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Check the Mobile App for regular updates. Program updates and changes through 13 October may be found on the Conference Program Update Sheet distributed in the registration bags.

Conference Schedule-at-a-Glance

Note: Dates and Times are subject to change. Check the Mobile App for regular updates. All times reflect Eastern time zone.

	Monday 17 October	Tuesday 18 October	Wednesday 19 October	Thursday 20 October	Friday 21 October
GENERAL & EXHIBITS					
Registration	15:00–20:00	07:00 –17:00	07:00–18:00	07:00–17:00	07:30–16:30
WORKinOPTICS.com Kiosk & E-Center	15:00–20:00	07:00 –17:00	07:00–17:00	07:00–17:00	07:30–16:30
Speaker Preparation Room	15:00–18:00	07:00–18:00	07:00–18:00	07:00–18:00	07:30–16:00
Coffee Breaks		10:00–10:30 15:30–16:00	09:30–10:30 14:30–15:00	09:30–10:00 16:00–16:30	10:00–10:30 15:30–16:00
Exhibit Hall Open			09:30–16:00	09:30–14:00	
Unopposed Exhibit-only Time			09:30–10:30 12:00–13:00 14:30–16:00	09:30–11:00 12:30–14:00	
Glass Art Contest & Auction			09:30–16:00	09:30–14:00	
OSA Student Chapter Competition			14:00–16:00		
PROGRAMMING					
FiO/LS Technical Sessions		08:00–18:00	10:30–18:00	14:00–18:30	08:00–18:00
Laser Science Symposium on Undergraduate Research		12:15–18:00			
Joint FiO/LS Plenary & Awards Sessions			08:00–09:30	08:00–09:30	
FiO Poster Sessions			14:30–16:00	09:30–11:00	
OSA Light the Future Speaker Series featuring Michio Kaku and Nobel Laureates				11:00–12:30	
Postdeadline Paper Sessions					10:30–12:30
SPECIAL EVENTS					
Women of Light, a Special Program for Women in Optics hosted by WiSTEE CONNECT	11:00–17:00				
Make Optics Career Roundtable	17:00–18:00				
Diversity & Inclusion Reception: A Look at the LGBT Climate in Physics	17:00–18:00				
FiO/LS Welcome Reception	18:30–20:30				
Optics in Digital Systems Technical Group Networking Breakfast		07:30–08:30			
OSA Fellow Members Lunch		12:00–13:15			
Optical Material Studies Technical Group Special Talk		12:00–13:30			
Polarization Technical Group Special Talk		12:00–13:30			
OSA Friends and Family Event		13:45–16:00			
Meet the OSA Editors' Reception		15:30–16:30			
Photonics Clambake 2016		17:30–20:30			
Optics & Energy: Reflections on the Past and Lighting the Future		18:00–19:00			
OSA Student Member Party		19:00–22:00			
Optics Alumni Networking Reception		19:00–22:00			
AIM Photonics Northeast Supply Conference (NESCO)			08:00–17:00		
Environmental Sensing Technical Group Special Talk			12:00–13:00		
Meet the Editors of the APS Journals Reception			15:30–17:00		
OIDA Member and Exhibitor Appreciation Reception			16:00–17:00		
OSA Annual Business Meeting			17:00–17:45		
DLS Annual Business Meeting			17:00–18:00		
OSA 100 Year BASH			18:30–21:30		
VIP Industry Leaders Networking Event				12:30–14:00	

Welcome to Frontiers in Optics 2016

We are pleased that you have chosen to join us to celebrate The Optical Society's centennial year as we return to the organization's birthplace, Rochester, New York. The 2016 Frontiers in Optics (FiO) Conference, the 100th Annual meeting of The Optical Society, will encompass the breadth of optical science and engineering and provide an atmosphere that fosters the exchange of information between those working on fundamental research and those looking for solutions to engineering problems. On behalf of the FiO Subcommittee Chairs, we would like to thank our colleagues from the Division of Laser Science (DLS) of the American Physical Society (APS) for assisting in cultivating joint topics and sessions that will greatly enhance the experience of the attendees at FiO 2016.

The technical program features nearly 900 invited, tutorial, and contributed oral and poster presentations by celebrated members of the community describing some of the most exciting advances in their fields. Special symposia and other major events further highlight major advances in many selected areas. This year's program also features two renowned Plenary speakers. Lukas Novotny, *ETH Zurich, Switzerland,* will give the presentation, "Controlling Light-matter Interactions on the Nanometer Scale" during Wednesday's Plenary session. Michal Lipson, *Columbia University, USA*, will discuss "Next Generation Silicon Photonics" at the Thursday Plenary session. Our Plenary session programming will also include the award presentations from two individuals receiving two of the highest honors for OSA and APS. Gerard Mourou, *University of Michigan, USA*, winner of the OSA 2016 Frederic Ives Medal/Jarus W. Quinn Prize, will give an address at the Wednesday Plenary session. Robert W. Boyd, recipient of the APS 2016 Arthur L. Schawlow Prize will present during Thursday's Plenary session. In addition to these distinguished speakers, OSA will celebrate our 100th Anniversary with a continuation of the Light the Future Speaker series. This event will feature Michio Kaku, Futurist and theoretical Physicist, *City College of New York, USA*.

FiO is pleased to offer several special symposia – The Symposium on 100 Years of Optical Design, Fabrication, Testing and Instrumentation – A Historical Look Back (Tuesday, 18 October, 08:00–14:30); The Symposium on the 50th Anniversary of Low-Loss Optical Fibers (Tuesday, 18 October, 08:00–15:30); The Symposium on Mesoscopic Optics of Disordered Media (Wednesday, 19 October, 10:30–14:00); A Tribute to Steve Jacobs (Wednesday, 19 October, 10:30–14:00); The Symposium on Mid-Infrared Fiber Sources (Thursday, 20 October, 14:00–18:30); The Symposium on 100 Years of Vision at OSA: Most Cited Vision Papers in OSA Journals (Thursday, 20 October, 14:00–16:00); The Symposium on Integrated Photonic Manufacturing (Friday, 21 October, 08:00–14:30); and the Symposium on Integrated Quantum Optics (Friday, 21 October, 14:30–17:30). Details about all the symposia are listed on the Symposia pages of this program.

This year's meeting is filled with many informational and networking events. Some of the highlights of FiO 2016 include the following:

- OSA's Science Educators' Day will be held on Sunday, 16 October, from 13:30–16:30, in the Grand Ballroom of the Hyatt Regency Rochester. Hosted by The Optical Society, Science Educator's Day (EDAY) provides middle and high school science teachers with a wide variety of optics-focused lesson plans and classroom demonstration guides. EDAY attendees receive materials that can be used in middle and high school classrooms.
- The Conference Welcome Reception will be held on Monday, 17 October, from 18:30–20:30.
- OSA Students will be welcomed at the OSA Student Member Party Tuesday, 18 October from 19:00–22:00
- Be sure to join us for the OSA 100 Year BASH on Wednesday, 19 October from 18:30–21:30.
- The Light the Future Speaker Series featuring a presentation by Michio Kaku will be held on Thursday, 20 October from 11:00–12:30
- Late-breaking advances in optics will be presented on Friday, 21 October, in the FiO Postdeadline Paper Sessions, running from 10:30–12:30.
- The OSA Foundation is pleased to announce the 8th annual Emil Wolf Outstanding Student Paper Competition. One award winner will be selected from each of the seven FiO subcommittees. Selections will be made based on the quality of the submitted technical summary and presentation. Winners will be announced at the end of the conference and in the next issue of *Optics & Photonics News* (OPN).
- Wednesday and Thursday, while you are enjoying the poster sessions and the coffee breaks in the Exhibit Hall and/or taking breaks from the presentations, please see the latest in scientific and optical instrumentation and information that our exhibitors have on display!

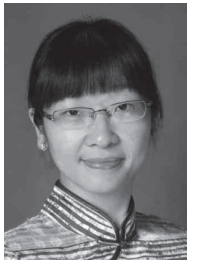
We welcome you to FiO 2016 and encourage you to take full advantage of the benefits of this year's social and networking opportunities, technical sessions, corporate programming, poster sessions and exhibition!

Scott Carney
University of Illinois at Urbana-Champaign, USA
General Chair

Urs Utzinger
University of Arizona, USA
General Chair

Tom Brown
University of Rochester, USA
Program Chair

Chris Dainty
University College London, UK
Program Chair



Ling Fu
Wuhan National Lab for Optoelectronics, China
Program Chair

Welcome to Laser Science 2016

The leadership of the Division of Laser Science (DLS) of the American Physical Society (APS) is pleased to welcome you to our 32nd annual meeting, Laser Science (LS) 2016, in Rochester, New York. We are grateful for the help of our colleagues and technical program Subcommittee Chairs, David Reis, Robert Alfano, Bo Zhen, Nick Vamivakas, Mohammad Hafezi, Carlos Baiz, Dirk Englund, and Christopher Milne, in organizing a broad range of topics in physics, biology and chemistry. This year's program includes many of the areas at the forefront of laser science that are customarily found at the annual DLS meeting. We have collaborated with our colleagues in The Optical Society to coordinate schedules to encourage your intellectual wanderings between DLS and OSA sessions.

In addition to an outstanding technical program with over 100 Laser Science presentations, there are many exciting special symposia and events scheduled for the meeting this year. Special attention is appropriate for the Symposium on Undergraduate Research on Tuesday, which showcases the work of some of our youngest scientists. The Symposium will feature a special poster session to present the work of selected undergraduate researchers. The technical sessions for the Laser Science meeting are organized around several broad themes: High Harmonic Generation from Solids to Gases; Multiphoton Effects and High Resolution Imaging; Advanced Nano-Photonic Lasers: Science and Application; Quantum Light Souces; Integrated Quantum Photonics; Nonreciprocal and Topological Photonic Devices; Nano-Plasmonics for Spectroscopy and Imaging; Advances in X-ray and XUV Laser Science and Applications; and General Laser Science. The DLS Business meeting will be held Wednesday, 19 October from 17:00–18:00. We welcome you to the Laser Science 2016 Meeting and encourage you to take full advantage of this year's technical and poster sessions, symposia, and plenary lectures, as well as an exhibit hall showcasing leading suppliers to the laser science community. Enjoy!

Kevin J. Kubarych
University of Michigan, USA,
Laser Science Co-Chair

Edo Waks
University of Maryland, USA,
Laser Science Co-Chair

General Information

Conference Services

Registration
Galleria

Registration Hours

Monday, 17 October	15:00–20:00
Tuesday, 18 October	07:00–17:00
Wednesday, 19 October	07:00–18:00
Thursday, 20 October	07:00–17:00
Friday, 21 October	07:30–16:30

Speaker Preparation Room
Aqueduct C/D

Speakers and presenters are encouraged to stop by the Speaker Preparation Room to test their computers and presentations prior to their session. The room will be equipped with LCD projectors and screens. Computers will be available to test presentations.

Speaker Preparation Hours

Monday, 17 October	15:00–18:00
Tuesday, 18 October	07:00–18:00
Wednesday, 19 October	07:00–18:00
Thursday, 20 October	07:00–18:00
Friday, 21 October	07:30–16:00

Media Room
Aqueduct A/B

A staffed media room is available for credentialed members of the media. Badges for pre-registered reporters and reporter registration are in the media room along with media kits kits, internet connectivity and printer, quiet work space and conference information.

Media Room Hours

Monday, 17 October	12:00–17:00
Tuesday, 18 October	08:00–17:00
Wednesday, 19 October	08:00–17:00
Thursday, 20 October	08:00–12:00

E-Center
Empire Lobby

The E-Center, offering free internet connectivity, will be open Monday through Friday during registration hours.

Exhibition
Empire Hall
Wednesday, 19 October, 09:30–16:00
Thursday, 20 October, 09:30–14:00

Exhibit Hours Exclusive

Wednesday, 19 October	09:30–10:30 12:00–13:00 14:00–16:00
Thursday, 20 October	09:30–11:00 12:30–14:00

The FiO Exhibit is open to all registered attendees. Visit a diverse group of companies representing every facet of the optics and photonics industries. For more information, see page 23.

Business Center
Hyatt Regency Rochester and Radisson Rochester Riverside

The Radisson Rochester Riverside Business Center is located in the hotel Lobby and features four computers for guest use as well as printers. Copying, and faxing services are offered through the Radisson Rochester Riverside Front Desk. These services are available 24 Hours a Day.

The Hyatt Regency Rochester's in-house Business Center, operated by CMI Communications, offers one-stop shopping for all of your business needs, including e-mail and high-speed Internet access, secretarial/transcription services, photocopying, and faxing. Guests of the Hyatt Regency Rochester have extended access to the business center which is available 24 hours a day, 7 days a week.

Lost and Found

For Lost and Found please check first at the conference registration counter in the Gallieria. Please put your name on all conference materials (including your Conference Program), as they will only be replaced for a fee.

Special Needs

If you have a disability and require special accommodations in order to fully participate in this conference, please contact Conference Management at the registration desk. Your specific needs will be addressed.

WiFi Access Instructions

To access the complimentary wifi services during the FiO/LS Conference, use the following information to log in. If you require more detailed instructions, a step-by-step access guide is available at the FiO registration desk.

Rochester Riverside Convention Center Wifi information:
SSID: FiO2016
Password: OSA100proud

Radisson Rochester Riverside Wifi Information:
SSID: RadissonRochesterRiverside
Password: none

WORKinOPTICS.com Kiosk

Empire Lobby

WORKinOPTICS.com provides a state-of-the-art platform to efficiently connect employers and job seekers within the optics and photonics community.

Your next job opportunity or new hire is just a click away.

- Post your resume at no charge to reach top employers.
- OSA Industry Development Associates Members get 20 free job postings.

First Aid and Emergency Information

In the event of an emergency at the Rochester Riverside Convention Center, please dial "0" from any black courtesy phone.

Medical Facilities

Strong Memorial Hospital
601 Elmwood Avenue
Rochester, New York 14642
+1 585.275.2100

Rochester General Hospital
1425 Portland Avenue Rochester, New York 14621
+1 585.922.4000

Highland Hospital
1000 South Avenue Rochester, New York 14620
+1 585.473.2200

Park Ridge Hospital
1555 Long Pond Road Rochester, New York 14626
+1 585.723.7000

Sponsoring Society Membership Booths

Galleria

APS and OSA Society Booth Hours

Monday, 17 October	15:00–20:00
Tuesday, 18 October	07:00–17:00
Wednesday, 19 October	07:00–17:00
Thursday, 20 October	07:00–17:00
Friday, 21 October	07:30–16:30

APS Booth

Galleria

Founded in 1899, the American Physical Society (APS) is a non-profit membership organization working to advance and diffuse the knowledge of physics. APS publishes the world's most widely read physics research and review journals: *Physical Review Letters, Physical Review X, Reviews of Modern Physics, Physical Review A-E, Physical Review Fluids, Physical Review Applied, Physical Review Accelerators and Beams, Physical Review Physics Education Research, and Physics.* Please stop by our table near Registration to learn more about the prestigious *Physical Review* collection and *Physical Review Fluids*, our newest journal dedicated to publishing innovative research that will significantly advance the fundamental understanding of fluid dynamics.

OSA Booth

Galleria

All FiO attendees are invited to stop by the OSA Booth. Not a Member? Join on-site and take advantage of a 50 percent dues discount on the Individual Member category. Sign up at the OSA Booth, which is located near Registration.

CAM Lounge

Empire Lounge

OSA is turning 100 in 2016! We're asking all OSA members to be a part of the celebration by participating in short videos. CAM (Centennial Authentic Moments) is an ongoing program of collecting scientific selfies where members will talk about what it means to be an OSA Member, how has OSA helped in their careers, what inspired them to get into the field of optics and what excites them about their current work in three minutes or less. The collection of these short videos will be featured on OSA's centennial website.

CAM Lounge Hours

Tuesday, 18 October	09:00–14:00
Wednesday, 19 October	09:00–14:30

OSA100 Exhibit

Empire Hall Booth #101 and Galleria

OSA is marking a century of sparking inspiration and smart innovation driven by 270,000 scientists, students, engineers and business leaders around the world. Visit the OSA100 Exhibit in the registration area to experience 100 iconic images from the history of optics, photonics and The Optical Society. A smaller version of the exhibit will also be featured at booth #101. To see the interactive version of the OSA100 Exhibit and learn more about OSA Centennial Activities, go to osa.org/100.

OSA100 Empire Hall Booth Hours

Wednesday, 19 October	09:30–16:00
Thursday, 20 October	09:30–14:00

OSA100 Galleria Booth Hours

Monday, 17 October	15:00–20:00
Tuesday, 18 October	07:00–17:00
Wednesday, 19 October	07:00–17:00
Thursday, 20 October	07:00–17:00
Friday, 21 October	07:30–16:30

Looking for Lunch? Food Trucks and Concessions!

We have planned some new exciting lunch options. On Tuesday, 18 October and Friday, 21 October a variety of food trucks will be available during lunch hours (cash and credit accepted) outside of the Rochester Riverside Convention Center. On Wednesday, 19 October, cash concessions will be available in the exhibit hall from 12:00–13:00, visit with the exhibitors and enjoy lunch (cash only please).

Free Lunch Provided by OSA

On Thursday, 20 October, join your FiO colleagues for a FREE lunch in the Exhibit Hall from 12:30–14:00. This is a great opportunity to meet the exhibitors who have contributed to our success over the last 100 years.

OSA
The Optical Society
100
Since 1916

OSA Membership is an investment in your future—with professional benefits and vital connections that can last your entire career. That's why **19,275** leaders in science, engineering and industry choose The Optical Society as their professional association.

As a Frontiers in Optics attendee, you can save 50% on a one-year, individual membership.* This special rate is available whether you're joining for the first time or renewing for another year.

Stop by the OSA Booth in the lobby area to take up the offer. (Then visit the OSA Centennial Exhibit, which reflects on 100 years of innovations and inventions in optics.)

* Promotion applies to 1-year individual membership only.

CARLOS LOPEZ-MARISCAL
Mexico

ARLENE SMITH
Ireland

Stay Connected

Conference Materials

Technical Digest and Postdeadline Papers

Technical attendees have EARLY (at least one week prior to the conference) and FREE continuous online access to the FiO/LS 2016 technical digest and Postdeadline papers. These 1-2-page summaries of tutorial, invited, and accepted contributed papers can be downloaded individually or by downloading daily .zip files. (.zip files are available for 60 days.)

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

Conference Program Update Sheet

Technical program changes received just prior to the meeting will be communicated in the onsite Conference Program Update Sheet distributed with your onsite registration materials. In addition, all updates will be made in the FiO/LS mobile app. We encourage you to review them carefully to stay informed on changes to the program.

Poster Presentation PDFs

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

Exhibit Buyers' Guide

The Exhibit Buyers' Guide is composed of descriptions and contact information for exhibiting companies at this year's conference, and exhibit hall activities. Guides will be provided to every FiO/LS attendee as part of registration. All exhibitor information changes will be communicated in the FiO/LS mobile application. We encourage you to review the mobile application carefully to stay informed of changes to the program.

Program Updates Board

Onsite Program changes will be posted on an update board located at the registration desk. Check daily for new information and/or reference the FiO/LS mobile app.

Join the Social Conversation at FiO/LS 2016!

We will be providing the latest updates throughout the conference using Twitter. Do you have a Twitter handle? Follow @Opticalsociety on Twitter. Tweet about your conference experience using #FIO16 in your tweets. Stop by the OSA booth for more details. Join the conversation. Follow @Opticalsociety on Twitter. Use hashtag #FIO16. Celebrate 100 years of optics at #OSA100.

Join the conversation.
Follow @Opticalsociety on Twitter.
Use hashtag **#FIO16**
and #OSA100

FiO/LS Mobile Application

Frontiers in Optics/Laser Science 2016 (FiO/LS 2016) has gone mobile again this year using CrowdCompass! We strongly encourage you to download our mobile guide to enhance your experience at FiO/LS 2016. You'll be able to plan your day with a personalized schedule and browse exhibitors, maps and general show info.

Schedule

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

Exhibit Hall

Search for exhibitors in alphabetical order, and set a bookmark reminder to stop by their booth. Tap on the map icon within a description, and you'll find their location on an expo floor map. View a daily schedule of all activities occurring on the show floor.

Attendees

All FiO/LS registered attendees are listed in the app. Send a contact request to an attendee, and initiate another valuable networking opportunity.

Download the App

The app is compatible with iPhone, iPad, iPod Touch and Android devices. To get the guide, choose one of the methods below:

1. Visit www.frontiersinoptics.com/app to download the application.
2. Scan the following image with your mobile phone (QR-Code reader required, e.g. 'Red Laser', 'Barcode Scanner')
3. Search for OSA Events in the app stores.

2017 OSA Optics and Photonics Topical Meetings and Congresses

		Submit your abstract by:
OFC	19 - 23 March Los Angeles, California, USA ofcconference.org	11 October 2016
Optical Trapping Applications (OTA) Novel Techniques in Microscopy (NTM) Bio-Optics: Design and Application (BODA) Optical Molecular Probes, Imaging and Drug Delivery (OMP) Optics and the Brain (BRAIN)	OSA Biophotonics Congress: Optics in the Life Sciences 2 - 5 April San Diego, California, USA osa.org/LifeSciencesOPC	29 November 2016
OSA Quantum Information and Measurement (QIM) - IV: Quantum Technologies	5 - 7 April Paris, France osa.org/qim	6 December 2016
CLEO: 2017	14 - 19 May San Jose, California, USA cleoconference.org	14 December 2016
OSA Digital Holography and 3-D Imaging Topical Meeting	29 May - 1 June Jeju Island, South Korea osa.org/dh	24 January 2017
CLEO/Europe - EQEC	25 - 29 June Munich, Germany www.cleoeurope.org	19 January 2017
European Conferences on Biomedical Optics	25 - 29 June Munich, Germany www.osa.org/ecbo	19 January 2017
3D Image Collection and Display Applied Industrial Optics (AIO) Computational Optical Sensing and Imaging (COSI) Imaging Systems and Applications (IS) Mathematics in Imaging Propagation Through and Characterization of Atmospheric and Oceanic Phenomena (pcAOP)	OSA Imaging and Applied Optics Congress 26 - 29 June San Francisco, California osa.org/ImagingOPC	15 February 2017

		Submit your abstract by:
Freeform Optics (Freeform) International Optical Design Conference (IODC) Optical Fabrication and Testing (OF&T)	OSA Design and Fabrication Congress 9 - 13 July Denver, Colorado, USA osa.org/DesignFabOPC	8 March 2017
OSA Nonlinear Optics Topical Meeting	17 - 21 July 2017 Waikoloa, Hawaii, USA osa.org/nlo	14 March 2017
Integrated Photonics Research, Silicon, and Nano-Photonics (IPR) Novel Optical Materials and Applications (NOMA) Optical Sensors (Sensors) Photonic in Switching (PS) Photonic Networks and Devices (Networks) Signal Processing in Photonic Communications (SPPCom)	OSA Advanced Photonics Congress 24 - 27 July New Orleans, Louisiana, USA osa.org/PhotonicsOPC	4 April 2017
CLEO/Pacific Rim	31 July - 4 August Singapore, Singapore photonics2017.org	1 January 2017
Frontiers in Optics/Laser Science	17 - 21 September Washington, D.C., USA frontiersinoptics.com	2 May 2017
Advanced Solid State Lasers Conference and Exhibition (ASSL) Laser Applications Conference	OSA Laser Congress 1 - 5 October Nagoya, Aichi, Japan osa.org/assl	30 May 2017
Solid State Lighting (SSL) Optical Nanostructures and Advanced Materials for Photovoltaics (PV) Optical and Photonics for Energy & the Environment (E2) Optics for Solar Energy (SOLAR)	OSA Light, Energy and the Environment Congress 6 - 9 November Boulder, Colorado, USA osa.org/EnergyOPC	5 July 2017

Conference Plenary Sessions and Awards Ceremony

Wednesday, 19 October, 08:00–09:30 and
Thursday, 20 October, 08:00–09:30
Lilac Ballroom

Join your colleagues to recognize recent OSA and APS/Division of Laser Science award and honor recipients. The sessions include the Ives Medal Address, the Schawlow Prize Lecture and two plenary presentations. The order of events:

Wednesday, 19 October

Welcome and Opening Remarks

Controlling Light-matter Interactions on the Nanometer Scale, Lukas Novotny, *ETH Zurich, Switzerland*

OSA Award and Medal Presentations

Ives Medal Address – **Extreme Light: From Multiphoton Ionization to Light Materialization and Beyond**, Gérard Mourou, *IZEST, Ecole Polytechnique Palaiseau, France*

Closing Remarks

Thursday, 20 October

Welcome

Next Generation Silicon Photonics, Michal Lipson, *Columbia Univ., USA*

OSA Fellow Member Recognition

APS Fellow Member Recognition

Schawlow Prize Lecture – **Nonlinear Optics and Laser Science,** Robert W. Boyd, *University of Ottawa, Canada*

Closing Remarks

Plenary Presentations

Controlling Light-matter Interactions on the Nanometer Scale, Lukas Novotny, *ETH Zürich, Switzerland*

The past 20 years have brought exceptional control over light-matter interactions on the nanoscale. Today, localized optical fields are being probed with nanoscale materials and, vice versa, nanoscale materials are being controlled and manipulated with localized fields.

In this talk, Lukas Novotny will discuss both early and recent developments in near-field optical spectroscopy and optical nanomanipulation.

About the Speaker

Lukas Novotny is a Professor of Photonics at ETH Zürich. His research is focused on understanding and controlling light-matter interactions on the nanometer scale. Novotny did his PhD at ETH Zürich and from 1996-99 he was a postdoctoral fellow at the Pacific Northwest National Laboratory, working on new schemes of single molecule detection and nonlinear spectroscopy. In 1999 he joined the faculty of the Institute of Optics at the University of Rochester where he started one of the first research programs to focus on nano-optics. Novotny is the author of the textbook Principles of Nano-Optics, which is currently in its second edition. He is a Fellow of The Optical Society and the American Association for the Advancement of Science.

Next Generation Silicon Photonics, Michal Lipson, *Columbia University, USA*

In the past decade, silicon photonics has recently been shown as a platform for high-performance optical devices that can be monolithically integrated with state-of-the-art microelectronics. The toolbox of integrated nanophotonics today is rich: from the ability to modulate, guide and amplify multiple wavelength sources at GHz bandwidths, to optomechanical MEMS and nonlinear devices.

In this talk, Michal Lipson will review the current challenges and recent achievements in the field of silicon nanophotonics and present recent results. Using highly-confined photonic structures, her team has demonstrated ultra-compact passive and active silicon photonic components that enhance the electro-optical, mechanical and nonlinear properties of the material.

About the Speaker

Prof. Michal Lipson is the Eugene Higgins Professor at Columbia University. She completed her B.S., M.S. and Ph.D. degrees in Physics in the Technion in 1998. Following a Postdoctoral position in MIT in the Material Science department from 1998 to 2001, she joined the School of Electrical and Computer Engineering at Cornell University and was named the Given Foundation Professor of Engineering at the School of Electrical and Computer Engineering in 2012. In 2015 she joined the electrical engineering department at Columbia University. Lipson is one of the pioneers of the field of silicon photonics. She holds over 20 patents and is the author of over 200 technical papers. Prof. Lipson's honors and awards include Macarthur Fellow, Blavatnik Award, IBM Faculty Award, and NSF Early Career Award. She is a Fellow of both the OSA and of IEEE. She was named by Thomson Reuters as a top 1% highly cited researcher in the field of Physics.

Awards Ceremony

APS and OSA will present awards and honors during the Plenary Session.

