

JW7A.110

Label-free Interferometric Scattering Imaging of Molecular Fluctuation Predicts Fluorescence Nuclear Microscope Images

Presenter: Yi-Teng Hsiao , *Academia Sinica*

We demonstrate a computational method to map the nuclear organization of live cells based on a deep-learning approach where the time-varying scattering signal is used to estimate the density of chromatin in the fluorescence image.

Authors:Yi-Teng Hsiao, Academia Sinica / Chia-Ni Tsai, Academia Sinica / Tsai-Ying Wu, Academia Sinica / Huan-Hsin Tseng, Academia Sinica / Yu Tsao, Academia Sinica / Chia-Lung Hsieh, Academia Sinica

JW7A.111

Designable Light Source for High Quality Ghost Imaging

Presenter: Dongxu Zhou , *Nankai University*

We design a light source with controllable parameters for high-quality ghost images based on Gerchberg-Saxton algorithm. The influence of parameters on image quality is studied. Images with improved resolution and visibility are demonstrated.

Authors:Dongxu Zhou, Nankai University / Zhang Hongzhi, Nankai University / Zhang Lu, Nankai University / Zhang Guoquan, Nankai University

JW7A.112

Ultrafast optically-induced melting of trimer clusters in 1T'-TaTe₂

Presenter: Robert Kaindl , *Lawrence Berkeley National Laboratory*



Relativistic ultrafast electron diffraction is used to track the transient structural dynamics of tantalum ditelluride. We observe rapid photo-induced melting of its low-temperature trimer superstructure as driven by intra-trimer charge transfer.

Authors: Khalid Siddiqui, Lawrence Berkeley National Laboratory / Daniel Durham, Lawrence Berkeley National Laboratory / Frederick Cropp, University of California Los Angeles / Sangeeta Rajpurohit, Lawrence Berkeley National Laboratory / Colin Ophus, Lawrence Berkeley National Laboratory / Yanglin Zhu, The Pennsylvania State University / Johan Carlström, Lawrence Berkeley National Laboratory / Camille Stavrakas, Lawrence Berkeley National Laboratory / Zhiqiang Mao, The Pennsylvania State University / Archana Raja, Lawrence Berkeley National Laboratory / Pietro Musumeci, University of California Los Angeles / Liang Tan, Lawrence Berkeley National Laboratory / Andrew Minor, Lawrence Berkeley National Laboratory / Daniele Filippetto, Lawrence Berkeley National Laboratory / Robert Kaindl, Lawrence Berkeley National Laboratory

JW7A.113

On the efficacy of classical deep learning methods on quantum information science

Presenter: Sanjaya Lohani , *IBM-HBCU Quantum Center, Howard University*

We study the efficacy of deep learning-based quantum state reconstruction methods with respect to inference and training, and then implement the reconstruction technique on an IBM quantum computer.

Authors: Sanjaya Lohani, IBM-HBCU Quantum Center, Howard University / Brian Kirby, Tulane University / Ryan Glasser, Tulane University / Thomas Searles, IBM-HBCU Quantum Center, Howard University

JW7A.114

Optical Steganography using Phase Encoding of Coherent States in a Noisy Thermal Channel

Presenter: Rishabh Jain , *Information Sciences Institute*

We demonstrate steganography through an optical communication channel by encrypting the information in the phase of the coherent state, where the phase distribution emulates a thermal state, making the communication both secure and secret.

Authors: Rishabh Jain, Information Sciences Institute / Arunkumar Jagannathan, Information Sciences Institute / Jonathan Habif, Information Sciences Institute

JW7A.115**FPGA Control Module for Quantitative Differential Phase Contrast Microscope**

Presenter: Yen-Chih Yu , *Institute of Nano Engineering and Microsystems, National Tsing Hua University*

An FPGA module has been developed to control a quantitative differential phase contrast microscope, which can perform three functions: asymmetric-illumination to obtain intensity images, high-speed image acquisitions and phase image reconstruction.

Authors:Yen-Chih Yu, Institute of Nano Engineering and Microsystems, National Tsing Hua University / J. Andrew Yeh, Institute of Nano Engineering and Microsystems, National Tsing Hua University / Yuan Luo, Institute of Medical Device and Imaging, National Taiwan University, Taipei

JW7A.118**Simple self-interference microscope design with geometric phase lens and polarization camera**

Presenter: Nikolai Petrov , *ITMO University*

We investigate an optical scheme and possibilities of digital holographic microscope with a geometrical phase lens. The phase imaging capability for micro-objects is verified.

Authors:Aleksey Chernykh, ITMO University / Alexandra Georgieva, ITMO University / Aleksei Ezerskii, ITMO University / Nikolai Petrov, ITMO University

JW7A.119**Experimental evaluation of inhomogeneous nonlinear refractive index distribution using time-resolved inline digital holography**

Presenter: Nikolai Petrov , *ITMO University*

Time-resolved inline digital holography was validated during the study of nonlinear optical properties of graphene microparticles on the sample glass. A set of probe pulse inline digital holograms was recorded and compared with simulated data.

Authors:Andrei Belashov, Ioffe Institute / Igor Shevkunov, Tampere University / sergey nalegaev, ITMO University / Sergei Putilin, ITMO University / Yu-Chih Lin, National Taiwan Normal University / Chau-Jern Cheng, National Taiwan Normal University / Nikolai Petrov, ITMO University

JW7A.120**Propagation Invariant Features of Aberration Laser Beams in a Turbulent Media**

Presenter: VASU DEV , *Indian Institute of Technology Ropar*

We study the propagation properties of aberration laser beams in a turbulent media. Our results show that the autofocusing and self-healing properties remain invariant in turbulent media under weak, moderate, and strong turbulence conditions.

Authors: VASU DEV, Indian Institute of Technology Ropar / Andra Naresh Kumar Reddy, Weizmann Institute of Science / Andrey V. Ustinov, Image Processing Systems Institute of RAS / Svetlana N. Khonina, Image Processing Systems Institute of RAS / Vishwa Pal, Indian Institute of Technology Ropar

JW7A.121**Revisiting the Photonic Spin-Hall Effect upon Reflection and Refraction**

Presenter: Zan Zhang , *Hengyang Normal University*

We revisit the photonic spin-Hall effect on reflection/refraction and find the reflected/refracted beam contains a spin-maintained component and a spin-flip one acquiring different geometric phases and distinct spin-Hall shifts.

Authors: Zan Zhang, Hengyang Normal University / WeiLai Xiao, Hengyang Normal University / Xiaohui Ling, Hengyang Normal University

JW7A.122**Erbium Doped Tapered Fiber for Generation of MW Level Peak Power Femtosecond Pulses at 1530 nm Wavelength**

Presenter: AASHISH KUMAR , *Indian Institute of Technology*

We present the design of an erbium-doped very large-mode-area tapered optical fiber for generation of 4.2 MW peak-power, 7 fs duration laser pulses at 1530 nm wavelength. The study would be useful for ultrafast laser processes.

Authors: AASHISH KUMAR, Indian Institute of Technology / Mohd Rehan, Indian Institute of Technology / Vipul Rastogi, Indian Institute of Technology

JW7A.123**Viewing Label-free White Blood Cells Using Phase-only Spatial Light Modulator**

Presenter: Reham Hamdy , *National Institute for Standards*

we present a method for viewing white blood cells (WBCs) with no dye using phase-only spatial light modulator (SLM). This non-destructive technique can be used for rapid investigation of white blood cells in three-dimension (3D).

Authors:Dahi Abdelsalam, National Institute of Standards / Reham Hamdy, National Institute for Standards

JW7A.124

Evaluation of Light Penetration for Photoacoustic Macroscale Imaging in Rat Organs

Presenter: Guo Heng , *University of Electronic Science and Technology of China*

The research evaluated the penetration capability of light for photoacoustic macroscale imaging inside different organs with three typical penetration depths, and proposed the optimal selection of illumination wavelengths to achieve the best SNR.

Authors:Guo Heng, University of Electronic Science and Technology of China / Aihui Sun, Southern University of Science and Technology / Lei Xi, Southern University of Science and Technology

JW7A.126

Photodamage Reduction on Harmonic Generation Microscopy at Low-Level Optical Power based on Deep Learning

Presenter: Yi Shen , *National Tsing Hua University*

We demonstrated a power enhancement method in harmonic generation microscopy based on deep learning to reduce the optical input power and consequently reduce the risk of photodamage.

Authors:Yi Shen, National Tsing Hua University / En-Yu Liao, National Taiwan University / Tsung-Ming Tai, NVIDIA / Yi-Hua Liao, National Taiwan University / Chi-Kuang Sun, National Taiwan University / Cheng-Kuang Lee, NVIDIA / Simon See, NVIDIA / Hung-Wen Chen, National Tsing Hua University

JW7A.131

Enhanced-Genetic-Algorithm-Based Absorption Performance Optimization of Epsilon-Near-Zero Multilayer

Presenter: Yuqing Wang , *Peking University*



By using enhanced genetic algorithm, the peak absorption of the 600 nm 6-layer ENZ multilayer is increased from 0.91 to 0.95 and the absorption bandwidth is broadened from 120 nm to 227 nm.

Authors: Yuqing Wang, Peking University / Jiaye Wu, Peking University / Chenxingyu Huang, Peking University / H. Y. Fu, Tsinghua University / Qian Li, Peking University

JW7A.132

MIM Plasmonic Waveguide for Absorption Spectroscopy

Presenter: Brajraj Singh , Mody University of Science and Technology, Lakshmanagarh-332311, Sikar, Rajasthan, INDIA.

A compact plasmonic waveguide proposed and investigated. It shows high response with near 90% transmission. First time, three absorption peaks are reported in the near infrared regime wavelength range with air cavity.

Authors: Manoj Mishra, Mody University of Science and Technology, Lakshmanagarh-332311, Sikar, Rajasthan, INDIA. / Brajraj Singh, Mody University of Science and Technology, Lakshmanagarh-332311, Sikar, Rajasthan, INDIA. / Mohit Sharma, Mody University of Science and Technology, Lakshmanagarh-332311, Sikar, Rajasthan, INDIA.

JW7A.135

Low-Loss 2×2 Wavelength-Independent Coupler Using MZI Based on Bézier Curves

Presenter: Marios Papadovasilakis , Khalifa University

We describe a Bézier curve-based wavelength-independent coupler using a Mach-Zehnder Interferometer (MZI). 3D FDTD simulations demonstrate constant, broadband splitting ratios with very low insertion loss (< 0.05 dB) and compact footprint ($138 \mu\text{m}^2$).

Authors: Marios Papadovasilakis, Khalifa University / Sujith Chandran, Information Science Institute / Yonas Gebregiorgis, Khalifa University / Yusheng Bian, GLOBALFOUNDRIES / Michal Rakowski, GLOBALFOUNDRIES / Rod Augur, GLOBALFOUNDRIES / Jaime Viegas, Khalifa University

JW7A.138

Broadside coupled graphene metamaterial cavities for ultrasensitive terahertz sensing

Presenter: sukhvinder kaur , Indian Institute of Technology Delhi



We demonstrate broadside coupling of “plus” shaped graphene resonators-based THz metamaterials. Due to relatively large interaction area leading to strong THz-matter interaction, our devices show high refractive index sensitivity of ~ 4.5 THz/RIU.

Authors: sukhvinder kaur, Indian Institute of Technology Delhi / Subhajit Karmakar, Indian Institute of Technology Delhi / Ravendra K. Varshney, Indian Institute of Technology Delhi / Dibakar Roy Chowdhury, Mahindra university

JW7A.140

Robust Direct Laser Image Recognition of Vehicle Parts Among Self-driving

Presenter: Hongbo Zhang , *Middle Tennessee State University*

Direct laser image recognition method is developed for recognition of different parts of vehicle among self-driving. Results show the method is robust for both red and green lasers and different weather and time conditions.

Authors: Hongbo Zhang, Middle Tennessee State University / wenjing zhou, Shanghai University / Wakeel Idewu, Virginia Military Institute / deng cao, Middle Tennessee State University / Isreal Williamson¹, Middle Tennessee State University

JW7A.141

Sensitivity Enhancement of a bi-metallic Surface Plasmon Resonance based Sensor Using Poynting vector Analysis

Presenter: HIMANSHU KUSHWAH , *Keshav Mahavidyalaya, University of Delhi*

Bi-metallic surface plasmon resonance sensor with a thin layer of high-index dielectric introduced between two metal layers to enhance sensitivity is proposed. Design parameters are calculated using a new formula for instantaneous Poynting vector.

Authors: HIMANSHU KUSHWAH, Keshav Mahavidyalaya, University of Delhi / Jagneet Anand, Keshav Mahavidyalaya, University of Delhi

JW7A.142

Ultra-Broadband Silicon Polarization Splitter-Rotator using Adiabaticity Engineering

Presenter: Hung-Ching Chung , *National Cheng Kung University*



Multi-wavelength adiabaticity engineering is utilized in optical waveguides to design an ultra-broadband silicon polarization splitter-rotator. A 141 μ m-long device exhibits excellent extinction ratio over a bandwidth of 300nm.

Authors:Hung-Ching Chung, National Cheng Kung University / Guan-Xun Lu, National Cheng Kung University / Shuo-Yen Tseng, National Cheng Kung University

JW7A.144

Graphene Nanoribbons Based Mid-infrared Photodetectors

Presenter: Vinod Sharma , *IIT Hyderabad*

We demonstrate tunable graphene nanoribbon-based photodetector for the wavelength range 5-12 μ m. We leverage the width dependence of bandgap in nanoribbons, and their tunable plasmonic properties to demonstrate photodetection at room temperature.

Authors:Vinod Sharma, IIT Hyderabad / Jinal Tapar, IIT Hyderabad / Saurabh Kishen, IIT Hyderabad / Naresh Emani, IIT Hyderabad

19:30 - 20:00 (UTC - 07:00)

SpE19

Special Event - Color Technical Group Coffee Break



Thursday, 04 November

6:00 - 7:30 (UTC - 07:00)

JTh1A

Joint Postdeadline Session II

President: Chau-Jern Cheng , *National Taiwan Normal University*

JTh1A.1

Vortex crystals in optically trapped exciton-polariton condensates

Presenter: Kirill Sitnik , *Skolkovo Institute of Science and Technology*

We excite a trapped condensate of polaritons and observe the formation of vortex crystal characterized by ordered arrangement of phase singularities. The condensate experiences competition between the trap Ince-Gaussian modes on a picosecond timescale.

Authors: Kirill Sitnik, Skolkovo Institute of Science and Technology / Sergey Alyatkin, Skolkovo Institute of Science and Technology / Helgi Sigurdsson, Science Institute, University of Iceland / Pavlos Lagoudakis, Skolkovo Institute of Science and Technology

JTh1A.2

Femtosecond Laser-Induced Polarization-Controlled Birefringence inside Nd:YAG Single Crystal

Presenter: Tatiana Lipateva , *Mendeleev University of Chemical Technology*



Laser-induced polarization-controlled birefringence (PCB) with unprecedented thermal resistance has been demonstrated in Nd:YAG crystal for the first time. Laser writing of PCB is promising for the development of novel crystal-based optical elements.

Authors:Tatiana Lipateva, Mendeleev University of Chemical Technology / Alexey Lipatiev, Mendeleev University of Chemical Technology / Sergey Fedotov, Mendeleev University of Chemical Technology / Andrey Okhrimchuk, Mendeleev University of Chemical Technology / Sergey Lotarev, Mendeleev University of Chemical Technology / Vladimir Sigaev, Mendeleev University of Chemical Technology

JTh1A.3

Few-Cycle Visible Light Generation in a Hollow-Core Fiber

Presenter: Riccardo Piccoli , *INRS-EMT*

175-fs-long pulses emitted by a commercial Yb-based laser are directly projected into the single-cycle regime at visible frequencies through the nonlinear mixing between spatial modes of a hollow-core fiber, without any post-compression technique.

Authors:Riccardo Piccoli, INRS-EMT / Jeffrey Brown, CPHT, CNRS, Institut Polytechnique de Paris / Younggyun Jeong, INRS-EMT / Andrea Rovere, INRS-EMT / Luca Zanotto, INRS-EMT / Mette Gaarde, Louisiana State University / Francois Legare, INRS-EMT / Arnaud Couairon, CPHT, CNRS, Institut Polytechnique de Paris / John Travers, Heriot-Watt University / Roberto Morandotti, INRS-EMT / Bruno Schmidt, few-cycle Inc. / Luca Razzari, INRS-EMT

JTh1A.4

Histological Discrimination Using Fractal Analysis and Refractive Index Variance

Presenter: Felix Fanjul-Velez , *University of Cantabria*

Histopathology presents artifacts, delays or subjective errors. Digital histology contributes to automation and diagnosis improvement. In this work we employ label-free tissue slices by phase contrast fractal dimension and refractive index variance.

Authors:Jose Luis Ganoza-Quintana, University of Cantabria / Felix Fanjul-Velez, University of Cantabria / Jose Luis Arce-Diego, University of Cantabria

JTh1A.5

Near Perfect Two-photon Interference out a of Down-converter on Silicon Nitride Chip

Presenter: Romain Dalidet , *Université Côte d'Azur, CNRS, Institut de Physique de Nice*

We report the first photon-pair source based on χ^2 nonlinearity process on a silicon platform, showing a record two-photon interference visibility exceeding 99%, opening a new horizon for quantum technologies.

Authors:Romain Dalidet, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Florent Mazeas, Ecole polytechnique fédérale de Lausanne, PHOSL / Edgars Nitiss, Ecole polytechnique fédérale de Lausanne, PHOSL / Ozan Yakar, Ecole polytechnique fédérale de Lausanne, PHOSL / Anton Stroganov, Ecole polytechnique fédérale de Lausanne, PHOSL / Laurent Labonté, Université Côte d'Azur, CNRS, Institut de Physique de Nice / Camille Brès, Ecole polytechnique fédérale de Lausanne, PHOSL / Sébastien Tanzilli, Université Côte d'Azur, CNRS, Institut de Physique de Nice

JTh1A.6

Optical Vortex Brillouin Laser in Chiral Photonic Crystal Fiber

Presenter: Xinglin Zeng , *Max-Planck Institute for the Science of Light*

We report the first experimental study of stimulated Brillouin scattering and Brillouin lasing by circularly polarized vortex modes in chiral photonic crystal fibers, and demonstrate conservation of spin and orbital angular momentum.

Authors:Xinglin Zeng, Max-Planck Institute for the Science of Light / Yang Chen, Max-Planck Institute for the Science of Light / Zheqi Wang, Max-Planck Institute for the Science of Light / Michael Frosz, Max-Planck Institute for the Science of Light / Paul Roth, Max-Planck Institute for the Science of Light / Gordon Wong, Max-Planck Institute for the Science of Light / Philip Russell, Max-Planck Institute for the Science of Light / Birgit Stiller, Max-Planck Institute for the Science of Light

8:00 - 9:00 (UTC - 07:00)

FTh2B

Ultrafast Phenomena I

Presenter: Judith Dawes , *Macquarie University*

FTh2B.1**Attosecond Imaging of Resonant Photoemission Dynamics***Invited***Presenter:** Pascal Salieres , *Laboratory Interactions Dynamics and Las*

Using momentum-resolved electron interferometry, we image helium two-photon ionization through intermediate bound states. This allows reconstructing in space and time the complete formation of the photoionized wavepacket.

Authors:Pascal Salieres, Laboratory Interactions Dynamics and Las / Alice Autuori, Université Paris Saclay / Dominique Platzer, Université Paris Saclay / Mariusz Lejman, Université Paris Saclay / Guillaume Gallician, Université Paris Saclay / Lucie Maëder, Université Paris Saclay / Antoine Covolo, Université Paris Saclay / Lea Bosse, Université Paris Saclay / Malay Dalui, Université Paris Saclay / David Bresteau, Université Paris Saclay / Jean-Francois Hergott, Université Paris Saclay / Olivier Tcherbakoff, Université Paris Saclay / Hugo Marroux, Université Paris Saclay / Vincent Loriot, Université de Lyon / Franck Lépine, Université de Lyon / Lionel Poisson, Université Paris Saclay / Richard Taïeb, Sorbonne Université / Jérémie Caillat, Sorbonne Université

FTh2B.2**(Withdrawn) Developing a high-repetition rate few-cycle short-wave infrared light source for strong-field experiments****Presenter:** Ivan Sytceвич , *Lund University*

We present a compact, 200 kHz short-wave infrared optical parametric amplifier. The system currently delivers sub-30 fs, 10 μ J pulses at 1900 nm. Further optimized dispersion management will in the future bring the setup to the few-cycle regime.