2016 Arthur L. Schawlow Prize in Laser Science

Nonlinear Optics and Laser Science, Robert W. Boyd, *University of Ottawa, Canada*

The interplay between nonlinear optics and the field of laser science will be reviewed. Topics to be stressed include the development of approaches for controlling the velocity of light, of quantum imaging methods, and composite nonlinear optical materials.

About the Speaker

Robert W. Boyd received the B.S. degree in physics in 1969 from Massachusetts Institute of Physics (MIT) and his Ph.D. in physics in 1977 from the University of California, Berkeley. He joined the faculty of the University of Rochester in 1977, and in 2001 became the M. Parker Givens Professor of Optics and Professor of Physics. In 2010, he became Professor of Physics and Canada Excellence Research Chair at the University of Ottawa. His research interests include studies of "slow" and "fast" light, orbital angular momentum of light, quantum communication, quantum imaging, nonlinear optical interactions and materials, and nanofabrication of photonic devices. He has written two books, co-edited two anthologies, published over 400 research papers (≈29,000 citations, Google h-index 71), and been awarded nine patents. He is the 2009 recipient of the Willis E. Lamb Award for Laser Science and Quantum Optics, the 2010 recipient of a Humboldt Research Prize, and the 2014 recipient of the Quantum Electronics Award of the IEEE Photonics Society.

2016 Frederic Ives Medal / Jarus Quinn Prize

Extreme Light: From Multiphoton Ionization to Light Materialization and Beyond, Gérard Mourou, *École Polytechnique, France*

The laser provides a convenient way to generate formidable fields—enough to break atomic bonds, drive particles relativistically over short distances or generate high energy radiations. A new way to compress large energy pulses into the attosecond-zeptosecond range has emerged. X-Ray pulses in the exawatt regime would ensue opening unfathomable possibilities for nuclear physics, high energy physics, astrophysics and cosmology, showing that the best in laser physics is yet to come.

About the Speaker

Gérard Mourou was the founding Director of the Center for Ultrafast Optical Science at the University of Michigan. For forty years, Mourou has pioneered the field of ultrafast lasers and their applications in scientific, engineering and medical disciplines. He is also the initiator of the Extreme Light Infrastructure (ELI) in Europe. With his student Donna Strickland he is the inventor of the chirped pulses amplification technique which allows ultrashort laser pulses to be amplified to petawatt optical powers, with the laser pulse being stretched out temporarily and spectrally before amplification. Mourou has recieved the Wood Prize from OSA, the Edgerton Prize from the SPIE, the Sarnoff Prize from the IEEE, and the 2004 IEEE/LEOS Quantum Electronics Award. He is a Fellow of OSA and IEEE, as well as a member of the U.S. National Academy of Engineering. Currently he is a distinguished professor emeritus at the University of Michigan, USA, and at the École Polytechnique in Palaiseau, France.

APS/Division of Laser Science Award

Arthur L. Schawlow Prize

Robert Boyd, *Univ. of Ottawa, Canada*

DLS sponsored APS Fellows:

Andrea Alu, *Univ. of Texas, Austin, USA*
Citation: For seminal contributions to electromagnetic theory and applications, nano optics, plasmonics, and metamaterials.

Hiroshi Amano, *Nagoya Univ., Japan*
Citation: For pioneering the materials science and device physics leading to the invention of blue light-emitting diodes with III nitride-based semiconductor heterostructures.

Hou-Ton Chen, *Los Alamos National Laboratory, USA*
Citation: For contributions to the development of active metamaterials and devices, and the development and understanding of few-layer metamaterials and metasurfaces, especially in the terahertz frequency range.

Zhingang Chen, *San Francisco State Univ., USA*
Citation: For seminal contributions on spatial solitons, photonic lattices, and beam shaping, and for promoting world-class research at an undergraduate institution.

Stefan Hell, *Max Planck Institute, Germany*
Citation: For pioneering contributions to the development and application of superresolved, far-field optical microscopy.

Mackillo Kira, *Philipps Univ. Marburg, Germany*
Citation: For contributions to theoretical semiconductor quantum optics.

Xiaogin Li, *Univ. of Texas, Austin, USA*
Citation: For contributions to quantum information, multidimensional coherent spectroscopy, nanophotonics based on AFM assembly, and spin dynamics in ferromagnetic nanostructures.

OSA Awards and Honors

OSA Fellowships

Irene Georgakoudi, *Tufts University, USA*

Elizabeth M. C. Hillman, *Columbia University, USA*

Cristina Masoller, *Universitat Politecnica de Catalunya, Spain*

David D. Smith, *NASA Marshall Space Flight Center, USA*

H. Philip Stahl, *NASA Marshall Space Flight Center, USA*

David Stork, *Rambus Inc., USA*

Andrey A. Sukhorukov, *Australian National University, Australia*

Mourad Zghal, *University of Carthage, Tunisia*

2016 Frederic Ives Medal/Jarus W. Quinn Prize

Gérard Mourou, *École Polytechnique, France*
For numerous pioneering contributions to the development of ultrafast and ultrahigh intensity laser science and for outstanding leadership of the international and commercial communities impacted by these technologies

Esther Hoffman Beller Medal

Bishnu P. Pal, *Mahindra École Centrale, India*
For over thirty-five years of guided wave photonics education, including the development of graduate and continuing education teaching programs and laboratories in optoelectronics and optical communications at IIT-Delhi, and for inspiring a generation of leading academic and industrial scientists

Max Born Award

Xiang Zhang, *University of California, Berkeley, USA*
For the experimental realization of major theoretical predictions in the field of metamaterials and graphene optics

Stephen D. Fantone Distinguished Service Award

G. Michael Morris, *RPC Photonics Inc., USA*
For extraordinary contributions to the OSA, including distinguished service as OSA President and a key role in the formation and leadership of the OSA Foundation

Paul F. Forman Team Engineering Excellence Award

Advanced LIGO Engineering Team
For innovative engineering creating the most sensitive measurement instrument ever built, leading to the first direct detection of gravitational waves.

Joseph Fraunhofer Award/Robert M. Burley Prize

Demetri Psaltis, *École Polytechnique Fédérale de Lausanne, Switzerland*
For pioneering contributions to the fields of photonics engineering and optofluidics.

Nick Holonyak, Jr. Award

Chennupati Jagadish, *Australian National University, Australia*
For pioneering work and sustained contributions to quantum-well, quantum-dot and nanowire optoelectronic devices and their integration

Emmett Leith Medal

Francis T.S. Yu, *Pennsylvania State University, USA*
For life-long important contributions to holography, white-light holography, partially coherent signal processing, optical correlators, and information optics.

Ellis R. Lippincott Award

Thomas Elsaesser, *Max Born Institute, Germany*
For seminal contributions to the understanding of the ultrafast coherent and incoherent vibrational dynamics of hydrogen bonds in liquids and biomolecules

Michael S. Feld Biophotonics Award

For leadership and pioneering contributions in the field of biphotonics, comprising the diverse use of label-free native fluorescence, Raman spectroscopy and optical imaging for cancer detection in tissues and cells

William F. Meggers Award

Brooks H. Pate, *University of Virginia, USA*
For the invention of the chirped- pulse Fourier transform microwave technique, which revolutionized rotational spectroscopy, leading to an explosion of novel spectroscopic, astrochemical, analytical, dynamical, and chemical kinetics applications

David Richardson Medal

Francisco J. Duarte, *Interferometric Optics, USA*
For seminal contributions to the physics and technology of multiple-prism arrays for narrow-linewidth tunable laser oscillators and laser pulse compression.

R. W. Wood Prize

Kishan Dholakia, *University of St. Andrews, U.K.*
For pioneering research into optical micromanipulation using shaped light for interdisciplinary photonics-based applications.

The Treasurer's Award: An OSA Employee Recognition Program

The Treasurer's Award, in recognition of the unique perspective our Treasurers have on the staff and their impact to the operations of the Society, will honor an employee who has made significant contributions to organizational excellence, who promotes and enacts innovative solutions or who exemplifies inspirational leadership.

Congratulations to the 2016 Treasurer's Award Recipient:

Deborah Herrin, *The Optical Society, USA*

Awards and Special Recognitions

OSA Foundation Grant Recipients

The OSA Foundation would like to congratulate our 2016 grant recipients. Through the following programs we have been able to provide over 30 grants, scholarships and prizes to help students attending FiO.

You can help to inspire and support the next generation of science and engineering innovators by making a donation to the OSA Foundation. All donations are matched 100% by the Optical Society—so your gift has twice the impact. To learn more and to make a donation online, visitwww.osa.org/foundation, or stop by the OSA booth.

OSA Foundation Travel Grant Recipients

Fernando Arturo Araiza Sixtos, *Faculty of Sciences, Mexico*
Pegah Asgari, *Zanjan Univ., Iran*
Gabriel Castillo-Santiago, *UNAM, Mexico*
Jin-hui Chen, *Nanjing Univ., China*
Andrew Huzortey, *Univ. of Cape Coast, Ghana*
Jem Teresa John, *Indian Inst. of Sciences, India*
Ivan Kam, *Instituto de Estudos Avançados (IEAv), Universidade Federal de São Paulo, Brazil*
Apurv Chaitanya Nellikka, *Physical Research Laboratory, India*
Yousef Pourvais, *Univ. of Tehran, Iran*
Nirmal Punjabi, *Indian Inst. of Technology, Bombay, India*
Zhuo Wang, *Huazhong Univ. of Sciences & Technology, China*
Jin-Min Wu, *Beijing Inst. of Technology, Beijing Key Laboratory or Fractional Signals and Systems, China*

OSA Foundation Boris P. Stoicheff Memorial Scholarship

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

Congratulations to the 2016 award recipient:
Christopher Pugh, *Univ. of Waterloo, Canada*

OSA Foundation Emil Wolf Outstanding Student Paper Competition

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

Congratulations to our finalists competing at FiO:

FiO 1: Optical Design and Instrumentation
Wenzhe Li, *Clemson Univ., USA*
Maria Papaioannou, *Univ. of Southampton, UK*
Piotr Tyczkowski, *Tampere Univ. of Technology, Finland*
Di Xu, *Univ. of Rochester, USA*

FiO 2: Optical Sciences
Zhe Guang, *Georgia Inst. of Technology, USA*
Nihal Jhajj, *Univ. of Maryland, USA*
Roman Khakimov, *Australian National Univ., USA*
Bethany Little, *Univ. of Rochester, USA*

FiO 3: Optics in Biology and Medicine
William Eldridge, *Duke Univ., USA*
Aleks Klimas, *George Washington Univ., USA*

FiO 4: Fiber Optics and Optical Communications
Krysta Boccuzzi, *Univ. of Rochester, USA*
Zhanwei Liu, *Cornell Univ., USA*
Samantha Nowierski, *Northwestern Univ., USA*

FiO 5: Integrated Photonics
Clément Javerzac-Galy, *Ecole Polytechnique Federale De Lausanne, Switzerland*
Moritz Merklein, *Centre for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS), The Univ. of Sydney, Australia*
Mengjie Yu, *Cornell Univ., USA*

FiO 6: Quantum Electronics
Lior Cohen, *Hebrew Univ. of Jerusalem, Israel*
Rick Leijssen, *FOM Inst. AMOLF, the Netherlands*
Christian Reimer, INRS-EMT, Canada

FiO 7: Vision and Color
Amanda Bares, *Cornell Univ., USA*
Michelle Victoria, *Univ. of Illinois at Urbana-Champain, USA*
Tao Jin,*Univ. of Waterloo, Canada*

OSA Foundation Incubic/Milton Chang Travel Grant

Funded by an endowment from Milton and Rosalind Chang, this program provides 10 grants of $500 USD each to enable students who present papers to travel to the Frontiers in Optics. Grants are awarded to the presenter and usually the first author of the paper. Congratulations to the 2015 Incubic/Milton Chang

Travel Grant Recipients:

Mahbub Alam, *Georgia Inst. of Technology, USA*
Surekha Barkur, *Manipal University, India*
Gabriel Castillo, *Universidad Nacional Autonoma de Mexico, Mexico*
Xiaobo Han, *Huazhong Univ. of Science and Technology, China*
Tong Lin, *National Univ. of Singapore, Singapore*
Sara Magdi, *American Univ. in Cairo, Egypt*
Emerson Melo, *Univ. of Sao Paulo, Brazil*
Patrick Stockton, *Colorado State Univ., USA*
Denise Valente, *Univ. College Dublin, Ireland*
Hengyun Zhou, *Harvard Univ., USA*

OSA Foundation Jean Bennett Memorial Student Travel Grant

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

Congratulations to our 2016 grant recipient:

Roxana Rezvani Naraghi, *University of Central Florida, USA*

OSA Foundation Robert S. Hilbert Memorial Student Travel Grant

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

Congratulations to our 2016 grant recipients:

Jin-hui Chen, *Nanjing University, China*

Ahmed Dorrah, *University of Toronto, Canada*

Denise Valente, *University College Dublin, Ireland*

Carl E. Anderson Award for Outstanding Doctoral Dissertation

The Carl E. Anderson Award for Outstanding Doctoral Dissertation in Laser Science was established in 2013 by the American Physical Society (APS) Division of Laser Science (DLS). Its purpose is to recognize doctoral research in the Laser Science area and to encourage effective written and oral presentation of research results. The award consists of $1,000 USD and a certificate citing the contribution made by the recipient. The finalists will present their work at a special session of the Laser Science conference on Tuesday, 18 October from 08:00-10:00 in the Highland Room E. The winner will be announced at the DLS business meeting Wednesday.

The following presentations will be given during this special session:

Giulio Vampa, *Univ. of Ottawa, Canada,* **Identifying and Using Recollision-based High Harmonics from Bulk Semiconductors**

Christoph Heyl, *Lund Univ., Sweden,* **Power-scaling Attosecond Sources Using Universal Scaling Principles for Nonlinear Optical Processes in Gases**

Mohammad Mirhosseini, *California Inst. of Technology, USA,* **Quantum Information with Structured Light**

Sylvain Ravets, *Joint Quantum Institute, USA,* **Development of Tools for Quantum Engineering Using Individual Atoms: Optical Nanofibers and Controlled Rydberg Interactions**

Special Symposia

Symposium on 100 Years of Optical Design, Fabrication, Testing, and Instrumentation - A Historical Look Back

Tuesday, 18 October, 08:00–10:00 (Part I), 10:30–12:00 (Part II), 13:30–14:30 (Part III)
Grand Ballroom A (Radisson)

Symposium Organizer: Julie Bentley, *Univ. of Rochester, USA*

This symposium celebrates 100 years of advances in optical design, optical fabrication and testing, and instrumentation by taking a historical look back. Topics to be discussed include the development of optical design software, the optical design of telescopes at NASA, the evolution of optical design and metrology at Tropel, a look into optical manufacturing at Kodak, the history of the Steward Mirror Lab, APOMA, and COM, and the ever changing landscape of optical metrology and optical instrumentation.

Invited Speakers:

John Bruning, *Retired, USA*, **History of Optical Design and Metrology at Tropel**

Joseph Howard, *NASA, USA,* **Large-data Center Interconnect: Emerging Technologies and Scaling Challenges**

John Grievenkamp, *The Univ. of Arizona, USA,* **Optics Goes to the Movies**

Dae Wook Kim, *Univ. of Arizona, USA*, **30 Years of Mirror Making at the Richard F. Caris Mirror Lab**

John Schoen, *US Dept. of Defense, USA,* **History of the Center for Optics Manufacturing**

Jim Sydor, *Sydor Optics, USA*, **APOMA: Past & Present**

Ed White, *Consultant, USA*, **History of Optical Manufacturing at Kodak**

Robert Wiederhold, *Optimax Systems, Inc., USA,* **The History of Optical Fabrication in Rochester NY**

Jim Wyant, *Univ. of Arizona, USA*, **Short History of Interferometric Optical Metrology**

Symposium on 50th Anniversary of Low-Loss Optical Fibers

Tuesday, 18 October, 08:00–10:00 (Part I), 10:30–12:00 (Part II), 13:30–15:30 (Part III)
Grand Ballroom B (Radisson)

Symposium Organizer: Alan F. Evans, *Corning, USA*

Optical fibers have changed our society by connecting the world. This fundamental global transformation occurred due to the advent of low-loss optical fiber for high-bandwidth transmission of optical data. This symposium celebrates the 50th anniversary of Charles K. Kao's seminal paper unfolding the alluring possibilities and opportunities of low-loss silica fiber. The presentations in this symposium will focus on the history of the development of silica fiber technologies, highlight significant milestones and advances to emerge from this paradigm shift in the way light is transmitted, and describe recent developments of low-loss fibers with advanced designs and materials.

Invited Speakers:

John Ballato, *Clemson Univ., USA,* **Back to the Future - Why Boring Old Materials and Designs are the Answer to Next Generation Optical Fibers**

Richard Epworth, *Retired, UK*, **The Birth of Optical Fiber Communications**

Yoel Fink, *MIT, USA,* **Realizing a Moore's Law for Fibers**

Randy Giles, *Nokia Bell Labs, USA*, **Origins of the Erbium-Doped Fiber Amplifier**

Takemi Hasegawa, *Sumitomo Electric Industries Ltd., Japan,* **Advances in Ultra-low Loss Silica Fibers**

Don Keck, *Retired, USA,* **Glass and Light: Enabling the Information Age**

Ming Jun Li, *Corning Inc., USA,* **Recent Development in Optical Fibers for High Capacity Transmission Systems**

John MacChesney, *John B. MacChesney Optical Materials, USA*, **AT&T's Contributions to Fiber Optics**

Stojan Radic, *Univ. of California San Diego,* **Transmitting Beyond The Fictitious Nonlinear Capacity Limit**

David Richardson, *Univ. of Southampton, UK,* **Recent Advances in Microstructured Optical Fibers and their Applications**

Robert Tkach, *Nokia Bell Labs, USA,* **High-Capacity Optical Communications – Can We Guess the Future from the Past?**

Laser Science Symposium on Undergraduate Research

Tuesday, 18 October, 12:15–18:00
Highland Room A

Organizer: Harold Metcalf, *Stony Brook Univ., USA*

The Symposium on Undergraduate Research has been a feature of the annual meeting of the Division of Laser Science of the American Physical Society (APS-DLS) for more than ten years, and has showcased the research work of approximately 400 students during that time. Students' presentations often describe their work during the previous summer. The Symposium has been supported by the DLS, OSA, and the NSF, along with several corporate sponsors. 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.

Symposium on Mesoscopic Optics of Disordered Media

Wednesday, 19 October, 10:30–12:00 (Part I), 13:00–14:00 (Part II)
Grand Ballroom D (Radisson)

Organizers: Aristide Dogariu, *CREOL, Univ. of Florida, USA;* Remi Carminati, *ESPCI ParisTech, France;* and Juan Jose Saenz, *Donostia International Physics Center, Spain*

In extreme environments, electromagnetic fields couple strongly to matter. Recent advances in understanding the complex phenomenology of multiple scattering offer unique opportunities for retrieving structural information and for controlling the propagation of light. At photonic mesoscales, fascinating interaction and confinement phenomena occur across different temporal and spatial scales. This symposium will gather international experts to discuss the experimental and theoretical progress in unveiling the properties of light propagating through and emitted in disordered media as well as a range of novel phenomena related to light-matter interaction.

Invited Speakers:

Girish Agarwal, *Oklahoma State Univ., USA,* **Long Range Light Matter Interactions at Hyperbolic Meta Surface**

Hui Cao, *Yale Univ., USA,* **Control of Optical Intensity Distribution inside a Disordered Waveguide**

Mathias Fink, *Ecole Sup Physique Chimie Industrielles, France,* **Wave Control and Holography with Time Transformations**

Allard Mosk, *Universiteit Twente, Netherlands,* **Open Channels in Scattering Media: See the Light Inside**

Silvia Vignolini, *Cambridge Univ., UK,* **Cellulose Bio-inspired Hierarchical Structures**

A Tribute to Steve Jacobs

Wednesday, 19 October, 10:30–12:00 (Part I), 13:00–14:00 (Part II)
Highland Room C

Organizer: Julie Bentley, *Univ. of Rochester, USA*

The Stephen D. Jacobs Symposium has been organized to honor the late Dr. Stephen D. Jacobs's contributions to the fields of *optical materials*, *liquid crystals*, *optics manufacturing* and *educational outreach*. Steve spent his entire career at the University of Rochester with appointments at the Laboratory for Laser Energetics (LLE), Institute of Optics, Materials Science and Chemical Engineering departments. His research included topics such as phosphate laser glass, frequency conversion crystals, liquid crystal laser optics, optical finishing of glass, ceramics and crystals, magnetorheological finishing (MRF), cholesteric liquid crystal flakes for display applications, and laser damage in multilayer dielectric coatings. In addition to his significant technical contributions Steve also had a passion for educational outreach. He volunteered as the educational outreach chair for the OSA-Rochester Section for over 15 years during which time he developed and organized the *Optics Suitcase* program that has been instrumental in introducing hundreds of thousands of young children to the fields of optics and materials science throughout the US and globally in over 40 countries. Steve Jacobs touched many lives, we are honored to have this special symposium in memory of our great colleague, friend and mentor.

Invited Speakers:

Tanya Kosc, *Univ. of Rochester, USA*, **Steve Jacobs: The Optics Outreach Innovator**

John Lambropoulos, *Univ. of Rochester, USA,* **Nanomechanics in Optical Manufacturing**

Ken Marshall, *Univ. of Rochester, USA*, **Thirty-five Years of Liquid Crystal Research at LLE: From Laser Fusion to Electronic Paper**

Kathleen Richardson, *UCF-CREOL, USA*, **Optical Glass Science – The How and Why We Got Here**

Aric Shorey, *Corning Inc., USA,* **Materials Development in Magnetorheological Finishing: The Work of Dr. Stephen Jacobs**

Symposium on Mid-Infrared Fiber Sources

Thursday, 20 October, 14:00–16:00 (Part I), 16:30–18:30 (Part II)
Grand Ballroom A (Radisson)

Organizer: Morten Ibsen, *Univ. of Southhampton, UK*

Optical sources in the mid-infrared wavelength range have become key for enabling applications in remote sensing, biomedical, materials processing, and homeland security. Specific applications in metrology, tomography, and isotope separation are enabled by optical access to the molecular fingerprint region. To date, mid-infrared fiber sources span the performance space from ultrafast pulses to kilowatts of power, from single-frequency to supercontinuum bandwidths, and cover spectral bands that cannot be addressed by other sources (e.g., QCLs). This symposium will focus on recent developments in mid-infrared fiber sources and related technologies, with the most advanced progress in the field including materials, devices, and applications.

Invited Speakers:

Caroline Amiot, *Tampere Univ. of Technology, Finland,* **Mid-IR Source for Ultra-broadband Cavity Enhanced Spectroscopy**

Martin Bernier, *Université Laval, Canada,* **All-fiber Sources Operating in the Mid-infrared**

Stuart Jackson, *Macquarie Univ., Australia,* **Power Scaling Concepts for Mid-infrared Fibre Lasers Using Fluoride Glass**

Khanh Kieu, *Univ. of Arizona, USA,* **Mid-IR Ultrafast Fibre Laser Sources**

Christian Rosenberg Petersen, *DTU, Denmark,* **Generation and Applications of High Average Power Mid-IR Supercontinuum in Chalcogenide Fibres**

Angela Seddon, *Univ. of Nottingham, UK,* **Medical Applications of Mid-IR Fibre Laser Technologies**

Brandon Shaw, *Naval Research Labs, USA,* **Highly Nonlinear Fibre for Applications in the Mid-IR**

Thibaut Sylvestre, *Univ. of Franche-Comté, France,* **Tutorial: Mid-IR Wavelength Conversion in Tapered Chalcogenide Fibres**

Symposium on 100 Years of Vision at OSA: Most Cited Vision Papers in OSA Journals

Thursday, 20 October 2016, 14:00–16:00
Highland Room E

Organizer: Susana Marcos, *Consejo Sup Investigaciones Cientificas, Spain*

Vision Science has been an active community at OSA, and a large percentage of publications on vision have been among the most top cited in OSA Journals (JOSA, JOSA A, Applied Optics, Optics Letters, Optics Express and Biomedical Optics Express, among others). The symposium hig,lights some classic vision science papers and their impact on today's research in the field. Selected thems range from the sensitivity of the eye and motion perception to wavefront sensing in the eye.

Invited Speakers:

Edward H. Adelson, *MIT, USA,* **Motion, Early Vision, and the Plenoptic Function**

Denis Pelli, *New York Univ., USA,* **Visual Sensitivity and Object Recognition**

Andrew Beau Watson, NASA, USA, **Fourier, Gabor, Reichardt, Hilbert: Guides on the Path to a Model of Human Motion Perception**

David Williams, *Univ. of Rochester, USA,* **Emerging Ocular Applications of Wavefront Correction**

Symposium on Integrated Photonic Manufacturing

Friday, 21 October, 08:00–10:00 (Part I), 13:30–14:30 (Part II)
Highland Room A

Symposium Organizer: Stefan Preble, R*ochester Inst. of Technology, USA*

This symposium gathers experts from academia, industry and foundries to discuss the progress that has been made and the challenges that remain to realize commercially successful integrated photonic manufacturing platforms.

Invited Speakers:

Roel Baets, *Universiteit Gent, Belgium,* **Silicon Photonics Plaforms: To Standardize or to Diversify?**

Keren Bergman, *Columbia Univ., USA,* **Manufacturing Silicon Photonics for High-performance Datacom Systems**

Peter de Dobbelaere, *Luxtera, USA***, Silicon Photonics: Applications and High Volume Manufacturing Platform**

Michael Liehr, *AIM Photonics, USA***, AIM Photonics - Manufacturing Challenges for Photonic Integrated Circuits**

Sylvie Menezo, *CEA-LETI, France***, Providing Silicon-Photonic Transceivers with an Efficient Laser Source: Where does "III-V/Silicon Heterogeneous Integration" Stand?**

Peter O'Brien, *Tyndall Institute, Ireland,* **Development of Integrated Photonic Packaging Standards and Foundry Capabilities**

Symposium on Integrated Quantum Optics

Friday, 21 October, 14:30 - 15:30 (Part I); 16:00–17:30 (Part II)
Highland Room A

Symposium Organizer: Stefan Preble, R*ochester Inst. of Technology, USA*

Quantum optics technologies have the potential to revolutionize computing, communication and sensing systems. Chip-scale implementations have resulted in rapid progress by integrating high quality photon sources, circuits and single photon detectors together. This symposium will focus on recent developments and the progress that is being made towards the realization of complex, chip-scale, quantum information systems.

Invited Speakers:

Benjamin Eggleton, *Univ. of Sydney, Australia*, **Multiplexing of Integrated Single Photon Sources**

Dirk Englund, *MIT, USA***, Quantum Information Processing Using Programmable Silicon Photonic Integrated Circuits**

Jeremy O'Brien, *Univ. of Briston, UK***, Title to be Announced**

Christine Silberhorn, *Universitat Paderborn, Germany***, Quantum Information Processing with Photon Temporal Modes**

Jelena Vuckovic, *Stanford Univ., USA***, Quantum Nanophotonics: From Inverse Design to Implementations**

Special Events

Science Educators Day (EDAY) 2016

Sunday, 16 October, 13:30–16:30
Grand Ballroom A-C, Hyatt Regency Rochester

The Optical Society Foundation (OSAF) in partnership with the American Association of Physics Teachers (AAPT) and The Optical Society (OSA) Rochester Local Section are hosting a special community outreach program and training for K-12 educators! This session will focus on light and color through fun, hands-on, and even *edible* science experiences.