Authors:Ivan Sytceвич, Lund University / Anne-Lise Viotti, Lund University / Chen Guo, Lund University / Anne L'Huillier, Lund University / Cord Arnold, Lund University

FTh2B.3**Self-synchronized Two-color Fiber Laser System for Stimulated Raman Scattering Microscopy in Cell-silent Regime****Presenter:** Meng ZHOU , *University of Hong Kong*

We present a 1.7- μm mode-locked laser in an all-fiber architecture and it is self-synchronized with a 1.0- μm mode-locked fiber laser. The two-color system can potentially realize stimulated Raman scattering microscopy between 1775 and 2221 cm^{-1} .

Authors: Meng ZHOU, University of Hong Kong

FTh2A

Integrated Laser Technology

Presenter: Chris Poulton , *Analog Photonics*

FTh2A.1

Precision Laser Stabilization using Photonic Integrated Coil Resonator

Presenter: KAIKAI LIU , *University of California Santa Barbara*

We report laser stabilization with record low frequency noise of 0.08 Hz^2/Hz at 70 kHz offset and a 150 Hz integral linewidth using an integrated 4-meter waveguide coil resonator with 144 Million intrinsic Q.

Authors: KAIKAI LIU, University of California Santa Barbara / Nitesh Chauhan, University of California Santa Barbara / Jiawei Wang, University of California Santa Barbara / Paul Morton, Morton Photonics / Ryan Behunin, Northern Arizona University / Daniel Blumenthal, University of California Santa Barbara

FTh2A.2

Monolithic InP 100-Port Optical Phased Array

Presenter: Kento Komatsu , *The University of Tokyo*

We design and fabricate the largest-scale InP-based optical phased array (OPA) with 100 waveguides. Beam steering with more than 80 resolvable points and the response time of less than 16 ns are demonstrated experimentally.

Authors: Kento Komatsu, The University of Tokyo / Yusuke Kohno, The University of Tokyo / Yoshiaki Nakano, The University of Tokyo / Takuo Tanemura, The University of Tokyo

FTh2A.3

Integrated Photonic Four-wave-mixing Optical Synthesizer

Presenter: Jennifer Black , *National Institute of Standards and Technology*

We present an integrated photonic optical synthesizer using four-wave-mixing based spectral translation. Our synthesizer operates with < 0.1 Hz accuracy and a fractional frequency precision of 4.8×10^{-13} at 1 second.

Authors:Jennifer Black, National Institute of Standards and Technology / Zachary Newman, National Institute of Standards and Technology / Su-Peng Yu, National Institute of Standards and Technology / David Carlson, National Institute of Standards and Technology / Scott Papp, National Institute of Standards and Technology

FTh2A.4

Supersymmetric Microring Laser Arrays in Two-dimensional Space

Presenter: Xingdu Qiao , *University of Pennsylvania*

To achieve phase-locking in coupled arrays, a two-dimensional (2D) supersymmetry (SUSY) formalism is developed and experimentally demonstrated. Our SUSY device features high power, single-mode lasing from a 2D, evanescently coupled microring array.

Authors:Xingdu Qiao, University of Pennsylvania / Bikashkali Midya, University of Pennsylvania / Zihe Gao, University of Pennsylvania / Zhifeng Zhang, University of Pennsylvania / Haoqi Zhao, University of Pennsylvania / Tianwei Wu, University of Pennsylvania / Jieun Yim, University of Pennsylvania / Ritesh Agarwal, University of Pennsylvania / Natalia Litchinitser, Duke University / Liang Feng, University of Pennsylvania

FTh2D

Plasmonics and Metamaterials

Presenter: Takuo Tanemura , *University of Tokyo*

FTh2D.1

2D Plasmonics and THz Nonlinear Optics

Invited

Presenter: Thomas Murphy , *University of Maryland*



We describe recent measurements that characterize the unusual nonlinear behavior of atomically thin materials in the THz regime, and how plasmonic metasurfaces can be engineered to tune and enhance the nonlinear response.

Authors: Thomas Murphy, University of Maryland / Martin Mittendorff, Universität Duisburg-Essen / Jeongwoo Han, Universität Duisburg-Essen / Stephan Winnerl, Helmholtz-Zentrum Dresden-Rossendorf / Matthew Chin, University of Maryland

FTh2D.2

Cubic Phase Metasurface for Three-Dimensional Optical Manipulation

Presenter: Hung Chuan Hsu , *National Taiwan University*

Here we design and fabricate the dielectric cubic phase metasurface to generate a polarization-independent Airy beam in visible. Moreover, the metasurface is integrated within the optical manipulation system and used to manipulate particles.

Authors: Hsin Yu Kuo, National Taiwan University / Hung Chuan Hsu, National Taiwan University / Sunil Vyas, National Taiwan University / Yu-Jung Lu, National Taiwan University / Yuan Luo, National Taiwan University / Din Ping Tsai, National Taiwan University

FTh2D.3

Metal-enhanced fluorescence: More than we thought

Presenter: Ilia Rasskazov , *University of Rochester*

We show that metal-dielectric core-shell nanoparticles with unusually thick dielectric coatings produce extreme fluorescence enhancement with a factor of $F \geq 3000$ for emitters located near Au@dielectric spherical particles under realistic conditions.

Authors: Ilia Rasskazov, University of Rochester / Alexander Moroz, Wave-scattering.com / P. Scott Carney, University of Rochester

LTh2E

Optical Cavity and Nanocavity Coupling

Presenter: Jingdi Zhang , *Hong Kong Univ. of Science & Technology*

LTh2E.1

Optical-Cavity Manipulation of Conical Intersections and Singlet Fission Dynamics

Presenter: Bing Gu , *University of California Irvine*

We demonstrate how cavity polaritons can be employed to manipulate the photochemical processes of molecules. Specifically, the singlet fission process in pentacene dimers is shown to be strongly suppressed by strong light-matter coupling.

Authors: Bing Gu, University of California Irvine / Shaul Mukamel, University of California Irvine

LTh2E.2

Room-Temperature Strong Coupling to Plasmonic Nanocavities

Presenter: Matthew Pelton , *UMBC (University of Maryland Baltimore County)*

We have demonstrated induced transparency and strong coupling between a single colloidal quantum dot and plasmonic metal nanocavities at room temperature. These structures have the potential to be ultrafast, low-power, nanoscale optical modulators.

Authors: Matthew Pelton, UMBC (University of Maryland Baltimore County)

LTh2E.3

Photoluminescence Emission of a Single Quantum Dot Coupled to Hybrid Photonic Nanostructures: Towards Single-Photon Sources

Presenter: Angela Barreda , *Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena*

We study the photoluminescence enhancement of a single quantum dot coupled to a metal-dielectric hybrid nanostructure, consisting of a gold dimer and silicon directors. This work may find applications in the development of single photon-sources.

Authors: Angela Barreda, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Maryam Moradi, Laboratory of Organic and Macromolecular Chemistry (IOMC), Friedrich Schiller University Jena / Alexander Minovich, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Michael Jäger, Laboratory of Organic and Macromolecular Chemistry (IOMC), Friedrich Schiller University Jena / Ullrich S. Schubert, Laboratory of Organic and Macromolecular Chemistry (IOMC), Friedrich Schiller University Jena / Thomas Pertsch, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Isabelle Staude, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena

LTh2E.4**Selective Coupling of Dark and Bright Excitons in 2D Transition Metal Dichalcogenide Alloys to Planar Microstructures**

Presenter: Lekshmi Eswaramoorthy , *IITB-Monash Research Academy*

We present a route to selectively couple dark and bright excitons in atomically thin transition metal dichalcogenide alloys to planar microstructures via anisotropic Purcell enhanced out-of-plane resonator modes engineered by tapering of micro-disk.

Authors: Lekshmi Eswaramoorthy, IITB-Monash Research Academy / Brijesh Kumar, Indian Institute of Technology Bombay / Sudha Mokkaapati, Monash University / Anshuman Kumar, Indian Institute of Technology Bombay

FTh2C**Computer-generated Holography and Holographic Display**

Presenter: Tomoyoshi Shimobaba , *Chiba University*

FTh2C.1**Interactive Generation of Full Color 4K Image Hologram**

Invited

Presenter: Hiroshi Yoshikawa , *Nihon University*

Interactive display is realized on PC without special hardware such as GPU or FPGA. Full color image holograms are generated over 10 frames per second with sub-million point cloud, converted from polygonal computer graphics data.

Authors: Hiroshi Yoshikawa, Nihon University / Naoki Yuasa, Nihon University / Takeshi Yaaguchi, Nihon University

FTh2C.2**Holographic Display by Computer-generated Binary Holograms**

Invited

Presenter: Jung-Ping Liu , *Feng Chia University*



Computer-generated binary holograms (CGBH) usually contain serious speckle noise and thus are not favored for holographic display. Here we will introduce various CGBH techniques for high-quality holographic display.

Authors:Jung-Ping Liu, Feng Chia University / Chen-Ming Tsai, Feng Chia University / Chia-Jung Cheng, Feng Chia University

9:15 - 10:00 (UTC - 07:00)

JTh3A

Visionary Session VI: Keith Nelson, Massachusetts Institute of Technology, USA

Presider: John Fourkas , *University of Maryland at College Park*

JTh3A.1

Light, Matter, and Their Interactions: The Gift That Keeps on Giving

Visionary

Presenter: Keith Nelson , *Massachusetts Institute of Technology*

Advances in THz through x-ray pulse generation have enabled optical control over molecular and collective modes, extending to guided far-from-equilibrium dynamical transformations that are monitored in real time. We celebrate and look ahead!

Authors:Keith Nelson, Massachusetts Institute of Technology

10:00 - 10:30 (UTC - 07:00)

SpE14



Special Event - Tech Talk: Silicon Photonics for the Visible Spectrum

10:00 - 12:00 (UTC - 07:00)

FTh4E

Nanophotonics and Plasmonics

Presider: Ryan Hamerly , *Massachusetts Institute of Technology*

FTh4E.1

Coupled Nano-Optomechanical Cavities for Enhancing Nonlinear Optomechanics

Presenter: Roel Burgwal , *Eindhoven University of Technology*

We fabricate a new multimode optomechanical system in a nanoscale photonic crystal platform, capable of enhancing nonlinear optomechanical coupling. Using thermal and oxidation tuning we match mode frequencies and demonstrate strong optical coupling.

Authors:Roel Burgwal, Eindhoven University of Technology / Ewold Verhagen, Eindhoven University of Technology

FTh4E.2

Enantioselective Optical Forces of Gain Functionalized Core-shell Chiral Nanoparticles

Presenter: Rfaqat Ali , *UNICAMP*

We present a novel enantioselective scheme of chiral plasmonic nanostructures by functionalizing them with optical gain, which allows for chiral resolution, all-optical sorting, and quantitative characterization of chirality of single nanoparticles.

Authors:Rfaqat Ali, UNICAMP / Felipe A. Pinheiro, UFRJ / Thiago Alegre, UNICAMP / Gustavo S. Wiederhecker, UNICAMP

FTh4E.3

Ultrafast Nonlinear Absorption and Pulse Propagation Dynamics in Metal-Dielectric Photonic Structure

Presenter: Jitendra Acharyya , *Indian Institute of Technology Delhi*

Ultrafast dynamics of 1D metal-dielectric periodic structure is investigated via femtosecond optical pump-probe technique. Further, a phenomenological pulse propagation model is employed to observe the pulse dynamics in the photonic miniband.

Authors:Jitendra Acharyya, Indian Institute of Technology Delhi / Akhilesh Mishra, Indian Institute of Technology Roorkee / G. Prakash, Indian Institute of Technology Delhi

FTh4E.4

Comparison of Piecewise Parabolic and PRBS Phase Modulation Schemes on the SBS Threshold

Presenter: Josh Young , *Baylor University*

We computationally compare piecewise parabolic and PRBS phase modulation schemes on the SBS threshold power. For power fractions inside a fixed bandwidth greater than 85%, we find that piecewise parabolic modulation produces a higher threshold.

Authors:Josh Young, Baylor University / Jeffrey White, University of Maryland Baltimore County / Chengli Wei, University of Mary Hardin-Baylor / Jonathan Hu, Baylor University / Curits Menyuk, University of Maryland Baltimore County

FTh4E.5

High-Finesse Surface Acoustic Wave Cavities on Etched-Groove GaAs

Presenter: Zixuan Wang , *National Institute of Standards and Technology*



We demonstrate etched-groove surface acoustic wave cavities on gallium arsenide with finesses reaching 100. These cavities can be used to enhance coupling between phonons and different quantum systems, providing a platform for quantum transduction.

Authors: Zixuan Wang, National Institute of Standards and Technology / Poolad Imany, National Institute of Standards and Technology / Ryan DeCrescent, National Institute of Standards and Technology / Robert Boutelle, National Institute of Standards and Technology / Corey McDonald, National Institute of Standards and Technology / Travis Autry, National Institute of Standards and Technology / Richard Mirin, National Institute of Standards and Technology / Kevin Silverman, National Institute of Standards and Technology

FTh4E.6

(Withdrawn) Experimental realization of actively tunable unidirectional surface plasmon-polaritons

Presenter: Yi Liang, *Guangxi Univerisity*

we experimentally investigate tunable unidirectional surface plasmon polaritons (SPPs) at the interface between gyrotropic and isotropic conductors. The directionality of the allowed SPP propagation can be flexibly controlled by the external field.

Authors: Yi Liang, Guangxi Univerisity / Samaneh Pakniyat, University of Wisconsin-Milwaukee / Yinxiao Xiang, West Virginia University / Jun Chen, University of Pittsburgh / Fan Shi, Tianjin University of Technology / George W Hanson, University of Wisconsin-Milwaukee / Cheng Cen, West Virginia University

FTh4E.7

Microdisk Design for Vertical Collection from Quantum Emitters

Presenter: Ian Hammond, *Brigham Young University*

We report on progress to improve the free space coupling and Purcell enhancement of a diamond microdisk resonator using eigenfrequency modal analysis and robust topology optimization.

Authors: Ian Hammond, Brigham Young University / Ryan Camacho, Brigham Young University / Dirk Englund, Massachusetts Institute of Technology / Yuqin Duan, Massachusetts Institute of Technology / Matthew Trusheim, Massachusetts Institute of Technology

FTh4E.8

Novel plasmonic metamaterials and flexible control of optical properties using random Ag nanostructures

Presenter: Koichi Okamoto , *Osaka Prefecture University*

Plasmonic metamaterials based on random structures on mirror were proposed to tune the optical properties due to the surface plasmon resonance. The resonance peaks were enhanced and dramatically sharpened, and flexibly tuned.

Authors: Koichi Okamoto, Osaka Prefecture University / Sayako Maeda, Osaka Prefecture University / Seiya Kaito, Osaka Prefecture University / Koki Matsuda, Osaka Prefecture University / Soshi Endo, Osaka Prefecture University / Kohei Shimanoe, Osaka Prefecture University / Tetsuya Matsuyama, Osaka Prefecture University / Kenji Wada, Osaka Prefecture University

10:15 - 12:00 (UTC - 07:00)

FTh4B

Ultrafast Phenomena II

President: Cord Arnold , *Lunds Universitet*

FTh4B.1

Non-perturbative focus diagnostics of 100-TW-class Laser Pulses

Presenter: Fumika Isono , *Lawrence Berkeley National Lab*

We present an online, non-destructive laser diagnostic capable of measuring the transverse position/pointing angle at focus of a 100-TW laser system using double-surface-coated wedged-mirror design for the final steering optic in the laser line.

Authors: Fumika Isono, Lawrence Berkeley National Lab / Jeroen van Tilborg, Lawrence Berkeley National Lab / Samuel Barber, Lawrence Berkeley National Lab / Joseph Natal, Lawrence Berkeley National Lab / Curtis Berger, Lawrence Berkeley National Lab / Hai-En Tsai, Lawrence Berkeley National Lab / Tobias Ostermayr, Lawrence Berkeley National Lab / anthony gonsalves, Lawrence Berkeley National Lab / Cameron Geddes, Lawrence Berkeley National Lab / eric esarey, Lawrence Berkeley National Lab

FTh4B.2**Multi-milijoule Infrared Pulses from a Laser Wakefield Accelerator**

Invited

Presenter: Amina Hussein , *University of Alberta*

We present high-resolution spectral measurements of long-wavelength light from a laser wakefield accelerator extending to 2.4 μm and with up to 15 mJ. Beam profile measurements and simulations suggest high focusability of these pulses.

Authors:Amina Hussein, University of Alberta / Josh Ludwig, University of Alberta / Yong Ma, University of Michigan / Paul-Edouard Masson-Laborde, CEA-DAM / Patrick Skrodzki, University of Michigan / Jesus Hinojosa, University of Michigan / Eric Peterson, University of Michigan / Igor Jovanovic, University of Michigan / Anatoly Maksimchuk, University of Michigan / John Nees, University of Michigan / Alexander Thomas, University of Michigan / Wojciech Rozmus, University of Alberta / Karl Krushelnick, University of Michigan

FTh4B.3**Efficient, High Peak-Power Post-Compression in a Compact Bulk Multi-Pass Cell**

Presenter: Ann-Kathrin Raab , *Lund University*

We demonstrate a compact, bulk multi-pass cell with high-transmission, for compressing the output of a 30 W, 250 fs Ytterbium source to 31 fs with a resulting peak power of 2.5 GW.

Authors:Ann-Kathrin Raab, Lund University / Marcus Seidel, Deutsches Elektronen-Synchrotron DESY / Ivan Sytceвич, Lund University / Chen Guo, Lund University / Gunnar Arisholm, FFI (Norwegian Defence Research Establishment) / Anne L'Huillier, Lund University / Cord Arnold, Lund University / Anne-Lise Viotti, Lund University

FTh4B.4**Microjoule-level Femtosecond Pulses From 3 to 10 μm by DFG in LiGaS₂ at 250 kHz**

Presenter: Nicolas Forget , *FASTLITE*

We demonstrate the direct generation, at a repetition of 250 kHz, of μJ -level, sub-160 fs pulses from 3 to 10 μm in a LiGaS₂ (LGS) crystal pumped at 1030 nm.

Authors:Vincent Femy, FASTLITE / Maxim Neradovskiy, FASTLITE / Thomas Pinoteau, FASTLITE / José Villanueva, FASTLITE / Olivier Albert, FASTLITE / Nicolas Forget, FASTLITE

FTh4B.5**Light-Field-Driven Current Control in Dielectrics with pJ-Level Laser Pulses at 80 MHz Repetition Rate**

Presenter: Zsuzsanna Pápa , *Wigner Research Centre for Physics*

We report detection of optically induced lightwave-driven currents in GaN, HfO₂ and SiO₂ achieved with laser oscillator pulses (80 MHz repetition rate). We demonstrate sensitivity of the current direction on the CEP of the pulses.

Authors: Vaclav Hanus, *Wigner Research Centre for Physics* / Viktoria Csajbok, *Wigner Research Centre for Physics* / Zsuzsanna Pápa, *Wigner Research Centre for Physics* / Judit Budai, *ELI-ALPS* / Zsuzsanna Márton, *ELI-ALPS* / Gellért Zsolt Kiss, *Wigner Research Centre for Physics* / Péter Sándor, *Wigner Research Centre for Physics* / Pallabi Paul, *Institute of Applied Physics* / Adriana Szeghalmi, *Institute of Applied Physics* / Zilong Wang, *Ludwig-Maximilians-Universität Munich* / Boris Bergues, *Ludwig-Maximilians-Universität Munich* / Matthias F. Kling, *Ludwig-Maximilians-Universität Munich* / György Molnár, *Centre for Energy Research* / János Volk, *Centre for Energy Research* / Péter Dombi, *Wigner Research Centre for Physics*

FTh4B.6**High-flux, 100-kHz Attosecond Pulse Train Source Driven by a High Average-Power Laser Beam**

Presenter: LÉNÁRD GULYÁS OLDAL , *ELI-ALPS, ELI-HU Non-profit Ltd.*

We report the generation of 50 pJ attosecond pulse trains at 100-kHz using a high average-power annular laser beam, which is the highest one until now among systems of repetition rate higher than 10 kHz.