- Learn about the components of white light with a "Rainbow Peephole," how some animals see patterns invisible to the human eye with "Magic Stripes," and how materials can change color with the "Magic Patch."
- Learn about color absorption and reflection as we predict the colors of M&M's under different colors of light and as we observe how light travels through colored gummy bears.
- Learn about color transmission as we observe the world through filters made of Jell-O.
- Participants will walk away with a variety of resources for their students and multiple lesson plans appropriate for K-12.

Student Leadership Conference (Invitation only)

Monday, 17 October, 07:00–17:00
Grand Ballroom, Holiday Inn Rochester Downtown

The OSA Student Leadership Conference (SLC) at FiO/LS brings together chapter officers from around the globe each year to network amongst their peers and to learn more about successful chapter management and careers in optics and photonics. This year's event will feature professional development, chapter management and education outreach programming.

Women of Light, a Special Program for Women in Optics hosted by WiSTEE CONNECT

Monday, 17 October, 11:00–17:00
Grand Ballroom F-G, Hyatt Regency Rochester

WiSTEE Connect is an organization which serves to connect female students, faculty members, and engineers in Science, Technology, Engineering, and Entrepreneurship (STEE) from regional universities and private companies in upstate New York. The vision of WiSTEE Connect is to promote women leadership in STEE and assist women involved in these areas to gain regional and/or global connections and recognition. This organization helps to bridge the gap between science and entrepreneurship while providing a forum though which women in these fields may learn, connect, and lead.

The overall goal of the "Women of Light" special session is to shine light upon women's careers in science, technology, engineering, mathematics, and entrepreneurship, recruit women across career ranks and disciplines, and build a sustainable community of women in both academia and industry from which career growth, mobility, and leadership opportunities may be sought out.

Diversity and Inclusion Program and Reception: A Look at the LGBT Climate in Physics

Monday, 17 October, 17:00–18:00
Grand Ballroom A-B, Hyatt Regency Rochester

OSA 100
DIVERSITY & INCLUSION IN OPTICS AND PHOTONICS

Speaker: Ramon Barthelemy, *American Institute of Physics Statistical Research Center, USA*

Please join Barthelemy as he shares highlights from the 2016 American Physical Society's (APS) LGBT Climate in Physics Report. Following the presentation join your colleagues for a networking reception to discuss ways the optics and photonics community can improve diversity and inclusion. We encourage you to attend this program to learn what OSA is doing to improve the experience of underrepresented members and support your colleagues as we continue this important conversation. First 50 attendees will receive a printed copy of APS's LGBT Report.

Make Optics Career Roundtable

Monday, 17 October 2016, 17:00–18:00
Grand Ballroom E, Hyatt Regency Rochester

Hosted by the OSA Optical Fabrication and Testing Technical Group, this event will provide students and recent graduates with the opportunity to connect with experienced professionals working in academia, industry and government roles. Contact TGactivities@osa.org to register for this career roundtable event.

OSA Optical Fabrication and Testing Technical Group

FiO/LS Welcome Reception

Monday, 17 October, 18:30–20:30
Galleria, Riverside Court, and Empire Lobby

Get the FiO/LS 2016 conference off to a great start by attending the Welcome Reception. Meet with colleagues from around the world and enjoy light hors d'oeuvres. This event is complimentary for FiO/LS Technical attendeees only. Non-technical attendees and guest tickets are available for $75 USD each.

Sponsored by THORLABS

Optics in Digital Systems Technical Group Networking Breakfast

Tuesday, 18 October 2016, 07:30–08:30
Genesee Suite G, Radisson Rochester Riverside

Members of the OSA Optics in Digital System Technical Group are invited to join us for a networking breakfast on Tuesday morning. The event will provide an opportunity to connect with fellow attendees who share an interest in this field and to learn more about this technical group. An RSVP is required for this technical group event as breakfast will be provided. Contact TGactivities@osa.org to register, pending availability.

Polarization Technical Group Special Talks

Tuesday, 18 October, 12:00–13:30
Genesee Suite G, Radisson Rochester Riverside

Organized by the OSA Polarization Technical Group, this event will feature a series of special talks by three high impact speakers working in this field. Join us to hear about our speakers' recent research and discuss advances in the field of polarization over lunch. An RSVP is required for this technical group event as lunch will be provided. Contact TGactivities@osa.org to register, pending availability.

Optical Material Studies Technical Group Special Talk

Tuesday, 18 October 2016, 12:00–13:30
Grand Ballroom D, Radisson Riverside Rochester

Join the OSA Optical Material Studies Technical Group for a special talk focused on photonics and optical materials. Dr. Michal Lipson of Columbia University will by the featured speaker. An RSVP is required for this technical group event as lunch will be provided. Contact TGactivities@osa.org to register, pending availability.

OSA Fellow Members Lunch

(Advance Registration Required)
Tuesday, 18 October, 12:00–13:15
Grand Ballroom A-C, Hyatt Regency Rochester

OSA Fellow Members are invited to join their colleagues for lunch. Advance registration is required.

OSA Members, Family and Friends Tour – Susan B. Anthony Museum & House

(Advance Registration Required)
Tuesday, 18 October, 13:45–16:00

OSA members and their families are welcome to attend a 90-minute tour of the National Susan B. Anthony Museum & House, which is the home of the legendary American women's rights leader during the most politically active period of her life. The home was the headquarters of the National American Woman Suffrage Association when Susan B. Anthony was its president. Come learn how she and fellow suffragists changed history for women's rights.

Shuttle transportation will depart from the Rochester Convention Center at 13:45 and guests will return at 16:00.

Meet the OSA Editors' Reception

Tuesday, 18 October, 15:30–16:30
Empire Lobby

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

Photonics Clambake 2016

(Ticket Required)
Tuesday, 18 October, 17:30–20:30
Grand Ballroom, Hyatt Regency Rochester

The Photonics Clambake is a melting pot of optics & photonics professionals who gather to enjoy one of the industry's premier networking events while relaxing with refreshing beverages, great food and lots of clams.

Reservations and payments must be made in advance, no payments will be accepted at the door.

Questions? Contact Mike Naselaris of Sydor Optics, Inc. at miken@sydor.com or +1.585.271.7300.

Optics & Energy: Reflections on the Past and Lighting the Future

Tuesday, 18 October, 18:00–19:00
Genesee Suite F, Radisson Riverside Rochester

Join the OSA Optics for Energy Technical Group for this special event highlighting the major milestones of the optics and energy partnership through the last century. Visionaries in the field will be invited to share their thoughts and provide insight into the future of energy-related research and applications. Brief presentations will be followed by informal discussions and networking over refreshments.

OSA Student Member Party

Tuesday, 18 October, 19:00–22:00
Grand Ballroom, Holiday Inn Rochester Downtown

OSA Student Members who are full technical registrants of FiO/LS are invited to attend the OSA Student Member Party. This birthday party will celebrate the next 100 years of leaders in the society with food, drinks and entertainment.

Optics Alumni Networking Reception

Tuesday, 18 October, 19:00–22:00
Riverside Ballroom and Lounge, Radisson Riverside Rochester

The Institute of Optics, University of Rochester; The College of Optical Sciences, University of Arizona; The College of Optics & Photonics, University of Central Florida; Rochester Institute of Technology; and Stanford Photonics Research Center, Stanford University, are honored to host our alumni and invited friends for a reception in conjunction with OSA FiO. Remarks from Optics Leaders will be featured at 8 PM, including Xi-Cheng Zhang, Thomas Koch, Bahaa Saleh and Thomas Baer.

Invitation only; registration is required.

AIM Photonics Northeast Supply Conference (NESCO)

Wednesday, 19 October, 08:00–17:00
Hyatt Regency Rochester, Grand Ballroom Salons A-D

The AIM Photonics Northeast Supply Conference (NESCO) provides a stage for established Photonics supply chain companies, new and emerging innovators, industry leaders, strategic investors, and venture capitalists to discuss the needs and requirements of the industry's future growth. Participants will gain insights into technology, capital, partnership, and collaboration strategies necessary for mutual success.

Who should attend?

- Entrepreneurs involved or interested in Photonics innovation
- Emerging Optics and Photonics companies seeking to network with technology partners and investors
- Investment professionals from the angel, venture, corporate and institutional communities
- R&D, purchasing, supply chain managers, and manufacturing senior executives from the Photonics industry

Questions? Please contact Frank Tolic at ftolic@sunypoly.edu

Glass Art Contest & Auction

Wednesday, 19 October, 09:30–16:00
Thursday, 20 October, 09:30–14:00
Empire Hall

Hosted by the OSA Rochester Section and the OSA Foundation

Optical fabricators and glass artists will showcase their unique approaches to the design and manufacture of glass artwork. Pieces will be displayed in the Frontiers in Optics Exhibition Hall, 19–20 October. All attendees are invited to vote for their favorite piece in the contest, and several of the pieces are available for auction. Proceeds will go to the OSA Rochester Section to support the Optics Suitecase and the OSA Foundation to support the Explore Optics Kit.

Environmental Sensing Technical Group Special Talk

Wednesday, 19 October, 12:00–13:00
Genesee Suite G, Radisson Hotel Rochester Riverside

Join the OSA Environmental Sensing Technical Group for a special talk focused on open-path sensing and the application of UAVs in environmental sensing. Dr. Azer Yalin of Colorado State University will be the featured speaker. An RSVP is required for this technical group event as lunch will be provided. Contact TGactivities@osa.org to register, pending availability.

Student Chapter Competition

Wednesday, 19 October, 14:00–16:00
Empire Hall

OSA challenges its student chapters to an annual competition where they showcase their unique and innovative skills with youth education outreach demonstrations. Each competing chapter will use the OSA Foundation & LASER Classroom Explore Optics Kit and any easily obtained items to create a new demonstration that is not already a part of these kits. Competitors will have their sights set on three cash prizes of up to $500, so it's a show you don't want to miss.

Meet the APS Journal Editors Reception

Wednesday, 19 October, 15:30–17:00
Riverside Court

The Editors of the APS journals invite you to join them for conversation and light refreshments. The Editors will be available to answer questions, hear your ideas, and discuss any comments about the journals. All are welcome. We hope you will be able to join us.

OIDA Member and Exhibitor Appreciation Reception

(OIDA Members and Exhibitors Only)
Wednesday, 19 October, 16:00–17:00
Empire Hall

Sponsored by

Exhibitors, finish up your first day and come relax and mingle with your colleagues. Join us in the exhibit hall immediately following the close of the show for some food and beverages sponsored by OSA Industry Development Associates. Join OSA and discover the benefits of Industry Membership. OSA can help corporations optimize product development resources and reduce time to market by giving professionals access to quality information, quality interactions and premium opportunities for collaboration. Join today! Contact oida@osa.org or +1.202.416.1474 for more information.

Division of Laser Science Annual Business Meeting

Wednesday, 19 October, 17:00–18:00
Genesee Suite F, Radisson Rochester Riverside

All members and interested parties are invited to attend the annual business meeting of the Division of Laser Science (DLS). The DLS officers will report on the activities of the past year and on plans for the future. Questions will be taken from the floor. This is your opportunity to help define the operations of the DLS and the LS Conference. The Carl E. Anderson Dissertation award will also be presented at this meeting.

OSA Annual Business Meeting

Wednesday, 19 October, 17:00–7:45
Regency Ballroom C, Hyatt Regency Rochester

Learn more about OSA and join the OSA Board of Directors for the Society's annual business meeting. An update on the Society's 2015 activities will be presented and the results of the Board of Directors election will be announced.

OSA 100 Year BASH

Wednesday, 19 October, 18:30–21:30
The Sibley Building, 228 East Main Street, Rochester, New York

OSA | 100

In celebration of the OSA Centennial, join OSA in acknowledging the innovators and inventions that inspire the future. This reception is sure to be a high point in a year of celebration. We've waited a century for this, and we want you to be a part of it!

Entry is free for registered attendees of Frontiers in Optics.

OSA Members who are not planning to attend as a Technical registrant can register for the free Exhibit Hall Only option and receive complimentary entry to the party.

Nonmembers who are not planning to attend as a Technical registrant can register for the free Exhibit Hall Only option then select the option to purchase a BASH ticket for $100 USD.

Additional guest BASH tickets are available for $100 USD each.

OSA Light the Future Speaker Series featuring Michio Kaku and Nobel Laureates

Thursday, 20 October, 11:00–12:30
Lilac Ballroom

This event will feature Michio Kaku, futurist and theoretical physicist, *City College of New York,* with Sir Peter L. Knight, emeritus professor, *Imperial College, London,* OSA Fellow, 2004 President.

Kaku's talk "Optics of the Future: Exploring the Universe and the Brain" will be followed by a discussion featuring a panel of Nobel Laureates including Roy Glauber, Nicolaas Bloembergen, Robert F. Curl, John L. Hall, W.E. Moerner, William D. Phillips and David J. Wineland.

VIP Industry Leaders Networking Event: Connecting Corporate Executives, Young Professionals & Students

Thursday, 20 October, 12:30–14:00
Grand Ballroom C, Hyatt Regency Rochester

This session brings together Industry Executives to share their business experience with Young Professionals, Recent Graduates and Students – how they started their careers, lessons learned and using their degree in an executive position. Informal networking during lunch is followed by a transition to "speed meetings" – brief, small-group visits with each executive to discuss industry trends or career topics.

Sponsored by GoFoton

Exhibition Information

Visit the Frontiers in Optics 2016 Exhibit in Empire Hall and get a glimpse of the latest optical innovations! The FiO 2016 exhibit floor will feature companies representing a broad range of the best products and applications in the optics and photonics industry. Don't miss this opportunity to learn about new products, find technical and business solutions and gain the most up-to-date market perspective of your industry. There is no charge to attend the exhibit—it's open to all registered attendees!

Exhibit Hours

Wednesday, 19 October, 09:30–16:00
Thursday, 20 October 09:30–14:00
Empire Hall

Exhibit Hall Unopposed Exhibit-Only Times

Wednesday, 19 October	09:30–10:30 12:00–13:00 14:30–16:00
Thursday, 20 October	09:30–11:00 12:30–14:00

Joint FiO/LS Poster Sessions

Wednesday, 19 October 14:30–16:00
Thursday, 20 October 09:30–11:00
Empire Hall

Poster presentations offer an effective way to communicate new research findings and provide an opportunity for lively and detailed discussion between presenters and interested viewers. Make sure to visit the poster sessions in the Exhibit Hall to see the more than 390 posters scheduled for presentation.

E-Posters

Wednesday, 19 October, 14:30–16:00
Thursday, 20 October, 09:30–11:00
Empire Hall

As a new feature of the 2016 FiO/LS Meeting, we have offered selected presenters the opportunity to present their paper as an E-poster. Like a conventional poster, an e-poster will convey an author's introduction, motivation, results, and conclusions, on one screen. However, e-posters will provide the author with the option to digitally bring up supplemental details for deeper discussion. E-posters will be presented in the Exhibit Hall (Empire Hall) during the two Joint Poster sessions. Each author selected for an E-poster will be given 45 minutes to present an E-poster. The remaining 45 minutes, the author will present their traditional poster within their designated poster slot. Please find a schedule of presentation times below.

Joint Poster Session I E-Poster Presentation Times
Wednesday, 19 October, 14:30–16:00

	Screen 1	Screen 2	Screen 3	Screen 4	Screen 5
14:30– 15:15	JW4A.117	JW4A.49	FW4A.196	JW4A.43	JW4A.83
15:15–16:00	JW4A.106	JW4A.9		JW4A.158	JW4A.132

Joint Poster Session II E-Poster Presentation Times
Thursday, 20 October, 09:30–11:00

	Screen 1	Screen 2	Screen 3	Screen 4	Screen 5
09:30–10:15	JTh2A.131	JTh2A.198	JTh2A.78	JTh2A.74	JTh2A.99
10:15–11:00	JTh2A.104			JTh2A.57	JTh2A.64

FiO 2016 Participating Companies:

(as of August 29, 2016)

4D Technology Corporation

American Institute of Physics

Apollo Optical Systems, LLC

Applied Image, Inc.

Asphericon

Axiom Optics

Bayside Photonics, Inc.

Bristol Instruments, Inc.

Chroma Technology Corp.

Class 5 Photonics

ComTec Solutions

Daheng New Epoch Technology, Inc.

De Gruyter

Energetiq Technology, Inc.

Fianium, Inc.

Future Photon Initiative

Glass Fab, Inc.

G-S Plastic Optics

Hamamatsu Corporation

Imagine Optic, Inc.

IOP Publishing Ltd.

Inrad Optics

Iridian Spectral Technologies

Jasper Display Corporation

Laser Focus World

Learning Glass Solutions

LEUKOS

Mahr-ESDI

MegaWatt Lasers

Menlo Systems, Inc.

Metrology Concepts, LLC

New Scale Technologies, Inc.

Newport Corporation

NiCoForm, Inc.

Nufern

Ophir-Spiricon, LLC

Optikos Corporation

Optimax Systems, Inc.

OptiPro Systems

OPTOCRAFT GmbH

OSA

OSA Centennial

OSA Foundation

PHASICS Corp.

Photonic Cleaning Technologies

Photonics Media/Laurin Publishing

Precision Optical Transceivers, Inc.

QED Technologies International, Inc.

RPC Photonics

SPIE: The Intl Society for Optics

Springer Nature

Sydor Optics, Inc.

Synopsys, Inc.

Syntec Optics

The Institute of Optics, University of Rochester

Thorlabs

Toptica Photonics, Inc.

TRIOPTICS USA

UltraFast Innovations

United Lens Co, Inc.

University of Arizona, College of Optics

University of Central Florida, CREOL

Wiley

Wordingham Technologies

Wuhan National Lab for Optoelectronics

Xiamen Freeform Optical Technology Co., Ltd.

Xonox Technology GmbH

Zygo Corporation

FiO/LS Committee

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

Frontiers in Optics General Chairs

Scott Carney, *University of Illinois at Urbana-Champaign, USA*
Urs Utzinger, *University of Arizona, USA*

Frontiers in Optics Program Chairs

Chris Dainty, *University College London, UK*
Tom Brown, *University of Rochester, USA*
Ling Fu, *Wuhan National Lab for Optoelectronics, China*

Frontiers in Optics Subcommittees

FiO 1: Optical Design and Instrumentation

Julie Bentley, *University of Rochester, USA,* **Subcommittee Chair**
Rob Bates, *FiveFocal LLC, USA*
Dewen Chang, *Beijing Institute of Technology, China*
Jessica DeGroote Nelson, *Optimax, USA*
Groot Gregory, *Synopsys, USA*
John Koshel, *University of Arizona, USA*
Byoungho Lee, *Seoul National University, South Korea*
Rongguang Liang, *University of Arizona, USA*
Xinye Lou, *Microsoft, USA*
Mike Marcus, *Lumetrics, USA*
Simon Thibault, *Laval University, Canada*
Qiwen Zhan, *University of Dayton, USA*

FiO 2: Optical Sciences

Jake Bromage, *University of Rochester, USA,* **Subcommittee Chair**
Cameron Geddes, *Lawrence Berkeley National Lab, USA,* **Subcommittee Chair**
Selçuk Aktürk, *Istanbul Technical University, Turkey*
Judith Dawes, *Macquarie University, Australia*
Greg Gbur, *UNC Charlotte, USA*
Cristina Hernandez-Gomez, *STFC Rutherford Appleton Laboratory, UK*
Igor Jovanovic, *Pennsylvania State University, USA*
Carlos Lopez Mariscal, *Naval Research Laboratory, USA*
Jie Qiao, *Rochester Institute of Technology, USA*
Shivanand, *Intel, USA*
Laura Sinclair, *NIST, USA*
Laszlo Veisz, *Max Planck Institute for Quantum Optics, Germany*

FiO 3: Optics in Biology and Medicine

Elizabeth Hillman, *Columbia University, USA,* **Subcommittee Chair**
J. Quincy Brown, *Tulane University, USA*
Irene Georgakoudi, *Tufts University, USA*
Christine Hendon, *Columbia University, USA*
Martin Leahy, *National University of Ireland Galway, Ireland*
Jonathan (Teng-Chieh) Liu, *University of Washington, USA*
Junle Qu, *Shenzhen University, China*
Gang Zheng, *University of Toronto, Canada*

FiO 4: Fiber Optics and Optical Communications

John Marciante, *University of Rochester, USA,* **Subcommittee Chair**
Goëry Genty, *Univ. of Tempere, Finland*
John Ballato, *Clemson University, USA*
James Dailey, *Vencore Labs, USA*
Iyad Dajani, *Air Force Research Lab., USA*
Fabrizio Di Pasquale, *Scuola Superiore Sant'Anna, Italy*
Diego Grosz, *Instituto Balseiro, Argentina*
Morten Ibsen, *Univ. of Southampton, UK*
Bill (Ping Piu) Kuo, *University of California San Diego, USA*
Drew Maywar, *RIT, USA*
Armando Pinto, *Aveiro University, Portugal*

FiO 5: Integrated Photonics

Stefan Preble, *Rochester Institute of Technology, USA,* **Subcommittee Chair**
Paul Barclay, *University of Calgary, Canada*
Lukas Chrostowski, *University of British Columbia, Canada*
Po Dong, *Alcatel-Lucent Bell Labs, USA*
Sasan Fathpour, *University of Central Florida, CREOL, USA*
Christian Grillet, *CNRS Ecole Centrale de Lyon, France*
Wei Guo, *University of Massachusetts Lowell, USA*
Wolfram Pernice, *Karlsruher Institut fur Technologie, Germany*
Lin Zhu, *Clemson University, USA*

FiO 6: Quantum Electronics

Alexander V. Sergienko, *Boston University, USA,* **Subcommittee Chair**
Antonio Badolato, *University of Rochester, USA*
Sara Ducci, *University of Paris VII, France*
Alexander Gaeta, *Columbia University, USA*
Nobuyuki Imoto, *Osaka University, Japan*
Gerd Leuchs, *University of Erlangen Nuremberg, Germany*
Jian-Wei Pan, *University of Science and Technology of China, China*
Andrew Shields, *Toshiba, UK*
Mark Thompson, *University of Bristol, UK*
Michael Vasilyev, *University of Texas Arlington, USA*

FiO 7: Vision and Color

Susana Marcos, *Consejo Sup Investigaciones Cientificas, Spain,* **Subcommittee Chair**
Melanie Campbell, *University of Waterloo, Canada*
Stacy Choi, *Ohio State University, USA*
Dan Neal, *Advanced Medical Optics, USA*
Ram Sabesan, *University of California Berkeley, USA*
Frank Schaeffel, *University of Tubingen, Germany*
Duje Tadin, *University of Rochester, USA*
Brian Vohnsen, *University College Dublin, Ireland*
Vicki Volbrecht, *University of Colorado, USA*
Yudong Zhang, *Institute of Optics and Electronics, Chinese Academy of Sciences, China*

Laser Science Committee

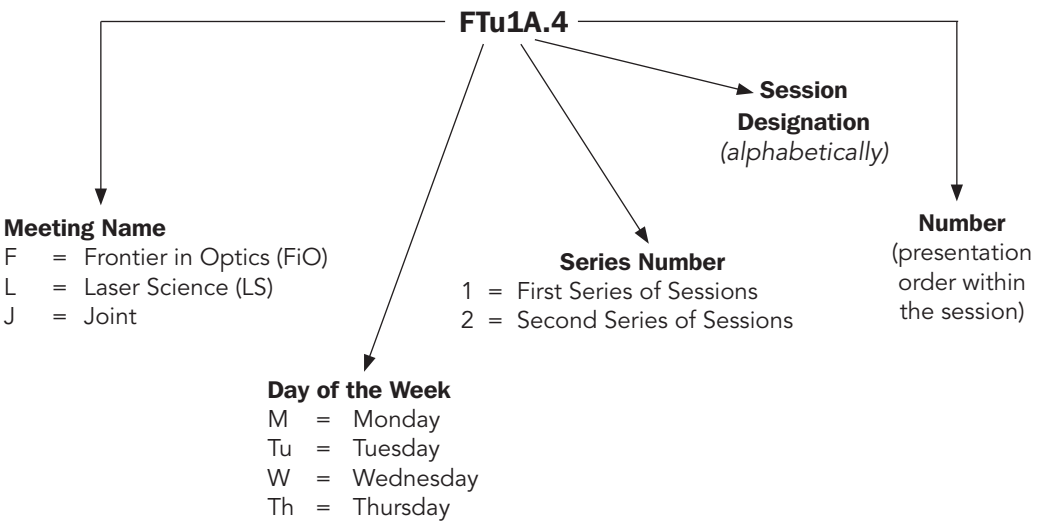
Laser Science Co-Chairs

Kevin J. Kubarych, *University of Michigan, USA*
Edo Waks, *University of Maryland, USA*

Laser Science Subcommittee Chairs

1. **High Harmonic Generation from Solids to Gases**
   David Reis, *Stanford Univ., USA,* **Subcommittee Chair**
2. **Multiphoton Effects and High Resolution Imaging**
   Robert Alfano, *CCNY, USA*, **Subcommittee Chair**
3. **Advanced Nano-Photonic Lasers: Science and Application**
   Bo Zhen, *MIT, USA,* **Subcommittee Chair**
4. **Quantum Light Sources**
   Nick Vamivakas, *University of Rochester, USA,* **Subcommittee Chair**
5. **Integrated Quantum Photonics**
   Dirk Englund, *Columbia University, USA,* **Subcommittee Chair**
6. **Nonreciprocal and Topological Photonic Devices**
   Mohammad Hafezi, *University of Maryland, USA,* **Subcommittee Chair**
7. **Nano-Plasmonics for Spectroscopy and Imaging**
   Carlos Baiz, *University of Texas, Austin, USA,* **Subcommittee Chair**
8. **Advances in X-ray and XUV Laser Science and Applications**
   Christopher Milne, *Paul Scherer Inst, USA,* **Subcommittee Chair**

Explanation of Session Codes



The first letter of the code designates the meeting (For instance, F = Frontiers in Optics, L = Laser Science, J=Joint). The second element denotes the day of the week (Monday = M, Tuesday = Tu, Wednesday = W, Thursday = Th). The third element indicates the session series in that day (for instance, 1 would denote the first parallel sessions in that day). Each day begins with the letter A in the fourth element and continues alphabetically through a series of parallel sessions. The lettering then restarts with each new series. The number on the end of the code (separated from the session code with a period) signals the position of the talk within the session (first, second, third, etc.). For example, a presentation coded FW1A.4 indicates that this paper is part of the Frontiers in Optics Meeting and is being presented on Wednesday (W) in the first series of sessions (1), and is the first parallel session (A) in that series and the fourth paper (4) presented in that session.