Authors: Peng Ye, *ELI-ALPS, ELI-HU Non-profit Ltd.* / LÉNÁRD GULYÁS OLDAL, *ELI-ALPS, ELI-HU Non-profit Ltd.* / Tamás Csizmadia, *ELI-ALPS, ELI-HU Non-profit Ltd.* / Zoltán Filus, *ELI-ALPS, ELI-HU Non-profit Ltd.* / Tímea Grósz, *ELI-ALPS, ELI-HU Non-profit Ltd.* / Péter Jójárt, *ELI-ALPS, ELI-HU Non-profit Ltd.* / Imre Seres, *ELI-ALPS, ELI-HU Non-profit Ltd.* / Zsolt Bengery, *ELI-ALPS, ELI-HU Non-profit Ltd.* / Barnabás Gilicze, *ELI-ALPS, ELI-HU Non-profit Ltd.* / Subhendu Kahaly, *ELI-ALPS, ELI-HU Non-profit Ltd.* / Katalin Varjú, *ELI-ALPS, ELI-HU Non-profit Ltd.* / Balazs Major, *ELI-ALPS, ELI-HU Non-profit Ltd.*

10:30 - 12:00 (UTC - 07:00)

FTh4D

Advanced Materials for Photonics

President: Takuo Tanemura , *University of Tokyo*

FTh4D.1

BTO-enhanced Silicon Photonics – a Scalable Platform with Ultra-efficient Optical Switches

Invited

Presenter: Stefan Abel , *Lumiphase AG*

We demonstrate a novel BTO-enhanced silicon photonic platform for high-volume applications for communication, optical computing, and sensing. Our platform exploits an ultra-strong Pockels effect, enabling large-scale, high-speed photonic circuits with low-power consumption, low-loss, and small-footprint.

Authors:Stefan Abel, Lumiphase AG

FTh4D.2

>150 GHz Hybrid-plasmonic BaTiO₃-on-SOI Modulator for CMOS Foundry Integration

Presenter: David Moor , *Institute of Electromagnetic Fields (IEF), ETH Zurich*

A ferroelectric, metal-oxide-semiconductor (MOS) based, hybrid-plasmonic modulator is shown to feature bandwidths of >150 GHz and is tested with 32 Gbit/s NRZ. The device is relying on BaTiO₃-on-SOI and potentially offers CMOS compatibility.

Authors:David Moor, Institute of Electromagnetic Fields (IEF), ETH Zurich / Joel Winiger, Institute of Electromagnetic Fields (IEF), ETH Zurich / Ping Ma, Institute of Electromagnetic Fields (IEF), ETH Zurich / Andreas Messner, Institute of Electromagnetic Fields (IEF), ETH Zurich / Bertold Bitachon, Institute of Electromagnetic Fields (IEF), ETH Zurich / Stefan Abel, Lumiphase AG / Felix Eltes, Lumiphase AG / Jean Fompeyrine, Lumiphase AG / Juerg Leuthold, Institute of Electromagnetic Fields (IEF), ETH Zurich

FTh4D.3

Industrial Development of Graphene Electronic and Optical Devices

Invited

Presenter: Ivor Guiney , *Paragraf Limited*

There are few graphene electronic products. Reasons include graphene non-uniformity; silicon incompatibility; and high production costs. Paragraf has solved these issues. We discuss our research and products using our graphene synthesis technique.

Authors:Ivor Guiney, Paragraf Limited / Tom Badcock, Paragraf Limited / John Tingay, Paragraf Limited

FTh4D.4

Dual-wavelength mode-locked erbium-doped fiber laser based on tungsten ditelluride coated fiber taper

Presenter: Ya Liu , *Yunnan Key Laboratory of Opto-Electronic Information Technology*

A dual-wavelength mode-locked fiber laser based on a polarization-dependent tungsten ditelluride coated fiber taper is demonstrated. Mode-locking at ~1530 nm and ~1556 nm simultaneously could be realized by simply tuning the intracavity loss.

Authors:Ya Liu, *Yunnan Key Laboratory of Opto-Electronic Information Technology* / Jie Yang, *Yunnan Key Laboratory of Opto-Electronic Information Technology* / Zhigao Zhu, *Yunnan Key Laboratory of Opto-Electronic Information Technology* / Xin Tan, *Yunnan Key Laboratory of Opto-Electronic Information Technology* / Guoqing Hu, *Key Laboratory of the Ministry of Education for Optoelectronic Measurement Technology and Instrument* / Peiguang Yan, *College of Optoelectronic Engineering, Shenzhen University*

FTh4C

Computational/Transformation Optics and Display

Presenter: Guohai Situ , *Shanghai Inst. Opt. Fine Mech.*

FTh4C.1

Computational 3D/4D Holographic Imaging

Invited

Presenter: Ni Chen , *King Abdullah Univ of Sci & Technology*



We present two techniques to advance high speed and quality three-dimensional (3D) holographic imagining: the model-based 3D Holo-Net and the joint optimization framework for dynamic 3D imaging. Both are verified with numerical and optical experiments.

Authors: Ni Chen, King Abdullah Univ of Sci & Technology / Congli Wang, University of California, Berkeley / Wolfgang Heidrich, King Abdullah Univ of Sci & Technology

FTh4C.2

Waveguide-Type Maxwellian Near-Eye Display for Augmented Reality with Replicated Eyebow Using Pin-Mirror Array Holographic Optical Element

Presenter: myeong-ho Choi , *Inha University*

We propose a novel waveguide-type Maxwellian near-eye display with an eyebow replication. Pin-mirror array holographic optical element is used to implement the Maxwellian-view effect and to replicate the small eyebow of the Maxwellian display.

Authors: myeong-ho Choi, Inha University / Jae-Hyeung Park, Inha University

FTh4C.3

Singular Value Decomposition (SVD)-Entropy as a Measure for Neural Network Reconstruction and Image Complexity

Presenter: Altai Perry , *University of California Riverside*

We explore SVD entropy as a measure of modal complexity and propose a zero-mean image normalization, where chiral images carry higher image complexity. SVD entropy aids design of training data for the reconstruction of natural scenes.

Authors: Altai Perry, University of California Riverside / Xiaojing Weng, University of California Riverside / Baurzhan Muminov, University of California Riverside / Luat Vuong, University of California Riverside

FTh4C.4

Design of Shift-, Scale- and Rotation Invariant Diffractive Optical Networks

Presenter: Deniz Mengü , *University of California Los Angeles*



We investigate the sensitivity of diffractive optical networks to random object translation, scaling and rotation operations, and present a deep learning-based training strategy to design shift-, scale- and rotation invariant diffractive networks

Authors: Deniz Mengu, University of California Los Angeles / Yair Rivenson, University of California Los Angeles / Aydogan Ozcan, University of California Los Angeles

FTh4C.5

High Throughput Multi-kernel Fourier Optic Classifier

Presenter: Zibo Hu , *George Washington University*

An Optical Fourier Network is empowered by passive Fourier transformation enabling convolutional networks. We demonstrate high throughputs by parallelizing the system via multiple-input and multiple-kernel capability of the convolutional classifier.

Authors: Zibo Hu, George Washington University / Maria Solyanik-Gorgone, George Washington University / Shurui Li, University of California / Puneet Gupta, University of California / Volker Sorger, George Washington University

LTh4F

Photonics and Nanophotonics

Presenter: Jaime Rivas , *Technische Universiteit Eindhoven*

LTh4F.1

Ultra-compact Integrated Photonic Devices Enabled by Digital Metamaterials

Invited

Presenter: Berardi Sensale-Rodriguez , *University of Utah*

We discuss recent progress on the design of passive integrated photonic devices and phase-change material based active devices enabled by digital metamaterials. This is a promising approach offering advantages in terms of efficiency and footprint

Authors: Wei Jia, University of Utah / Sourangsu Banerji, University of Utah / Apratim Majumder, University of Utah / Alex Hamrick, University of Utah / Rajesh Menon, University of Utah / Berardi Sensale-Rodriguez, University of Utah

LTh4F.2

Suppressing Meta-holographic Artifacts by Laser Coherence Tuning

Presenter: Yaniv Eliezer , *Yale University*

Metaholograms suffer from coherent artifacts originating from the electromagnetic cross-talk and nanoscale defects. Here, we introduce an efficient method to remove the artifacts by precisely fine-tuning the spatial coherence of illumination.

Authors:Yaniv Eliezer, Yale University / Geyang Qu, Ministry of Industry and Information Technology Key Lab of Micro-Nano Optoelectronic Information System, Shenzhen Graduate School, Harbin Institute of Technology / Wenhong Yang, Ministry of Industry and Information Technology Key Lab of Micro-Nano Optoelectronic Information System, Shenzhen Graduate School, Harbin Institute of Technology / Yujie Wang, Ministry of Industry and Information Technology Key Lab of Micro-Nano Optoelectronic Information System, Shenzhen Graduate School, Harbin Institute of Technology / Hasan Yilmaz, Yale University / Shumin Xiao, Ministry of Industry and Information Technology Key Lab of Micro-Nano Optoelectronic Information System, Shenzhen Graduate School, Harbin Institute of Technology / Qinghai Song, Ministry of Industry and Information Technology Key Lab of Micro-Nano Optoelectronic Information System, Shenzhen Graduate School, Harbin Institute of Technology / Hui Cao, Yale University

LTh4F.3

Frontiers in Nanophotonics: Enabling Technology for Next-generation Biosensors

Invited

Presenter: Hatice Altug , *Ecole Polytechnique Federale de Lausanne*

In this talk, I will present our research on nanophotonics based high performance biosensing, mid-infrared spectroscopy, and bioimaging technologies as well as demonstrate their applications on areas including disease diagnostics and life sciences.

Authors:Hatice Altug, Ecole Polytechnique Federale de Lausanne

LTh4F.4

High-momentum 2D Exciton-polaritons in Monolayer Semiconductors

Presenter: Itai Epstein , *Tel Aviv University*



We predict the existence of in-plane propagating exciton-polaritons supported by monolayer semiconductors, which can carry large momentum in the visible spectrum, exhibiting two orders-of-magnitudes larger confinement compared to plasmon-polaritons.

Authors:Itai Epstein, Tel Aviv University / Frank Koppens, ICFO

FTh4A

Computational Imaging with Machine Learning

Presenter: Sixian You , *Massachusetts Institute of Technology*

FTh4A.1

Deep Optics

Invited

Presenter: Gordon Wetzstein , *Stanford University*

We discuss strategies for the co-design of optics and image processing to engineer hybrid optical-digital computational imaging and optical computing systems.

Authors:Gordon Wetzstein, Stanford University

FTh4A.2

Virtual Biomarkers for Next Generation Pathology

Invited

Presenter: Yair Rivenson , *Pictor Labs*

In this talk we'll focus on the unprecedented opportunities of virtual biomarkers to reshape the field of histopathology through recent advancements in computer vision and high-throughput slide scanning microscopes.

Authors:Yair Rivenson, Pictor Labs

FTh4A.3

Reduce Computational Complexity! Inspiration from Flies

Invited

Presenter: Luat Vuong , *University of California Riverside*

Inspired by clustered typologies of anthropod corneal nanostructures, we study the optical preprocessing of visual data with shallow, dense, neural networks. We focus on the role of topological defects in encoders that reduce computational complexity.

Authors: Luat Vuong, University of California Riverside

11:00 - 11:30 (UTC - 07:00)

SpE15

Special Event - Tech Talk: Topological Insulator Lasers

11:00 - 12:30 (UTC - 07:00)

Th2A

Precision Measurements and Quantum Metrology III

Presenter: Benjamin Brecht , *Paderborn University*

Th2A.1

(Withdrawn) Realization of an ion Trap Quantum Classifier

Presenter: Tarun Dutta , *National University of Singapore*

We report the experimental realization of a versatile quantum classifier that uses the data re-uploading supervised machine learning algorithm based on a single-ion quantum processing unit. The accuracy of our classifier is benchmarked on a variety of datasets, finding the separation of the classes associated with regions in various dimensions.

Authors: Tarun Dutta, National University of Singapore

Th2A.2



Resolving Two Bright Correlated Thermal Point-Sources

Presenter: Ilya Karuseichyk , Sorbonne University

We present an analytical expression for the sensitivity of point-sources' separation estimation for correlated thermal sources for both spatial mode demultiplexing and direct imaging. The result obtained does not rely on the assumption of low-intensity sources.

Authors: Ilya Karuseichyk, Sorbonne University / Giacomo Sorelli, Sorbonne University / Mattia Walschaers, Sorbonne University / Manuel Gessner, ENS / Nicolas Treps, Sorbonne University

Th2A.3

Using Outcome Purity to Compare Multiplexed Detectors

Presenter: Timon Schapeler , Paderborn University

We use quantum detector tomography to compare the outcome purity of four classes of multiplexed SNSPDs. This allows a direct method of comparing the quality of different multiplexing architectures for practical applications.

Authors: Timon Schapeler, Paderborn University / Jan Philipp Hoepker, Paderborn University / Tim J. Bartley, Paderborn University

Th2A.4

Rigorous Characterization of Single-Photon Detectors Using Generalized Decoy-State Scheme

Presenter: Gong Zhang , National University of Singapore

We experimentally demonstrate a generalized decoy-state scheme to rigorously characterize the efficiency and noise of single-photon detectors with relaxed requirement on the detector's physical model, which could open new possibilities in device calibration standards.

Authors: Gong Zhang, National University of Singapore / Haibo Wang, National University of Singapore / Jishen Zhang, National University of Singapore / Chao Wang, National University of Singapore / Haiwen Xu, National University of Singapore / Yan Liang, University of Shanghai for Science and Technology / Charles Lim, National University of Singapore / Xiao Gong, National University of Singapore

Th2A.5



Spreading of Quantum Information Through a Disordered Quantum Walk

Presenter: Farzam Nosrati , *Universita di Palermo*

We propose a quantum probing protocol, a Mach-Zehnder-like interferometric setup, employing quantum walks to explore quantum information spreading patterns, such as anomalous and classical transport, as well as Anderson localization.

Authors: Farzam Nosrati, *Universita di Palermo* / Alessandro Laneve, *Dipartimento di Fisica, Sapienza Universit\`{a} di Roma* / Mashid Khazaei Shadfar, *Universita di Palermo* / Andrea Gerdani, *Dipartimento di Fisica, Sapienza Universit\`{a} di Roma* / Kobra Mahdavi pour, *Universita di Palermo* / Federico Pegoraro, *Dipartimento di Fisica, Sapienza Universit\`{a} di Roma* / Paolo Mataloni, *Dipartimento di Fisica, Sapienza Universit\`{a} di Roma* / Rosario Lo Franco, *Dipartimento di Ingegneria*

Th2A.6

Activating Hidden Metrological Usefulness

Presenter: Geza Toth , *UPV/EHU*

We consider bipartite entangled states that cannot outperform separable states in any linear interferometer. We show that these states can be more useful metrologically than separable states if several copies of the state are provided or an ancilla is added.

Authors: Geza Toth, *UPV/EHU*

Th2B

Quantum Optics of Light-atom Interactions II

Presenter: Michael Duncan , *Optica*

Th2B.1

Strong Rydberg-Mediated Photon-Photon Interactions

Invited

Presenter: Ofer Firstenberg , *Weizmann Institute of Science*



Rydberg atoms can mediate effective interaction between individual photons, leading to quantum nonlinear optics. I will present recent achievements in this field, including observation of high-order photonic bound states and strong three-photon interactions.

Authors: Ofer Firstenberg, Weizmann Institute of Science

Th2B.2

Preparation and Laser Trapping of Cold Circular Rydberg Atoms for Quantum Simulation

Presenter: Paul Méhaignerie , *Laboratoire Kastler Brossel*

We report on our recent experimental results that pave the way for the realization of quantum simulations with Circular Rydberg atoms: we present the preparation and laser-trapping of these states in an optical-access cryostat.

Authors: Paul Méhaignerie, Laboratoire Kastler Brossel

Th2B.3

Quantum Control of two-Level Atoms With far-Detuned few-Cycle Pulses - an Analytical Case

Presenter: Bing Zeng , *The University of Alabama in Huntsville*

A two-level system driven by a far-off-resonance few-cycle square pulse is theoretically analyzed. A closed-form solution well-matched with simulation is presented without using the rotating wave approximation.

Authors: Bing Zeng, The University of Alabama in Huntsville / Lingze Duan, The University of Alabama in Huntsville

Th2B.4

Coherence of Light Scattered by a Large Number of Independent Single-Photon Emitters

Presenter: Lukas Slodicka , *Palacky University*



We present the experimental characterization of coherence of light scattered from ensembles of noninteracting trapped ions. We set up and prove an indistinguishable emission from many ions by observation of photon bunching in a single-mode Hanbury-Brown and Twiss detection scheme.

Authors: Lukas Slodicka, Palacky University / Artem Kovalenko, Palacky University / Lukas Lachman, Palacky University / Dung Tran, Palacky University / Daniel Babjak, Palacky University / Adam Lešundák, Czech Academy of Sciences / Tuan Pham, Czech Academy of Sciences / Lukas Podhora, Palacky University / Ondrej Číp, Czech Academy of Sciences / Radim Filip, Palacky University

Th2B.5

Optimal Quantum Feedback Algorithm for Spin Ensemble Purification

Presenter: Urs Haeusler, *University of Cambridge*

We present a coherent quantum feedback algorithm to purify a mesoscopic spin ensemble at the ultimate level of a single spin. Moreover our feedback can engineer classically correlated states extending over multiple modes.

Authors: Urs Haeusler, University of Cambridge / Daniel Jackson, University of Cambridge / Leon Zaporski, University of Cambridge / Jonathan Bodey, University of Cambridge / Noah Shofer, University of Cambridge / Mete Atatüre, University of Cambridge / Claire Le Gall, University of Cambridge / Dorian Gangloff, University of Cambridge

Th2C

Quantum Information Processing and Computing I

Presenter: Alexander Huck

Th2C.1

Quantum Information Processing of Entangled Photons With a Programmable Multi-Plane Light Converter

Presenter: Ohad Lib, *The Hebrew University of Jerusalem*



We demonstrate a reconfigurable and scalable processor of entangled photons based on multi-plane light conversion and perform key tasks of quantum information processing including high-dimensional entanglement certification, arbitrary state transformations, and mode conversion.

Authors: Ohad Lib, The Hebrew University of Jerusalem / Kfir Sulimany, The Hebrew University of Jerusalem / Yaron Bromberg, The Hebrew University of Jerusalem

Th2C.2

Ab-Initio Automated Optimization of Nonlocality in Photonic Quantum States

Presenter: Emanuele Polino, *La Sapienza*

We push to the limit the device-independent paradigm by implementing an adaptive automated algorithm able to optimize the nonclassicality of unknown quantum systems, tuning parameters with unknown response functions.

Authors: Davide Poderini, *La Sapienza* / Emanuele Polino, *La Sapienza* / Giovanni Rodari, *La Sapienza* / Alessia Suprano, *La Sapienza* / Rafael Chaves, *Federal University of Rio Grande do Norte* / Fabio Sciarrino, *La Sapienza*

Th2C.3

(Withdrawn) Correlation Measures on Spin Squeezing Model Under the Effect of Intrinsic Decoherence

Presenter: Venkat Abhignan, *National Institute of Technology, Trichy*

We study the effects of intrinsic decoherence on a spin squeezing model by measuring the dynamic nature of quantum correlations quantified by entanglement, steering and measurement-induced nonlocality (MIN). We show the robust natures of quantum steering and MIN, which go beyond entanglement.

Authors: Venkat Abhignan, *National Institute of Technology, Trichy* / Muthuganesan R., *SASTRA Deemed University*

Th2C.4

Certification of Incompatible Measurements Using Quantum Steering

Presenter: Shubhayan Sarkar, *Center for Theoretical Physics*



We propose a one-sided device-independent protocol for certification of any set of d-outcome projective measurements that are “genuinely incompatible measurements” meaning that they do not share any invariant subspace including mutually unbiased bases.