Agenda of Sessions — Sunday, 16 October

13:30–16:30	**Science Educator's Day,** *Hyatt Regency Rochester, Grand Ballroom A-C*

Monday, 17 October

07:00–17:00	**OSA Annual Student Chapter Leadership (Invitation only),** *Holiday Inn Hotel Rochester, Grand Ballroom*
11:00–17:00	**Women of Light, a Special Program for Women in Optics hosted by WiSTEE CONNECT,** *Hyatt Regency Rochester, Grand Ballroom F-G*
15:00–20:00	**Registration,** *Galleria*
17:00–18:00	**Diversity & Inclusion Program and Reception: A Look at the LGBT Climate in Physics,** *Hyatt Regency Rochester, Grand Ballroom A-B*
17:00–18:00	**Make Optics Career Roundtable,** *Hyatt Regency Rochester, Grand Ballroom E*
18:30–20:30	**FiO/LS Welcome Reception,** *Galleria, Riverside Court, and Empire Lobby*

Agenda of Sessions — Tuesday, 18 October

	Grand Ballroom A (Radisson)	Grand Ballroom B (Radisson)	Grand Ballroom C (Radisson)	Grand Ballroom D (Radisson)
07:00–17:00	**Registration,** *Galleria*			
07:30–08:30	**Optics in Digital Systems Technical Group Networking Breakfast,** *Radisson Rochester, Riverside, Genessee Suite G*			
08:00–10:00	**FTu1A • Symposium on 100 Years Optical Fabrication I**	**FTu1B • Symposium on 50th Anniversary of Low-Loss Optical Fibers I**	**FTu1C • Laser-Plasma Interactions and Acceleration**	**FTu1D • Silicon Photonics I**
10:00–10:30	**Coffee Break,** *West Corridor and Skyway Lobby (Radisson)*			
10:30–12:00	**FTu2A • Symposium on 100 Years Optical Fabrication II**	**FTu2B • Symposium on 50th Anniversary of Low-Loss Optical Fibers II**	**FTu2C • Laser-Matter Interactions**	**FTu2D • Silicon Photonics II**
12:00–13:30	**Lunch Break** *(on your own)*			
12:00–13:30	**Polarization Technical Group Special Talks,** *Radisson Rochester Riverside, Genesee Suite G*			
12:00–13:15	**OSA Fellow Members Lunch** *(Advance Registration Required), Hyatt Regency Rochester, Grand Ballroom, A-C*			
12:00–13:30	**Optical Material Studies Technical Group Special Talk,** *Radisson Riverside Rochester, Grand Ballroom B*			
12:15–14:55	**LTu2J • Laser Science Symposium on Undergraduate Research Poster Session,** *Riverside Court*			
13:30–15:30	**FTu3A • Symposium on 100 Years Optical Fabrication III** (ends at 14:30) ——— **FTu4A • Tutorial: Bill Casserly** (begins at 14:45)	**FTu3B • Symposium on 50th Anniversary of Low-Loss Optical Fibers III**	**FTu3C • Ultrafast and THz Souces**	**FTu3D • Plasmonic and Photonic Crystal Devices**
13:45–16:00	**OSA Members, Family and Friends Tour – Susan B. Anthony Museum & House,** *Shuttle transportation will depart from the Hyatt Regency Rochester at 13:45*			
15:30–16:00	**Coffee Break,** *West Corridor and Skyway Lobby (Radisson)*			
15:30–16:30	**Meet the OSA Editors' Reception,** *Empire Lobby*			
16:00–18:00	**FTu5A • Optics in Consumer Electronics** (ends at 17:30)	**FTu5B • Laser Material Processing**	**FTu5C • Frequency Combs and High Harmonic Generation**	**FTu5D • Mid-Infrared Integrated Photonics** (ends at 17:45)
17:30–20:30	**Photonics Clambake 2016** *(ticket required),* **Hyatt Regency Rochester,** *Grand Ballroom*			
18:00–19:00	**Optics & Energy: Reflections on the Past and Lighting the Future,** *Radisson Rochester Riverside, Genesee Suite F*			
19:00–22:00	**OSA Student Member Party,** *Holiday Inn Hotel Rochester, Grand Ballroom*			
19:00–22:00	**Optics Alumni Networking Reception,** *Radisson Rochester Riverside, Riverview Ballroom and Lounge*			

Key to Shading

Frontiers in Optics Laser Science Joint

Highland Room A	Highland Room B	Highland Room C	Highland Room D	Highland Room E
Registration, *Galleria*				
Optics in Digital Systems Technical Group Networking Breakfast, *Radisson Rochester, Riverside, Genessee Suite G*				
LTu1E • Carl E. Anderson Award for Outstanding Doctoroal Dissertation Session	**FTu1F • Three-Dimensional Optical Design**	**FTu1G • Quantum Effects in Metamaterials**	**LTu1H • Nanophotonics I**	**FTu1I • Novel Light Generation and Manipulation in Fiber Devices I**
Coffee Break, *West Corridor and Skyway Lobby (Radisson)*				
LTu2E • X-ray and XUV I	**FTu2F • Resolution and Measuring Limits**	**FTu2G • Optics and Photonics of Disordered Systems**	**LTu2H • Multiphoton Effects I** (ends at 11:30)	**FTu2I • Novel Fiber Devices**
Lunch Break *(on your own)*				
Polarization Technical Group Special Talks, *Radisson Rochester Riverside, Genesee Suite G*				
OSA Fellow Members Lunch *(Advance Registration Required), Hyatt Regency Rochester, Grand Ballroom, A-C*				
Optical Material Studies Technical Group Special Talk, *Radisson Riverside Rochester, Grand Ballroom B*				
LTu2J • Laser Science Symposium on Undergraduate Research Poster Session, *Riverside Court*				
LTu3E • Laser Science Symposium on Undergraduate Research I (15:00–16:30)	**FTu3F • Optical Properties of Materials**	**FTu3G • Integrated Quantum Optics**	**LTu3H • Quantum Light Sources I** (ends at 15:00)	**FTu3I • Novel Light Generation and Manipulation in Fiber Devices II**
OSA Members, Family and Friends Tour – Susan B. Anthony Museum & House, *Shuttle transportation will depart from the Hyatt Regency Rochester at 13:45*				
Coffee Break, *West Corridor and Skyway Lobby (Radisson)*				
Meet the OSA Editors' Reception, *Empire Lobby*				
LTu5E • Laser Science Symposium on Undergraduate Research II (starts at 16:45)	**LTu5F • X-ray and XUV II**	**FTu5G • Nonlinear Optics in Micro/Nano-Optical Structures I**	**FTu5H • Nano-Plasmonics for Spectroscopy**	**FTu5I • Novel Light Generation and Manipulation in Fiber Devices III**
Photonics Clambake 2016 *(ticket required), Hyatt Regency Rochester, Grand Ballroom*				
Optics & Energy: Reflections on the Past and Lighting the Future, *Radisson Rochester Riverside, Genesee Suite F*				
OSA Student Member Party, *Holiday Inn Hotel Rochester, Grand Ballroom*				
Optics Alumni Networking Reception, *Radisson Rochester Riverside, Riverview Ballroom and Lounge*				

Agenda of Sessions — Wednesday, 19 October

	Grand Ballroom A (Radisson)	Grand Ballroom B (Radisson)	Grand Ballroom C (Radisson)	Grand Ballroom D (Radisson)
07:00–18:00	**Registration,** *Galleria*			
08:00–09:30	**JW1A • Joint Plenary Session,** *Lilac Ballroom*			
08:00–17:00	**AIM Photonics Northeast Supply Conference (NESCO),** *Hyatt Regency Rochester, Grand Ballroom A-D*			
09:30–16:00	**Exhibit Hall Open,** *Empire Hall*			
09:30–16:00	**Glass Art Contest,** *Empire Hall*			
09:30–10:30	**Unopposed Exhibit Only Time and Coffee Break,** *Empire Hall*			
10:30–12:00	**FW2A • Novel Design Concepts for Eye Correction and Vision Simulators I**	**FW2B • Quantum Communications I**	**FW2C • Biomedical Optics**	**FW2D • Symposium on Mesoscopic Optics of Disordered Media I**
12:00–13:00	**Lunch Break** *(on your own)* **and Unopposed Exhibit Only Time,** *Empire Hall*			
12:00–13:00	**Environmental Sensing Technical Group Special Talk,** *Genesee Suite G, Radisson Hotel Rochester Riverside*			
13:00–14:30	**FW3A • Novel Design Concepts for Eye Correction and Vision Simulators II**	**FW3B • Quantum Communications II**	**FW3C • Diffuse Imaging and Optical Propertiesv**	**FW3D • Symposium on Mesoscopic Optics of Disordered Media II** (ends at 14:00)
14:00–16:00	**Student Chaper Competition,** *Empire Hall*			
14:30–15:00	**Coffee Break,** *Empire Hall*			
14:30–16:00	**JW4A • Joint Poster Session I and Unopposed Exhibit Only Time,** *Empire Hall (see page 23 for specific e-poster viewing times)*			
15:30–17:00	**Meet the Editors of the APS Journals,** *Riverside Court*			
16:00–17:00	**OIDA Members and Exhibitor Appreciation Reception** *(OIDA members and exhibitors only),* *Empire Hall*			
16:00–18:00	**FW5A • Understanding Myopia Development** (ends at 17:30)	**FW5B • High Power Fiber Lasers and Beam Combining** (ends at 18:15)	**FW5C • Optical Coherence Tomography**	**FW5D • Integrated Photonics**
17:00–17:45	**OSA Annual Business Meeting,** *Hyatt Regency Rochester, Regency Ballroom C*			
17:00–18:00	**APS Division of Laser Science Annual Business Meeting,** *Radisson Hotel Rochester Riverside, Genesee Suite F*			
18:30–21:30	**OSA 100 Year BASH,** *The Sibley Building, 228 East Main Street, Rochester, New York*			

Key to Shading

Frontiers in Optics Laser Science Joint

Highland Room A	Highland Room B	Highland Room C	Highland Room D	Highland Room E
Registration, *Galleria*				
JW1A • Joint Plenary Session, *Lilac Ballroom*				
AIM Photonics Northeast Supply Conference (NESCO), *Hyatt Regency Rochester, Grand Ballroom A-D*				
Exhibit Hall Open, *Empire Hall*				
Glass Art Contest, *Empire Hall*				
Unopposed Exhibit Only Time and Coffee Break, *Empire Hall*				
FW2E • Exotic States and Applications I	**FW2F • Optical Fibers for Space Projects**	**FW2G • Symposium: Tribute to Steve Jacobs I**	**FW2H • Adaptive Optics and Inferometry**	**LW2I • Integrated Quantum Photonics I** (ends at 12:30)
Lunch Break *(on your own)* **and Unopposed Exhibit Only Time,** *Empire Hall*				
Environmental Sensing Technical Group Special Talk, *Genesee Suite G, Radisson Hotel Rochester Riverside*				
FW3E • Plasmonics	**FW3F • Quantum Entanglement**	**FW3G • Symposium: Tribute to Steve Jacobs II** (ends at 14:00)	**FW3H • Optical Design and GRIN Materials**	**LW3I • Multiphoton Effects II**
Student Chaper Competition, *Empire Hall*				
Coffee Break, *Empire Hall*				
JW4A • Joint Poster Session I and Unopposed Exhibit Only Time, *Empire Hall (see page 23 for specific e-poster viewing times)*				
Meet the Editors of the APS Journals, *Riverside Court*				
OIDA Members and Exhibitor Appreciation Reception *(OIDA members and exhibitors only)***,** *Empire Hall*				
FW5E • Ultrafast Lasers and Applications	**FW5F • Nonlinear Optics in Micro/Nano-Optical Structures II**	**FW5G • Optical Fabrication and Metrology**	**FW5H • Freeform Design and Metrology**	**LW5I • Integrated Quantum Photonics II**
OSA Annual Business Meeting, *Hyatt Regency Rochester, Regency Ballroom C*				
APS Division of Laser Science Annual Business Meeting, *Radisson Hotel Rochester Riverside, Genesee Suite F*				
OSA 100 Year BASH, *The Sibley Building, 228 East Main Street, Rochester, New York*				

Agenda of Sessions — Thursday, 20 October

	Grand Ballroom A (Radisson)	Grand Ballroom B (Radisson)	Grand Ballroom C (Radisson)	Grand Ballroom D (Radisson)
07:00–17:00	**Registration,** *Galleria*			
08:00–09:30	**JTh1A • Joint Plenary Session,** *Lilac Ballroom*			
09:30–14:00	**Exhibits Open,** *Empire Hall*			
09:30–14:00	**Glass Art Contest,** *Empire Hall*			
09:30–10:00	**Coffee Break,** *Empire Hall*			
09:30–11:00	**JTh2A • Joint Poster Session II and Unopposed Exhibit Only Time,** *Empire Hall (see page 23 for specific e-poster viewing times)*			
11:00–12:30	**JTh3A • OSA Light the Future Speaker Series featuring Michio Kaku and Nobel Laureates,** *Lilac Ballroom*			
12:30–14:00	**Free Lunch (provided by OSA),** *Exhibit Hall, Empire Hall*			
12:30–14:00	**VIP Industry Leaders Networking Event: Connecting Corporate Executives, Young Professionals & Students,** *Hyatt Regency Rochester, Grand Ballroom B-C*			
14:00–16:00	**FTh4A • Symposium on Mid-Infrared Fiber Sources I**	**FTh4B • Optical Vortices**	**FTh4C • Computational Imaging I**	**FTh4D • Optics Meets Neuroscience I**
16:00–16:30	**Coffee Break,** *West Corridor and Skyway Lobby (Radisson)*			
16:30–18:30	**FTh5A • Symposium on Mid-Infrared Fiber Sources II**	**FTh5B • Optical Vortices, Polarization and Mode Shaping**	**FTh5C • Computational Imaging II**	**FTh5D • Optics Meets Neuroscience II**

Key to Shading

Frontiers in Optics Laser Science Joint

Highland Room A	Highland Room B	Highland Room C	Highland Room D	Highland Room E
Registration, *Galleria*				
JTh1A • Joint Plenary Session, *Lilac Ballroom*				
Exhibits Open, *Empire Hall*				
Glass Art Contest, *Empire Hall*				
Coffee Break, *Empire Hall*				
JTh2A • Joint Poster Session II and Unopposed Exhibit Only Time, *Empire Hall (see page 23 for specific e-poster viewing times)*				
JTh3A • OSA Light the Future Speaker Series featuring Michio Kaku and Nobel Laureates, *Lilac Ballroom*				
Free Lunch (provided by OSA), *Exhibit Hall, Empire Hall*				
VIP Industry Leaders Networking Event: Connecting Corporate Executives, Young Professionals & Students, *Hyatt Regency Rochester, Grand Ballroom B-C*				
FTh4E • High Capacity Optical Communications and Data Centers I	**FTh4F • Quantum Communication and Networking I**	**FTh4G • Integrated Nonlinear Optics I**	**FTh4H • Probing Ocular Biomechanics with Imaging Techniques / Novel Applications of Femtosecond Lasers in Ophthalmology**	**FTh4I • Symposium on 100 Years of Vision at OSA: Most Cited Vision Papers in OSA Journals**
Coffee Break, *West Corridor and Skyway Lobby (Radisson)*				
FTh5E • High Capacity Optical Communications and Data Centers II	**FTh5F • Quantum Communication and Networking II**	**FTh5G • Integrated Nonlinear Optics II**	**LTh5H • Topological Photonics I**	**LTh5I • High Harmonic Generation**

Agenda of Sessions — Friday, 21 October

	Grand Ballroom A (Radisson)	Grand Ballroom B (Radisson)	Grand Ballroom C (Radisson)	Grand Ballroom D (Radisson)
07:30–16:30	**Registration,** *Galleria*			
08:00–10:00	**FF1A • Imaging and Therapy Inside the Human Body**	**FF1B • Optical Fiber Sensors I**	**FF1C • Quantum Information Processing in Integrated Systems**	**FF1D • Quantum Optical Technologies**
10:00–10:30	**Coffee Break,** *West Corridor and Skyway Lobby (Radisson)*			
10:30–12:30	**FF2A • Postdeadline Session I**	**FF2B • Postdeadline Session II**	**FF2C • Postdeadline Session III**	
12:30–13:30	**Lunch** *(on your own)*			
13:30–15:30	**FF3A • Advanced Microscopy Methods and Applications**	**FF3B • Optical Fiber Sensors II**	**FF3C • Quantum Electronics I**	**FF3D • Quantum Optical measurement and Quantum Technologies I**
15:30–16:00	**Coffee Break,** *West Corridor and Skyway Lobby (Radisson)*			
16:00–18:00	**FF5A • In-vivo Spectroscopy, Metabolism and Raman**	**FF5B • Optical Manipulation, Processing and Applications**	**FF5C • Quantum Electronics II**	**FF5D • Quantum Optical Measurement and Quantum Technologies II**

Key to Shading

Frontiers in Optics Laser Science Joint

Highland Room A	Highland Room B	Highland Room C	Highland Room D	Highland Room E
Registration, *Galleria*				
FF1E • Symposium on Integrated Photonic Manufacturing I	**FF1F • Strongly Confined Nanoscale Waveguides, Photonic Crystals and Resonator Devices**	**FF1G • Wavefront Sensing and Phase Retrieval** (begins at 08:30)	**FF1H • General Optical Sciences I**	**LF1I • Nanophotonics II**
Coffee Break, *West Corridor and Skyway Lobby (Radisson)*				
LF2D • General Laser Science I	**LF2E • General Laser Science II**	**LF2F • Quantum Light Sources II**	**LF2G • General Laser Science III** (begins at 10:45)	**LF2H • High Harmonic Generation II**
Lunch *(on your own)*				
FF3E • Symposium on Integrated Photonic Manufacturing II (ends at 14:30) **FF4A • Symposium on Integrated Quantum Optics I** (begins at 14:30)	**FF3F • Ultrafast Dynamics and laser Ion Acceleration**	**FF3G • Polarization Control and Measurements**	**FF3H • General Optical Sciences II**	**LF3I • X-ray and XUV III**
Coffee Break, *West Corridor and Skyway Lobby (Radisson)*				
FF5E • Symposium on Integrated Quantum Optics II (ends at 17:30)	**FF5F • Hybrid Integration** (ends at 18:15)	**FF5G • Beams and Optical Coherence**	**FF5H • Exotic States and Applications II**	**LF5I • Topological Photonics II**

Grand Ballroom A (Radisson)	Grand Ballroom B (Radisson)	Grand Ballroom C (Radisson)	Grand Ballroom D (Radisson)

FiO

07:00–17:00 Registration, *Galleria*

07:30–08:30 Optics in Digital Systems Technical Group Networking Breakfast, *Radisson Rochester Riverside, Genessee Suite G*

08:00–10:00
FTu1A • Symposium on 100 Years of Optical Design, Fabrication, Testing, and Instrumentation - A Historical Look Back I
Presider: Jannick Rolland, Univ. of Rochester, USA

FTu1A.1 • 08:00 Invited
Optical Designs of NASA Telescopes, Joseph M. Howard[1]; [1]*NASA Goddard Space Flight Center, USA*. A brief historical summary of NASA's space telescopes is presented with an emphasis on their science applications and resulting optical design forms.

FTu1A.2 • 08:30 Invited
Short History of Interferometric Optical Metrology, James C. Wyant[1]; [1]*Univ. of Arizona, Coll of Opt Sciences, USA*. The use of the Twyman-Green interferometer for optical metrology was introduced the same year OSA was founded, 1916. This talk gives a short history of interferometric metrology and the enhancements provided by lasers and computers.

08:00–10:00
FTu1B • Symposium on the 50th Anniversary of Low Loss Optical Fibers I
Presider: Alan Evans; Corning Incorporated, USA

FTu1B.1 • 08:00 Invited
The Birth of Optical Fiber Communications, Richard Epworth[1]; [1]*Retired, UK*. Fifty years ago the optical fiber revolution began with the pioneering publication: "Dielectric-fibre surface waveguides for optical frequencies", the work of a small team at a British research laboratory. This is their story.

FTu1B.2 • 08:30 Invited
Glass and Light: Enabling the Information Age, Donald B. Keck[1]; [1]*Consultant, USA*. Forty-six years ago, a technological syzygy of four inventions/breakthroughs – including Corning's low-loss optical fiber – created the Information Age. We'll revisit that remarkable milestone, and the world-changing impact of optical telecommunications.

Join the conversation.
Follow @Opticalsociety on Twitter.
Use hashtag **#FIO16**
and #OSA100

08:00–10:00
FTu1C • Laser-Plasma Acceleration and Photon Sources
Presider: To be Announced

FTu1C.1 • 08:00 Tutorial
Laser Plasma Acceleration Using the PW-class BELLA Laser, Wim Leemans[1], Anthony J. Gonsalves[1], Kei Nakamura[1], Hann-Shin Mao[1], Sven Steinke[1], Csaba Toth[1], Josst Daniels[1], Daniel E. Mittelberger[1], Carlo Benedetti[1], Stepan Bulanov[1], Cameron G. Geddes[1], Jean-Luc Vay[1], Carl B. Schroeder[1], Eric E. Esarey[1]; [1]*Lawrence Berkeley National Laboratory, USA.*The physics and status of electron acceleration of electrons using intense laser pulses that excite tens of gigavolt per meter fields in plasmas will be discussed and the path forward to practical machines.

Biography: Wim Leemans is the Director of the Accelerator Technology and Applied Physics (ATAP) Division and Director of the BELLA (Berkeley Lab Laser Accelerator) Center at LBNL. He obtained his Ph.D. from UCLA and joined LBNL in 1991. His main research focuses on the development of laser driven plasma accelerators and applications. He has received numerous awards including most recently the 2009 E.O. Lawrence Award from the DOE, the Advanced Accelerator Concepts Award in 2012, the 2014 DOE Secretary's Achievement Award for the BELLA Project and is a Fellow of the APS, IEEE, and AAAS.

08:00–10:00
FTu1D • Silicon Photonics I
Presider: Wei Guo; Univ. of Massachusetts Lowell, USA

FTu1D.1 • 08:00 Invited
Technologies for Next Generation Silicon Photonics, Michal Lipson[1]; [1]*Columbia Univ., USA*. We have demonstrated technologies for ultra high bandwidth silicon photonics. These include multi-mode communications multiplexing enabling bandwidth scaling and back-end integration with new materials such as graphene for ultra high speed devices.

FTu1D.2 • 08:30
A compliant polymer interface with 1.4dB loss between standard fibers and nanophotonic waveguides, Tymon . Barwicz[1], Alexander Janta-Polczynski[2], Shotaro Takenobu[3], Jean-Francois Morissette[2,4], Bo Peng[1], Yoichi Taira[1], Hidetoshi Numata[5], Swetha Kamlapurkar[1], Sebastian Engelmann[1], Paul Fortier[2], Nicolas Boyer[2]; [1]*IBM TJ Watson Research Center, USA;*[2]*IBM Bromont, Canada;* [3]*AGC Electronics, Technol. Gen. Div., Asahi Glass Co, Japan;* [4]*Universite de Sherbrooke, Canada;* [5]*IBM Research - Tokyo, Japan*. We demonstrate improved performance in interfacing standard fibers with nanophotonic waveguides through a mechanically compliant polymer interface. We show ~1.4dB peak transmission with 0.8dB penalty over a ~100nm bandwidth and all polarizations.

Highland Room A	Highland Room B	Highland Room C	Highland Room D	Highland Room E
LS	FiO		LS	FiO

07:00–17:00 Registration, *Galleria*

07:30–08:30 Optics in Digital Systems Technical Group Networking Breakfast, *Radisson Rochester Riverside, Genessee Suite G*

08:00–10:00
LTu1E • Carl E. Anderson Award for Outstanding Doctoroal Dissertation Award Session

Presider: Kristan L. Corwin, Kansas State Univ., USA

LTu1E.1 • 08:00 Invited

Identifying and Using Recollision-Based High Harmonics From Bulk Semiconductors, Giulio Vampa[1]; *[1]Univ. of Ottawa, Canada*. In the generation of high harmonics from ZnO and Si crystals we find that "generalized recollisions" between electrons and their holes dominate the emission, and show how they can be used.

LTu1E.2 • 08:30 Invited

Power-scaling Attosecond Sources Using Universal Scaling Principles for Nonlinear Optical Processes in Gases, Christoph Heyl[1,2], H. Coudert-Alteirac[1], M. Miranda[1], M. Louisy[1], P. Rudawski[1], F. Brizuela[1], K. Kovacs[3,4], V. Tosa[3,4], E. Balogh[4,5], K. Varju[4,5], P. Johnsson[1], A. Couairon[6], C. L. Arnold[1], A. L. Huillier[1]; *[1]Lund Univ., Sweden; [2]JILA, NIST, Univ. of Colorado, USA; [3]National Inst. for R&D Isotopic and Molecular Technologies, Romania; [4]ELI-ALPS, Hungary; [5]Dept. of Optics and Quantum Electronics, Univ. of Szeged, Hungary; [6]Centre de Physique Theorique, Ecole Polytechnique, CNRS, France*. Scaling attosecond sources to higher pulse energy and/or repetition rate can benefit many applications. We present a scaling framework for nonlinear light-matter interactions, applicable to attosecond pulse generation and other nonlinear phenomena as e.g. filamentation.

08:00–10:00
FTu1F • Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning

Presider: Jaime Cardenas, Univ. of Rochester, USA

FTu1F.1 • 08:00 Invited

Reconfigurable Photonics Metasurfaces , Nikolay I. Zheludev[1,2]; *[1]ORC, Univ. of Southampton, UK; [2]CDPT/TPI/SPMS, Nanyang Technological Univ., Singapore.*The changing balance of forces at the nanoscale offers the opportunity to develop reconfigurable nanomembrane metamaterials in which thermal, electromagnetic Coulomb, Lorentz and Ampère forces can be used to control their optical properties.

FTu1F.2 • 08:30

Ni-TaN Nanocomposite Absorber For Next-Generation Extreme Ultraviolet Lithography, Darrick Hay[1], Patrick Bagge[1], Ian Khaw[1], Lei Sun[2], Obert Wood[3], Yulu Chen[3], Ryoung-Han Kim[3], Zhengqing Qi[3], Zhimin Shi[1]; *[1]Department of Physics, Univ. of South Florida, USA; [2]GlobalFoundries Inc. , USA; [3]GlobalFoundries Inc. , USA*. A thin Ni-TaN nano-composite absorber is studied for next-generation EUV lithography. We show that the performance is insensitive to the size and location of nano-particles, and that such an absorber can greatly reduce HV bias.

08:00–10:00
FTu1G • Quantum Effects in Metamaterials

Presider: Gerd Leuchs; Univ. Erlangen-Numberg, Germany

FTu1G.1 • 08:00 Invited

Nonlinear Metamaterial Nanophotonics, Anatoly Zayats[1]; *[1]King's College London, UK*. Metamaterials and metasurfaces open up opportunities to design the enhanced nonlinear properties in a desired spectral range beyond nonlinear response of the constituents. We overview second and third-order nonlinearities in plasmonic metamaterials.

FTu1G.2 • 08:30 Invited

Photonic Hyperctystals. Evgenii E. Narimanov[1]; *[1]Purdue Univ., USA*. Photonic hypercrystals form a new universality class of artificial optical media. These hyperbolic metamaterials with a periodic spatial variation of permittivity on subwavelength scale, combine the features of metamaterials and photonic crystals.

08:00–10:00
LTu1H • Nanophotonics I

Presider: Bo Zhen; MIT, USA

LTu1H.1 • 08:00 Invited

Spatial Coherence Engineering of Lasers, Hui Cao[1]; *[1]Yale Univ., USA*. We develop lasers with low spatial coherence to achieve speckle-free imaging. We also invent a fast and efficient method of switching the spatial coherence of a laser for multimodality
microscopy.

LTu1H.2 • 08:30 Invited

InGaN/GaN Dot-in-Nanowire Lasers on Silicon, Pallab K. Bhattacharya[1]; *[1]Univ. of Michigan, USA*. The fabrication and characteristics of monolithic edge-emitting InGaN/GaN dot-in-nanowire array diode lasers on (001)Si will be presented.

08:00–10:00
FTu1I • Novel Light Generation and Manipulation in Fiber Devices I

Presider: Benjamin Wetzel; INRS - EMT, Canada

FTu1I.1 • 08:00 Tutorial

UV Generation in Silica Fibres, Yun Wang[1], M.I.M. Abdul Khudus[1], Francesco De Lucia[1], Qi Sun[1], Jing He[1], Pier J. A. Sazio[1], Rand Ismaeel[1], Martynas Beresna[1], Peter Horak[1], Gilberto Brambilla[1,2]; *[1]Univ. of Southampton, UK; [2]The Future Manufacturing Hub, UK*. The generation of UV light in solid core silica fibres has been achieved using intermodal phase matched four wave mixing in optical fibre tapers or rare earth doping with Gd.