Authors: Shubhayan Sarkar, Center for Theoretical Physics / Debashis Saha, Center for Theoretical Physics / Remigiusz Augusiak, Center for Theoretical Physics

Th2C.5

A Long-Lived Spin Qubit in an Optically Active Semiconductor Quantum dot

Presenter: Leon Zaporski , *University of Cambridge*

We report on the first spin-control experiments in optically active GaAs/AlGaAs quantum dots. Using dynamic decoupling, we retain a quantum superposition for up to 27 μ s, a ten-fold improvement over the state-of-the-art.

Authors: Leon Zaporski, University of Cambridge / Jonathan Bodey, University of Cambridge / Noah Shofer, University of Cambridge / Santanu Manna, JKU / Daniel Jackson, University of Cambridge / Saimon Covre Da Silva, JKU / Urs Haeusler, University of Cambridge / Mete Atatüre, University of Cambridge / Dorian Gangloff, University of Cambridge / Armando Rastelli, JKU / Claire Le Gall, University of Cambridge

Th2C.6

Optical Investigation of GeV Center in Diamond Observation of Energy Level Fluctuations and Blinking

Presenter: Maxime Bergamin , *DTU*

We report on the detailed spectroscopic investigation of a deeply implanted Germanium vacancy centers in diamond at cryogenic temperatures and using a resonant cross-polarization excitation scheme.

Authors: Maxime Bergamin, DTU / Daniel Allepuz Requena, DTU / Ilya Radko, DTU / Erika Janitz, McGill University / Lilian Childress, McGill University / Alexander Huck, DTU / Ulrik Lund Andersen, DTU

12:30 - 13:00 (UTC - 07:00)

SpE11

Special Event - Thursday Virtual Coffee Break I

12:40 - 13:00 (UTC - 07:00)

HT2

Exhibit Hall Event - Hot Topic Coffee Break: Will Congress Provide a Windfall for Science Budgets?

13:00 - 13:45 (UTC - 07:00)

SpE20

Special Event - Fiber Optics Technology and Applications
Technical Group Special Talk on Fiber Sensors

13:00 - 14:00 (UTC - 07:00)

Exhibit Hall Event - Dedicated Exhibit Time

13:00 - 14:30 (UTC - 07:00)



Th4A

Quantum Imaging I

Presenter: Radek Lapkiewicz , *Uniwersytet Warszawski*

Th4A.2

Engineering Spatial Correlations in Entangled Twin Beams

Presenter: Gaurav Nirala , *The University of Oklahoma*

We show full control over the spatial correlations in a macroscopic quantum state of light generated via four-wave mixing. Taking advantage of momentum conservation, we engineer the distribution of the correlations via control of the angular spectrum of the pump.

Authors: Gaurav Nirala, The University of Oklahoma / Siva Pradyumna, The University of Oklahoma / Ashok Kumar, The University of Oklahoma / Alberto Marino, The University of Oklahoma

Th4A.4

Resolution of two-Color Quantum Imaging With Undetected Photons

Presenter: Andres Vega , *Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena*

We analyze the diffraction-limited resolution of quantum imaging with undetected photons with non-degenerate photon-pairs. We find that the resolution is half of the longest of both wavelengths and is achieved using sources with sub-wavelength thicknesses.

Authors: Andres Vega, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Elkin Santos, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Jorge Fuenzalida, Fraunhofer Institute for Applied Optics and Precision Engineering IOF / Marta Gilaberte Basset, Fraunhofer Institute for Applied Optics and Precision Engineering IOF / Thomas Pertsch, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Markus Gräfe, Fraunhofer Institute for Applied Optics and Precision Engineering IOF / Sina Saravi, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Frank Setzpfandt, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena

Th4A.5**Subwavelength-Resolution Imaging With Undetected Photons Using Thin Sources of Photon Pairs**

Presenter: Elkin Santos , *Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena*

We present an imaging scheme with undetected photons that overcomes the diffraction limit by transferring near-field information at the wavelength that illuminates the object to the far-field of its paired wavelength generated in a thin photon-pair source.

Authors:Elkin Santos, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Sina Saravi, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena / Thomas Pertsch, Fraunhofer Institute for Applied Optics and Precision Engineering IOF, / Frank Setzpfandt, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University Jena

Th4A.1**(Withdrawn) Imaging and Spectroscopy With Mid-IR Undetected Photons**

Invited

Presenter: Sven Ramelow , *Humboldt Universität zu Berlin*

Nonlinear Interferometers based on SPDC enable compact and cost-effective sensing at otherwise challenging wavelength regions such as the mid-IR. Here, we present experimental results on imaging, spectroscopy and OCT and highlight their potential on real-world, industry-ready applications.

Authors:Sven Ramelow, Humboldt Universität zu Berlin

Th4A.3**Asynchronous Quantum Ghost Imaging**

Presenter: Carsten Pitsch , *Karlsruhe Institute of Technology*

We implemented a novel setup for quantum ghost imaging using two asynchronously running detectors. The subsequent temporal evaluation allows photon pair matching independent of the path length of the photons, thus enabling efficient 3D Imaging.

Authors:Carsten Pitsch, Karlsruhe Institute of Technology / Dominik Walter, Fraunhofer IOSB

Th4B

Integrated and On-chip Quantum Devices I

Presenter: Michael Duncan , *Optica*

Th4B.1

Advanced Quantum State Engineering With Pockels Nonlinear Integrated Optics

Invited

Presenter: Linran Fan , *University of Arizona*

Pockels nonlinearity provides advantages in the efficiency and functionality of quantum state engineering. In this talk, we will present our recent result in the generation of complex quantum states including squeezed light and high-dimensional hyperentanglement.

Authors: Linran Fan, University of Arizona

Th4B.2

(Withdrawn) Squeezed Light Generation and Characterization With an Integrated Thin-Film Lithium Niobate Nanophotonic Circuit

Presenter: Hubert Stokowski , *Stanford University*

We present an integrated photonic system for generating and characterizing squeezed light. Using a 1554 nm pump with 40 mW of power from a continuous-wave laser, we detect 1.01 ± 0.02 dB of squeezing (≈ 8 dB on chip).

Authors: Hubert Stokowski, Stanford University / Timothy McKenna, Stanford University / Vahid Ansari, Stanford University / Taewon Park, Stanford University / Alex Hwang, Stanford University / Jatadhari Mishra, Stanford University / Marc Jankowski, Stanford University / Carsten Langrock, Stanford University / Martin Fejer, Stanford University / Amir Safavi-Naeini, Stanford University

Th4B.3

Coupling Emission From Strained Hexagonal Boron Nitride Thin Films to Monolithic Buckled Microcavities

Presenter: Kyle Scheuer , *University of Alberta*



We show design and fabrication processes for an optical cavity compatible with emission from continuous hBN films. We also present preliminary optical results. Our results provide a scalable approach for on-chip single photon emitters.

Authors: Kyle Scheuer, University of Alberta / Phillip Kirwin, University of Alberta / Ray DeCorby, University of Alberta

Th4B.5

Fibre-Integrated Laser-Written Quantum Memory for Light-Matter Entanglement

Presenter: Jelena Rakonjac , *ICFO-The Institute of Photonic Sciences*

We demonstrate the storage of light-matter entanglement between a telecom photon and an integrated solid-state quantum memory. The quantum memory is a fibre-coupled waveguide written in a rare-earth doped crystal.

Authors: Jelena Rakonjac, *ICFO-The Institute of Photonic Sciences* / Giacomo Corrielli, *Istituto di Fotonica e Nanotecnologie (IFN) - CNR and Dipartimento di Fisica* / Dario Lago-Rivera, *ICFO-The Institute of Photonic Sciences* / Alessandro Seri, *ICFO-The Institute of Photonic Sciences* / Margherita Mazzera, *Heriot-Watt University* / Samuele Grandi, *ICFO-The Institute of Photonic Sciences* / Roberto Osellame, *Istituto di Fotonica e Nanotecnologie (IFN) - CNR and Dipartimento di Fisica* / Hugues de Riedmatten, *ICFO-The Institute of Photonic Sciences*

Th4B.4

Quantum Cryptography With a Full-Fledged Photonic Integrated Chip System

Presenter: Davide Marangon , *Toshiba Europe Limited - Cambridge Research Laboratory*



Integrated photonics can enable a wide deployment of quantum cryptography but this integration is technologically challenging. We addressed the challenges and built a complete, real-time and deployable quantum key distribution system based on integrated photonics.

Authors: Davide Marangon, Toshiba Europe Limited - Cambridge Research Laboratory / Taofiq Paraïso, Toshiba Europe Limited - Cambridge Research Laboratory / Thomas Roger, Toshiba Europe Limited - Cambridge Research Laboratory / Innocenzo De Marco, Toshiba Europe Limited - Cambridge Research Laboratory / Mirko Sanzaro, Toshiba Europe Limited - Cambridge Research Laboratory / Robert Woodward, Toshiba Europe Limited - Cambridge Research Laboratory / James Dynes, Toshiba Europe Limited - Cambridge Research Laboratory / Zhiliang Yuan, Toshiba Europe Limited - Cambridge Research Laboratory / Andrew Shields, Toshiba Europe Limited - Cambridge Research Laboratory

14:00 - 14:30 (UTC - 07:00)

SpE16

Special Event - Tech Talk: Generalized Collective Mode Spectroscopy and Quantum Probes of Quantum Matter from a Theory Perspective

14:00 - 15:00 (UTC - 07:00)

JTh5A

Joint Poster Session III

JTh5A.1

Optimizing Direct-Field Acceleration of Electrons by Tuning the Gouy Phase

Presenter: Shanny Pelchat-Voyer , *Université Laval*

We show using test-particle simulations that the energy gain from direct-field acceleration can be improved by up to 50 % using paraxial radially polarized laser pulses with a total Gouy phase variation under 2π .

Authors: Shanny Pelchat-Voyer, Université Laval / Michel Piché, Université Laval

JTh5A.2

Experimental Demonstration of Conditional Weak Measurement and Its Use on Incompatible Observables

Presenter: Thomas Bailey , *University of Ottawa*

We experimentally demonstrate a method to find the joint value of incompatible observables using two successive weak measurements, where the result of the second is conditional on the first.

Authors: Thomas Bailey, University of Ottawa / Raphael Abrahao, University of Ottawa / Jeff Lundeen, University of Ottawa

JTh5A.3

Entanglement of Photonic Angular Qudits

Presenter: Graciana Puentes , *University of Buenos Aires*

We report a scheme to generate maximally entangled states in D -dimensional quantum systems using angular diffraction masks containing $N=D^{1/2}$ angular slits in the arms of correlated twin photons produced by Spontaneous Parametric Down Conversion.

Authors: Graciana Puentes, University of Buenos Aires / Giacomo Sorelli, Laboratoire Kastler Brossel

JTh5A.4

Emergence of Coherent Backscattering from Specific Realizations of Coherent Wave Scattering in Disordered Media

Presenter: Nooshin Mohammadi Estakhri , *University of Michigan*



Interactions between a coherent beam and random media can create enhanced coherent backscattering effects. Using a first-principles scattering model for scalar waves, we study this phenomenon for specific disordered geometries.

Authors:Nooshin Mohammadi Estakhri, University of Michigan / Theodore Norris, University of Michigan

JTh5A.5

Bound States in the Continuum-assisted High-Q Optical Absorption using Resonant Dielectric Metasurfaces on Metal

Presenter: Guoce Yang , *Emory University*

The appropriate gap distance between Mie resonant dielectric metasurfaces and a metal mirror can control bound states in the continuum without any broken geometric symmetry and enable high-Q optical perfect absorbers.

Authors:Guoce Yang, Emory University / Monica Allen, Munitions Directorate / Jeffery Allen, Munitions Directorate / Hayk Harutyunyan, Emory University

JTh5A.6

Resonator-Free Sub-MHz Spectral Feature Using Polarization-Dependent Gain in a Spun Fiber

Presenter: Neel Choksi , *University of Toronto*

We demonstrate a novel resonator-free approach to realize tunable, sub-MHz features by exploiting gain-enhanced polarization pulling in a spun fiber. A 0.72 MHz dip is experimentally achieved, equivalent to a Q-factor approaching 1 billion.

Authors:Neel Choksi, University of Toronto / Yi Liu, University of Toronto / Rojina Ghasemi, University of Toronto / Li Qian, University of Toronto

JTh5A.7

Decay of a Single Atom Coupled to One-dimensional Guided Photonic Modes

Presenter: Logan Patrick , *Miami University*



Emitters coupled to waveguides have emerged as ideal platforms to achieve strong light-matter interaction in recent experiments. Here, we study the decaying of an atom into one-dimensional guided photonic modes using the master equation approach.

Authors: Logan Patrick, Miami University / Umar Arshad, Miami University / Pawan Khatiwada, Miami University / Imran Mirza, Miami University

JTh5A.8

Conversion from Atomic to Telecom Photons by Four-wave Mixing in Optically Pumped Warm Rb

Presenter: Jonathan Kwolek , *U.S. Naval Research Lab*

We convert atomic photons of the ^{87}Rb D1 transition at 795 nm to telecom photons at 1529 nm with efficiency of 6% by employing four-wave mixing in a warm vapor. Optical pumping enhances the four-wave mixing process, enabling such high efficiency.

Authors: Jonathan Kwolek, U.S. Naval Research Lab / Adam Black, U.S. Naval Research Lab / Mark Bashkansky, U.S. Naval Research Lab

JTh5A.9

Implementation of a PoF/RoF-based 5G NR Mobile Fronthaul

Presenter: Arismar Cerqueira Sodre Junior , *National Institute of Telecommunications (Inatel)*

We report the implementation of a 5G NR mobile fronthaul based on power-over-fiber (PoF) and radio-over-fiber (RoF) technologies. Over 475 mW was delivered to an RoF module at 23.5% efficiency.

Authors: Letícia Carneiro de Souza, National Institute of Telecommunications (Inatel) / Eduardo Saia Lima, National Institute of Telecommunications (Inatel) / Arismar Cerqueira Sodre Junior, National Institute of Telecommunications (Inatel)

JTh5A.10

A Study on the Analysis of the Raman Spectra of Furin and Peptide-O

Presenter: Michael Stroschio , *University of Illinois at Chicago*



Furin and Peptide-O (PepO) play significant roles in several biological processes. Therefore, their Raman spectra can be useful to researchers. Here, we have obtained and characterized the Raman spectrum of furin and PepO.

Authors:Shreya Ghosh, University of Illinois at Chicago / Joel Schwartz, University of Illinois at Chicago / Mitra Dutta, University of Illinois at Chicago / Michael Stroschio, University of Illinois at Chicago

JTh5A.11

Single-pass Cutting of Glass Using Ultrafast Airy Beams

Presenter: Craig Ungaro , *Corning Inc.*

Modified ultrafast Airy beams are used to cut glass samples with a rounded edge using a single pass process. Energy absorption during the process is analyzed via nonlinear modeling.

Authors:Craig Ungaro, Corning Inc. / Anping Liu, Corning, Inc.

JTh5A.12

Space-time Wave Packets with Arbitrary Acceleration Profiles

Presenter: Murat Yessenov , *CREOL, University of Central Florida*

We present space-time wave packets with fully controllable axial acceleration profiles, including pulses with superlinear acceleration/deceleration and pulses first accelerating then decelerating upon free space propagation.

Authors:Murat Yessenov, CREOL, University of Central Florida / Layton Hall, CREOL, University of Central Florida / Ayman Abouraddy, CREOL, University of Central Florida

JTh5A.13

Synthesis of Space-time Wave Packets Localized in All Dimensions

Presenter: Murat Yessenov , *CREOL, University of Central Florida*

We present the first demonstration of space-time wave packets localized in all dimensions. We confirm the diffraction-free propagation in free space stemming from tight spatio-temporal correlation. and compare them with that of a pulsed Bessel beam.

Authors:Murat Yessenov, CREOL, University of Central Florida / Zhaozhong Chen, University of Glasgow / Martin Lavery, University of Glasgow / Ayman Abouraddy, CREOL, University of Central Florida

JTh5A.14**Portable Cellphone-Based Digital Lensless Holographic Microscope****Presenter:** MARIA LOPERA , *Universidad EAFIT*

The implementation of a compact and portable digital lensless holographic microscope (P-DLHM) attached to a cellphone is presented. This proposal offers a potential tool for telemedicine applications via the *in-situ* study of biological samples.

Authors:MARIA LOPERA, Universidad EAFIT / Carlos Trujillo, Universidad EAFIT**JTh5A.15****Thermo-optic enhancement of the optomechanical transduction****Presenter:** Cauê Moreno Kersul de Castro Carvalho , *University of Campinas*

We show how the dynamic thermo-optic effect can be used to enhance the optomechanical transduction. As an example, we compare thermo-optic effects in silicon on oxide against silicon on diamond devices.

Authors:Cauê Moreno Kersul de Castro Carvalho, University of Campinas / André Primo, University of Campinas / Gustavo Wiederhecker, University of Campinas / Thiago Alegre, University of Campinas**JTh5A.16****Temporal Study of a Nd³⁺ Doped TZA Glass Random Laser****Presenter:** Jessica Dipold , *IPEN/CNEN*

The temporal behavior of TeO₂-ZnO pellets of different Nd concentrations is studied. A shortening of the decay time is observed, indicating random laser behavior for this new laser material.

Authors:Jessica Dipold, IPEN/CNEN / Evellyn Magalhaes, Escola Politecnica da USP / Camila Bordon, Escola Politecnica da USP / Luciana Kassab, Faculdade de Tecnologia de Sao Paulo / Niklaus Wetter, IPEN/CNEN**JTh5A.17****Graphene-based Mid-infrared Plasmonic Conveyor Belt Network for Versatile Manipulations of Nanoscale Objects****Presenter:** Peter Liu , *University at Buffalo*

A mid-infrared graphene plasmonic conveyor belt network can induce tunable bipolar optical gradient forces on nano-objects made of dispersive materials, which can be exploited for trapping, transportation, sorting and fractionation of nano-objects.

Authors: Peter Liu, University at Buffalo / Puspita Paul, University at Buffalo

JTh5A.21

Clock Synchronization using the Quantum Zeno Effect

Presenter: Saurabh Shringarpure , *University of Maryland Baltimore County*

We investigate the use of the quantum Zeno effect to prevent the desynchronization of two-level atomic clocks by frequently measuring an observable of the combined state of the system.

Authors: Saurabh Shringarpure, University of Maryland Baltimore County / James Franson, University of Maryland Baltimore County

JTh5A.22

Surface to Volume Ratio as a Design Principle for ENZ-based Plasmon Assisted Electro-Optic Modulators

Presenter: Mohammad Ariful Hoque Sojib , *Virginia Commonwealth University*

Increasing the ratio of ENZ surface area to device volume containing TCO material exhibits improved performance for the ENZ-based Electro-absorption Modulator in terms of the ratio of Extinction Ratio and Insertion Loss.

Authors: Mohammad Ariful Hoque Sojib, Virginia Commonwealth University / Dhruv Fomra, Virginia Commonwealth University / Vitaliy Avrutin, Virginia Commonwealth University / Nathaniel Kinsey, Virginia Commonwealth University

JTh5A.23

A Non-Markovian Model of the Photosynthetic Reaction Center

Presenter: Antonio Lim , *Miami University*

In this work, we present a realistic dissipative five-level quantum heat engine model of the photosynthetic reaction center which demonstrates greater levels of achieved and sustained coherence than its Markovian analogue.

Authors: Antonio Lim, Miami University / Zibo Wang, Miami University / Imran Mirza, Miami University

JTh5A.24**Optimization of diamond optomechanical crystal cavities**

Presenter: Flavio Moraes , *University of Campinas - UNICAMP*

In this work, we improved a design optimization method for OMC cavities, combining FEM simulations with Dakota optimization toolkit. We achieved a diamond based nanobeam with high optical quality factor and largest reported optomechanical coupling.

Authors: Flavio Moraes, University of Campinas - UNICAMP / Emerson de Melo, University of São Paulo / Gabriel de Aguiar, University of Campinas - UNICAMP / Gustavo Wiederhecker, University of Campinas - UNICAMP / Thiago Alegre, University of Campinas - UNICAMP

JTh5A.25**Realization of Bi-directional Superluminal Ring Lasers Using Adjacent Transitions in Two Isotopes of Rubidium**

Presenter: Zifan Zhou , *Northwestern University*

We present the experimental realization of simultaneous bi-directional superluminal lasing in a triangular ring cavity. The sensitivity enhancements of the lasers, inferred from simulation, are 505 and 362 at the two-photon resonance frequency.

Authors: Zifan Zhou, Northwestern University / Nicholas Condon, Digital Optics Technologies / Devin Hileman, Digital Optics Technologies / Shih Tseng, Digital Optics Technologies / Selim Shahriar, Northwestern University

JTh5A.28**The Coherence-Orbital Angular Momentum Representation of Partially Coherent Beams**

Presenter: Gregory Gbur , *University of North Carolina at Charlotte*

We discuss the properties of the COAM (coherence-orbital angular momentum) formalism for describing the OAM properties of partially coherent beams, and possible uses in applications.

Authors: Gregory Gbur, University of North Carolina at Charlotte / Olga Korotkova, University of Miami

JTh5A.29

Second Harmonic Generation of Spatiotemporal Optical Vortices and Conservation of Orbital Angular Momentum

Presenter: Sina Zahedpour Anaraki , *University of Maryland, College Park*

We experimentally demonstrate for the first time the second harmonic generation of spatiotemporal optical vortices (STOVs), conservation of STOV orbital angular momentum (OAM) and verify STOV photons can have OAM orthogonal to propagation.

Authors:Sina Zahedpour Anaraki, University of Maryland, College Park / Scott Hancock, University of Maryland, College Park / Howard Milchberg, University of Maryland, College Park

JTh5A.30

Custom Terahertz Pulses for Nonlinear Vibrational Excitation

Presenter: Claire Rader , *Brigham Young University*

We combine THz pulses from two complimentary crystals to increase peak field strength and create a broad, smooth spectrum. We show the utility of using this strong THz pulse to nonlinearly excite vibrations in solids

Authors:Claire Rader, Brigham Young University / Brittany Knighton, Brigham Young University / Zachary Zaccardi, Brigham Young University / David Michaelis, Brigham Young University / Jeremy Johnson, Brigham Young University

JTh5A.31

Modeling Ultrafast Anharmonic Vibrational Coupling in Gas-Phase Fluorobenzene Molecules

Presenter: Aldair Alejandro , *Brigham Young University*

We use first-principles calculations to model ultrafast anharmonic coupling in gas-phase fluorobenzene after excitation with a multi-THz pump. Understanding intramolecular energy flow is crucial to understanding collisional energy transfer.

Authors:Aldair Alejandro, Brigham Young University / Emma Nelson, Brigham Young University / Eric Sevy, Brigham Young University / Jeremy Johnson, Brigham Young University

JTh5A.33

Tunable Magnon-Photon Beam-Splitter Based on a Cold Atomic Cloud

Presenter: Jiefei Chen , *Southern University of Science and Technology*

The flying photons are stored into an atomic cloud as “magnons”, i.e., the ground-state atomic excitation. A tunable magnon-photon beam-splitter, which induces interference from Hermitian to non-Hermitian, is demonstrated through a cold atomic cloud.

Authors:Jiefei Chen, Southern University of Science and Technology

JTh5A.34

Transparent Boundary Conditions for Quasi-Bound States in Open Systems

Presenter: Jonathan Heinz , *University of Arizona*

We investigate novel transparent boundary conditions that reduce the size of quasi-bound state simulations in open systems. This method has applications in many areas, including tunneling ionization rates and leaky modes in fibers.

Authors:Jonathan Heinz, University of Arizona / Miroslav Kolesik, University of Arizona

JTh5A.35

N00N States Dynamics in Jaynes-Cummings Arrays

Presenter: Adriana Cruz , *Miami University*

We analyze the dissipative dynamics of uni- and bi-photon N00N states in Jaynes-Cummings arrays with fiber-coupled many qubit-cavity subsystems. We use quantum state fidelity to track the N00N state transfer from qubits to cavity modes.

Authors:Adriana Cruz, Miami University / Imran Mirza, Miami University

JTh5A.36

Experimental Violation of the Leggett-Garg Inequality with Classical Light

Presenter: Wenlei Zhang , *Tulane University*

We experimentally demonstrate the violation of the Leggett-Garg inequality using the polarization of a classical laser beam. Our results show maximum violation of the Leggett-Garg inequality with a macroscopic system.

Authors:Wenlei Zhang, Tulane University / Ravi Saripalli, Tulane University / Jacob Leamer, Tulane University / Ryan Glasser, Tulane University / Denys Bondar, Tulane University

JTh5A.37**Nanoparticle Trapping Using Quasi-BIC Modes**

Presenter: Sen Yang , *Vanderbilt University*

We propose an all-dielectric nanotweezer based on quasi-bound states in the continuum for low laser power optical trapping with negligible heating effect. Optical measurements for the packaged chip are presented as well.

Authors: Sen Yang, Vanderbilt University / Chuchuan Hong, Vanderbilt University / Justus Ndukaife, Vanderbilt University

JTh5A.38**Radio Frequency Interference Management with Free-Space Optical Communication and Photonic Signal Processing**

Presenter: Yang Qi , *Rowan University*

We design and experimentally demonstrate a radio frequency interference management system with free-space optical communication and photonic signal processing. The system provides real-time interference cancellation in 6 GHz wide bandwidth.

Authors: Yang Qi, Rowan University / Ben Wu, Rowan University

JTh5A.39**Free Space Wavelength Division Multiplexing Around 1550 nm Using PQ:PMMA Transmission Holograms**

Presenter: Julian Gamboa , *Northwestern University*

We demonstrate PQ:PMMA transmission holograms for free space wavelength division multiplexing around 1550 nm, which can be used in free-space communication systems that require eye-safe lasers. The wavelength can be customized during fabrication.

Authors: Julian Gamboa, Northwestern University / Tabassom Hamidfar, Northwestern University / Joseph Vonckx, Digital Optics Technologies / Mohamed Fouda, Digital Optics Technologies / Selim Shahriar, Northwestern University

JTh5A.40**Collisions of Moving Gap Solitons in a Nonlinear Dual-Core System with a Uniform Bragg Grating and a Bragg Grating with Dispersive Reflectivity**

Presenter: Md Bellal Hossain , *The University of Sydney*

We analyze the dynamics of colliding moving solitons in a dual-core system where one core possesses a uniform Bragg grating and the other core has a Bragg grating with dispersive reflectivity.

Authors: Md Bellal Hossain, The University of Sydney / Javid Atai, The University of Sydney

JTh5A.41

Interaction of solitons in a semilinear dual-core Bragg grating with phase mismatch

Presenter: Shuvashis Saha , *The University of Sydney*

We investigate the interaction dynamics between two co-propagating quiescent gap solitons in a semilinear dual-core model where both cores have Bragg gratings with phase mismatch.

Authors: Shuvashis Saha, The University of Sydney / Javid Atai, The University of Sydney

JTh5A.42

Spatiotemporal Characterization of Simulated High-Intensity Optical Vortices

Presenter: Elizabeth Grace , *Georgia Institute of Technology*

This work examines annular optical vortices, investigates their applications in laser-driven particle sources, and simulates the characterization and retrieval of these pulses using a novel technique, STRIPED FISH.

Authors: Elizabeth Grace, Georgia Institute of Technology / Tammy Ma, Lawrence Livermore National Laboratory / Derek Mariscal, Lawrence Livermore National Laboratory / Blagoje Djordjevic, Lawrence Livermore National Laboratory / Joochan Kim, University of California San Diego / Zhe Guang, Georgia Institute of Technology / Sahel Hakimi, Lawrence Berkeley National Laboratory / Andrew Longman, Lawrence Livermore National Laboratory / Lieselotte Obst-Huebl, Lawrence Berkeley National Laboratory / Tobias Ostermayr, Lawrence Berkeley National Laboratory / Raspberry Simpson, Massachusetts Institute of Technology / Kelly Swanson, Lawrence Livermore National Laboratory / Graeme Scott, Lawrence Livermore National Laboratory / Hai-En Tsai, Lawrence Berkeley National Laboratory / Ghassan Zeraouli, Colorado State University / Cameron Geddes, Lawrence Berkeley National Laboratory / Scott Wilks, Lawrence Livermore National Laboratory / Rick Trebino, Georgia Institute of Technology

JTh5A.43**Thermal and Loss Characterization of Mechanically Released Whispering Gallery Mode Resonators**

Presenter: Alejandro Grine , *Sandia National Laboratories*

We present a methodology for thermally characterizing and determining absorption and scattering losses in released ring WGM optical resonators. We subsequently deduce absorption and scattering contributions in $Q = 350k$ silicon nitride resonators.

Authors: Samuel Robison, Sandia National Laboratories / Alejandro Grine, Sandia National Laboratories / Michael Wood, Sandia National Laboratories / Darwin Serkland, Sandia National Laboratories

JTh5A.45**Polarized Optical Injections for Photonic Generation of Microwave Signals**

Presenter: Hong Lin , *Bates College*

We numerically investigate photonic generation of microwaves in vertical-cavity surface-emitting lasers. Our results show that parallel optical injection can produce microwaves in a wider frequency range than orthogonal injection.

Authors: Hong Lin, Bates College / Muhammad Abdullah, Bates College / Yanhua Hong, Bangor University

JTh5A.46**Features Extraction and Classification Methods for Automatic Selection of Two Different Types of Paint for Automotive Parts**

Presenter: Miguel Torres-Cisneros , *University of Guanajuato*

Two different white paint tones are evaluated using a Convolutional Neural Network to extract the vector characteristics. The results show that our method can select the correct tone with 100 % of precision.

Authors: Deborah Martinez Camacho, Centro de Investigaciones en Óptica / Rafael Guzmán-Cabrera, University of Guanajuato / Daniel May-Arrijoja, Centro de Investigaciones en Óptica / Iván Hernandez-Romano, CONACYT-DICIS, University of Guanajuato / Miguel Torres-Cisneros, University of Guanajuato

JTh5A.47**Monitoring of the Gold Nanoparticles during Preparation Processes**

Presenter: Shahriar Esmaeili , *Texas A&M University*

We have fabricated the AuNPs and monitored their photophysical properties at different fabrication stages using electron microscopy and dynamic light scattering. This study enables us to observe the changes in the AuNPs during the nucleation.

Authors:Shahriar Esmaeili, Texas A&M University / Navid Rajil, Texas A&M University / Philip Hemmer, Texas A&M University / Marlan Scully, Texas A&M University

JTh5A.48

Optimal Primary Colors

Presenter: Benjamin Carter , *California State University Long Beach*

Optimal primary colors produce the widest color gamut as measured by area in the CIE 1976 u0v0 chromaticity diagram. The best results for 3 and 4 primaries yield 84.9% and 93.5% area coverage, respectively. © 2021 The Author(s)

Authors:Benjamin Carter, California State University Long Beach

JTh5A.49

Ultrasensitive Terahertz Refractive Index Based Twin-core Flat Photonic Crystal Fiber Sensor

Presenter: Aruna Gandhi M S , *Peking University Shenzhen Graduate School*

The proposed twin-core photonic crystal flat-fiber biosensor achieves maximum sensitivities for cervical cancer cell and breast cancer cells type I, II of 0.8333 THz/RIU, 16.4286 THz/RIU and 0.7857 THz/RIU, respectively.

Authors:Aruna Gandhi M S, Peking University Shenzhen Graduate School / Qian Li, Peking University Shenzhen Graduate School

JTh5A.50

Time-Resolved Infrared-Resonant Third-Order Sum-Frequency Spectroscopy of Hydrogen Bonding in Acetone and Water Mixture

Presenter: Kai Wang , *Sun Yat-sen University*



By measuring the decoherence times and peak shifts of CC vibration of acetone, we experimentally demonstrated a novel coherent time-resolved Infrared spectroscopy technique to study hydrogen bond in acetone and water mixture.

Authors:Jizhou Wang, Texas A&M University / Kai Wang, Sun Yat-sen University / Zehua Han, Texas A&M University / Xingqi Xu, Zhejiang University / Dawei Wang, Zhejiang University / Alexei Sokolov, Texas A&M University / Marlan Scully, Texas A&M University

JTh5A.51

Quantum Imaging With Undetected Photons Enabled by Twin-Photon Position Correlation

Presenter: Balakrishnan Viswanathan , *Oklahoma State University*

Quantum imaging with undetected photons is a unique imaging technique in which photons illuminating the object are not detected. We generalize this technique to a new domain where the object is in the near field.

Authors:Balakrishnan Viswanathan, Oklahoma State University / Gabriela Lemos, Instituto de Fisica, Universidade Federal do Rio de Janeiro / Mayukh Lahiri, Oklahoma State University

JTh5A.53

Multimode Fiber Differential Imaging Based on Singular Value Decomposition

Presenter: Weiwei Gao , *School of Science, Beijing University of Posts and Telecommunications, Beijing 100876, China*

Multimode fiber differential imaging based on singular value decomposition is proposed to improve imaging quality by constructing an orthogonal matrix and subtracting a background noise, for both singular value decomposition and differential imaging.

Authors:Weiwei Gao, School of Science, Beijing University of Posts and Telecommunications, Beijing 100876, China / Huixia mo, School of Science, Beijing University of Posts and Telecommunications, Beijing 100876, China / Guohua Wu, School of Electronic Engineering, Beijing University of Posts and Telecommunications, Beijing 100876, China / Longfei Yin, School of Electronic Engineering, Beijing University of Posts and Telecommunications, Beijing 100876, China

JTh5A.54

Unbiased No-Switching Continuous-Variable Quantum Key Distribution

Presenter: Yiming Bian , *Beijing University of Posts and Telecommunications*

We report a practical no-switching continuous-variable quantum key distribution protocol with unbiased quadrature detection, which shows the potential to compensate for the asymmetry imperfections of practical heterodyne detector.

Authors:Yiming Bian, Beijing University of Posts and Telecommunications / Fengkai Sun, Beijing University of Posts and Telecommunications / Yichen Zhang, Beijing University of Posts and Telecommunications

JTh5A.55

Optical Imaging Interferometric Microscopy with Grating Coupler Illumination

Presenter: Preyom Dey , *University of New Mexico*

A new technique of extending the resolution limit for synthetic aperture microscopy with off-axis coherent illumination through a superstrate is used to image a 120nm CD structure with a 0.4NA lens at 532nm (Abbe limit:~665nm).

Authors:Preyom Dey, University of New Mexico / Alexander Neumann, University of New Mexico / Steve Brueck, University of New Mexico

JTh5A.56

Optical data processing with discrete solitons in waveguide arrays

Presenter: Amaria Javed , *UAE University*

We present a design and protocol to add binary numbers and to achieve an essential feature of an optical transistor, namely the amplification of input signal with the use of discrete solitons in waveguide arrays.

Authors:Amaria Javed, UAE University

JTh5A.57

The Utility of Linear Approximation of Image Transmission through Multimode Fiber

Presenter: Yuanhang Liu , *Beijing University of Posts and Telecommunications*



Utility of light intensity based linear approximation of image transmission through multimode fiber is undermined by simple neural network modeling, i.e., single full connection layer with ReLU activation, necessitates inclusion of nonlinearity.

Authors: Yuanhang Liu, Beijing University of Posts and Telecommunications / Yangyang Xiang, Beijing University of Posts and Telecommunications / Mingying Lan, Beijing University of Posts and Telecommunications / Junhui Li, Beijing University of Posts and Telecommunications / Li Gao, Beijing University of Posts and Telecommunications

JTh5A.58

Simplified superoscillatory lenses for superresolution imaging

Presenter: Rui Qi , *UNC Charlotte*

Superoscillation theory has become an important technique for superresolution imaging. We extend a new method for designing superoscillatory filter based on superoscillation. Phase- and amplitude-only filters are created and compared for performance.

Authors: Rui Qi, UNC Charlotte / Gregory Gbur, UNC Charlotte

JTh5A.59

Broadband Comb-like Supercontinuum Generation with Tunable Repetition Rate Using Two-pulse Bound State

Presenter: Shijie Chen , *Peking University*

We theoretically and experimentally demonstrate the 18.986 GHz, 274-nm-wide comb-like supercontinuum generation using two-pulse bound state. The repetition rate can be adjusted by changing the pulse separation.

Authors: Shijie Chen, Peking University / Renlai Zhou, Harbin Engineering University / Xuanyi Liu, Tsinghua University / H. Y. Fu, Tsinghua University / Qian Li, Peking University

JTh5A.60

Large Field of View Focal Stack Generation Based on Spatial Consistent Stitching

Presenter: Di He , *Beijing Information Science and Technology University*



Large FOV focal stack can be generated by stitching the small FOV RGB-D data and PSFs estimation. Spatial information clustering and spatial consistent reference are used to maintain the spatial consistency.

Authors:Di He, Beijing Information Science and Technology University / Wenyue Li, Beijing Information Science and Technology University / Chang Liu, Beijing Information Science and Technology University / Shuang Zhao, Beijing Information Science and Technology University / Zhehai Zhou, Beijing Information Science and Technology University

JTh5A.61

THz Strong Coupling Between Metamaterials and Superconducting Josephson Plasmons

Presenter: KELSON KAJ , *University of California, San Diego*

Terahertz spectroscopy is used to investigate the coupling between metamaterial resonators and the c-axis Josephson plasma resonance in superconducting $\text{La}_{1.85}\text{Sr}_{0.15}\text{CuO}_4$. The redshift of the plasma resonance frequency is indicative of strong coupling.

Authors:KELSON KAJ, University of California, San Diego / Ian Hammock, University of California, San Diego / Chunxu Chen, Boston University / Xiaoguang Zhao, Boston University / Kevin Cremin, University of California, San Diego / Jacob Schalch, University of California, San Diego / Yuwei Huang, Boston University / Michael Fogler, University of California, San Diego / Dmitri Basov, Columbia University / Xin Zhang, Boston University / Richard Averitt, University of California, San Diego

JTh5A.62

Scene Depth Reconstruction from Light Field Based on Fourier Disparity Layers Representation

Presenter: fei Wei , *Beijing Information Science and Technology University*

Based on Fourier Disparity Layers representation, depth reconstruction can be converted to reconstructing the disparity layers, which includes layer-by-layer FDL filtering, inverse Fourier transform and global fusion of disparity layers.

Authors:fei Wei, Beijing Information Science and Technology University / Chang Liu, Beijing Information Science and Technology University / Di He, Beijing Information Science and Technology University / Jun Qiu, Beijing Information Science and Technology University

JTh5A.63**Photonic Interference Cancellation with Hybrid Free Space Optical Communication and MIMO Receiver**

Presenter: Taichu Shi , *Rowan University*

We proposed and demonstrated a hybrid blind source separation system which can switch between multiple-input and multi-output mode and free space optical communication mode depends on different situation to get best condition for separation.

Authors: Taichu Shi, Rowan University / Yang Qi, Rowan University / Ben Wu, Rowan University

JTh5A.64**Analysis of Solid-core Photonic Crystal Fiber for Confinement Loss and Birefringence with Square Air Hole Layers**

Presenter: Ritu Raj Singh , *Netaji Subhas University of Technology, Delhi*

The solid core PCF with square-shaped air hole layers around the core is designed and analyzed by varying the number of rings (n). Increase in the number of rings results to decrease in mode confinement loss and increase in birefringence.

Authors: Ritu Raj Singh, Netaji Subhas University of Technology, Delhi / Devansh Srivastava, Indian Institute of Information Technology Ranchi / Wridheeman Bhattacharya, Indian Institute of Information Technology Ranchi

JTh5A.65**Common Basis Encoding of Similar Image Sequence Based on Correspondence Ghost Imaging**

Presenter: Jiali Yang , *Beijing University of Posts and Telecommunications*

Faithfully encoding different images by the same basis throughout the whole, such as magnetic resonance imaging sequence, is shown to be possible. Utilizing similarity, correspondence ghost imaging outperforms random patterns on basis construction.