Biography: Gilberto Brambilla is a professor at the Optoelectronics Research Centre at the University of Southampton, where he has been employed as a researcher since 2002. He obtained his MSc (Material Engineering) with honours from Politecnico di Milano (Italy) and his PhD degree in Optoelectronics from the ORC in 2002. In 2007 he was awarded the prestigious Research Fellowship from the Royal Society. He has been the director of the EPSRC Centre for Innovative Manufacturing in Photonics until 2015. As co-director for the Future Photonics Hub he has responsibility for the research on the platforms in the Hub.

FTu1A • Symposium on 100 Years of Optical Design, Fabrication, Testing, and Instrumentation - A Historical Look Back I—Continued

FTu1A.3 • 09:00 Invited

Precision Optics and Metrology at Tropel, John H. Bruning[1]; [1]*Retired, Corning, USA.* This talk is a personal perspective on the evolution of precision optics and metrology at Tropel in Rochester, highlighting early applications of computers, lasers and microlithography, and their impact on microelectronics, photonics and healthcare.

FTu1B • Symposium on the 50th Anniversary of Low Loss Optical Fibers I—Continued

FTu1B.3 • 09:00 Invited

Bell Lab's Seminal Testing to of Optical Fiber Systems: Past, Present and Future, John MacChesney[1]; [1]*John B. MacChesney Optical Materials, USA.* Bell labs invents and produces low-loss optical fibers for ATR transmission networks. MSB has been widely. Bell Labs are the continuing leaders in the area of WDM and high-capacity transmission systems.

FTu1C • Laser-Plasma Acceleration and Photon Sources—Continued

FTu1C.2 • 08:45

Experimental observation of multiphoton Thomsonscattering, Wenchao Yan[1], Grigory Golovin[1], Colton Fruhling[1], Daniel Haden[1], Ping Zhang[1], Jun Zhang[1], Baozhen Zhao[1], Cheng Liu[1], Shouyuan Chen[1], Sudeep Banerjee[1], Donald P. Umstadter[1]; [1]*Univ. of Nebraska Lincoln, USA.* High power laser light is used to study Thomson scattering in the highly multiphoton regime.The experimental results are consistent with ultra-high field strengths and the scattering of close to 10^3 laser photons per electron.

FTu1C.3 • 09:00

Measuring Ultralow Emittance of Laser-Driven Electron Beams with Spectroscopic Imaging of Inverse-Compton-Scattered X-rays, Grigory Golovin[1], Sudeep Banerjee[1], Cheng Liu[1], Shouyuan Chen[1], Jun Zhang[1], Baozhen Zhao[1], Ping Zhang[1], Matthew Veale[2], Matthew Wilson[2], Paul Seller[2], Donald P. Umstadter[1]; [1]*UNL, USA;* [2]*STFC, UK.* We report the first measurement of laser-wakefield-accelerated electron beam transverse emittance, as well as its evolution, performed via a novel technique employing spectroscopic imaging of inverse-Compton scattered x-rays.

FTu1C.4 • 09:15

Single Recollision Event with High Ponderamotive Energy, T J. Hammond[1]; [1]*JAS Labs, U. Ottowa, USA.* We use the interplay of nonlinear optics and spatio-temporal coupling to synthesize a sub-cycle pulse. It generates isolated attosecond pulses, tuneable in energy by the carrier envelope phase over an octave in the extreme ultraviolet.

FTu1D • Silicon Photonics I—Continued

FTu1D.3 • 08:45

60.5 dB Silicon Mach-Zehnder Interferometer using Self-Optimising Beam-Splitters, Callum M. Wilkes[1], Xiaogang Qiang[1], Jianwei Wang[1], Raffaele Santagati[1], Stefano Paesani[1], Xiaoqi Zhou[2], Pete Shadbolt[3], Terry Rudolph[3], David Miller[4], Mark G. Thompson[1], Jeremy L. O'Brien[1,4]; [1]*CQP, Univ. of Bristol, UK;* [2]*Sun Yat-Sen Univ., China;*[3]*Imperial College, London, UK;* [4]*Stanford Univ., USA.* We demonstrate an ultra-high extinction MZI on a reconfigurable silicon photonic chip, using a self-optimising approach to adjust variable beam-splitters. This result paves the way for large-scale integrated photonic quantum information applications.

FTu1D.4 • 09:00

Subwavelength Grating Athermal Mach-Zehnder Silicon Photonics Interferometer With Enhanced Fabrication Error Tolerance and Wide Spectral Range, Peng Xing[1], Jaime P. Viegas[1]; [1]*Masdar Inst. of Science and Tech, United Arab Emirates.* We present an experimental validation of a broadband athermal Mach-Zehnder interferometer with subwavelength grating waveguide in one of the arms to increase its fabrication error tolerance, while achieving less than 10 pm/K thermal sensitivity.

FTu1D.5 • 09:15

Apodized Grating for Silicon Tunable Delay Lines, Lingjun Jiang[1], Stephen Anderson[1], Young H. Kim[1], Weimin Zhou[2], Zhaoran R. Huang[1]; [1]*Rensselaer Polytechnic Inst., USA;*[2]*Sensors &Electron Devices Directorate, US Army Research Laboratory, USA.* We investigated three designs of apodized silicon grating waveguides for delay line applications. A tunable delay of 140ps/mm for wavelength tuning and 130ps/mm/V for voltage tuning has been achieved in our best design.

Highland Room A

LS

LTu1E • Carl E. Anderson Award for Outstanding Doctoroal Dissertation Award Session—Continued

LTu1E.3 • 09:00 Invited

Quantum Information with Structured Light, Mohammad Mirhosseini[1,2], O. S. Magana-Loaiza[2], M. N. O'Sullivan[2], Brandon Rodenburg[2], Zhimin Shi[3], Mehul Malik[2,4], M. P. Lavery[5], Miles J. Padgett[6], D. J. Gauthier[7], Robert W. Boyd[8]; [1]*California Inst. of Technology, USA;* [2]*The Inst. of Optics, Univ. of Rochester, USA;* [3]*Dept. of Physics, Univ. of South Florida, USA;* [4]*Inst. for Quantum Optics and Quantum Information (IQOQI), Austrian Academy of Sciences, Austria;* [5]*School of Enginering, Univ. of Glasgow, UK;* [6]*School of Physics and Astronomy, Univ. of Glasgow, UK;* [7]*Dept. of Physics, Duke Univ., USA;* [8]*Dept. of Physics, Univ. of Ottawa, Canada.* We investigate structured photons as carriers of quantum information. We describe our implementation of quantum cryptography with orbital angular momentum, and present our results on efficient implementation of quantum state tomography for structured light fields.

Highland Room B

FiO

FTu1F • Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning—Continued

FTu1F.3 • 08:45 Invited

Inverse Methods and the Design of Sub-wavelength Scattering Elements for Super-resolution, Michael A. Fiddy[1]; [1]*Univ of North Carolina at Charlotte, USA.* Subwavelength-scale scatterers convert evanescent into propagating waves. Nonlinear inverse scattering algorithms may reveal these processes leading to superresolved images but they may be replaced by propagating through designed optical structures.

FTu1F.4 • 09:15

Characteristics of Three-Dimensional Bicontinuous Periodic Structures Produced by Multi-Beam Interference, Shruthi Kumara Vadivel[1], Matthieu Leibovici[1], Thomas K. Gaylord[1]; [1]*Georgia Inst. of Technology, USA.* The ranges of bicontinuity for three-dimensional, periodic structures made by multi-beam interference are reported, along with their volume fractions and surface areas. Corresponding results for sphere-based models are presented for comparison.

Highland Room C

FiO

FTu1G • Quantum Effects in Metamaterials—Continued

FTu1G.3 • 09:00

Trapped Ultracold Atoms Make Perfect Quantum Metamaterials, Pankaj K. Jha[1], Michael Mrejen[1], Jeongmin Kim[1], Chihhui Wu[1], Yuan Wang[1], Yuri Rostovtsev[2], Xiang Zhang[1];[1]*Univ. of California, Berkeley, USA;* [2]*Univ. of North Texas, USA.* We introduce a novel platform for quantum metamaterial by engineering the electromagnetic response of ultracold atoms loaded in an artificial crystal of light. Our proposal opens the door for applications at single-photon level with metamaterials.

FTu1G.4 • 09:15

Engineering a Giant Nonlinear Optical Response for a Meta-Surface on an Epsilon-Near-Zero Material, Mohammad Z. Alam[1], Israel de Leon[1,2], Sebastian A. Schulz[1], Jeremy Upham[1], Robert W. Boyd[1]; [1]*Univ. of Ottawa, Canada;* [2]*Tecnológico de Monterrey, Mexico.* A meta-surface of plasmonic antennas on a thin epsilon-near-zero substrate exhibits a broadband nonlinear response with $|n_2|$ values up to eight orders of magnitude larger than that of silica glass and $|\Delta n|>3.0$.

Highland Room D

LS

LTu1H • Nanophotonics I—Continued

LTu1H.3 • 09:00 Invited

Title to be Announced, Steven G. Johnson[1]; [1]*Massachusetts Inst. of Technology, USA.* Abstract not available.

Highland Room E

FiO

FTu1I • Novel Light Generation and Manipulation in Fiber Devices I—Continued

FTu1I.2 • 08:45

Mid-IR Supercontinuum up to 5.4 μm in a 15 meter-long Fluoroindate Fiber, Jean-Christophe Gauthier[1], Vincent Fortin[1], Jean-Yves Carrée[2], Samuel Poulain[2], Marcel Poulain[2], Réal Vallée[1], Martin Bernier[1]; [1]*Universite Laval, Canada;* [2]*Le Verre Fluoré, France.* We present a simple approach for supercontinuum (SC) generation up to 5.4 μm using a low-loss fluoroindate fiber. It is pumped by an erbium-doped fluoride fiber amplifier seeded with 400 ps pulses at 2.75 μm.

FTu1I.3 • 09:00

Formation of Cascading Solitons in Fiber Amplifiers, Francisco Rodrigo Arteaga Sierra[1], Aku J. Antikainen[1], Govind P. Agrawal[1]; [1]*The Inst. of Optics, Univ. of Rochester, USA.* We study numerically the formation of cascading solitons when a single femtosecond pulse is launched into a fiber amplifier. Because of Raman spectral shifts, the output spectrum is relatively broad and exhibits high coherence.

FTu1I.4 • 09:15

Intracavity Dissipative Four-Wave Mixing at Different Dispersion Regimes of an Ultrafast Fiber Laser, Sinem Yilmaz[1,2], Hakan S. Sayinc[2], Fatih Ömer Ilday[1,3], Jörg Neumann[2], Dietmar Kracht[2]; [1]*Physics department, Bilkent Univ., USA;* [2]*Laser Zentrum Hannover e.V., Germany;* [3]*Department of Electrical and Electronics Engineering, Bilkent Univ., Turkey.* We investigated a system which generates ultrahigh repetition rate of 100 GHz stable pulse trains for different dispersion regimes in combination of a high-finesse Fabry Perot filter inside the laser setup.

Grand Ballroom A (Radisson)	Grand Ballroom B (Radisson)	Grand Ballroom C (Radisson)	Grand Ballroom D (Radisson)

FiO

FTu1A • Symposium on 100 Years of Optical Design, Fabrication, Testing, and Instrumentation - A Historical Look Back I—Continued

FTu1A.4 • 09:30 Invited

Optics Goes to the Movies, John Greivenkamp[1]; [1]*Univ. of Arizona, USA.* The Museum of Optics at the Univ. of Arizona has acquired a number of movies that provide interesting windows into the history of optical design and fabrication. Portions of several of these movies will be shown.

FTu1B • Symposium on the 50th Anniversary of Low Loss Optical Fibers I—Continued

FTu1B.4 • 09:30 Invited

Origins of the Erbium-Doped Fiber Amplifier, Randy Giles[1]; [1]*Nokia Bell Labs, USA.* Optical amplification in lightwave systems became practical with the invention of the Erbium-doped Fiber Amplifier (EDFA) in the late 1980s. This talk will trace the early work on the erbium-doped fiber and the enabling technologies that took the EDFA from lab experiments to its wide deployment resulting in a dramatic bandwidth expansion of commercial lightwave systems.

FTu1C • Laser-Plasma Acceleration and Photon Sources—Continued

FTu1C.5 • 09:30 Invited

Staging of Laser-plasma Accelerators, Sven Steinke[1], Jeoren van Tilborg[1], Carlo Benedetti[1], Cameron G. Geddes[1], Carl B. Schroeder[1], Joost Daniels[1], Kelly K. Swanson[1], Anthony J. Gonsalves[1], Kei Nakamura[1], Brian H. Shaw[1], Eric E. Esarey[1], Wim Leemans[1]; [1]*Lawrence Berkeley National Laboratory, USA.* We present an experiment where two indepedant laser-plasma accelerators where coupled by an active plasma lens. Electron beam trapping in the second stage was varified by an 100 MeV energy gain.

FTu1D • Silicon Photonics I—Continued

FTu1D.6 • 09:30 Invited

Silicon Photonic Switches for Datacenters, Ming C. Wu[1], Tae Joon Seok[1], Sangyoon Han[1]; [1]*Univ. of California Berkeley, USA.* Silicon photonics offers unprecedented capability to integrate large-scale optical switches on a chip. We review the current state-of-the-art of silicon photonic switches, and describe our large-scale (64x64) switches with microsecond switching time.

10:00 -10:30 Coffee Break, *West Corridor and Skyway Lobby (Radisson)*

Highland Room A

LS

LTu1E • Carl E. Anderson Award for Outstanding Doctoroal Dissertation Award Session—Continued

LTu1E.4 • 09:30 Invited

Development of Tools for Quantum Engineering Using Individual Atoms: Optical Nanofibers and Controlled Rydberg Interactions, Sylvain Ravets[2,1], Jonathan E. Hoffman[2], Fredrik K. Fatemi[3], Steve L. Rolston[2], Luis A. Orozco[2], Daniel Barredo[1], Henning Labuhn[1], Thierry Lahaye[1], Antoine Browaeys[1]; [1]*Institut d'optique, France;* [2]*Joint Quantum Inst., USA;* [3]*Naval Research Laboratory, USA*. Robust hybrid quantum systems have been imagined to combine the strengths of multiple approaches while hopefully compensating for their weaknesses. This paper reports on the progress made on two different setups that are developed toward this goal.

Highland Room B

FiO

FTu1F • Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning—Continued

FTu1F.5 • 09:30

Using Near IR Scattering Nanoparticles to Improve Transparent Solar Cell Efficiency, Duncan C. Wheeler[1], Yichen Shen[1], Marin Soljacic[1]; [1]*Physics, MIT, USA*. We use near IR scattering nanoparticles and a wavelength selective mirror to create a light trapping effect. When used with a transparent solar cell, theoretical calculations show that efficiency can double without decreasing transparency.

FTu1F.6 • 09:45

Reversibly tunable hydrophilic nano/microporous polymer photonic crystal, Dengxin Ji[1], Haomin Song[1], Borui Chen[1], Alec Cheney[1], Nan Zhang[1], Tim Thomay[1], Chi Zhou[1], Qiaoqiang Gan[1], Alexander Cartwright[1]; [1]*State Univ. of New York at Buffalo, USA*. Here we report a low cost fabrication method to finely manipulate the pore size of nano/microporous materials and demonstrate its application for reversible color tuning of porous polymer photonic crystals based on atmosphere humidity condensation.

Highland Room C

FTu1G • Quantum Effects in Metamaterials—Continued

FTu1G.5 • 09:30 Invited

Gain Optical Nonlinearities and Non-volatile Switching in Photonic Metamaterials, Nikolay I. Zheludev[2,1]; [1]*CDPT/TPI/SPMS, Nanyang Technological Univ., Singapore;* [2]*ORC, Univ. of Southampton, UK*. Extremely large nonlinearities can be obtained in all-dielectric and plasmonic metamaterials through the exploitation of optomechanical and thermal response of the nanostructures, that can be additionally enhances by the use of superconductors

Highland Room D

LS

LTu1H • Nanophotonics I—Continued

LTu1H.4 • 09:30

Random laser dynamics with temporally modulated pumping, Stefan Bittner[1], Sebastian Knitter[1], Hui Cao[1]; [1]*Yale Univ., USA*. We present a detailed experimental study of the temporal dynamics of lasing in disordered dielectric nanostructures. The irregular temporal modulations of the pump intensity lead to strong fluctuations of the emission intensity and lasing spectrum.

LTu1H.5 • 09:45

Lasing Using Bound States in the Continuum, Ashok Kodigala[1], Thomas Lepetit[1], Qing Gu[1], Babak Bahari[1], Yeshaiahu Fainman[1], Boubacar Kante[1]; [1]*Univ. of California, San Diego, USA*. We have designed a high quality factor cavity that is based on a bound state in the continuum and harnessed its properties to demonstrate a novel type of surface emitting laser in the c-band (~1550nm).

Highland Room E

FiO

FTu1I • Novel Light Generation and Manipulation in Fiber Devices I—Continued

FTu1I.5 • 09:30

Near-Gaussian Spatial Mode from a Mid-IR Acetylene-filled Hollow-Core Fiber Laser, Neda Dadashzadeh[1], Manasa Thirugnanasambandam[1], Kushan Weerasinghe[1], Benoit Debord[2], Matthieu Chafer[2], Frédéric Gérôme [2], Fetah Benabid[2], Brian Washburn[1], Kristan L. Corwin[1]; [1]*Kansas State Univ., USA;* [2]*Univ. of Limoges, France*. We report good beam quality with $M^2 = 1.14 \pm 0.02$ for a 3μm output pulse energy of 1.15μJ from an acetylene-filled hollow-core fiber laser. Beam quality was characterized as a function of 3μm pulse energy.

FTu1I.6 • 09:45

Supercontinuum Generation in Photonic Crystal Fibers with Longitudinally Varying Dispersion Using Dual-Wavelength Pumping, Aku J. Antikainen[1], Francisco Rodrigo Arteaga Sierra[1], Govind P. Agrawal[1]; [1]*Univ. of Rochester, USA*. We demonstrate extension of supercontinuum bandwidth through dual-pumping and longitudinally varying dispersion in photonic crystal fiber and explain the spectral features in terms of accelerated soliton self-frequency shift and temporal reflections.

10:00 -10:30 Coffee Break, *West Corridor and Skyway Lobby (Radisson)*

10:30–12:00
FTu2A • Symposium on 100 Years of Optical Design, Fabrication, Testing, and Instrumentation - A Historical Look Back II

Presider: Kate Medicus, Optimax, USA

FTu2A.1 • 10:30 Invited

30 Years of Mirror Making at the Richard F. Caris Mirror Lab, Hubert M. Martin[1], John Hill[2], Dae Wook Kim[1]; [1]*Univ. of Arizona, USA;* [2]*Large Binocular Telescope Observatory, USA*. The Richard F. Caris Mirror Lab at the Univ. of Arizona has made lightweight honeycomb mirrors for some of the world's largest telescopes. Its 30 years of mirror making history, enabling a series iconic telescopes, is presented.

FTu2A.2 • 11:00 Invited

History of the Center for Optics Manufacturing, John M. Schoen[1]; [1]*Laboratory for Laser Energetics, Univ. of Rochester, USA*. The Center for Optics Manufacturing (COM) at the Univ. of Rochester was a U.S. Army Center of Excellence from 1990–2004 as a focal point for development, demonstration, and implementation of manufacturing technology.

10:30–12:00
FTu2B • Symposium on the 50th Anniversary of Low-Loss Optical Fibers II

Presider: Alan Evans; Corning Incorporated, USA

FTu2B.1 • 10:30 Invited

Recent Development in Optical Fibers for High Capacity Transmission Systems, Ming-Jun Li[1]; [1]*Corning Incorporated, USA*. We present recent development in optical fibers for long haul and short reach applications. We discuss new single mode and multimode fibers for increasing system capacity and next generation fibers for space division multiplexing.

FTu2B.2 • 11:00 Invited

Advances in Ultra-low Loss Silica Fibers, Takemi Hasegawa[1], Yoshinori Yamamoto[1], Yoshiaki Tamura[1], Tetsuya Hayashi[1]; [1]*Sumitomo Electric Industries Ltd, Japan*. Advances in silica-core fiber realizes ultra-low 0.152dB/km loss in commercial products, along with low bending and splice losses due to advanced waveguide design. These technologies are further applied to SDM fiber with ultra-low 0.158dB/km loss.

10:30–12:00
FTu2C • Laser-Matter Interactions

Presider: Jake Bromage, Univ. of Rochester, USA

FTu2C.1 • 10:30 Invited

Time-resolved Holographic Imaging of Femtosecond Laser-induced Damage Process in Dielectric Thin Films, Andrius Melninkaitis[1], Balys Momgaudis[1], Robertas Grigutis[1], Linas Smalakys[1], Nerijus Šiaulys[1], Laurent Gallais[2], Valdas Sirutkaitis[1]; [1]*Vilnius Univ. Laser Research Center, Lithuania;* [2]*Institut Fresnel - UMR 7249, France*. Digital holographic-microscopy was used to capture dynamics of femtosecond damage process in dielectric thin films. Ultrafast amplitude- and phase-contrast movies were recorded and interpreted numerically by using Keldysh and multi-rate equations.

FTu2C.2 • 11:00

D-Scan Determination of BK7 Ultrashort Pulses Ablation Parameters Temporal Dependence, Leandro M. Machado[1], Wagner de Rossi[1], Nilson D. Vieira[1], Ricardo E. Samad[1];[1]*IPEN/CNEN-SP, Brazil*. The D-Scan technique was used to quickly measure the BK7 ablation threshold for many superpositions and ultrashort pulses temporal widths, allowing the determination of the ablation parameters dependence on the pulses duration.

10:30–12:00
FTu2D • Silicon Photonics II

Presider: Sasan Fathpour; CREOL, Univ. of Central Florida, USA

FTu2D.1 • 10:30 Invited

Single Nanoparticle Detection Using Silicon Nitride Two-Dimensional Coupled-Resonator Optical-Waveguides, Andrew W. Poon[1], Jiawei Wang[1]; [1]*Hong Kong Univ of Science & Technology, Hong Kong*. We report single nanoparticle detection using silicon nitride two-dimensional coupled-resonator optical-waveguides (CROWs). Our experiments based on light-scattering imaging show real-time binding of 100nm-radius particles using 2×2 microring CROWs.

FTu2D.2 • 11:00

An O-band Polarization Splitter-Rotator in a CMOS-Integrated Silicon Photonics Platform, Wesley D. Sacher[1], Bo Peng[1], Jessie C. Rosenberg[1], Marwan Khater[1], Yves Martin[1], Jason S. Orcutt[1], Yurii A. Vlasov[1], William M. Green[1], Tymon . Barwicz[1]; [1]*IBM TJ Watson Research Center, USA*. We demonstrate an adiabatic polarization splitter-rotator fabricated in a production CMOS-integrated Si photonic process. The measured insertion loss is ≤ 1.0dB and the polarization extinction is better than 27dB over the 60nm bandwidth measured.

Highland Room A

LS

10:30–12:00
LTu2E • X-ray and XUV I
Presider: Christopher Milne; Paul Scherrer Institut, Switzerland

LTu2E.1 • 10:30 Invited
Title to be Announced, Yoann Pertot[1]; [1]*ETH Zurich, Switzerland.* Abstract not available.

LTu2E.2 • 11:00 Invited
HHG Generated Soft X-ray Supercontinuum for Absorption Spectroscopy, A.S. Johnson[1], L. Miseikis[1], D.A. Wood[1], D.R. Austin[1], C. Brahms[1], S. Jarosch[1], C.S. Stuber[1], P. Ye[1], Jonathan P. Marangos[1]; [1]*Imperial College London, UK.* We report the generation of a soft X-ray supercontinuum in the 150 – 450 eV photon energy range using HHG from a 1.5 cycle CEP stable intense laser pulse at 1800 nm which was used to measure XANES spectra of a 200 nm polythiophene (P3HT) film.

Highland Room B

FiO

10:30–12:00
FTu2F • Resolution and Measurement Limits
Presider: Simon Thibault; Universite Laval, Canada

FTu2F.1 • 10:30
Super-Resolving Two Point Sources Using a Single Tailored Spatial Projective Measurement, Hugo M. Ferretti[1,2], Weng-Kian Tham[1,2], Aephraim M. Steinberg[1,2]; [1]*Department of Physics, Univ. of Toronto, Centre for Quantum Information and Quantum Control and Inst. for Optical Sciences, Canada;* [2]*Canadian Inst. For Advanced Research, Canada.* We introduce a new technique for estimating the distance between two point sources. We present progress towards an experimental demonstration of the advantages of this technique over the more traditional Image Plane Counting.

FTu2F.2 • 10:45
Simultaneous fluorescent and quantitative phase imaging through spatial frequency projections, Patrick A. Stockton[1], Randy Bartels[1], Jeffrey J. Field[1]; [1]*Colorado State University, USA.* We introduce a new imaging technique to simultaneously image fluorescence and phase with a single element detector. This is accomplished by taking advantage of modulation transfer and Fourier optics to reconstruct the fluorescence and phase.

FTu2F.3 • 11:00
Retrieving Inter-Segment Piston Error Using Broadband Light, Scott Paine[1], James R. Fienup[1]; [1]*Univ. of Rochester, USA.* Traditional phase retrieval methods fail to retrieve piston errors greater than 0.5 waves in segmented systems because of 2-pi ambiguities. We present and characterize an algorithm that uses broadband light to determine such piston errors.

Highland Room C

10:30–12:00
FTu2G • Optics and Photonics of Disordered Systems
Presider: Akira Furusawa; Univ. of Tokyo, Japan

FTu2G.1 • 10:30 Invited
Speckle-Based Spectrometers, Hui Cao[1]; [1]*Yale Univ., USA.* The speckle pattern, produced by a random scattering medium or a multimode fiber/waveguide, is sensitive to wavelength and used as a fingerprint to recover the spectrum. We achieve high spectral resolution with small footprint.

FTu2G.2 • 11:00
Anderson Localization in the Deep Subwavelength Regime, Hanan H. Herzig Sheinfux[1], Yaakov Lumer[1], Guy Ankonina[1], Azriel Genack[2], Guy Bartal[1], Mordechai Segev[1]; [1]*Technion Israel Inst. of Technology, Israel;* [2]*Physics, Queens College and Graduate Center of CUNY, USA.* We experimentally demonstrate, for the first time, that localization of visible light can occur in deep subwavelength disordered multilayers with ~15 nm layer thicknesses. Transmission is shown to be sensitive to 2 nm thickness variations.

Highland Room D

LS

10:30–11:30
LTu2H • Multiphoton Effects I
Presider: Robert Alfano; CUNY City College, USA

LTu2H.1 • 10:30 Invited
Multiphoton Interactions in Nonlinear Optical Waveguides, Govind P. Agrawal[1]; [1]*Univ. of Rochester, USA.* We review the role of multiphoton interactions when ultrashort optical pulses propagate inside nonlinear optical waveguides. Topics covered include self-phase modulation, two-photon absorption, and four-wave mixing.

LTu2H.2 • 11:00 Invited
An *in vivo* Two-Photon Fluorescence Approach to Quantify the Blood-Brain Barrier Permeability for Drug Delivery in Brain, Lingyan Shi[1]; [1]*Columbia Univ., USA.* A new method was developed to quantify the blood-brain barrier (BBB) solute permeability postnatal rat brain and adult by using two-photon imaging system in vivo.