Authors: Jiali Yang, Beijing University of Posts and Telecommunications / Chaowei Yuan, Beijing University of Posts and Telecommunications / Junhui Li, Beijing University of Posts and Telecommunications / Mingying Lan, Beijing University of Posts and Telecommunications / Li Gao, Beijing University of Posts and Telecommunications

JTh5A.66**Ultraviolet Disinfection System with Autonomous Targeting**

Presenter: Taichu Shi , *Rowan University*

We proposed and demonstrated a UV disinfection system by using a galvo system as hardware and machine learning as software to tactically disinfect common items rather than a broad case use.

Authors: Ben Zierdt, Rowan University / Thomas DeGroat, Rowan University / Samuel Furman, Rowan University / Nicolas Papas, Rowan University / Zachary Smoot, Rowan University / Taichu Shi, Rowan University / Yang Qi, Rowan University / Ben Wu, Rowan University

JTh5A.67**Light Field Alpha Matting Based on Propagation by Spatio-angular Consistency**

Presenter: Tianyi Liu , *Beijing Information Science and Technology University*

Light field alpha matting is achieved by propagating the closed form solution of the central view image matting of the light field to other views, which is based on propagation model by intrinsic spatio-angular consistency.

Authors: Tianyi Liu, Beijing Information Science and Technology University / Chang Liu, Beijing Information Science and Technology University / Di He, Beijing Information Science and Technology University / Jun Qiu, Beijing Information Science and Technology University

JTh5A.68**0.1 Hz/ $\sqrt{\text{Hz}}$ Frequency Stability in a Passive, Optical Fiber Frequency Reference**

Presenter: Ya Zhang , *Australian National University*

A digital interferometric fiber frequency reference is demonstrated with frequency stability of 0.1 Hz/ $\sqrt{\text{Hz}}$ above 100 Hz. The thermal stability is validated using an optical frequency comb, and key noise sources are identified and modeled.

Authors: Ya Zhang, Australian National University / Chathura Bandutunga, Australian National University / Terry McRae, Australian National University / Malcolm Gray, Australian National University / Jong Chow, Australian National University

JTh5A.69

Two-Dimensional Spatial Frequency Modulation Imaging with Wavelength Multiplexing

Presenter: John Czerski , *Colorado School of Mines*

We present a scan free extension of SPIFI imaging by wavelength multiplexing. A high-speed spectrometer provides rapid data collection with no beam scanning or frequency swept sources. Results and Images are presented.

Authors:John Czerski, Colorado School of Mines / Jeff Squier, Colorado School of Mines

JTh5A.70

Demonstration of a Universal Angular Dispersion Analyzer

Presenter: Layton Hall , *University of Central Florida*

We construct a pulsed-beam shaper capable of introducing arbitrary angular dispersion into a pulsed field, and utilize it to synthesize a host of optical fields that have eluded optics to date.

Authors:Layton Hall, University of Central Florida / Ayman Abouraddy, University of Central Florida

JTh5A.71

Observation of the Space-Time Talbot Effect

Presenter: Layton Hall , *University of Central Florida*

We demonstrate self-imaging in space and time of a discretized spatio-temporal optical field lattice in which the diffraction and dispersion lengths, and thus the spatial and temporal Talbot lengths, are intrinsically equal.

Authors:Layton Hall, University of Central Florida / Murat Yessenov, University of Central Florida / Sergey Ponomarenko, Dalhousie University / Ayman Abouraddy, University of Central Florida

JTh5A.72

Demonstration of the Temporal Talbot Effect in Free Space Utilizing Space-Time Wave Packets

Presenter: Layton Hall , *University of Central Florida*



The temporal Talbot effect has been realized only in optical fibers. We demonstrate the temporal Talbot effect for the first time in absence of material dispersion by utilizing freely propagating dispersive space-time wave packets.

Authors:Layton Hall, University of Central Florida / Murat Yessenov, University of Central Florida / Sergey Ponomarenko, Dalhousie University / Ayman Abouraddy, University of Central Florida

JTh5A.75

Excited States and Optical Power of Ground-state Emission in Quantum Dot Lasers with Asymmetric Barrier Layers

Presenter: Levon Asryan , *Virginia Polytechnic Institute and State University*

Continuous-wave power of ground-state emission in quantum dot lasers with asymmetric barrier layers is studied. Unlike conventional lasers, the power is virtually unaffected by excited-to-ground state relaxation delay of carriers in quantum dots.

Authors:Levon Asryan, Virginia Polytechnic Institute and State University / John Monk, Virginia Polytechnic Institute and State University

JTh5A.76

Speckle in BRDF Measurements: Solid Angle Considerations

Presenter: Pierre Chavel , *Institut d Optique Graduate School*

The bidirectional reflectance distribution function, applying to scattering media, is prone to speckle. Conditions to average out speckle by integration over solid angle both on the illumination side and on the detection side are analyzed

Authors:Pierre Chavel, Institut d Optique Graduate School / Thomas Labardens, Conservatoire national des Arts et Metiers / Lionel Simonot, Universite de Poitiers / Mathieu Hebert, Universite de Lyon UJM / Yvan Sortais, Institut d Optique Graduate School / Gael Obein, Conservatoire national des Arts et Metiers

JTh5A.77

Study of Depolarization of Partially Coherent and Partially Polarized Light through a Linear Retarder

Presenter: Cristian Hernández Cely , *Universidad Industrial de Santander*



We show a model based on the polarization matrix formalism and the theory of statistical distributions on Poincaré Sphere, which describes a controlled depolarization method for a partially polarized beam passing through a rotating retarder.

Authors:Cristian Hernández Cely, Universidad Industrial de Santander / Rafael Torres Amaris, Universidad Industrial de Santander

JTh5A.78

Vibration-Tolerant Design of Free-Space Optical Links for Datacenters

Presenter: Kai Zheng , *BD bioscience*

Free space optical links can be used in datacenter networks to overcome wired network architecture. We present robust design concepts to maximize optical misalignment tolerance for free space optical links in the presence of vibration

Authors:Kai Zheng, BD bioscience / Max Curran, Stonybrook University / Himanshu Gupta, Stonybrook University / Jon Longtin, Stonybrook University

JTh5A.79

A Novel Photonic Integrated Circuit for Orbital Angular Momentum Detection

Presenter: Rudra Gnawali , *Applied Optimization Inc.*

We explain the design of a tunable metal oxide semiconductor compatible silicon photonic integrated circuit, capable of transmission/reception of beams with distinct orbital angular momentum states.

Authors:Rudra Gnawali, Applied Optimization Inc. / Md. Shah Alam, University of Dayton / Zhanibek Bolatbekz, University of Dayton / Tamara Payne, Applied Optimization Inc. / Marshal Kiplinger, Applied Optimization Inc. / Andrew Volk, Applied Optimization Inc. / Joshua Hendrikson, Air Force Research Laboratory / Imad Agha, University of Dayton

JTh5A.80

Convolutional Neural Network for Binary Classification of Chromophobe Renal Cell Carcinoma and Oncocytoma

Presenter: Andrew Cheng , *Rutgers University*

Multiphoton microscopy images of chromophore renal cell carcinoma and renal oncocytoma were classified using a convolutional neural network inspired by techniques in recent architectures and yielded over 70% accuracy.

Authors: Andrew Cheng, Rutgers University / Michael Icaza, Southern Connecticut State University / Nicholas Judd, Southern Connecticut State University / Jason Smith, Rensselaer Polytechnic Institute / Sushmita Mukherjee, Weill Cornell Medical College / Manu Jain, Memorial Sloan Kettering Cancer Centre / Binlin Wu, Southern Connecticut State University

JTh5A.81

Polarization Label-Free Microscopy Imaging of Biological Samples by Exploiting the Zeeman Laser Emission

Presenter: Fabio Callegari , *Italian Institute of Technology (IIT)*

In this work, we exploited the dual-frequency, dual-polarization emission of a Zeeman laser acting as illumination stage of a multimodal optical scanning microscope to obtain polarization-resolved images of biological samples.

Authors: Fabio Callegari, Italian Institute of Technology (IIT) / Aymeric Le Gratiet, Italian Institute of Technology (IIT) / Alessandro Zunino, Italian Institute of Technology (IIT) / Ali Mohebi, Italian Institute of Technology (IIT) / Paolo Bianchini, Italian Institute of Technology (IIT) / Colin JR Sheppard, Italian Institute of Technology (IIT) / Alberto Diaspro, Italian Institute of Technology (IIT)

JTh5A.82

CW Cr²⁺:ZnSe laser tunable from 2.1 to 2.3 μm for SS-OCT

Presenter: Dmitry Nazarov , *Bauman Moscow State Technical University*

We demonstrate a laser source based on a Cr²⁺:ZnSe crystal tunable in 2.1-2.3 μm spectral range using a birefringent filter for SS-OCT. A mathematical model for calculating complex multi-element Lyot filter was developed

Authors: Dmitry Nazarov, Bauman Moscow State Technical University / Elizaveta Kozlova, Bauman Moscow State Technical University / Mikhail Tarabrin, Bauman Moscow State Technical University

JTh5A.83

Hybrid Electro-Optical Pumping of Active Plasmonic Nanostructures

Presenter: Dmitry Fedyanin , *Moscow Institute of Physics and Technology*

We propose hybrid electro-optical pumping of active plasmonic structures and demonstrate that this hybrid approach can outperform both pure electrical pumping and pure optical pumping and enable novel functionalities.

Authors: Andrey Vyshnevyy, Moscow Institute of Physics and Technology / Dmitry Fedyanin, Moscow Institute of Physics and Technology

JTh5A.84

Polarization-Controlled Terahertz Spectroscopy of Graphene-Based Films

Presenter: Anatoly Kvitsinskiy , *ITMO University*

We experimentally studied a room-temperature layer-number effect of chemical-vapor-deposition-synthesized multilayer-graphene-on-glass structures on its electrical conductance using a polarization-resolved terahertz time-domain spectroscopic system.

Authors: Anatoly Kvitsinskiy, ITMO University / Maxim Rybin, Prokhorov General Physics Institute of the Russian Academy of Sciences / Anton Zaitsev, ITMO University / Kirill Bogdanov, ITMO University / Dmitry Zykov, ITMO University / Elena Obraztsova, Prokhorov General Physics Institute of the Russian Academy of Sciences

JTh5A.85

Nonlinear Conversion of Orbital Angular Momentum States of light

Presenter: Pascal Bassene , *Rensselaer Polytechnic Institute*

We investigate the second harmonic generation of light field carrying orbital angular momentum in bulk $\chi^{(2)}$ material.

We demonstrate higher efficiency of frequency conversion and mode spatial distribution based on three-wave nonlinear optical mixing.

Authors: Pascal Bassene, Rensselaer Polytechnic Institute / Finn Buldt, Rensselaer Polytechnic Institute / Nazifa Rumman, Rensselaer Polytechnic Institute / Tianhong Wang, Rensselaer Polytechnic Institute / Phillip Heitert, Rensselaer Polytechnic Institute / Moussa N'gom, Rensselaer Polytechnic Institute

JTh5A.86

Second-Harmonic Generation in Directly-Grown MoS₂ Monolayers on Exposed-Core Fibers

Presenter: Gia Quyet Ngo , *Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University*

We report the substantial second-harmonic generation produced from exposed core optical fibers, coated with single-layer MoS₂ crystals, grown by a one-step CVD process. This second-order process is tunable and supported by intermodal phase matching.

Authors: Gia Quyet Ngo, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University / Emad Najafidehaghani, Institute of Physical Chemistry, Abbe Center of Photonics, Friedrich Schiller University / Ziyang Gan, Institute of Physical Chemistry, Abbe Center of Photonics, Friedrich Schiller University / Sara Khazaei, Institute of Solid State Theory and Optics, Friedrich Schiller University / Antony George, Institute of Physical Chemistry, Abbe Center of Photonics, Friedrich Schiller University / Ulf Peschel, Institute of Solid State Theory and Optics, Friedrich Schiller University / Alessandro Tuniz, University of Sydney, School of Physics / Heike Ebendorff-Heidepriem, Institute for Photonics and Advanced Sensing, School of Physical Sciences, University of Adelaide / Markus A. Schmidt, Leibniz Institute of Photonic Technology / Andrey Turchanin, Institute of Physical Chemistry, Abbe Center of Photonics, Friedrich Schiller University / Falk Eilenberger, Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University

JTh5A.89

Luminous Horocycles in Ferrofluids

Presenter: Alberto Tufaile , *University of Sao Paulo*

We have observed the formation of light rings in a thin film of ferrofluid subjected to a magnetic field, and associated them with horocycles.

Authors: Alberto Tufaile, University of Sao Paulo

JTh5A.90

Qualitative Concentration Analysis of Glucose in a Solution Using Spectroscopic Measurement

Presenter: Omnia Abd El-Rahman Nematallah , *Cairo University*

Glucose concentration change in solution was recorded by studying transmission and absorption coefficient at different laser wavelengths, showing decrease in transmittance and increase in absorption coefficient due to increased glucose concentration

Authors: Omnia Abd El-Rahman Nematallah, Cairo University / Ibrahim Abdelhalim, Cairo University / Tawfik Ismail, Nile University

JTh5A.91

On-chip Nano-object Trapping with Conjugate Optical and Thermophoretic Force

Presenter: Chuchuan Hong , *Vanderbilt University*

We demonstrate an on-chip hybrid plasmonic-waveguide based trapping system to combine electro-thermo-plasmonic flow and negative thermophoresis with optical gradient force in realizing stable and fast trapping of sub-nm particles (10 nm).

Authors:Chuchuan Hong, Vanderbilt University / Samprity Saha, Virginia Commonwealth University / Dhruv Fomra, Virginia Commonwealth University / Nathaniel Kinsey, Virginia Commonwealth University / Justus Ndukaife, Vanderbilt University

JTh5A.92

On Large Purcell Enhancement of an On-Chip Emitter Trapping System

Presenter: Samprity Saha , *Virginia Commonwealth University*

We investigate the Purcell enhancement (>500x) and collection efficiency (10%) achievable for an emitter trapped in a hybrid-plasmonic-waveguide based tweezer with the prospect of realizing a compact, on-chip platform for single-photon generation.

Authors:Samprity Saha, Virginia Commonwealth University / Chuchuan Hong, Vanderbilt University / Dhruv Fomra, Virginia Commonwealth University / Justus Ndukaife, Vanderbilt University / Nathaniel Kinsey, Virginia Commonwealth University

JTh5A.93

Grazing incidence interferometry for testing rough aspherics

Presenter: Sergej Rothau , *Institute of Optics, Information, and Photonics*

Here, we demonstrate the theory, the setup and the results of a grazing incidence interferometer using visible light in combination with phase shifting techniques for the surface measurement of convex steep rotational symmetric and rough aspherics.

Authors:Sergej Rothau, Institute of Optics, Information, and Photonics / Tobias Schamburek, Institute of Optics, Information, and Photonics / Klaus Mantel, Max Planck Institute for the Science of Light / Norbert Lindlein, Institute of Optics, Information, and Photonics

JTh5A.95

Backward Acceleration of Electrons by a Radially Polarized Ultra-Intense Laser Focus During Ionization of High Charge State of Neon

Presenter: Nour Hissi , *The Ohio State University*

We investigate direct acceleration of electrons produced during ionization of Neon gas using tightly focused and radially polarized Petawatt-class short pulse lasers.

Backwards propagation is demonstrated at specific initial conditions of Neon ions.

Authors:Nour Hissi, The Ohio State University / Enam Chowdhury, The Ohio State University

JTh5A.97

Modeling an On-Chip Opto-Thermo-Mechanical Nano-Switch for Integrated Photonics Application

Presenter: Samprity Saha , *Virginia Commonwealth University*

We report a plasmon-driven thermomechanical switch, which is actuated using the ohmic losses of plasmons as a highly concentrated and thermally isolated heat source. This device operates with sub-15ns switching time and sub-10mW power consumption.

Authors:Samprity Saha, Virginia Commonwealth University / Dhruv Fomra, Virginia Commonwealth University / Justus Ndukaife, Vanderbilt University / Vitaliy Avrutin, Virginia Commonwealth University / Nathaniel Kinsey, Virginia Commonwealth University

JTh5A.98

Polarization-Entanglement Complementary Relation of Light with Center-of-Mass Geometric Representation

Presenter: Xiao-Feng Qian , *Stevens Institute of Technology*

We report a universal complementary relation between optical polarization and entanglement for general arbitrary light fields. A novel geometric representation via the mechanical center-of-mass interpretation is also demonstrated.

Authors:Xiao-Feng Qian, Stevens Institute of Technology

JTh5A.99

Design of Lissajous Beams

Presenter: Wenrui Miao , *University of North Carolina at Charlotte*



In this paper we describe how to design a class of beams containing a single Lissajous singularity on axis such that the Lissajous singularity is invariant over significant propagation distances.

Authors: Wenrui Miao, University of North Carolina at Charlotte / Gregory Gbur, University of North Carolina at Charlotte

JTh5A.100

Deep Learning enabled Forward Modeling and Inverse Design of Integrated Nanophotonic Gratings

Presenter: Ahmad Usman , *Habib University*

We demonstrate deep learning enabled forward and inverse design of silicon nanophotonic grating. Predicted response by forward modeling and predicted responses and geometries by inverse design are shown with a MSE of 10⁻⁴.

Authors: Ahmad Usman, Habib University / Hussaina Ali Akbar, Habib University / Anusha Rehman, Habib University / Zeeshan Karim, Habib University / Syed Hasan Asim, Habib University

JTh5A.101

Enhanced Self-injection Locking of Semiconductor Laser to High-Q Microresonator.

Presenter: Ramzil Galiev , *Moscow State University*

In this work we theoretically study a scheme of a self-injection locking to a high-Q microresonator with drop-port coupled mirror, in which optical feedback level is optimally adjusted by tuning the drop-port mirror coupling.

Authors: Ramzil Galiev, Moscow State University / Nikita Kondratiev, Russian Quantum Center / Valery Lobanov, Russian Quantum Center / Igor Bilenko, Moscow State University

JTh5A.102

Generation of Pure Quartic Solitons From Passively Mode-Locked Thulium Doped Fiber Laser

Presenter: Anjali P.S. , *Indian Institute of Technology Madras*



We report the numerical modeling and simulation results targeted towards the generation of pure quartic solitons in the 2 μm wavelength range in a passively modelocked thulium doped fiber laser to extract higher pulse energies

Authors:Anjali P.S., Indian Institute of Technology Madras / Balaji Srinivasan, Indian Institute of Technology Madras / Deepa Venkitesh, Indian Institute of Technology Madras

JTh5A.103

Discrimination between Normal and Cancer Blood Cells Using Phase-only Spatial Light Modulator

Presenter: Rania Abdelazeem , *National Institute of Laser Enhanced Sciences*

We discriminate between normal and cancer white cells extracted from peripheral blood film images based on holographic projection using phase-only spatial lightmodulator. This technique provides important information in diagnosis of blood diseases.

Authors:Rania Abdelazeem, National Institute of Laser Enhanced Sciences / Dahi Abdelsalam, National Institute of Standards

JTh5A.104

Quantitative Phase Imaging by Automatic Phase Shifting Generated by Phase-only Spatial Light Modulator

Presenter: Rania Abdelazeem , *National Institute of Laser Enhanced Sciences*

We describe a simple phase shifting method with no moving parts based on grayscale levels of spatial light modulator. Four images with different shifts were generated and reconstructed to quantify the phase of test object.

Authors:Rania Abdelazeem, National Institute of Laser Enhanced Sciences / Dahi Abdelsalam, National Institute of Standards

JTh5A.105

Ten Billion Shot Update of NASA's Global Ecosystem Dynamics Investigation (GEDI) Laser Transmitter Systems

Presenter: Paul Stysley , *NASA GSFC*



The Global Ecosystems Dynamics Investigation employs three laser systems delivered by NASA Goddard Space Flight Center. We report on the status of these systems after over 2 years and 10 billion shots in orbit.

Authors:Paul Stysley, NASA GSFC / Donald Coyle, NASA GSFC / Demetrios Poullos, NASA GSFC / Erich Frese, SSAI / Robert Switzer, SSAI / James Blair, NASA GSFC

JTh5A.106

Generation of Volumetrically-Full Poincaré Beams

Presenter: Andy Black , *University of Rochester*

A volumetrically-full Poincaré beam is a nonuniformly polarized beam that represents every state of full and partial polarization. We demonstrate the generation of an instantly accessible volumetrically-full Poincaré beam for the first time.