Highland Room E

FiO

10:30–12:00
FTu2I • Novel Fiber Devices
Presider: John Ballato; Clemson Univ., USA

FTu2I.1 • 10:30
CO_2 Laser Structuring of Semiconductor-core Glass Fibers, Michael Fokine[3], Thomas Hawkins[2], Maxwell Jones[2,4], John Ballato[2], Ursula J. Gibson[1]; [1]*Norges Teknisk Naturvitenskapelige Univ, Norway;* [2]*Clemson Univ., USA;* [3]*KTH Royal Inst. of Technology, Sweden;* [4]*Nufern, Inc, USA.* A scanning CO_2 laser system is used to process semiconductor core glass fibers. The conditions can be tuned to melt the core and soften the glass, producing resonators, tapers and bends.

FTu2I.2 • 10:45
Self-Cleaning of Femtosecond-Pulsed Beams in Graded-Index Multimode Fiber, Zhanwei Liu[1], Logan G. Wright[1], Demetrios Christodoulides[2], Frank W. Wise[1]; [1]*Cornell Univ., USA;* [2]*Univ. of Central Florida, USA.* We observe a nonlinear spatial self-cleaning process in multimode fiber. Experiments and simulations show this effect is caused by Kerr nonlinear interactions between the modes. Several important applications will be discussed.

FTu2I.3 • 11:00
Composite Material Hollow Antiresonant Fibers, Walter Belardi[1], Pier Sazio[1], Francesco De Lucia[1], Francesco Poletti[1]; [1]*ORC, Univ. of Southampton, UK.* We analyze air-core fiber designs with different materials in the cladding, including structures with an extended bandwidth and hybrid semiconductor/glass fibers with very low attenuation. We report on the first realization of this fiber type.

FTu2A • Symposium on 100 Years of Optical Design, Fabrication, Testing, and Instrumentation - A Historical Look Back II–Continued

FTu2A.3 • 11:30 Invited

APOMA: Past & Present, James M. Sydor[1,2]; [1]*Sydor Optics Inc, USA;* [2]*Sydor Technologies, USA*. Overview and updates related to APOMA (American Precision Optics Manufacturers Association) including why APOMA was formed, the history of APOMA, past accomplishments, current events and what the future holds. Visit apoma.org for more info.

FTu2B • Symposium on the 50th Anniversary of Low-Loss Optical Fibers II–Continued

FTu2B.3 • 11:30 Invited

High-Capacity Optical Communications – Can We Guess the Future from the Past?, Robert Tkach[1]; [1]*Nokia Bell Labs, USA*. Optical communications has made incredible progress over the last few decades. An amazing range of technologies have enabled over a thousand-fold increase in capacity. This talk will look at past trends and try to guess how the future will evolve.

FTu2C • Laser-Matter Interactions–Continued

FTu2C.3 • 11:15

Control of electron localization in dissociating H_2^+ via manipulating two-state population dynamics, Zhuo Wang[1], Pengfei Lan[1], Peixiang Lu[1]; [1]*Huazhong Univ of Science & Technology, China*. We propose a scheme to steer the electron localization by using the combination of a phase-stabilized few-cycle midinfrared laser pulse and a low-frequency field. We perform the simulation by solving the time-dependent Schrödinger equation.

FTu2C.4 • 11:30

Optical pump/x-ray probe measurements of solid-state diffusional mixing, Matthew F. DeCamp[1], Aaron Loether[1], Brian Kelly[1], Karl Unruh[1], Anthony DiChiara[2]; [1]*Univ. of Delaware, USA;* [2]*Argonne National Labs, USA*. Optical pump/x-ray probe experiments on an optically excited metallic multilayer film are presented. The resulting diffraction patterns reveal photo-initiated solid-state diffusional mixing resulting in the formation of a new metallic alloy.

FTu2C.5 • 11:45

Ferroelectric domains inversion in lithium niobate crystal using femtosecond infrared pulses, Wieslaw Z. Krolikowski[2], Xin Chen[1], Pawel Karpinski[1], Vlad Shvedov[1], Andreas Boes[3], Arnan Mitchell[3], Yan Sheng[1]; [1]*Australian National Univ., Australia;* [2]*Texas A&M Univ. at Qatar, Qatar;* [3]*RMIT Univ., Australia*. Periodic inversion of ferroelectric domains is realized in a lithium niobate by focused femtosecond laser beam. One and two-dimensional patterns are fabricated. Quasi-phase matched frequency doubling @815nm is demonstrated in a channel waveguide.

FTu2D • Silicon Photonics II–Continued

FTu2D.3 • 11:15

Ultrasmall in-plane photonic crystal demultiplexer fabricated with photolithography, Yuta Ooka[1], Nurul Ashikin B. Daud[1], Tomohiro Tetsumoto[1], Takasumi Tanabe[1]; [1]*Tanabe photonic structure group, Japan*. We demonstrate a demultiplexer with a small footprint, dense spacing and tunability obtained using a photolithographic photonic crystal. Eight-port demultiplexing with a 267 GHz spacing is demonstrated with high wavelength tunability.

FTu2D.4 • 11:30

Non-Hermitian Parametric Amplification via Four Wave Mixing, Asif Ahmed[1], Xiang Meng[1], Jerry I. Dadap[1], Ramy El-Ganainy[2], Richard M. Osgood[1]; [1]*Columbia Univ., USA;*[2]*Michigan Technological Univ., USA*. We demonstrate that for four wave mixing in silicon waveguides, the signal beam can be strongly amplified even in the absence of Hermitian phase matching condition if the idler beam suffers optical attenuation.

FTu2D.5 • 11:45

Monolithic Integration of WDM Light Source for Silicon Photonics by Cascade of Al_2O_3: Er^{3+} DFB Lasers, Purnawirman Purnawirman[1], Nanxi Li[3], emir salih magden[1], gurpreet singh[1], jonathan D. bradley[1], michele moresco[1], thomas adam[2], Gerard Leake[2], Douglas Coolbaugh[2], Michael Watts[1]; [1]*Massachusetts Inst. of Technology, USA;* [2]*College of Nanoscale Science and Engineering, Univ. at Albany, State Univ. of New York, USA;* [3]*Harvard Univ., USA*. We demonstrate a monolithic integration of WDM light source for silicon photonics by cascade of Al_2O_3: Er^{3+} DFB lasers. Simultaneous operation of four channels is achieved with dl/dT = 15.3±0.1 pm/°C temperature dependent wavelength shift.

12:00–13:30 Lunch Break *(on your own)*

12:00–13:30 Optical Material Studies Technical Group Special Talk, *Radisson Rochester Riverside, Grand Ballroom D*

12:00–13:30 Polarization Technical Group Special Talks, *Radisson Rochester Riverside, Genessee Suite G*

12:00–13:15 OSA Fellow Members Lunch *(Advance Registration Required), Hyatt Regency Rochester, Grand Ballroom, A-C*

12:15–14:55 LTu2J • Laser Science Symposium on Undergraduate Research Poster Session, *Riverside Court*

13:45–16:00 OSA Members, Family and Friends Tour – Susan B. Anthony Museum & House, *Shuttle transportation will depart from the Hyatt Regency Rocehster at 13:45*

Highland Room A

LS

LTu2E • X-ray and XUV I–Continued

LTu2E.3 • 11:30 Invited

Exploiting the Longitudinal Coherence of FERMI: Coherent Control with Multicolor FEL Pulses, Kevin Prince[1]; [1]*Intl Centre for Theoretical Physics, Italy.* FELs based on SASE have poor longitudinal coherence, whereas the seeded FEL FERMI is nearly transform limited. This opens the way to performing coherent control experiments, as demonstrated recently, Nature Photonics 10 (2016) 176.

Highland Room B

FiO

FTu2F • Resolution and Measurement Limits–Continued

FTu2F.4 • 11:15

Weak Value Measurements with Pulse Recycling, Courtney Byard[1], Trent Graham[1], Andrew Jordan[2], Paul Kwiat[1]; [1]*Univ. of Illinois at UC, USA;* [2]*Physics and Astronomy, Univ. of Rochester, USA.* Recycling undetected photons in a weak measurement can substantially improve the signal-to-noise ratio. We demonstrate a preliminary improvement by a factor of 1.36 over a system with no recycling, potentially reaching a factor of 3.2.

FTu2F.5 • 11:30

Common Path Heterodyne Interferometer for Single Nanoparticle Detection in Fluids, Sarah Kurmulis[1], Lukas Novotny[1]; [1]*Photonics Laboratory, ETH Zurich, Switzerland.*Sensitivity of interferometric detection of nanoparticles is limited by path length fluctuations. We present a common path heterodyne interferometer using a vibrating plate that allows stable and sensitive sizing of single nanoparticles in solution.

FTu2F.6 • 11:45

Fault-tolerant and finite-error localization for point emitters within the diffraction limit, Zong Sheng Tang[1], Kadir Durak[1], Alexander Ling[1,2]; [1]*Center for Quantum Technologies, Singapore;* [2]*Department of Physics, National Univ. of Singapore, Singapore.* We implement a finite-error estimator for determining the separation between two incoherent point sources even with small separation. This technique has good tolerance to error, making it an interesting consideration for high resolution instruments.

FTu2G • Optics and Photonics of Disordered Systems–Continued

FTu2G.3 • 11:15

Replica Symmetry Breaking in Random Lasers Based on Colloidal Rh-6G and Specially Designed TiO_2 Nanoparticles, Pablo I. Pincheira[2], Andréa Silva[2], Sandra Carreño[2], Serge Fewo[3], Andre de Lima Moura[2,1], Ernesto Raposo[2], Anderson Gomes[2], Cid B. de Araújo[2]; [1]*Universidade Federal de Alagoas, USA;* [2]*Departamento de Física, Universidade Federal de Pernambuco, Brazil;* [3]*Univ. of Yaounde I, Yaoundé, Cameroon.* Replica symmetry break and a photonic paramagnetic to spin-glass phase transition in a random laser based on ethanol solution of Rhodamine 6G and specially designed amorphous TiO_2 nanoparticles is demonstrated.

FTu2G.4 • 11:30

Multiple Most-Likely Path Solutions for Continuously Monitored, Driven Qubits, Philippe Lewalle[1], Areeya Chantasri[1], Andrew Jordan[1]; [1]*Univ. of Rochester, USA.* We examine most-likely paths for continuously monitored pure-state qubits, obtained as an extremum of a stochastic path integral. By considering the evolution of the Lagrange Manifold, we locate multiple-path solutions, analogous to optical caustics.

FTu2G.5 • 11:45

Using Polarized Light to Investigate Shell Structure of Sea Dwelling Organisms, Joshua A. Jones[1], Enrique J. Galvez[1], Rebecca A. Metzler[1], Anthony J. D'Addario[1], Carrie Burgess[1], Brian Regan[1], Samantha Spano[1], Ben Cvarch[1]; [1]*Colgate Univ., USA.* We present our work on using polarized light to investigate the structure of nacre in three shelled species: bivalve, cephalopod and gastropods. Data were collected using imaging polarimetry of monochromatic light passing through thin samples.

Highland Room C

Highland Room D

LS

LTu2H • Multiphoton Effects I–Continued

Highland Room E

FiO

FTu2I • Novel Fiber Devices–Continued

FTu2I.4 • 11:15

Characteristics of Dissimilar-Fiber Long-Period Fiber Gratings, Pengfei Wang[1,2], Thomas K. Gaylord[2]; [1]*Beijing Jiaotong Univ., China;* [2]*Georgia Inst. of Technology, USA.* A new kind of long-period fiber grating that contains dissimilar fiber types is fabricated and demonstrated. This dissimilar-fiber long-period fiber grating (DF-LPFG) is shown to exhibit good resonant attenuation and an acceptable insertion loss.

FTu2I.5 • 11:30

Maskless photolithography using a photon sieve on an optical fiber tip, Raquel Flores[1], Ricardo Janeiro[1], Dionísio Pereira[1], Jaime Viegas[1]; [1]*Masdar Inst., United Arab Emirates.*A photon sieve inscribed on a single mode optical fiber tip by focused ion beam milling is demonstrated for maskless lithography of a photoresist with a 405 nm wavelength laser.

FTu2I.6 • 11:45

The Reflectivity Measurement of a Dynamically Formed Fiber Bragg Grating Inside an Yb-doped Fiber, Ivan A. Lobach[1], Roman V. Drobyshev[1], Andrei A. Fotiadi[2,3], Sergey I. Kablukov[1], Sergey A. Babin[1]; [1]*Inst. of Automation and Electrometry, Russian Federation;* [2]*Electromagnetism and Telecommunication department, Univ. of Mons, Belgium;*[3]*Ulyanovsk State Univ., Russian Federation.* Spatial hole burning in an active medium of a linear cavity Yb-doped fiber laser leads to formation of a dynamical fiber Bragg grating. Reflectivity of the grating (~5%) is measured for the first time.

12:00–13:30 Lunch Break *(on your own)*

12:00–13:30 Optical Material Studies Technical Group Special Talk, *Radisson Rochester Riverside, Grand Ballroom D*

12:00–13:30 Polarization Technical Group Special Talks, *Radisson Rochester Riverside, Genessee Suite G*

12:00–13:15 OSA Fellow Members Lunch *(Advance Registration Required), Hyatt Regency Rochester, Grand Ballroom, A-C*

12:15–14:55 LTu2J • Laser Science Symposium on Undergraduate Research Poster Session, *Riverside Court*

13:45–16:00 OSA Members, Family and Friends Tour – Susan B. Anthony Museum & House, *Shuttle transportation will depart from the Hyatt Regency Rocehster at 13:45*

Grand Ballroom A (Radisson)

13:30–14:30
FTu3A • Symposium on 100 Years of Optical Design, Fabrication, Testing, and Instrumentation - A Historical Look Back III

Presider: Dae Wook Kim, Univ. of Arizona, USA

FTu3A.1 • 13:30 Invited

History of Optics Manufacturing in Rochester, New York, Jim VanKouwenberg[1], Robert Wiederhold[1]; [1]*Optimax Systems Inc, USA*. Optics manufacturing has a long history in Rochester with interesting stories of how companies developed and spun off other companies. This paper presents an historical overview as well as a few examples using current businesses.

FTu3A.2 • 14:00 Invited

Title to be Announced, Edward White[1]; [1]*CDGM Glass Company USA, USA*. Abstract not available.

Grand Ballroom B (Radisson)

13:30–15:30
FTu3B • Symposium on the 50th Anniversary of Low-Loss Optical Fibers III

Presider: Alan Evans; Corning Incorporated, USA

FTu3B.1 • 13:30 Invited

Recent Advances in Microstructured Optical Fibers and their Applications, David Richardson[1]; [1]*Univ. of Southampton, UK*. I review recent advances in microstructured fiber technology (in particular exploiting either multiple spatial cores/channels, and/or a hollow core) to deliver significant improvements in both conventional and emerging applications in communications, lasers and sensing.

FTu3B.2 • 14:00 Invited

Transmitting Beyond The Fictitious Nonlinear Capacity Limit, Stojan Radic[1]; [1]*Univ. of California San Diego, USA*. With introduction of low-loss fibers, it appears that the transmission capacity is limited by Kerr response. We discuss the genesis of this misconception and describe the physics that does not recognize "nonlinear Shannon limit".

Grand Ballroom C (Radisson)

13:30–15:30
FTu3C • Ultrafast Sources and Applications

Presider: Jie Qiao, Rochester Inst. of Technology, USA

FTu3C.1 • 13:30 Tutorial

Towards Attosecond Measurement in Complex Molecules and the Condensed Phase, Jonathan P. Marangos[1]; [1]*Imperial College London, UK*. The challenge of measuring ultrafast electron dynamics will be explained. Recent progress on soft X-ray sources based upon XFELs and HHG and their appication to time resolved absorption spectroscopy and related techniques will be described.

Biography: Jon Marangos graduated with a BSc in Physics from Imperial College in 1982 and a PhD in 1986. Currently he holds the Lockyer Chair in Physics at Imperial College and is an OSA Fellow. Recently he has been looking at the problems of controlling the electron dynamics driven in complex systems by strong laser fields and in developing high power sub-femtosecond light sources. He is involved in free electron laser science having led the UK New Light Source Project from 2008-2010 and is an active participant in experiments at X-ray FELs in USA, Japan and Europe.

FTu3C.3 • 14:15

Dynamics of Large Femtosecond Filament Arrays: Possibilities, Limitations, and Trade-offs, Wiktor Walasik[1], Natalia M. Litchinitser[1]; [1]*Univ. at Buffalo, USA*. We show that the dynamics of multifilament array propagation is affected by relative phase of the generating beams, number of filaments, separation between them, and initial power. We find the optimal parameters ensuring high array stability.

Grand Ballroom D (Radisson)

13:30–15:45
FTu3D • Plasmonic and Photonic Crystal Devices

Presider: Jeurg Leuthold; ETH Zurich, Switzerland

FTu3D.1 • 13:30 Invited

Physical Scaling Laws of Nanophotonics, Ke Liu[1], Shuai Sun[1], Arka Majumdar[2], Volker J. Sorger[1]; [1]*Electrical and Computer Engineering, George Washington Univ., USA;*[2]*Univ. of Washington, USA*. We show that nanophotonic device performance scales non-monotonically with critical length and define the metric [Speed / (Energy/bit x Footprint)] to assess the quality of link performance based-on both optical and electrical tradeoffs.

FTu3D.2 • 14:00

Ultracompact Field-Effect Plasmonic Modulator, Kaifeng Shi[1], Zhaolin Lu[1]; [1]*Rochester Inst. of Technology, USA*. We present an ultracompact electro-absorption (EA) plasmonic modulator based on the field effect inside a metal-insulator-conductive oxide (MIC) structure. The modulator has an effective length of only 800nm, and can potentially work at high speed.

FTu3D.3 • 14:15

On-Chip Plasmonic Spectrometer, Yuval Tsur[1], Ady Arie[1]; [1]*Tel Aviv Univ., Israel*. The first on-chip spectrometer utilizing propagating surface plasmon polaritons, is demonstrated. It can enable compact Raman spectroscopy, and harnesses the plasmonic field-enhancement to potentially improve micro-particle spectroscopy.

Highland Room A

LS

15:00–16:30
LTu3E • Laser Science Symposium on Undergraduate Research I
Presider: Hal Metcalf, SUNY, Stony Brook, USA

See the program distributed with registration materials for complete information.

Highland Room B

FiO

13:30–15:30
FTu3F • Optical Properties of Materials
Presider: Christopher Dorrer, Univ. of Rochester, USA

FTu3F.1 • 13:30
Resonant cavity-enhanced holographic imaging in ultrathin topological insulator films, Zengji Yue[1], Gaolei Xue[1], Min Gu[1]; *[1]Physics, RMIT, Australia*. We report computer-generated holography in ultrathin topological insulator films, which serve as natural optical resonant cavities and remarkably enhances the phase modulations in the holograms.

FTu3F.2 • 13:45
Tailoring the Optical Properties of Boron Doped μc-Si:H Thin Films by Changing the SiH_4/H_2 Ratio Using RF-PECVD Process, Ghada Dushaq[1], Ammar Nayfeh[1], Mahmoud Rasras[1]; *[1]Masdar Inst., United Arab Emirates*. This paper depicts the effect of SiH_4/H_2 dilution ratio (R) on the structural and optical properties of amorphous silicon matrix with embedded microcrystals of silicon. The thin films are prepared using RF-standard PECVD process.

FTu3F.3 • 14:00
2D Coherent Spectroscopy of Strained GaAs, Alan D. Bristow[1], Brian L. Wilmer[1], Daniel Webber[2], Kimberley Hall[2]; *[1]West Virginia Univ., USA; [2]Dalhousie Univ., Canada*.2D coherent spectroscopy explore low- and high-strain GaAs layers. The interplay of many-body effecs and strain is shown through polarization. Low strain has similar, closer spaced excitons. For high strain, many-body effects appear bestronger.

FTu3F.4 • 14:15
Intermediate Time Relaxation in super cooled liquid studied by optical Kerr effect spectroscopy, Miaochan Zhi[1], Marcus T. Cicerone[1]; *[1]National Inst. of Standards and Technology, USA*. We performed optical Kerr effect (OKE) experiments in propylene carbonate and showed that the ubiquitously observed but yet unexplained intermediate relaxation process in OKE response is due to cooperative molecular motion in liquids.

Highland Room C

13:30–15:30
FTu3G • Integrated Quantum Optics
Presider: Tobias Kippenberg; Ecole Polytechnique Federale de Lausanne, Switzerland

FTu3G.1 • 13:30 Invited
Artificial Gauge Fields and Photonic Topological Phenomena, Vaakov Lumer[1], Miguel Bandres[1], Yonatan Plotnik[1], Hanan H. Herzig Sheinfux[1], Alexander Szameit[2], Mikael C. Rechtsman[3], Mordechai Segev[1]; *[1]Technion Israel Inst. of Technology, Israel; [2]Univ. of Jena, Germany; [3]Penn State, USA*. Artificial gauge fields allow unprecedented control of light flow in photonic systems, enabling the observation of topological insulators and other topological phenomena in photonics. We present an overview of this area along with new results.

FTu3G.2 • 14:00 Invited
Hybrid Quantum Information Processing, Akira Furusawa[1]; *[1]The Univ. of Tokyo, Japan*. Hybridization of qubit and continuous-variable quantum information processing (QIP) enables us to realize high-fidelity and efficient QIP. I will show our research activities for that direction.

Highland Room D

LS

14:00–15:30
LTu3H • Quantum Light Sources I
Presider: A. Nick Vamivakas, Univ. of Rochester, USA

LTu3H.1 • 14:00 Invited
Single Defect Centers in Wide-Bandgap Materials: Stable, Bright and Pure Quantum Light Sources, Tim Schroder[1]; *[1]Massachusetts Inst. of Technology, USA*. A promising class of single photon emitters consists of crystal defect centers in wide-bandgap materials. Here, we introduce, discuss, and compare such color centers in established and new materials including diamond, silicon carbide, and boron and gallium nitride.

Highland Room E

FiO

13:30–15:30
FTu3I • Novel Light Generation and Manipulation in Fiber Devices II
Presider: Shankar Pidishety, Indian Inst. of Technology Madras, India

FTu3I.1 • 13:30 Invited
The Inviscid Burgers' Equation in Nonlinear Fiber Optics, Benjamin Wetzel[1,2], Domenico Bongiovanni[1], Michael Kues[1], Yi Hu[3], Zhigang Chen[3,4], Stefano Trillo[5], John M. Dudley[6], Stefano Wabnitz[7], Roberto Morandotti[1]; *[1]INRS - EMT, Canada; [2]Univ. of Sussex, UK; [3]Nankai Univ., China; [4]San Francisco State Univ., USA; [5]Universita di Ferrara, Italy; [6]Université de Franche-Comté, France; [7]Università degli Studi di Brescia, Italy*. We report on the experimental generation of Riemann waves in an optical fiber system, allowing for the controlled formation of shock waves, as analytically described by a seminal equation of fluid dynamics: the so-called Inviscid Burgers' Equation.

FTu3I.2 • 14:00
Multi-peak Dispersive Wave Generation in Single-Capillary-Assisted Chalcogenide Optical Fibers, Satya P. Singh[2], Vishwatosh Mishra[2], Shailendra K. Varshney[2,1]; *[1]Department of E&ECE, IIT Kharagpur, India; [2]Department of Physics, IIT Kharagpur, India*. We propose methodology to generate multi-peak dispersive waves in capillary chalcogenide optical fiber with the aid of longitudinal thermal-gradient and thermal-tuning of dispersion of fiber, which is only possible in cascaded fiber system.

FTu3I.3 • 14:15
Optomechanical contribution to the intensity-dependent refractive index of optical microfibers and nanofibers, Wei Luo[1], Yun-chao Shi[1], Fei Xu[1], Yan-qing Lu[1]; *[1]Nanjing Univ., China*. We carefully examine the Lorentz optical force in silica microfibers and nanofibers and show that optomechanical effect contributes significantly to the value of the nonlinear index.

14:45–15:30
FTu4A • Tutorial - Bill Casserly
Presider: Julie Bentley; Univ. of Rochester, USA

FTu4A.1 • 14:45 Tutorial

Illumination Design for Consumer Electronic Applications, William J. Cassarly[1]; [1]*Synopsys, Inc, USA.* Illumination design is a core part of many consumer electronic products. This tutorial will explain fundamental illumination concepts using both hardware demonstrations and 'virtual' demonstrations using Monte-Carlo simulations.

Biography: Bill is a key contributor to the advancement of computer-aided illumination engineering, particularly in the development of practical and effective optimization capabilities for illumination systems. Bill is an SPIE Fellow, holds 48 US patents, and teaches illumination design courses. Bill has authored numerous papers and a chapter on illumination engineering in the Optical Society of America's Handbook of Optics. At the 2006 and 2010 International Optical Design Conferences, Dr. Cassarly submitted the winning solution for the Illumination Design Problem.

FTu3B • Symposium on the 50th Anniversary of Low-Loss Optical Fibers III—Continued

FTu3B.3 • 14:30 Invited

Realizing a Moore's Law for Fibers, Yoel Fink[1]; [1]*Massachusetts Inst. of Technology, USA.* Professor Fink will share the vision of creating the "AFFOA Law" enabling the transformation of fiber and fabric materials into highly functional devices and systems that will see, hear, sense, communicate, store and convert energy and change color.

FTu3B.4 • 15:00 Invited

Back to the Future - Why Boring Old Materials and Designs are the Answer to Next Generation Optical Fibers, John Ballato[1]; [1]*Clemson Univ., USA.* Kao and Hockham probably never envisioned the optical power levels that today coursing down optical fiber. This talk, purposefully provocative, discusses how old glasses and simple designs are best for addressing continued power scaling.

FTu3C • Ultrafast Sources and Applications—Continued

FTu3C.2 • 14:30

High Harmonic Spectroscopy for Molecular Imaging with Coulomb Wave Functions, Chunyang Zhai[1,2], Lixin He[1,2], Pengfei Lan[1,2], Xiaosong Zhu[1,2], Yang Li[1,2], Feng Wang[1,2], Wenjing Shi[1,2], Qingbin Zhang[1,2], Peixiang Lu[1,2]; [1]*Wuhan National Laboratory for Optoelectronics, Huazhong Univ of Science and Technology, China;* [2]*School of Physics, Huazhong Univ of Science and Technology, China.* We experimentally reconstruct the molecular orbital of N$_2$ by using a Coulomb-corrected molecular orbital tomography method. This method shows a significant improvement in eliminating the artificial structures caused by plane wave approximation.

FTu3C.2 • 14:45

Sub-160-fs pulses dechriped to its Fourier transform limit generated from the all-normal dispersion fiber oscillator, Jan Szczepanek[1], Tomasz M. Kardas[2], Yuriy Stepanenko[2];[1]*Faculty of Physics, Univ. of Warsaw, Poland;* [2]*Inst. of Physical Chemistry, Polish Academy of Sciences, Poland.* We present an all-normal dispersion fiber oscillator which, delivers high energy pulses recompressible to their Fourier transform limit duration. 2nJ, sub-160 fs pulses directly from the oscillator were effectively used for supercontinuum generation.

FTu3C.1 • 15:00 Invited

High-power Femtosecond Thin-disk Oscillators for Mid-infrared and Extreme Ultraviolet Generation, Oleg Pronin[1], Jonathan Brons[1], Marcus Seidel[1], Jinwei Zhang[1], Ferenc Krausz[1,2];[1]*Max Planck Inst. of Quantum Optics, Germany;* [2]*Ludwig-Maximilians-Universität München, Germany.* Recent advances in the development of femtosecond thin-disk oscillators are reported. A novel mode-locking technique relying on distributed Kerr-lenses is presented. The generation of W-level mid-infrared frequency comb is described.

FTu3D • Plasmonic and Photonic Crystal Devices—Continued

FTu3D.4 • 14:30

Superradiance in Arrays of Plasmonic Nanoantennas, Saumya Choudhary[1], Sylvia D. Swiecicki[2], Israel de Leon[3,4], Sebastian A. Schulz[4], Jeremy Upham[4], John E. Sipe[2], Robert W. Boyd[1,4]; [1]*Inst. of Optics, Univ. of Rochester, USA;* [2]*Physics, Univ. of Toronto, Canada;* [3]*School of Engineering and Sciences, Tecnológico de Monterrey, Mexico;* [4]*Physics, Univ. of Ottawa, Canada.* We demonstrate by experiment, simulation, and a simple analytical model that superradiance can be observed in a planar array of nanoantennas, with a linewidth that scales linearly with the number of nanoantennas within a square wavelength.

FTu3D.5 • 14:45

Subdiffraction Optical Motion Transduction using a Scalable Plasmomechanical Platform, Brian J. Roxworthy[1], Vladimir Aksyuk[1]; [1]*Center for Nanoscale Science and Technology, National Inst. of Standards and Technology, USA.* We present a scalable platform for producing reconfigurable plasmonic devices. Using localized-gap plasmon resonators exhibiting large quality factors, we demonstrate sensitive, plasmon-based measurement of motion from a deep subdiffraction region.

FTu3D.6 • 15:00

Quasi-coherent mixing of mechanical excitations in vacuum, Tong Lin[1,2], Xingwang Zhang[1], Feng Tian[1], Fook Siong Chau[1], Guangya Zhou[1]; [1]*National Univ. of Singapore, Singapore;* [2]*Zhejiang Univ. , China.* We investigate the cavity optomechanics of the coupled nanobeam resonators on a silicon-on-insulator platform and demonstrate the quasi-coherent mixing of mechanical excitations in vacuum.

Highland Room A

LS

LTu3E • Laser Science Symposium on Undergraduate Research I—Continued

Highland Room B

FiO

FTu3F • Optical Properties of Materials—Continued

FTu3F.5 • 14:30
High-order hyper-Rayleigh scattering in BBO nanocrystals, Igor P. de Miranda[1], Lauro Maia[2], Cid B. de Araújo[1], Edilson L. Falcao-Filho[1]; *[1]Universidade Federal de Pernambuco, Brazil; [2]Instituto de Física, Universidade Federal de Goiás, Brazil*. We report on the high-order hyper-Rayleigh emission in BBO nanocrystals with dimensions of ~8 nm. The samples excitation was performed at 2000 nm, emission up to the fifth harmonic, i.e., 400 nm was detected.

FTu3F.6 • 14:45
Optical birefringence from P3HT nanofibers in alternating electric field, Gleb Lobov[1], Yichen Zhao[1], Alleksandrs Marinins[1], Min Yan[1], Jiantong Li[1], Abhilash Sugunan[2], Lars Thylen[1], Lech Wosinski[1], Michael Östling[1], Muhammet Toprak[1], Sergei Popov[1]; *[1]Royal Inst. of Technology, Sweden; [2]SP Technical Research Inst. of Sweden, Sweden*. AC poling allowing to control the orientation of P3HT nanofibers, result in strong optical birefringence with promising implementation in a novel type of optical modulator, without necessary embedding into any hosting matrix, e.g. liquid crystal.

FTu3F.7 • 15:00
Polarization Dependence of the Second Harmonic Generation and Raman Scattering from Atomically Thin $MoTe_2$, Ryan Beams[1], Luiz Gustavo Cançado[2], Sergiy Krylyuk[1], Irina Kalish[1,3], Patrick Vora[4], Albert Davydov[1], Stephan J. Stranick[1]; *[1]National Inst of Standards & Technology, USA; [2]Departamento de Fisica, Universidade Federal de Minas Gerais, Brazil; [3]Irina Kalish, LLC, USA; [4]Physics Department, George Mason Univ., USA*. We study the symmetry properties of 1T' $MoTe_2$ using polarized Raman and second harmonic generation. We find that while the inversion symmetry is broken for even numbers of layers, the Raman modes are nearly unchanged.

Highland Room C

FiO

FTu3G • Integrated Quantum Optics—Continued

FTu3G.3 • 14:30
Configurable heralded two-photon states on a chip, Panagiotis Vergyris[1], Thomas Meany[2], Tommaso Lunghi[1], James Downes Downes[2], Michael Steel[2], Michael Withford[2], Olivier Alibart[1], Sébastien Tanzilli[1]; *[1]Laboratoire de Physique de la Matiére Condensée, Universite Nice Sophia Antipolis - CNRS UMR 7336, France; [2]Department of Physics and Astronomy, Macquarie Univ., Australia*. We show the potential of a hybrid technology for realizing highly complex circuits for quantum photonic applications. We demonstrate the most advanced chip enabling four photon generation and manipulation for heralding tunable two-photon states.

FTu3G.4 • 14:45
High Performance Photon Sources for Quantum Silicon Photonics, Jeffrey A. Steidle[1], Michael L. Fanto[1,2], Christopher C. Tison[2], Zihao Wang[1], Paul Alsing[2], Stefan F. Preble[1];*[1]Rochester Inst. of Technology, USA; [2]Air Force Research Lab, USA*. High performance silicon ring resonator photon-pair sources have been realized to produce entangled states and by balancing the losses in the resonator we achieved heralding efficiencies of ~96%.

FTu3G.5 • 15:00
Bayesian quantum phase estimation on an integrated Silicon photonic device, Stefano Paesani[1], Antonio Andreas Gentile [1], Raffaele Santagati[1], Jianwei Wang[1], Nathan Wiebe[2], David Tew[3], Jeremy L. O'Brien[1], Mark G. Thompson[1]; *[1]Centre for Quantum Photonics, Univ. of Bristol, UK; [2]Quantum Architectures and Computation Group, Microsoft Research, USA; [3]School of Chemistry, Univ. of Bristol, UK*. We demonstrate a Bayesian approach for practical and robust implementation of the quantum phase estimation algorithm. We implement it on a reconfigurable Silicon quantum photonic device, demonstrating its importance for future quantum applications.

Highland Room D

LS

LTu3H • Quantum Light Sources I—Continued

LTu3H.3 • 14:30 Invited
New Types of Artificial Atoms and Molecules for Quantum Information Technologies, Han Htoon[1]; *[1]Center for Integrated Nanotechnologies, Los Alamos National Laboratory, USA*. Quantum light emission from solitary oxygen dopants of carbon nanotubes and plasmonically coupled core/thick-shell nanocrystal quantum dot molecules will be presented as evidences of their potential in quantum information technologies.

LTu3H.4 • 15:00 Invited
Engineering Quantum Emitters for Integrated Quantum Networks, Mete Atature[1]; *[1]Cambridge Univ., UK*. Solid-state quantum emitters possess multiple advantages including high-bandwidth operation and on-chip integration. I will cover recent progress in InGaAs quantum dots for optically coupled spin networks as well as new emitters in layered materials.

Highland Room E

FiO

FTu3I • Novel Light Generation and Manipulation in Fiber Devices II—Continued

FTu3I.4 • 14:30
Direct Measurement of Temporal Rogue Waves Generated by Spontaneous Modulation Instability, Mikko Narhi[1], Benjamin Wetzel[2], Cyril Billet[3], Jean-Marc Merolla[3], Shanti Toenger[3], Thibaut Sylvestre[3], Roberto Morandotti[2], Frederic Dias[4], Goëry Genty[1], John M. Dudley[3]; *[1]Tampere Univ. of Technology, Finland; [2]Institut National de la Recherche Scientifique, Canada; [3]Femto-ST, France; [4]Univ. College Dublin, Ireland*. We measure the real time intensity profiles of localized structures emerging from spontaneous modulation instability. We show that the results can be interpreted in terms of analytical solutions of the nonlinear Schrödinger equation.

FTu3I.5 • 14:45
Leveraging Birefringence and Gain Anisotropy in a Nonlinear Fabry-Perot Resonator to Achieve a High-Contrast Optical AND Gate, Saif A. Al Graiti[1], Drew N. Maywar[1];*[1]Rochester Inst. of Technology, USA*. A 60.9-degree polarization rotation on the Poincare sphere produced by the anisotropic response of a nonlinear Fabry-Perot resonator is leveraged with an in-line polarizer to achieve a 31.2-dB-contrast optical AND gate.

FTu3I.6 • 15:00
Torsional modes of a nanofiber: polarimetric excitation and read out., Eliot Fenton[1], Adnan Khan[1], Burkley Patterson[1], Pablo Solano[1], Steve L. Rolston[1], Luis A. Orozco[1], Fredrik K. Fatemi[2]; *[1]Univ. of Maryland at College Park, USA; [2]Army Research Laboratory, USA*. We present a study of the torsional modes of a nanofiber excited with AM circularly polarized driving laser propagating through the fiber. We resolve the frequencies of the modes using polarimetry in a heterodyne configuration.

Grand Ballroom A (Radisson)	Grand Ballroom B (Radisson)	Grand Ballroom C (Radisson)	Grand Ballroom D (Radisson)

FiO

FTu4A • Tutorial - Bill Casserly—Continued

FTu3B • Symposium on the 50th Anniversary of Low-Loss Optical Fibers III—Continued

FTu3C • Ultrafast Sources and Applications—Continued

FTu3D • Plasmonic and Photonic Crystal Devices—Continued

FTu3D.7 • 15:15
Active control of the vacuum field in nanomechanical photonic crystal structures, Michele Cotrufo[1], Midolo Leonardo[1], Maurangelo Petruzzella[1], Zarko Zobenica[1], Frank W. M. van Otten[1], Andrea Fiore[1]; [1]*COBRA Research Inst., Eindhoven Univ. of Technology, Netherlands.* We investigate a photonic-crystal-based nano-opto-electro-mechanical system which allows controlling the spatial localization of the vacuum electromagnetic field.Large modulations of the optical Q-factor are predicted and experimentally demonstrated.

FTu3D.8 • 15:30
Figure of Merit for planar plasmonic waveguides with a Kerr nonlinearity, C. Martijn de Sterke[1], Guangyuan Li[1], Stefano Palomba[1]; [1]*Univ. of Sydney, Australia.* We illustrate the use of a Figure of Merit for nonlinear plasmonic waveguides with a set of one-dimensional geometries for which the fields are known analytically, bringing out the physical requirements for optimizing such structures.

15:30–16:00 Coffee Break, *West Corridor and Skyway Lobby (Radisson)*

15:30–16:30 Meet the OSA Editors' Reception, *Empire Lobby*

Highland Room A	Highland Room B	Highland Room C	Highland Room D	Highland Room E
LS	FiO		LS	FiO
LTu3E • Laser Science Symposium on Undergraduate Research I—Continued	**FTu3F • Optical Properties of Materials—Continued**	**FTu3G • Integrated Quantum Optics—Continued**	**LTu3H • Quantum Light Sources I—Continued**	**FTu3I • Novel Light Generation and Manipulation in Fiber Devices II—Continued**
	FTu3F.8 • 15:15 **Controlling Dipole Orientation Near A Dielectric Interface Via Substrate and Buffer Layer,** Xuan Long Ho[1], Po-Jui Chen[1], Wei Yen Woon[2], Jonathon David White[1]; [1]*Department of Photonics Engineering, Yuan Ze Univ., Taiwan;* [2]*Department of Physics, National Central Univ., Taiwan.* Fluorescence lifetime of Rhodamine 6G on an air-dielectric interface increased by a factor of three as thickness of a PMMA layer increased suggesting a change in dipole orientation from isotropic to perpendicular.	**FTu3G.6 • 15:15** **Rogue-soliton generation via Anderson localisation,** Mohammed F. Saleh[1], Claudio Conti[2], Fabio Biancalana[1]; [1]*Heriot Watt Univ., UK;* [2]*Department of Physics, Univ. Sapienza, Inst. for Complex Systems (ISC-CNR), Italy.* We offer a new explanation of how rogue-solitons generated during the modulation instability process in optical fibres are formed. Our novel point of view is based on Anderson localisation effect assisted by an optical-event horizon.		**FTu3I.7 • 15:15** **Microwave Beam Steering System with Simultaneous Spectral Bandpass Filtering Using Optical True Time Delay,** Wenjing Xu[1]; [1]*Beijing Univ. of Posts and Telecomm, China.*A novel microwave beam steering system with spectral filtering using optical true time delay is proposed. 90 degrees beam steering with four elements and spectral filtering with 26-dB passband-to-stopband contrast ratio are simultaneously obtained.

15:30–16:00 Coffee Break, *West Corridor and Skyway Lobby (Radisson)*

15:30–16:30 Meet the OSA Editors' Reception, *Empire Lobby*

Grand Ballroom A (Radisson)

16:00–17:30
FTu5A • Optics in Consumer Electronics
Presider: Julie Bentley; Univ. of Rochester, USA

FTu5A.1 • 16:00 Invited
Human Centric Optical Design Enabling Next Generation Wearable Displays, Bernard Kress[1]; [1]*Microsoft Corporation, USA*. High resolution over large FOV with accurate 3D cues are key to the ultimate AR/VR experience. Human centric optical design is a key enabler for such requirements while addressing size, weight and power constrains.

FTu5A.2 • 16:30
Retro-reflective Characteristics of Transparent Screen for Head Mounted Projection Displays, Shoaib R. Soomro[1], Hakan Urey[1]; [1]*Optical Microsystems Laboratory, Electrical engineering department, Koc Univ., Turkey.* Retro-reflective features of microbeads based transparent screen are explored. Analytical expression of reflection cone is formulated and experimentally validated. Screen luminance for different viewing conditions is calculated when used with HMPD.

FTu5A.3 • 16:45
Flexible holographic 3D display with wide viewing angle, Gaolei Xue[2,1], Qiming Zhang[2], Juan Liu[1], Yongtian Wang[1], Min Gu[2]; [1]*Beijing Inst. of Technology, China;* [2]*Royal Melbourne Inst. of Technology, Australia.* A flexible 3D holographic display has been designed based on the high refractive index materials on a flexible substrate. The dramatically increased viewing angle of the curved hologram is numerically demonstrated.

Grand Ballroom B (Radisson)

16:00–18:00
FTu5B • Laser Material Processing
Presider: Jie Qiao, Rochester Inst. of Technology, USA

FTu5B.1 • 16:00 Invited
Laser Doping and Texturing of Silicon for Advanced Optoelectronic Devices, Eric Mazur[1]; [1]*Harvard Univ., USA.* Irradiating a semiconductor with intense laser pulses in the presence of dopants changes the sample's optical, material, and electronic properties. The resulting material has applications in detection and energy harvesting.

FTu5B.2 • 16:30
Herringbone Patterned Laser-Induced Periodic Surface Structures (LIPSS), Erik M. Garcell[1], Chunlei Guo[1]; [1]*Univ. of Rochester, USA.* Herringbone patterned laser-induced periodic surface structures (LIPSS) are observed on Cu using a femtosecond laser. We find the ideal experimental conditions for producing herringbone structures.

FTu5B.3 • 16:45
Determining Optimized Laser Parameters for Non-Thermal Femtosecond Laser Processing of Silicon, Lauren Taylor[1], Jie Qiao[1]; [1]*Rochester Inst. of Technology, USA.*Femtosecond laser processing of silicon showed effective material removal, but with detrimental artifacts resulting from heating and oxidation. A thermal model was constructed to predict optimized processing parameters to mitigate heat accumulation.

Grand Ballroom C (Radisson)

16:00–18:00
FTu5C • Frequency Combs and High Harmonic Generation
Presider: Laura Sinclair, NIST, USA

FTu5C.1 • 16:00 Invited
Attosecond Light Sources in the Water Window, Zenghu Chang[1]; [1]*Univ. of Central Florida, CREOL, USA.* By driving high-order harmonic generation with an Optical Parametric Chirped Pulse Amplifier at 1.7 μm and implementing polarization gating, isolated attosecond pulses with photon energy extending to more than 400 eV were produced and characterized.

FTu5C.2 • 16:30
Enhancement of high harmonic generation efficiency using incommensurate two colour fields, Barry D. Bruner[1], Oren Pedatzur[1], Doron Azoury[1], Michael Krueger[1], Gal Orenstein[1], Nirit Dudovich[1]; [1]*Weizmann Inst. of Science, Israel.* We demonstrate large enhancements in high harmonic generation efficiency driven by two colour laser fields, compared with single colour fields of equivalent energy. The enhancement occurs due to scaling of the ionization rate by the two colour field.

FTu5C.3 • 16:45
Localized High Harmonic Generation in Semiconductor Nanostructures, Murat Sivis[2,1], Marco Taucer[2], Kyle Johnston[2], Giulio Vampa[2], Andre Staudte[2], Andrei Naumov[2], David Villeneuve[2], Claus Ropers[1], Paul Corkum[2]; [1]*4th Physical Inst. - Solids and Nanostructures, Georg-August Univ., Germany;* [2]*Joint Attosecond Science Laboratory, National Research Council, Canada.* We investigate the enhancement and localization of high harmonic generation in a nanostructured ZnO-crystal by spectral analysis and microscopic imaging. We show a robust method of distinguishing localized harmonic emission from the bulk emission.

Grand Ballroom D (Radisson)

16:00–17:45
FTu5D • Mid-Infrared Integrated Photonics
Presider: Stefan Preble; Rochester Inst. of Technology, USA

FTu5D.1 • 16:00 Invited
Mid IR Silicon Photonics, Graham T. Reed[1]; [1]*Univ. of Southampton, UK.* In this paper we present a review of passive and active photonic devices in three mid-IR silicon photonics material platforms: germanium on silicon, suspended silicon and silicon on insulator (SOI).

FTu5D.2 • 16:30
Mid-Infrared Dual-Comb Source Using a Silicon Microresonator, Mengjie Yu[1,2], Yoshitomo Okawachi[2], Austin Griffith[1], Michal Lipson[2], Alexander L. Gaeta[2]; [1]*Cornell Univ., USA;* [2]*Columbia Univ., USA.* We demonstrate a dual-comb source in the mid-infrared using soliton modelocking in two silicon microresonators. Modelocking is achieved simultaneously using a single continuous-wave pump source using thermal control and free-carrier injection.

FTu5D.3 • 16:45
Mid-infrared supercontinuum generation in a SiN waveguide pumped at 1.55 micron, Davide Grassani[1], Adrien Billat[1], Martin Hubert Peter Pfeiffer[1], Hairun Guo[1], Thibault North[1], Tobias J. Kippenberg[1], Camille-Sophie Bres[1]; [1]*EPFL, Switzerland.* We report supercontinuum generation extending to 3.6 micron in silicon-nitride waveguides pumped by a commercial source at 1.55 micron. The span is a bandwidth record for the platform and demonstrates its potential as mid-infrared source.

Highland Room A

Highland Room B

LS

16:45–18:00
LTu5E • Laser Science Symposium on Undergraduate Research II
Presider: Hal Metcalf, SUNY, Stony Brook, USA

See the program distributed with registration materials for complete information.

16:00–18:00
LTu5F • X-ray and XUV II
Presider: Jonathan P. Marangos; Imperial College London, UK

LTu5F.1 • 16:00 Invited
Shrinking the Synchrotron: Tabletop Extreme Ultraviolet Absorption of Transition Metal Complexes, Josh Vura-Weis[1]; [1]*Department of Chemistry, UIUC, USA.* High-harmonic extreme ultraviolet spectroscopy is shown to be sensitive to the electronic structure of molecular transition metal complexes, distinguishing the oxidation state, spin state, and ligand field, and metal identity of coordination systems.

LTu5F.2 • 16:30 Invited
Transient Wave Mixing Spectroscopy Using High Order Harmonic Attosecond Pulses and Few-cycle NIR Laser, Wei Cao[1,2], Erika R. Warrick[1,2], Ashley Fidler[1,2], Stephen R. Leone[1,3], Daniel M. Neumark[1,2]; [1]*Chemical Sciences Division, Lawrence Berkeley National Laboratory, USA;* [2]*Dept. of Chemistry, Univ. of California, USA;* [3]*Department of Chemistry, Univ. of California, USA.* We demonstrate the wave mixing process between weak extreme ultraviolet (XUV) attosecond pulses and strong near-infrared (NIR) few-cycle laser pulses in gas phase atoms. It offers a means for ultrafast nonlinear XUV spectroscopy.

Highland Room C

Highland Room D

Highland Room E

FiO

16:00–18:00
FTu5G • Nonlinear Optics in Micro/Nano-Optical Structures I
Presider: Anatoly Zayats; King's College London, UK

FTu5G.1 • 16:00 Invited
Hybrid Silicon Photonic Circuits for Chip-Scale Quantum Optics, Hong Tang[1]; [1]*Yale Univ., USA.* I will present the heterogeneous integration of active nanostructured materials on silicon chips for low-loss waveguiding and the exploitation of hybrid photonic circuits for efficient light conversion, manipulation and detection on silicon platform.

FTu5G.2 • 16:30 Invited
Photonic Quantum Networks, Ian A. Walmsley[1], Joshua Nunn[1], Brian J. Smith[1], Steve Kolthammer[1], Dylan Saunders[1], Stefanie Barz[1], Jelmer Renema[1], Patrick Ledingham[1], Andreas Eckstein[1], Benjamin Brecht[1], Amir Feizpour[1], Helen Chrzanowski[1]; [1]*Univ. of Oxford, UK.* Photonic networks offer the promise for delivering robust quantum information processing technologies, from sensor arrays to quantum simulators. New sources, detectors and memories illustrate progress towards building scalable quantum network.

16:00–18:00
LTu5H • Nano-Plasmonics for Spectroscopy
Presider: Kevin Kubarych; Univ. of Michigan, USA

LTu5H.1 • 16:00 Invited
Ultrafast Microscopy of Plasmonic Modes of Ag Nanocrystals Grown on Si Substrates, Hrvoje Petek[1]; [1]*Univ. of Pittsburgh, USA.* We investigate the plasmonic modes of Ag nanocrystals grown in situ on Si(001) substrate by time-resolved photoelectron emission microscopy. Spectromicroscopic measurements reveal high-order plasmonic modes of Ag nanowires and Ag/Si interface.

LTu5H.2 • 16:30 Invited
Nanoscale Characterization and Control of Functional Materials Using Near-field Spectroscopy, Joanna M. Atkin[1]; [1]*Univ. of North Carolina - Chapel Hi, USA.* Scattering-based near-field spectroscopy allows for measurements of nanometer heterogeneity in a wide variety of materials. I will discuss the use of near-field spectroscopy to probe the functional properties of nanostructured electronic materials.

16:00–18:00
FTu5I • Novel Light Generation and Manipulation in Fiber Devices III
Presider: Gilberto Brambilla; Univ. of Southampton, UK

FTu5I.1 • 16:00 Tutorial
Polarization Effects in Optical Fibers For Distributed Sensing, Andrea Galtarossa[1], Luca Palmieri[1]; [1]*Universita degli Studi di Padova, Italy.* We show that the analysis of the state of polarization of Rayleigh backscattered light may be useful in developing distributed polarization sensitive optical fiber sensors able to measure mechanical parameters, electric current and magnetic field.

Biography: Andrea Galtarossa is full professor at Department of Information Engineering, University of Padova, Italy. He is co-author of about 150 regular and invited papers in propagation effects of polarized signals in single-mode optical fibers. He has been member of the Technical Program Committee of European Conference on Optical Communication (ECOC) and Optical Fiber Conference (OFC) and Technical co-chair of ECOC 2010. He was Topical Editor of OSA Optics Letters (2008-2012) and he is Deputy Editor of OSA Optics Letters (since 2013). He is Fellow of OSA and Senior Member of IEEE.

FTu5I.2 • 16:45
Observation of surface Brillouin scattering in microstructured optical fibers, Joel Cabrel Tchahame[1], Jean-Charles Beugnot[1], Kien Phan Huy[1], Vincent Laude[1], alexandre Kudlinski[1], Thibaut Sylvestre[1]; [1]*CNRS, France.* We report the observation of surface Brillouin scattering in a small-core microstructured optical fiber and show that this new type of scattering is highly sensitive to the air-hole microstructure, thus providing an efficient way to control it.

FTu5A • Optics in Consumer Electronics—Continued

FTu5A.4 • 17:00
Efficient Structured Light Generator, Tasso R. Sales[1], Amber Betzold[1], Michael Morris[1]; [1]*RPC Photonics Inc, USA*. We describe a refractive micro-structure that generates a pseudo-random structured light pattern for gesture recognition and 3D sensing applications. The optical element provides wide field-of-view, high efficiency, and no zero order.

FTu5A.5 • 17:15
Holographic Light Management in Photovoltaic Systems, Raymond K. Kostuk[1], Juan Russo[2], Jose Castro[4], Deming Zhang[3], Shelby Vorndran[1]; [1]*Univ. of Arizona, USA;* [2]*Luminit, USA;* [3]*Seagate Technology, USA;* [4]*Panduit, USA*. In this paper the application of holographic optical elements for photovoltaic energy conversion is reviewed including broadband concentrators and spectrum splitting systems with volume and computer generated holograms.

FTu5B • Laser Material Processing—Continued

FTu5B.4 • 17:00 Invited
Graphene Oxide Thin Films for Functional Photonic Devices, Baohua Jia[1], Xiaorui Zheng[1], Han Lin[1], Yunyi Yang[1], Scott Fraser[1]; [1]*Swinburne Univ. of Technology, Australia*. Using direct laser printing technology, we present functional photonic devices made from graphene oxide films demonstrating their great potentials as an emerging integratable platform for ultrathin, light weight and flexible photonic applications.

FTu5B.5 • 17:30
Flexible Laser Scribed Biomimetic Supercapacitors , Litty Thekkekara[1], Dan Li[2], Ling Qiu[2], Min Gu[3]; [1]*Swinburne Univ. of Technology, Australia;* [2]*Department of Material Engineering, Monash Univ., Australia;* [3]*School of Science, RMIT Univ., Australia*. An enhancement of 10^1 $Whcm^{-3}$ in the energy storage density was attained for the laser scribed graphene oxide supercapacitors using the biomimetic structures adopted from Fern leaf structures in comparison with its planar electrode counterpart.

FTu5C • Frequency Combs and High Harmonic Generation—Continued

FTu5C.4 • 17:00 Invited
Cavity-Enhanced Fourier Transform and Vernier Spectroscopy with Optical Frequency Combs, Lucile Rutkowski[1], Amir Khodabakhsh[1], Alexandra C. Johansson[1], Venkata Ramaiah-Badarla[1], Aleksandra Foltynowicz[1]; [1]*Umeå Univ., Sweden*. We present optical frequency comb Fourier transform spectroscopy in near-infrared for broadband high-resolution spectroscopy, and the first implementation of continuous-filtering Vernier spectroscopy in mid-infrared for fast multispecies detection.

FTu5C.5 • 17:30
Generation of Low-Phase-Noise Millimeter Waves in a Wide Frequency Range by Using a Frequency Comb based on Electro-Optics-Modulators, Atsushi Ishizawa[1], Tadashi Nishikawa[2], Takahiro Goto[2], Kenichi Hitachi[1], Tetsuomi Sogawa[1], Hideki Gotoh[1]; [1]*NTT Basic Research Laboratories, Japan;* [2]*Tokyo Denki Univ., Japan*. Using an electro-optics-modulator-based optical frequency comb at telecommunications wavelengths, we have successfully demonstrated that phase noise in a commercially available signal generator from 6 to 72 GHz can be dramatically reduced.

FTu5D • Mid-Infrared Integrated Photonics—Continued

FTu5D.4 • 17:00 Invited
Antimonid Based Mid-Infrared Detectors and Focal Plane Arrays, Sanjay Krishna[1]; [1]*Center for High Technology Materials, USA*. The use of "unipolar barrier engineering" to realize high performance infrared detectors and focal plane arrays will be discussed. A metamaterial detector structure will be demonstrated using Type II superlattices.