Authors:Andy Black, University of Rochester / Robert Boyd, University of Rochester

JTh5A.107

Polariton-mediated Coupling of Quasi-degenerate Porphyrin Excitons

Presenter: Aleksandr Avramenko , *Wayne State University*

Polariton formation involves the hybridization of molecular and cavity photon excitations. We examine how the hybridization of two nearly degenerate excitons depend on their collective coupling to the photonic fluctuations in a single cavity mode.

Authors:Aleksandr Avramenko, Wayne State University / Aaron Rury, Wayne State University

JTh5A.108

Single-stage post-compression of an Ytterbium fiber laser down to 20 fs

Presenter: laura silletti , *Deutsches Elektronen-Synchrotron DESY*



We demonstrate single-stage post-compression of an Ytterbium fiber laser to about 20 fs based on spectral broadening in a gas-filled multipass cell. A compression factor of seven has been achieved with a throughput of 86%.

Authors:laura silletti, Deutsches Elektronen-Synchrotron DESY / Prannay Balla, Deutsches Elektronen-Synchrotron DESY / Esmerando Escoto, Deutsches Elektronen-Synchrotron DESY / Katinka Horn, Deutsches Elektronen-Synchrotron DESY / Vincent Wanie, Deutsches Elektronen-Synchrotron DESY / Andrea Trabattoni, Deutsches Elektronen-Synchrotron DESY / Francesca Calegari, Deutsches Elektronen-Synchrotron DESY / Christoph M. Heyl, Deutsches Elektronen-Synchrotron DESY

JTh5A.109

Ultrafast Sampling Oscilloscope for Arbitrary Single Photon Waveforms

Presenter: Benjamin Crockett , *Institut National de la Recherche Scientifique (INRS)*

We demonstrate high-speed detection of low-photon waveforms using slow off-the-shelf detectors. Using a detector with a distorted instrument response function spanning > 1 ns, we recover single photon waveforms at a resolution of 60 ps

Authors:Benjamin Crockett, Institut National de la Recherche Scientifique (INRS) / James van Howe, Augustana College / Nicola Montaut, Institut National de la Recherche Scientifique (INRS) / Roberto Morandotti, Institut National de la Recherche Scientifique (INRS) / Jose Azana, Institut National de la Recherche Scientifique (INRS)

JTh5A.110

Spontaneous Brillouin Scattering in Gas-filled Anti-resonant Fibre

Presenter: Malak Galal , *École Polytechnique Fédérale de Lausanne*

Spontaneous Brillouin scattering is measured for the first time in a hollow-core anti-resonant fibre (HC-ARF) filled with Nitrogen (N_2) gas at different pressures. A Brillouin gain of $0.029 \text{ m}^{-1}\text{W}^{-1}$ is yielded at a pressure of 34.7 bar.

Authors:Malak Galal, École Polytechnique Fédérale de Lausanne / Li Zhang, École Polytechnique Fédérale de Lausanne / Fan Yang, École Polytechnique Fédérale de Lausanne / Suneetha Sebastian, École Polytechnique Fédérale de Lausanne / Shoufei Gao, Institute of Photonics Technology, Jinan University / Yingying Wang, Institute of Photonics Technology, Jinan University / Luc Thévenaz, École Polytechnique Fédérale de Lausanne

JTh5A.111

An Automated Tool to Analyse 3D Fluorescence Images of Stained Nuclei

Presenter: Lisa Cuneo , *Istituto Italiano di Tecnologia*

We present an automatic and parameter-free tool to segment 3D fluorescence image stacks of stained nuclei and to quantify chromatin compaction, exploiting machine learning algorithms combined with statistical analysis.

Authors: Lisa Cuneo, *Istituto Italiano di Tecnologia* / Francesca Baldini, *Istituto Italiano di Tecnologia* / Marco Castello, *Istituto Italiano di Tecnologia* / irene NEPITA, *Istituto Italiano di Tecnologia* / Simonluca Piazza, *Istituto Italiano di Tecnologia* / Laura Vergani, *Università degli studi di Genova* / Alberto Diaspro, *Istituto Italiano di Tecnologia*

JTh5A.112

Genetic Algorithm optimization for Scatter Correction in Bone

Presenter: Adrian Liversage , *University of Georgia*

Implementing a standard Adaptive Optics microscope with an additional DMD, an SHG PSF beyond the mean-free path is used as a seed for the Genetic Algorithm, recovering the PSF by manipulation of the DMD.

Authors: Adrian Liversage, *University of Georgia* / Tianyi Zheng, *University of Georgia* / Kayvan Tehrani, *University of Illinois at Urbana-Champaign* / Peter Kner, *University of Georgia* / Luke Mortensen, *University of Georgia*

JTh5A.113

Quantum Shadow Imaging with Thermal Light

Presenter: Ziqi Niu , *William & Mary*

We show that the shapes of opaque objects can be recovered with a few-photon thermal light using spatial quantum noise analysis. Our method is immune to the camera dark noise thanks to camera-based homodyne detection.

Authors: Ziqi Niu, *William & Mary* / Savannah Cuzzo, *William & Mary* / Pratik Barge, *Louisiana State University* / Hwang Lee, *Louisiana State University* / Lior Cohen, *Louisiana State University* / Eugeny Mikhailov, *William & Mary* / Irina Novikova, *William & Mary*

JTh5A.114

Investigation of Diffractive Structure Designs through Printoptical® Technology

Presenter: Bisrat Girma Assefa , *BGA Optics and Photonics Technology*

Realizing micro-scale diffractive grating and freeform fresnel lens using a customized ray-mapping based freeform surface designing algorithm and Printoptical® 3D-printing technology, respectively, are proposed. ©2021 The Author , Itä-Suomi Yliopisto

Authors: Bisrat Girma Assefa, BGA Optics and Photonics Technology

JTh5A.115

Linear and Nonlinear Distributed Stress Sensing with Graphene-decorated Optical Fibers

Presenter: Julio Benitez , *Comision Nacional de Energia Atomica(CNEA)*

We propose a novel scheme for the linear and nonlinear distributed sensing of stress based on graphene-decorated optical fibers and conventional optical time-domain reflectometry (linear sensing) and spectral monitoring (nonlinear sensing).

Authors: German Fernandez, Comision Nacional de Energia Atomica(CNEA) / Nicolas Linale, Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) / Julio Benitez, Comision Nacional de Energia Atomica(CNEA) / Diego Grosz, Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)

JTh5A.116

Spectral Broadening and Tuning of a Modelocked Ultrafast Yb:Fiber Laser Through the Inclusion of a Longpass Free-Space Optical Filter

Presenter: Nicholas Cooper , *University of Georgia*

The use of a longpass optical filter within the lasing cavity of a Yb: fiber laser is demonstrated to expand the traditional lasing bandwidth beyond initial limitations without degradation in pulse compressibility or noise.

Authors: Nicholas Cooper, University of Georgia / Melanie Reber, University of Georgia

JTh5A.117

Theory of Transient Magneto-Electric Rectification

Presenter: Gregory Smail , *University of Michigan*



Ultrafast transient behavior of magneto-electric (M-E) rectification is investigated with the magnetic torque model. Unlike all-electric nonlinearities, the speed and amplitude of the M-E rectification moment depends strongly on molecular properties.

Authors:Gregory Smail, University of Michigan / Stephen Rand, University of Michigan

JTh5A.119

Experimental Results for a Hybrid SDM and WDM System Using Commercially Available Transceivers

Presenter: Ce Su , *Florida Institute of Technology*

This paper demonstrates a two-channel SDM system in a single core multimode fiber that complements WDM. Each SDM channel carries C-band and O-band WDM signals operating at 10 Gbps to enable 40 Gbps over the multimode fiber.

Authors:Ce Su, Florida Institute of Technology / Swaroopini Harish, Florida Institute of Technology / Mingxuan Tu, Florida Institute of Technology / Syed Murshid, Florida Institute of Technology

JTh5A.120

Application-Specific Photonic Integrated Circuit

Presenter: Chen Shen , *George Washington University*

We introduce an application-specific photonic integrated circuit that can solve partial differential equations using finite difference mesh.

Authors:Chen Shen, George Washington University / Volker Sorger, George Washington University

JTh5A.121

Wave Front Sensor For Wide-Aperture Laser Beams.

Presenter: Sergey Kazantsev , *Moscow Polytechnic University*

The results of experimental studies of a wave front sensor based on the Talbot effect are presented. The high advantages of this sensor for the analysis of dynamic optical density disturbances in transparent materials have been demonstrated.

Authors:Stepan Andreev, Moscow Polytechnic University / Sergey Kazantsev, Moscow Polytechnic University / Andrey Muzychka, Moscow Polytechnic University

JTh5A.122

Calculation of the Phase Noise at Comb-Line Frequencies in a Frequency Comb

Presenter: Ishraq Md Anjum , *University of Maryland Baltimore County*

We calculate the phase noise in a modified uni-traveling carrier photodetector for frequency comb applications. In contrast to a continuous wave, a frequency comb is characterized by a distinct phase noise for each comb line.

Authors: Ishraq Md Anjum, *University of Maryland Baltimore County* / Seyed Mahabadi, *University of Maryland Baltimore County* / Ergun Simsek, *University of Maryland Baltimore County* / Curits Menyuk, *University of Maryland Baltimore County*

JTh5A.123

Locking a Laser Beam on Dipoles of a Dielectric Surface

Presenter: Cristian Bahrim , *Lamar University*

We report experimental evidence for locking a probe laser beam on the vibratory dipoles of a dielectric surface through a destructive interference mechanism triggered by a stronger coupling laser which simultaneously irradiates the same dipoles.

Authors: Cristian Bahrim, *Lamar University*

JTh5A.124

Statistical Analysis of a Random Fiber Laser With Er-Doped Fiber as Gain and Feedback Medium

Presenter: Bismarck Lima , *Pontifical Catholic University of Rio de Janeiro*

A Random Fiber Laser is demonstrated with feedback from the Rayleigh scattered light from the Er-doped fiber gain medium. Laser threshold is characterized and the correlation analysis of emitted intensities indicates strong mode competition.

Authors: Bismarck Lima, *Pontifical Catholic University of Rio de Janeiro* / Pedro Tovar, *Pontifical Catholic University of Rio de Janeiro* / Jean von der Weid, *Pontifical Catholic University of Rio de Janeiro*

JTh5A.125

Target-wavelength-trimmed SHG in Gallium Phosphide on-oxide ring-resonators

Presenter: Shivangi Shree , *University of Washington*



We demonstrate postfabrication target-wavelength tuning in a GaP on oxide integrated photonic platform via electron-beam exposure of HSQ cladding, which is required for desired wavelength conversion applications such as quantum frequency conversion.

Authors: Shivangi Shree, University of Washington / Lillian Thiel, University of Washington / Alan Logan, University of Washington / Srivatsa Chakravarthi, University of Washington / Karine Hestroffer, Humboldt-Universität zu Berlin / Fariba Hatami, Humboldt-Universität zu Berlin / Kai-Mei Fu, University of Washington

JTh5A.127

Coherent Fourier Scatterometry Techniques Using Orbital Angular Momentum Beams for Defect Detection

Presenter: Bin Wang, *University of Colorado Boulder*

We introduce a set of novel defect inspection techniques based on bright-field CFS using coherent orbital angular momentum beams. These new techniques will potentially enable increased sensitivity for in-line nanoscale defect inspection.

Authors: Bin Wang, University of Colorado Boulder / Michael Tanksalvala, University of Colorado Boulder / Zhe Zhang, University of Colorado Boulder / Yuka Esashi, University of Colorado Boulder / Nicholas Jenkins, University of Colorado Boulder / Margaret Murnane, University of Colorado Boulder / Henry Kapteyn, University of Colorado Boulder / Chen-Ting Liao, University of Colorado Boulder

JTh5A.128

Mode-locked Fiber-laser Repetition-frequency Stabilization Using a Low-cost FPGA Board

Presenter: Dipenkumar Barot, *National Institute of Standards and Technology*

We demonstrate repetition frequency stabilization of a mode-locked laser using an FPGA board and open-source software. The stabilized repetition frequency exhibited low timing jitter and an Allan variance of 8×10^{-12} at 100 s gate time.

Authors: Dipenkumar Barot, National Institute of Standards and Technology / Ari Feldman, National Institute of Standards and Technology / Brian Washburn, National Institute of Standards and Technology

JTh5A.129

Enhanced Reverse Saturable Absorption in Bi₂Se₃ Nanoplates Doped PMMA Thin Film

Presenter: Partha Mondal , *Indian Institute of Science, Bangalore, India*

We demonstrate reverse saturation absorption (RSA) property of PMMA and PMMA/Bismuth Selenide (Bi_2Se_3) composite employing open aperture z-scan technique. The z-scan results demonstrate enhanced RSA property with the increase in doping concentration.

Authors: Partha Mondal, Indian Institute of Science, Bangalore, India / Priyanka Choubey, Indian Institute of Technology, Kharagpur, India / Anu Gupta, Indian Institute of Technology, Kharagpur, India / Sayantan Bhattacharya, The University of Sheffield, Sheffield, England / Tara Singh, Indian Institute of Technology, Kharagpur, India / Meher Wan, National Institute of Science Communication and Policy Research, New Delhi, India / Shailendra Varshney, Indian Institute of Technology, Kharagpur, India

JTh5A.130

Multi-color Driven High-dimensional Bi-photon Quantum Frequency Combs: Versatile Joint Spectral Intensity with Tunable Entropies

Presenter: Raktim Haldar , *Leibniz University Hannover*

We demonstrate the tunability of Von Neumann entropy of a high-dimensional bi-photon quantum frequency comb possessing multiple antidiagonal correlation lines in joint spectral intensity in an onchip microresonator through multi-chromatic excitations

Authors: Raktim Haldar, Leibniz University Hannover / Alí Angulo Martínez, Leibniz University Hannover / Hatam Mahmudlu, Leibniz University Hannover / Philip Rübeling, Leibniz University Hannover / Charalambos Klitis, University of Glasgow / Marc Sorel, University of Glasgow / Michael Kues, Leibniz University Hannover

JTh5A.131

Adaptive Optics Microscopy for Mouse Imaging

Presenter: tianyi zheng , *University of Georgia*

We developed an AO multiphoton microscopy for highly distorting bone by SHG guidestar with SHWFS. Together with a DM, we correct the aberrations in the curved sample, thereby improving the intensity of PSF, revealing features of collagen and bone.

Authors: tianyi zheng, University of Georgia / Kayvan Tehrani, University of Georgia / Adrian Liversage, University of Georgia / Luke Mortensen, University of Georgia / Peter Kner, University of Georgia

JTh5A.132**Nascent Rotational Distributions of CO Excited by Optical Centrifuge and Master Equation Modeling of Collisional Energy Transfer**

Presenter: Matthew Laskowski , *University of Maryland*

See paper file upload

Authors:Matthew Laskowski, University of Maryland / Millard Alexander, University of Maryland / Amy Mullin, University of Maryland

JTh5A.133**Full Color Recording of Linearly Polarized Light**

Presenter: Barbara Kilosanidze , *Institute of Cybernetics of Georgian Technical University*

The paper outlines the capabilities of color recording of monochromatic polarized light. This effect was revealed within the framework of research and development of organic polarization-sensitive media conducted by us.

Authors:Irakli Chaganava, Institute of Cybernetics of Georgian Technical University / Barbara Kilosanidze, Institute of Cybernetics of Georgian Technical University / George Kakauridze, Institute of Cybernetics of Georgian Technical University

JTh5A.134**Cascaded Second Order Optical Nonlinearities in a Dielectric Metasurface**

Presenter: Sylvain Gennaro , *Sandia National Laboratories*

In this work, we analyze the second and third harmonic signal from a dielectric metasurface in conjunction with polarization selection rules to unambiguously demonstrate the occurrence of cascaded second-order nonlinearities.

Authors:Sylvain Gennaro, Sandia National Laboratories / Chloe Doiron, Sandia National Laboratories / Nicholas Karl, Sandia National Laboratories / Prasad Padmanabha Iyer, Sandia National Laboratories / Michael Sinclair, Sandia National Laboratories / Igal Brener, Sandia National Laboratories

JTh5A.137**Bit-Error Rate Reduction of Free-Space Optical ON-OFF Keying with Atmospheric Effects**

Presenter: Nicholas Savino , *Tulane University*



We examine the efficacy of machine learning in reducing the bit-error rate of a free-space optical ON-OFF keying communication scheme in the presence of experimentally generated atmospheric effects: turbulence and thermal background radiation.

Authors: Nicholas Savino, Tulane University / Manon Bart, Tulane University / Paras Regmi, Louisiana State University / Sanjaya Lohani, University of Illinois-Chicago / Lior Cohen, Louisiana State University / Sara Wyllie, Tulane University / Harry Shaw, NASA Goddard Space Flight Center / Haleh Safavi, NASA Goddard Space Flight Center / Hwang Lee, Louisiana State University / Thomas Searles, University of Illinois-Chicago / Brian Kirby, United States Army Research Laboratory / Ryan Glasser, Tulane University

JTh5A.138

Rytov's EMT Applicability for Photonic Lattices

Presenter: Nasrin Razmjooei, *UT Arlington*

We address the properties of photonic lattices by Rytov's EMT method. The symmetric solution of Rytov's eigenvalue equations pertains to normal incidence angles with the asymmetric solution being relevant for off-normal illumination.

Authors: Nasrin Razmjooei, *UT Arlington* / Robert Magnusson, *UT Arlington*

JTh5A.139

Visible and Near Infrared Broadband Plasmonic Absorber

Presenter: Vitaly Rodriguez Esquerre, *Federal University of Bahia*

Broadband absorbers for visible and near-infrared frequencies, based on multilayered metal-insulator (MI) structures have been analyzed. The influence of geometrical parameters has been studied in order to maximize the absorption and bandwidth.

Authors: Joaquim Junior Isidio de Lima, UNIVASF / Ary Allan Souza Lins, UNIVASF / Andressa Mara Menezes Alexandre, UNIVASF / Paulo Soares Filho, UNIVASF / Vitaly Rodriguez Esquerre, *Federal University of Bahia*

JTh5A.140

Bioinspired patterning to mitigate photon surface absorption

Presenter: Krishnan Thyagarajan, *Palo Alto Research Center (PARC) Xerox*



We demonstrate the use of Levy walk inspired patterning to mitigate photon absorption on surfaces, by up to 40%. Robustness of the effect across trap densities and fabrication deviations for heavy tailed distributions, is verified.

Authors: Krishnan Thyagarajan, Palo Alto Research Center (PARC) Xerox

JTh5A.141

Metamaterial Waveguide Modelling by an Artificial Neural Network with Genetic Algorithm

Presenter: Vitaly Rodriguez Esquerre , *Federal University of Bahia*

We implement a hybrid artificial neural network (ANN) for the analysis of dielectric and metamaterial based waveguides operating in the wavelength spectrum of the infrared where long propagation lengths can be observed.

Authors: Roney das Mercês Cerqueira, Federal University of Recôncavo of Bahia / Anderson Dourado Sisnando, Federal University of Recôncavo of Bahia / Vitaly Rodriguez Esquerre, Federal University of Bahia

JTh5A.144

Azimuthal Force on a Dielectric Particle due to Superpositions of Fundamental Modes of a Silicon Strip Waveguide

Presenter: Ryan Patton , *The Ohio State University*

We compute the azimuthal force on a dielectric particle near a silicon waveguide due to superpositions of fundamental modes. A peak of 75 fN/mW is observed for a 250×250 nm² core at 1550 nm wavelength.

Authors: Ryan Patton, The Ohio State University / Ronald Reano, The Ohio State University

JTh5A.145

The analysis of the atomic population inversion under a few cycle strong shaped laser with a double exponential wave form

Presenter: Nadia Boutabba , *Fatima College of Health Sciences*



In this paper we control the atomic population inversion of a three-level atomic medium by applying a few-cycle strong laser pulse to excite the system. We use a strong field which has the shape of a double exponential function.

Authors: Nadia Boutabba, Fatima College of Health Sciences / Sofiane Grira, Abu Dhabi University / Hichem Eleuch, University of Sharjah

SpE27

Special Event - Nonlinear Optics Technical Group Coffee Break

14:30 - 15:00 (UTC - 07:00)

SpE12

Special Event - Thursday Virtual Coffee Break II

15:00 - 15:30 (UTC - 07:00)

SpE18

Special Event - Tech Talk: Cylite Delivers Hyperparallel OCT into Ophthalmic Markets

Th3A

QIM Poster Session

Th3A.1

Vector Optomechanical Entanglement



Presenter: LI Ying , *Hunan Normal University*

The polarizations of optical fields, provide more degrees of freedom to manipulate coherent light-matter interactions. Here we propose how to achieve a coherent switch of optomechanical entanglement in a polarized-light-driven cavity system. This ability can be important for building a quantum network.

Authors:LI Ying, Hunan Normal University / Ya-Feng Jiao, Hunan Normal University / Jing-Xue Liu, Hunan Normal University / Adam Miranowicz, Adam Mickiewicz University / Yun-Lan Zuo, Hunan Normal University / Le-Man Kuang, Hunan Normal University / Hui Jing, Hunan Normal University

Th3A.2

Efficient Qubit Phase Estimation Using Adaptive Measurements

Presenter: Marco Rodríguez García , *Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas - Universidad Nacional Autónoma de México*

We propose a new adaptive scheme based on covariant measurements for phase estimation in qubits, showing that the proposal is both mathematically and experimentally more realistic and more efficient than the methods currently available.

Authors:Marco Rodríguez García, Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas - Universidad Nacional Autónoma de México / Isaac Pérez Castillo, Universidad Autónoma Metropolitana-Iztapalapa / Pablo Barberis-Blostein, Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas - Universidad Nacional Autónoma de México

Th3A.3

Optimally Squeezed Atomic States for Quantum Metrology

Presenter: Sebastian Carrasco , *U.S. Army Research Laboratory*

We propose a novel pulse sequence that drives an ensemble of cold trapped atoms into an optimal squeezed state. These states have a fundamental precision scaling proportional to the inverse of the number of atoms.

Authors:Sebastian Carrasco, U.S. Army Research Laboratory / Michael Goerz, U.S. Army Research Laboratory / Vladan Vuletic, Massachusetts Institute of Technology / Vladimir Malinovsky, U.S. Army Research Laboratory

Th3A.4



Quadrupole Excitation of a Single Atom With Tightly Focused Structured Beam

Presenter: Leila Mashhadi , *University of Southsmpton*

I analyze the quadrupole excitation of a single atom, trapped at the center of a tightly focused Laguerre Gaussian beam, considering the interplay between spin and orbital angular momenta in the focused field.

Authors:Leila Mashhadi, University of Southsmpton

Th3A.5

Qubit Registers for Noiseless Amplification

Presenter: Anders Bjerrum , *Center for Macroscopic Quantum States (bigQ), Technical University of Denmark*

We perform a theoretical investigation into how the entanglement of a two-mode squeezed state can be stored and purified using noiseless amplification with a collection of solid-state qubits.

Authors:Anders Bjerrum, Center for Macroscopic Quantum States (bigQ), Technical University of Denmark / Jonatan Brask, Center for Macroscopic Quantum States (bigQ), Technical University of Denmark / Ulrik Lund Andersen, Center for Macroscopic Quantum States (bigQ), Technical University of Denmark

Th3A.6

Nonreciprocal Optical Solitons in a Spinning Kerr Resonator

Presenter: Baijun Li , *Hunan Normal University*

We propose an experimentally accessible platform to achieve nonreciprocal control of optical solitons. We show that in a spinning Kerr resonator, different soliton states appear for the input fields in different directions.

Authors:Baijun Li, Hunan Normal University / Sahin. K. Özdemir, University Park / Xun-Wei Xu, Hunan Normal University / Lin Zhang, Shaanxi Normal University / Le-Man Kuang, Hunan Normal University / Hui Jing, Hunan Normal University

15:00 - 17:00 (UTC - 07:00)



LTh6E

Ultrafast Dynamics in Complex Systems III

President: Liuyan Zhao , *University of Michigan*

LTh6E.1

Low-energy Electrodynamics and Optical Signatures of Excitonic Insulator State in Ta_2NiSe_5

Presenter: Sheikh Rubaiat Ul Haque , *University of California San Diego*

We performed infrared pump - THz probe spectroscopy on the excitonic insulator, Ta_2NiSe_5 . Parametric amplification of an IR-active phonon exhibits an order parameter-like behavior, suggesting a novel approach to monitor exciton condensate dynamics.

Authors: Sheikh Rubaiat Ul Haque, University of California San Diego / Marios H Michael, Harvard University / Junbo Zhu, Massachusetts Institute of Technology / Yuan Zhang, University of California San Diego / Lukas Windgatter, Max Planck Institute for the Structure and Dynamics of Matter (MPSD) / Simone Latini, Max Planck Institute for the Structure and Dynamics of Matter (MPSD) / Gufeng Zhang, University of California San Diego / Jingdi Zhang, University of California San Diego / Angel Rubio, Max Planck Institute for the Structure and Dynamics of Matter (MPSD) / Joseph G Checkelsky, Massachusetts Institute of Technology / Eugene Demler, Harvard University / Richard Averitt, University of California San Diego

LTh6E.2

Terahertz Driven Opacity-Transparency Transition in Photoexcited Carbon Nanotubes

Presenter: Alden Bradley , *Oregon State University*

CNTs exhibit extraordinary nonlinear THz responses upon optical excitation. Its conductivity reduces at intermediate intensities, while soaring elsewhere. Field-effect mobility and carrier multiplications govern the rise and fall of the conductivity.

Authors: Byounghwak Lee, Oregon State University / Ali Mousavian, Oregon State University / Alden Bradley, Oregon State University / Yun-Shik Lee, Oregon State University

LTh6E.3

Unpacking Nonlinear Vibrational Excitations in CdWO₄

Presenter: Megan Nielson , *Brigham Young University*

Using 2D THz spectroscopy, we explore nonlinear energy transfer in CdWO₄. Fitting power dependent THz measurements with a complex model allows us to determine nonlinear photonic and phononic parameters. We compare with first-principles calculations.

Authors: Megan Nielson, Brigham Young University / Brittany Knighton, Brigham Young University / Lauren Davis, Brigham Young University / Aldair Alejandro, Brigham Young University / Emma Nelson, Brigham Young University / Jeremy Johnson, Brigham Young University

LTh6E.4

Universal Phase Dynamics in VO₂ Devices via Operando Diffraction

Invited

Presenter: Aaron Lindenberg , *Stanford University*

Using stroboscopic electron diffraction, we perform synchronized time-resolved measurements of atomic motions and electronic transport in operating vanadium dioxide switches. We discover an electrically triggered, isostructural state that forms transiently on microsecond time scales

Authors: Aaron Lindenberg, Stanford University

LTh6E.5

2D-THz Spectroscopy of Marginal Fermi Glass

Invited

Presenter: Peter Armitage , *Johns Hopkins University*

Using terahertz two-dimensional coherent spectroscopy, we investigate the effects of long range Coulomb interaction in phosphorus-doped silicon, a classic example of a correlated disordered electron system in three dimensions.

Authors: Peter Armitage, Johns Hopkins University

FTh6A

Computational Microscopy with Machine Learning

Presenter: Yibo Zhang , *PathAI*



FTh6A.1**Real-time Optical Biopsy via Machine Learning and Nonlinear Optical Microscopy***Invited***Presenter:** Sixian You , *Massachusetts Institute of Technology*

Abstract not available.

Authors: Sixian You, *Massachusetts Institute of Technology***FTh6A.2****End-to-end Learning for Computational Microscopy***Invited***Presenter:** Laura Waller , *University of California Berkeley*

This talk will describe end-to-end learning for development of new microscopes that use computational imaging to enable 3D fluorescence and phase measurement.

Authors: Laura Waller, *University of California Berkeley***FTh6A.3****DeepTrack 2.0: A Framework for Deep Learning for Microscopy***Invited***Presenter:** Giovanni Volpe , *Goteborgs Universitet*

We present DeepTrack 2.0, a software to design, train, and validate deep-learning solutions for digital microscopy. We demonstrate it for applications from particle localization, tracking, and characterization, to cell counting and classification, to virtual staining.

Authors: Giovanni Volpe, *Goteborgs Universitet* / Benjamin Midtvedt, *Goteborgs Universitet* / Saga Huld Helgadottir, *Goteborgs Universitet* / Aykut Argun, *Goteborgs Universitet* / Jesús Pineda, *Goteborgs Universitet* / Daniel Midtvedt, *Goteborgs Universitet***FTh6C**

Classical/Quantum Information Processing, Sensing and Metrology

Presenter: Juliet Gopinath , *University of Colorado at Boulder*

FTh6C.1

The New Multimode Optics - Understanding and Exploiting Controllable Complexity

Tutorial

Presenter: David A. B. Miller , *Stanford University*

Emerging applications in communications, sensing, and classical and quantum information processing demand complex controllable circuits. Novel interferometric mesh architectures, new algorithmic approaches, including self-configuring circuits, and a clarified modal mathematical approach, promise sophisticated circuits beyond previous optics.

Authors:David A. B. Miller, *Stanford University*

FTh6C.2

An Optical Neural Network Operating with Less than 1 Photon per Multiplication

Presenter: Tianyu Wang , *Cornell University*

We report an experimental demonstration of an optical neural network performing image classification with high accuracy using less than 1 photon per scalar multiplication, validating theoretical predictions about quantum-limited performance of ONNs.

Authors:Tianyu Wang, *Cornell University* / Shi-Yuan Ma, *Cornell University* / Logan Wright, *Cornell University* / Tatsuhiro Onodera, *Cornell University* / Brian Richard, *Cornell University* / Peter McMahon, *Cornell University*

FTh6C.3

Quantum Acceleration in Adaptive Modal Imaging of N Stars

Presenter: Fanglin Bao , *Purdue University*



Traditional imaging of point sources in the sub-Rayleigh region usually needs prohibitively-long integration time. Here we propose quantum-accelerated imaging (QAI) to significantly reduce the measurement time using an information-theoretic approach.

Authors: Fanglin Bao, Purdue University / Hyunsoo Choi, Purdue University / Vaneet Aggarwal, Purdue University / Zubin Jacob, Purdue University

FTh6C.4

Exact Mapping Between a Laser Network and the Classical XY Hamiltonian

Presenter: sagie gadasi , *Weizmann Institute of Science*

We demonstrate experimentally and validate theoretically an exact mapping between coupled-lasers networks and classical spin Hamiltonians by adjusting the loss rate of the individual lasers.

Authors: Igor Gershenzon, Weizmann Institute of Science / Geva Arwas, Weizmann Institute of Science / sagie gadasi, Weizmann Institute of Science / Chene Tradonsky, Weizmann Institute of Science / Asher Friesem, Weizmann Institute of Science / Oren Raz, Weizmann Institute of Science / Nir Davidson, Weizmann Institute of Science

FTh6C.5

Modelling Photon-pair Generation in Nanoresonators Using Quasinormal Mode Expansions

Presenter: Maximilian Weissflog , *Friedrich Schiller University*

We model SPDC in dielectric nanoresonators based on quasinormal modes (QNMs). Using QNMs, the process reduces to a few interacting modes, providing intuition and enabling the design of nanoscale SPDC sources with complex functionalities.

Authors: Maximilian Weissflog, Friedrich Schiller University / Sina Saravi, Friedrich Schiller University / Carlo Gigli, Université de Paris and CNRS / Giuseppe Marino, Université de Paris and CNRS / Romain Dezert, Université de Paris and CNRS / Vincent Vinel, Université de Paris and CNRS / Adrien Borne, Université de Paris and CNRS / Giuseppe Leo, Université de Paris and CNRS / Thomas Pertsch, Friedrich Schiller University / Frank Setzpfandt, Friedrich Schiller University

FTh6B

Novel Passive Photonics

Presider: Zhaoran Huang , *Rensselaer Polytechnic Institute*

FTh6B.1

Theory for Twisted Bilayer Photonic Crystal Slabs

Presenter: Beicheng Lou , *Stanford University*

We analyze scattering properties of twisted bilayer photonic crystal slabs through a high-dimensional plane wave expansion method, which does not involve super-cell approximation, and explain the spectrum with an intuitive correspondence relation.

Authors:Beicheng Lou, Stanford University / Shanhui Fan, Stanford University

FTh6B.2

Photonic molecule electro-optic modulators for efficient, widely tunable RF sideband generation and wavelength conversion

Presenter: MANUJ KUMAR SINGH , *Boston University*

We propose photonic molecule electro-optic modulators with tunable supermodesplitting for efficient widely tunable RF sideband generation. Using an auxiliary tunable off-resonant cavity as a variable coupler maintains a high Q/V.

Authors:MANUJ KUMAR SINGH, Boston University / Bohan Zhang, Boston University / Deniz Onural, Boston University / Hayk Gevorgyan, Boston University / Milos Popovic, Boston University

FTh6B.3

Coherent Thermo-Optic Noise Cancellation in an Optical Microcavity

Presenter: Christopher Panuski , *MIT*

We show that thermo-optic noise in a photonic crystal microcavity can be suppressed by coherently canceling thermo-refractive and thermo-elastic noises. Our optimized design reduces the impact of thermal fluctuations by over one order of magnitude.

Authors:Christopher Panuski, MIT / Jordan Goldstein, MIT / Dirk Englund, MIT / Ryan Hamerly, MIT

FTh6B.4

Silicon Waveguides and Resonators with Sub-0.1 dB/cm Propagation Loss and Over 7 Million Q in a Foundry Process

Presenter: Deniz Onural , *Boston University*

Propagation loss is characterized vs. waveguide width in a 220\,nm silicon photonics foundry platform to form a compact model. Test paperclips and racetrack resonators with quality factors up to 7.6 million reveal losses as low as 0.064 dB/cm.

Authors:Deniz Onural, Boston University / Hayk Gevorgyan, Boston University / Bohan Zhang, Boston University / Anatol Khilo, Ayar Labs / Milos Popovic, Boston University

FTh6B.5

Compact Silicon Nitride Interferometer

Presenter: fahimeh Armin , *Université du Québec à Montréal*

We demonstrate a silicon nitride interferometer with waveguides having different effective indexes instead of lengths to avoid waveguide bends, reduce losses and footprint.

Authors:fahimeh Armin, Université du Québec à Montréal / Frederic Nabki, École de technologie supérieure ÉTS / Michaël Ménard, Université du Québec à Montréal

FTh6B.6

Can one critically couple to a multimode, coupled-cavity finite equispaced comb resonator?

Presenter: MANUJ KUMAR SINGH , *Boston University*

A coupled-cavity, finite-equispaced-comb resonator based on “Kac matrix” could be an important photonic component.We show an optimal cavity to the bus waveguide,with coupling set to “critically couple” the geometric mean of the supermode escape rates

Authors:MANUJ KUMAR SINGH, Boston University / Bohan Zhang, Boston University / Milos Popovic, Boston University

FTh6B.7

Hybrid guided space-time modes with controllable group indices in a multi-mode planar waveguide

Presenter: Abbas Shiri , *University of Central Florida*



In a multi-mode waveguide, higher-order modes are usually slower than lower order modes. We circumvent this limitation and demonstrate anomalous group-index behavior using space-time wave packets in a 4-microns-thick multi-mode planar waveguide.

Authors: Abbas Shiri, University of Central Florida / Ayman Abouraddy, University of Central Florida

FTh6B.8

Tunably Coupled Photonic Molecules on a Chip Scale

Presenter: Simon Woska , *Karlsruhe Institute of Technology (KIT)*

We present an all-polymeric photonic molecule from coupled whispering gallery mode cavities on a chip-scale liquid crystal elastomer substrate. The substrate's temperature-induced actuation is used to widely and precisely tune the coupling strength.

Authors: Simon Woska, Karlsruhe Institute of Technology (KIT) / Pascal Rietz, Karlsruhe Institute of Technology (KIT) / Osman Karayel, Karlsruhe Institute of Technology (KIT) / Heinz Kalt, Karlsruhe Institute of Technology (KIT)

FTh6D

General Quantum Electronics

Presenter: Ebrahim Karimi , *University of Ottawa*

FTh6D.1

Quantum Electron-Optics - New Research Directions

Invited

Presenter: Avraham Gover , *Tel-Aviv University*



Review of emerging research on interaction of free electrons with light and matter in the quantum regime. Theory of stimulated and spontaneous interactions of pre-shaped quantum electron wavepackets with light and with bound electron qubit states

Authors:Avraham Gover, Tel-Aviv University / Du Ran, Tel-Aviv University / Bin Zhang, Tel-Aviv University / Yiming Pan, Technion / Reuven Ianconescu, Tel-Aviv University / Jacob Scheuer, Tel-Aviv University / Aharon Friedman, Ariel University / Amnon Yariv, California Institute of Technology

FTh6D.2

Quantum-Enhanced Interferometry Via Extreme Non-Degenerate Energy-Entangled Photons

Presenter: Colin Lualdi , *University of Illinois at Urbana-Champaign*

We perform two-photon interference with highly non-degenerate frequency-entangled photons. Our system improves on existing interferometers by promising attosecond temporal resolution while offering robustness against dispersion, background, and loss.

Authors:Colin Lualdi, University of Illinois at Urbana-Champaign / Kristina Meier, University of Illinois at Urbana-Champaign / Spencer Johnson, University of Illinois at Urbana-Champaign / Paul Kwiat, University of Illinois at Urbana-Champaign

FTh6D.3

Theory and experiment for resource-efficient joint weak-measurement

Presenter: Aldo Camilo Martinez Becerril , *University of Ottawa*

Weak measurement allows the measurement of two incompatible observables, a 'joint weak-measurement' (JWM). Until now, JWM uses one read-out, a separate system, per observable. We demonstrate a JWM technique which requires only one read-out.

Authors:Aldo Camilo Martinez Becerril, University of Ottawa / Gabriel Bussi eres, University of Ottawa / Davor Curic, University of Calgary / Lambert Giner, University of Ottawa / Raphael Abrahao, University of Ottawa / Jeff Lundeen, University of Ottawa

FTh6D.4

Interferometry-Based Astronomical Imaging Using Nonlocal Interference With Single-Photon States

Presenter: Matthew Brown , *University of Oregon*



Recent proposals suggest that a distributed single-photon would outperform weak coherent or thermal states as a phase reference for long-baseline interferometry of dim sources. We demonstrate experimental results toward confirming this prediction.

Authors: Matthew Brown, University of Oregon / Valerian Thiel, University of Oregon / Markus Allgaier, University of Oregon / Michael Raymer, University of Oregon / Brian Smith, University of Oregon / Paul Kwiat, University of Illinois Urbana-Champaign / John Monnier, University of Michigan

FTh6D.5

Unscrambling Entanglement through a Complex Medium

Presenter: Mehul Malik , *Heriot-Watt University*

We demonstrate the transport of six-dimensional spatial-mode entanglement through a complex medium consisting of a commercial multi-mode fiber by carefully 'scrambling' the photon that did not enter it, rather than unscrambling the photon that did.

Authors: Mehul Malik, Heriot-Watt University / Natalia Valencia, Heriot-Watt University / Suraj Goel, Heriot-Watt University / Will McCutcheon, Heriot-Watt University / Hugo Defienne, University of Glasgow

FTh6D.6

Multi-photonic Entanglement, a Geometric Approach

Presenter: Songbo Xie , *University of Rochester*

A new genuine tripartite entanglement measure is revealed, interpreted as the area of a so-called concurrence triangle. The new measure is found superior to previous attempts. Specific examples are illustrated.

Authors: Songbo Xie, University of Rochester / Joseph Eberly, University of Rochester

FTh6D.7

Emulating Quantum-enhanced Long-Baseline Interferometric Telescopy

Presenter: David Diaz , *University of Illinois Urbana-Champaign*



We demonstrate the underlying mechanism for quantum-enhanced telescoping, using multiple interconnected Hong-Ou-Mandel interferometers to recover the visibility amplitude and relative phase of the source light into multiple simulated telescopes.

Authors: David Diaz, University of Illinois Urbana-Champaign / Yujie Zhang, University of Illinois Urbana-Champaign / Virginia Lorenz, University of Illinois Urbana-Champaign / Paul Kwiat, University of Illinois Urbana-Champaign