FTu5D.5 • 17:30
Mid-infrared ultra high Q factors in fluoride crystalline microresonators, Clément Javerzac-Galy[1], Caroline Lecaplain[1], Michael L. Gorodetsky[2,3], Tobias J. Kippenberg[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland;* [2]*Russian Quantum Center, Russian Federation;* [3]*Faculty of Physics, M. V. Lomonosov Moscow State Univ., Russian Federation*. Using an uncoated chalcogenide tapered fiber as high ideality coupler, we demonstrate ultra-high quality factors deep in the mid-infrared with crystalline microresonators. Due to low multiphonon absorption we obtain the highest mid-IR optical finesse.

LS

LTu5E • Laser Science Symposium on Undergraduate Research II—Continued

LTu5F • X-ray and XUV II—Continued

LTu5F.3 • 17:00 Invited

Frontiers of X-ray Science Developed with an XFEL Facility SACLA, Tetsuo Katayama[2], Makina Yabashi[1]; [1]*RIKEN SPring-8 Center, Japan;* [2]*Japan Synchrotron Radiation Research Institute (JASRI) Advanced Light Source and Optics Research Group XFEL, Japan.* I will present latest status and perspective on a Japanese XFEL facility SACLA, including recent relocation of the SCSS test accelerator to the SACLA facility in order to enhance a capability in softer x-ray region.

LTu5F.4 • 17:30 Invited

Single Particle Imaging at the Linac Coherent Light Source, Andy Aquila[1]; [1]*LCLS, SLAC, USA.* Results from LCLS's Single Particle Imaging Initiative, a community-involved program tasked with the goal of overcoming the technical challenges for reaching ultimately atomic resolution in X-ray imaging of single-particles, will be discussed.

FiO

FTu5G • Nonlinear Optics in Micro/Nano-Optical Structures I—Continued

FTu5G.3 • 17:00

Tunable Cavity-Enhanced Quantum Light Sources for Integrated Quantum Photonics, Maurangelo Petruzzella[1], Birindelli Simone[1], Francesco Pagliano[1], Zarko Zobenica[1], Midolo Leonardo[1], Lianhe Lianhe[2], Edmund Linfield[2], Andrea Fiore[1]; [1]*Applied Physics, Eindhoven Univ. of Technology, Netherlands;* [2]*School of Electronic and Electrical Engineering, Univ. of Leeds, UK.* We report the control over the spontaneous emission of energy-tunable quantum emitters embedded in passive waveguide circuits, realized by coupling Stark-tunable quantum dots to electromechanically-compliant photonic crystal molecules.

FTu5G.4 • 17:15

Measurement of photon-pair generation in waveguide arrays with specialized poling, Francesco Lenzini[1], James Titchener[2], Paul Fisher[1], Andreas Boes[3], Alexander Poddubny[4,5], Sachin Kasture[1], Ben Haylock[1], Matteo Villa[1], Arnan Mitchell[3], Alexander S. Solntsev[2], Andrey A. Sukhorukov[2], Mirko Lobino[1]; [1]*Griffith Univ., Australia;* [2]*The Australian National Univ., Australia;* [3]*RMIT Univ., Australia;* [4]*ITMO Univ., Russian Federation;* [5]*Ioffe Physical-Technical Inst. of the Russian Academy of Science, Russian Federation.* We present the realization of an inhomogeneously poled nonlinear waveguide array for the generation of photon pairs. The device is characterized by coincidence counting and a novel method based on reversed sum-frequency generation measurements.

FTu5G.5 • 17:30

High Efficiency Superconducting Single-Photon Detectors Evanescently Coupled to Laser Written Waveguides, Rubayet Al Maruf[1], Christopher Haapamaki[1], Michal Bajcsy[1];[1]*Inst. for Quantum Computing, Department of Electrical and Computer Engineering, Canada.* SNSPDs evanescently coupled to silicon waveguides can have low system efficiency due to mode mismatch issue. We propose to improved this by substituting the silicon waveguides with silica waveguides, such as fibers or laser-written waveguides.

LTu5H • Nano-Plasmonics for Spectroscopy—Continued

LTu5H.3 • 17:00 Invited

Withdrawn.

LTu5H.4 • 17:30 Invited

Ultrafast Methods for Investigating Structure and Dynamics of Biological Systems, Carlos Baiz[1]; [1]*Univ. of Texas at Austin, USA.* We describe a suite of ultrafast IR spectroscopy tools and molecular models designed to probe biological interfaces, including membrane protein structure, and interfacial environments surrounding the lipid bilayer.

FTu5I • Novel Light Generation and Manipulation in Fiber Devices III—Continued

FTu5I.3 • 17:00

Ultra-Long DFB Fiber Bragg Grating for Stimulated Brillouin Scattering in Standard Fiber, Sébastien Loranger[1], Victor Lambin Iezzi[1], Raman Kashyap[1,2]; [1]*Ecole Polytechnique de Montreal, Canada;* [2]*Electrical Engineering Department, Polytechnique Montreal, Canada.* We demonstrate stimulated Brillouin scattering (SBS) in standard fiber using ultra-long distributed feedback (DFB) fiber Bragg gratings (FBG). This is the first observation of SBS in standard fiber with a DFB.

FTu5I.4 • 17:15

Multiband RF Filter Enabled Through Optical Phase-Sensitive Amplification, James M. Dailey[1], Anjali Agarwal[1], Paul Toliver[1]; [1]*Vencore Labs, USA.* We report experimental measurements on an RF photonic multiband filter realized using a simple, passive spectral phase mask and fiber-based optical phase-sensitive amplifier resulting in 1 GHz bands with an extinction given by amplifier-gain-squared.

FTu5I.5 • 17:30

Generation of Radially and Azimuthally Polarized Beams using All-fiber Fused Couplers, Shankar Pidishety[3,1], Gilberto Brambilla[1], Siddharth Ramachandran[2], Balaji Srinivasan[3];[1]*Optoelectronics Research Centre, Univ. of Southampton , UK;* [2]*Electrical and Computer Engineering Department, Boston Univ. , USA;* [3]*Department of Electrical Engineering, Indian Inst. of Technology Madras, India.* We demonstrate the generation of radially and azimuthally polarized beams using an all-fiber fused coupler fabricated using single mode fiber (SMF) and air-core fiber. The generated beams exhibit high stability with ~85% power coupling efficiency.

Grand Ballroom A (Radisson)	Grand Ballroom B (Radisson)	Grand Ballroom C (Radisson)	Grand Ballroom D (Radisson)
FiO			
FTu5A • Optics in Consumer Electronics—Continued	**FTu5B • Laser Material Processing—Continued**	**FTu5C • Frequency Combs and High Harmonic Generation—Continued**	**FTu5D • Mid-Infrared Integrated Photonics—Continued**
	FTu5B.6 • 17:45 **An investigation of light behaviour in the multilayer photopolymer during holographic recording,** Ra'ed A. Malallah[1], Haoyu Li[1], Inbarasan Muniraj[1], John T. Sheridan[1];[1]*Univ. College Dublin, Ireland.* We show the calculation for photpolymerization process using the multilayer technique by varying the dye concentration. The 3D **N**onlocal**P**hotopolymerization **D**riven **D**iffusion model is applied to calculate the resulting absorption and polymerization.	**FTu5C.6 • 17:45** **Testing QED with Ramsey-Comb spectroscopy in the deep-UV range,** Sandrine Galtier[1], Robert K. Altmann[1], Laura S. Dreissen[1], Kjeld S. Eikema[1]; [1]*Vrije Universiteit Amsterdam, Netherlands.* By combining upconversion of amplified frequency comb laser pulses with Ramsey-spectroscopy, we developed deep-UV Ramsey-Comb excitation, leading to highly accurate two-photon spectroscopy in krypton, and molecular hydrogen for testing QED.	

17:30–20:30 Photonics Clambake 2016, *(ticket required), Hyatt Regency Rochester, Grand Ballroom*

18:00–19:00 Optics & Energy: Reflections on the Past and Lighting the Future, *Radisson Rochester Riverside, Genesee Suite F*

19:00–22:00 OSA Student Member Party, *Holiday Inn Hotel Rochester, Grand Ballroom*

19:00–22:00 Optics Alumni Networking Reception, *Radisson Rochester Riverside, Riverview Ballroom and Lounge*

Highland Room A	Highland Room B	Highland Room C	Highland Room D	Highland Room E
LS		FiO		
LTu5E • Laser Science Symposium on Undergraduate Research II—Continued	**LTu5F • X-ray and XUV II—Continued**	**FTu5G • Nonlinear Optics in Micro/Nano-Optical Structures I—Continued** **FTu5G.6 • 17:45** **Inherently Non-Reciprocal On The Nanoscale: Nonlinear Generation Via Multipole Interference,** Ekaterina Poutrina[1,2], Augustine Urbas[1]; [1]*Air Force Research Laboratories, USA;*[2]*UES, Inc., USA.* We show that nonreciprocal directionality of nonlinear generation, where the generation direction is preserved when reversing the fundamental beam(s), is inherent and realistically observable in the nonlinear multipolar response of nanostructures.	**LTu5H • Nano-Plasmonics for Spectroscopy—Continued**	**FTu5I • Novel Light Generation and Manipulation in Fiber Devices III—Continued** **FTu5I.6 • 17:45** **Period-doubling vector soliton generation from a linear cavity mode-locked laser using a faraday rotator mirror,** Yingling Pan[1], Xin Zhao[1], Ya Liu[1,2], Meng Zhang[1], Zheng Zheng[1,2]; [1]*School of Electronic and Information Engineering, Beihang Univ., China;* [2]*Collaborative Innovation Center of Geospatial Technology, China.* Experimental observation of high-contrast, period-doubling vector solitons generated by a linear cavity mode-locked fiber laser is reported, which is mode-locked with a carbon nanotube modelocker and has a faraday rotator end mirror.

17:30–20:30 Photonics Clambake 2016, *(ticket required), Hyatt Regency Rochester, Grand Ballroom*

18:00–19:00 Optics & Energy: Reflections on the Past and Lighting the Future, *Radisson Rochester Riverside, Genesee Suite F*

19:00–22:00 OSA Student Member Party, *Holiday Inn Hotel Rochester, Grand Ballroom*

19:00–22:00 Optics Alumni Networking Reception, *Radisson Rochester Riverside, Riverview Ballroom and Lounge*

FiO

07:00–18:00 Registration, *Galleria*

08:00–09:30 JW1A • Joint Plenary Session, *Lilac Ballroom*

08:00–17:00 AIM Photonics Northeast Supply Conference (NESCO), *Hyatt Regency Rochester, Grand Ballroom A-D*

09:30–16:00 Exhibit Hall Open, *Empire Hall*

09:30–16:00 Glass Art Contest, *Empire Hall*

09:30–10:30 Unopposed Exhibit Time and Coffee Break, *Empire Ballroom*

10:30–12:00
FW2A • Novel Design Concepts for Eye Correction and Vision Simulators I
Presider: Brian Vohnsen, Univ. College Dublin, Ireland

FW2A.1 • 10:30 Invited
Myopia Control Off-Axis Correction Lenses, Earl Smith[1]; [1]*Univ. of Houston, USA.* The defocus-sensitive mechanisms that regulate ocular growth operate in a regionally selective manner. Optical manipulations of peripheral vision can influence growth, potentially slowing myopia progression, without altering central vision.

10:30–12:00
FW2B • Quantum Communications I
Presider: Rainer Steinwandt; Florida Atlantic Univ., USA

FW2B.1 • 10:30 Invited
The Interplay between Cryptography and Quantum Technology - Challenges and Opportunities, Rainer Steinwandt[1]; [1]*Florida Atlantic Univ., USA.* Quantum technology has substantial potential for cryptology. This talk discusses cryptanalytic implications – how common hardness assumptions are invalidated and security models deserve to be revisited – and how quantum technology can transcend limitations of classical cryptography.

10:30–12:00
FW2C • Biomedical Optics
Presider: Mike Marcus, Lumetrics, USA

FW2C.1 • 10:30 Invited
3D High-definition Wide Field-of-view Optical Coherence Microscopy Advancing Real-time in-vivo Cellular Imaging, Cristina Canavesi[1], Andrea Cogliati[2], Adam Hayes[3], Patrice Tankam[3], Anand Santhanam[4], Kevin Rolland-Thompson[5], Jannick P. Rolland[3,1]; [1]*LighTopTech Corp., USA;* [2]*Electrical and Computer Engineering, Univ. of Rochester, USA;* [3]*The Inst. of Optics, Univ. of Rochester, USA;* [4]*Radiation Oncology, Univ. of California, USA;* [5]*Synopsys Inc., USA.* In-vivo imaging requires micron-scale resolution in 3D, ~1 mm depth of imaging and large field-of-view (≥1 mm). Optical coherence microscopy breaks the cellular lateral resolution limit of optical coherence tomography, enabling advances in biotech.

10:30–12:00
FW2D • Symposium on Mesoscopic Optics of Disordered Media I
Presider: Aristide Dogariu, CREOL, Univ. of Florida, USA

FW2D.1 • 10:30 Invited
Control of Optical Intensity Distribution inside a Disordered Waveguide, Hui Cao[1], R. Sarma[1], Yaron Bromberg[1], Alexey Yamilov[2], Sasha Petrenko[2]; [1]*Yale Univ., USA;* [2] *Dept. of Physics, Missouri Univ. of Science & Technology, USA.* We use the adaptive wavefront shaping technique to vary the total energy inside a disordered silicon waveguide, and change the energy density distribution across the sample by selective coupling to high or low transmission eigenchannels.

Highland Room A	Highland Room B	Highland Room C	Highland Room D	Highland Room E
FiO				LS

07:00–18:00 Registration, *Galleria*

08:00–09:30 JW1A • Joint Plenary Session, *Lilac Ballroom*

08:00–17:00 AIM Photonics Northeast Supply Conference (NESCO), *Hyatt Regency Rochester, Grand Ballroom A-D*

09:30–16:00 Exhibit Hall Open, *Empire Hall*

09:30–16:00 Glass Art Contest, *Empire Hall*

09:30–10:30 Unopposed Exhibit Time and Coffee Break, *Empire Ballroom*

10:30–12:00
FW2E • Exotic States and Applications I

Presider: Shivanand, Purdue Univ., USA

FW2E.1 • 10:30 Invited

Exotic States of Light for Microscopy, Monika A. Ritsch-Marte[1]; [1]*Medical Univ. of Innsbruck, Austria*. Using tailored optical wavefronts or "exotic" optical beams in a microscope leads to a wealth of opportunities to modify the imaging performance. Advantages and problematic issues of recent approaches and general trade-offs will be discussed.

10:30–12:00
FW2F • Optical Fibers for Space Projects

Presider: Morten Ibsen; Univ. of Southampton, UK

FW2F.1 • 10:30 Tutorial

Recent Advances in Radiation Hardened Fiber-Based Technologies, Sylvain Girard[1], Youcef Ouerdane[1], Thierry Robin[2], Benoit Cadier[2], Aziz Boukenter[1]; [1]*Laboratoire Hubert Curien, Universite Saint Etienne, France;* [2]*Photonics Division, Photonics Division, IXBlue, France*. Several recent techniques are presented allowing to increase the radiation tolerance of fibers and fiber-based sensors to the harsh radiation constraints associated with space, high energy physics or nuclear power plants.

10:30–12:00
FW2G • A Tribute to Steve Jacobs I

Presider: Jonathan Zuegel, Univ. of Rochester, USA

FW2G.1 • 10:30 Invited

Optical Glass Science – the How and Why We Got There, Kathleen A. Richardson[1]; [1]*Univ. of Central Florida, CREOL, USA*. Optical glasses play a critical role in photonic systems and components. Know-how in glass manufacturing and characterization realized at LLE in the early 1980's led by Steve Jacobs, continue to yield advancement throughout our community.

10:30–12:00
FW2H • Adaptive Optics and Interferometry

Presider: Christina Schwartz, Univ. of Rochester, USA

FW2H.1 • 10:30

Wavefront Shaping For Measurements Through Diffusing Phase Boundaries, Nektarios Koukourakis[1], Bob Fregin[1], Jörg König[2], Lars Buettner[1], Jürgen Czarske[1]; [1]*TU Dresden, Germany;* [2]*IFW, Germany*. We show that aberrations introduced by diffusing phase boundaries can be compensated by using guide-stars. Flow field measurements based on image correlation through rough phase boundaries are presented.

10:30–12:30
LW2I • Integrated Quantum Photonics I

Presider: To be Announced

LW2I.1 • 10:30 Invited

Quantum Silicon Photonics: Photon sources and Circuits, Stefan F. Preble[1], Jeffrey A. Steidle[1], Michael Fanto[1,2], Christopher C. Tison[2], Gregory A. Howland[2], Edwin Hach [1], Paul Alsing[2]; [1]*Rochester Inst. of Technology, USA;* [2]*Air Force Research Laboratory, USA*. We report high performance ring resonator photon sources and the integration of the sources into quantum photonic circuits. We also discuss ring resonators as a building block for compact, reconfigurable, linear quantum optical circuits.

(continued on page 61)

FW2A • Novel Design Concepts for Eye Correction and Vision Simulators I—Continued

FW2A.2 • 11:00 Invited

New Technologies to Increase the Range of Vision of Intraocular Lenses, Aixa Alarcon[1], Marrie H. van der Mooren[1], Carmen Canovas[1], Henk Weeber[1], Patricia Piers[1]; [1]*Abbott Medical Optics Inc, Netherlands.* Traditional methods to increase depth of focus result in the reduction of distance vision and increased side-effects. We present how the combination of different technologies can significantly improve depth of focus and visual performance.

FW2B • Quantum Communications I—Continued

FW2B.2 • 11:00

Hyperdense Coding with Single Photons, Alexander Hill[1], Trent Graham[1], Paul Kwiat[1]; [1]*Univ. of Illinois (UIUC), USA.* We present current progress on an experimental implementation of quantum hyperdense coding, a quantum communication protocol which is capable of transmitting up to 2.58 bits per hyperentangled photon pair.

FW2B.3 • 11:15

Comparing the Information Capacity of Entangled Laguerre-Gaussian and Hermite-Gaussian Modal Sets in a Finite Aperture System, Sara Restuccia[1], Daniel Giovannini[2], Miles J. Padgett[1]; [1]*Glasgow Univ., UK;* [2]*The Edward S. Rogers Department of Electrical and Computer Engineering, Univ. of Toronto, Canada.* Within a parametric down-conversion process we compare information capacity associated with the entangled spatial modes as measured in the Hermitte-Gaussian and Lagueere-Gaussian modal basis in an optical system of finite aperture.

FW2C • Biomedical Optics—Continued

FW2C.2 • 11:00

Tomographic Coaxial Scanning Microscopy Using a Conical Lens (Axicon) , Boris Y. Zeldovich[1], Bahaa E. Saleh[1]; [1]*Univ. of Central Florida, CREOL, USA.* A new form of tomographic coaxial scanning microscopy is proposed by replacing the standard lens in confocal microscopy with a conical lens (axicon) that generates pencil-like illumination and detection along lines through the object.

FW2C.3 • 11:15

Stokes vector based Second Harmonic Generation Microscopy reveals molecular structure, Nirmal Mazumder[3,1], Jianjun Qiu[1,2], Fu J. Kao[1]; [1]*biophotonics, national yang ming Univ., Taiwan;* [2]*Huazhong Univ. of Science and Technology, Key Laboratory of Biomedical Photonics, China;* [3]*Biophysics, Manipal Univ., India.* We developed a four-channel photon counting based Stokes polarimeter for spatial characterization of polarization properties of Second Harmonic (SH) light. Thus, the critical polarization parameters can be obtained.

FW2D • Symposium on Mesoscopic Optics of Disordered Media I—Continued

FW2D.2 • 11:00 Invited

Wave Control and Holography with Time Transformations, Mathias Fink[1]; [1]*Ecole Sup Physique Chimie Industrielles, France.* Because time and space play a similar role in wave propagation, wave control can be achieved or by manipulating spatial boundaries or by manipulating time boundaries. Here we emphasize the role of time boundaries manipulation. We show that sudden changes of the medium properties generate instant wave sources that emerge instantaneously from the entire wavefield and can be used to control wavefield and to revisit the holographic principles.

FW2E • Exotic States and Applications I—Continued

FW2E.2 • 11:00
Topological Darkness of Tamm Plasmons for High-Sensitivity Singular-Phase Optical Detection, Svetlana V. Boriskina[1], Jonathan Tong[1], Yoichiro Tsurimaki[1], Victor N. Boriskin[2], Alexander Semenov[3], Mykola I. Ayzatskiy[2], Yuri P. Machekhin[4], Gang Chen[1]; [1]*Massachusetts Inst. of Technology, USA;* [2]*Kharkiv Inst. of Physics and Technology, Ukraine;*[3]*Inst. for Single Crystals NASU, Ukraine;* [4]*Kharkiv National Univ. of Radio Electronics, Ukraine*. Multilayered photonic-plasmonic structures exhibit topologically protected zero reflection if they are designed to support Tamm plasmon modes. Sharp phase changes associated with the Tamm mode excitation dramatically improve sensitivity of detectors.

FW2E.3 • 11:15
Creating `Optics' for Singular Atom Optics with Spinor Bose–Einstein Condensates, Justin T. Schultz[1], Azure Hansen[1], Joseph D. Murphree[1], Maitreyi Jayaseelan[1], Nicholas P. Bigelow[1]; [1]*Univ. of Rochester, USA*. We present methods to create waveplates and phase plates for pseudo-spin-1/2 atomic systems via two-photon Raman interactions. The interactions are geometrically represented as rotations on the Bloch sphere.

FW2F • Optical Fibers for Space Projects—Continued

Biography: Sylvain Girard got his PhD degree from Saint-Etienne University (UJM), France in 2003. He joined CEA bas a post-doctoral fellow, was recruited in 2004 and became a senior member of technical staff. He was in charge of vulnerability and radiation hardening studies of photonics for the Laser Mégajoule. In 2012, Sylvain joined UJM as Full Professor to work on the development of predictive models for the behavior of optical materials and components under irradiation. He has co-authored more than 140 journal papers and is the recipient of the 2013 IEEE NPSS Early Achievement and the 2014 IEEE Léon-Nicolas Brillouin Awards.

FW2F.2 • 11:15
Small Diameter Polarization Maintaining Photonic Crystal Fiber for Spaceborne Miniaturized Gyroscopes, Cai Wei[1], Jing Jin[1], Jingming Song[1], Wei Li[2], Wenyong Luo[2], Ningfang Song[1], Chunxi Zhang[1]; [1]*Beihang Univ., China;* [2]*FiberHome Telecommunication Technologies CO., Ltd., China.* An optimized small diameter polarization maintaining photonic crystal fiber (PM-PCF) is proposed. Radiation response of the PM-PCF and the performance of a 300-m mini coil demonstrate that the fiber is suitable for spaceborne gyroscopes.

FW2G • A Tribute to Steve Jacobs I—Continued

FW2G.2 • 11:00 Invited
Thirty-Five Years of Liquid Crystal Research at LLE: From Laser Fusion to Electronic Paper, Kenneth L. Marshall[1]; [1]*Univ. of Rochester, USA*. This presentation chronicles the collaborations and events that lead to Steve Jacobs' efforts in the 1980's to develop high-peak-power liquid crystal (LC) optics for OMEGA and the LC applications research spawned at LLE from that pioneering work.

FW2H • Adaptive Optics and Interferometry—Continued

FW2H.2 • 10:45
A Versatile Method for Precise Control of Non-Uniform Beam Front Polarizations, Matthew T. Runyon[1], Lambert Giner[1], Alicia Sit[1], Marissa Granados-Baez[1], Ebrahim Karimi[1], Jeff Lundeen[1]; [1]*Univ. of Ottawa, Canada*. The generation of customized, non-uniform beam front polarization profiles are accomplished through the use of two incidences on a spatial light modulator and traditional optical components such as waveplates, lenses, mirrors, and beam splitters.

FW2H.3 • 11:00
Improvements in accuracy and process efficiency with multimode measurements of ophthalmic contact lenses, David C. Compertore[1]; [1]*Lumetrics, USA*. Typically, qualifying a contact lens requires four different types of equipment, resulting in excessive handling of the contact lens. Combining measurements strongly reduces the risks and increases the efficiency of the quality control processes.

FW2H.4 • 11:15 Invited
Advances in Adaptive Optics for Microscopy and Nanoscopy, Martin J. Booth[1,2]; [1]*Univ. of Oxford, UK;* [2]*SAOT, Univ. of Erlangen Nurnberg, Germany.*Adaptive optics has been widely applied to microscopes to compensate specimen-induced aberrations. We report on recent developments extending these techniques to more challenging methods, including to super-resolution microscopes, or nanoscopes.

LW2I • Integrated Quantum Photonics I—Continued

LW2I.2 • 11:00 Invited
Title to be Announced, Alexander L. Gaeta[1]; [1]*Columbia Univ., USA*. Abstract not available.

FW2A • Novel Design Concepts for Eye Correction and Vision Simulators I—Continued

FW2A.3 • 11:30
Temporal multiplexing and simulation of multifocal intraocular lenses, Vyas Akondi[1], Carlos Dorronsoro[1], Enrique Gambra[1], Maria Vinas[1], Daniel Pascual[1], Sara Aissati[1], Susana Marcos[1]; [1]*Consejo Sup Investigaciones Cientificas, Spain*. Tunable lenses can simulate multifocal intraocular lenses through temporal multiplexing. The effect of sampling, response time of tunable lens and choice of the through-focus optical quality metric in evaluating the temporal profile are investigated.

FW2A.4 • 11:45
Light Sword Lens as Effective Method of Presbyopia Compensation, Krzysztof Petelczyc[1], Karol Kakarenko[2,3], Andrzej Kolodziejczyk[1], Zbigniew Jaroszewicz[2,3], Marek T. Rekas[5], Alejandro Mira-Agudelo[4], John Fredy Barrera [4], Rodrigo Henao[4]; [1]*Faculty of Physics, Warsaw Univ of Tech, Poland;* [2]*Inst. of Aplied Optics, Poland;* [3]*National Inst. of Telecomunications, Poland;* [4]*Facultad de Ciencias Exactas y Naturales, Universidad de Antioquia UdeA, Colombia;* [5]*Ophthalmology Department, Military Inst. of Medicine, Poland*. The monocular vision tests of 34 presbyopic patients was performed for defocused BCDVA vision, stenopia and Light Sword Lens correction. We show that visual acuity in the LSL case is better than others while contrast sensitivity matches normal vision.

FW2B • Quantum Communications I—Continued

FW2B.4 • 11:30
Observation of Intrinsic Spin-Orbit Interaction of Light in Few-Mode Optical Fiber, Dashiell L. Vitullo[1], Cody C. Leary[3], Patrick Gregg[2], Roger Smith[1], Dileep V. Reddy[1], Siddharth Ramachandran[2], Michael G. Raymer[1]; [1]*Univ. of Oregon, USA;* [2]*Electrical & Computer Engineering, Boston Univ., USA;* [3]*Physics, College of Wooster, USA*. Interaction between spin and intrinsic orbital angular momentum of light in a straight few-mode fiber is observed to generate rotation for both polarization and spatial profiles, in agreement with recent prediction.

FW2B.5 • 11:45
Experimentally Demonstrating Quantum Data Locking with a Quantum Enigma Machine, Daniel Lum[1], Michael Allman[2], Thomas Gerrits[2], Varun Verma[2], Cosmo Lupo[3], Seth Lloyd[3], Sae Woo Nam[2], John Howell[1]; [1]*Univ. of Rochester, USA;* [2]*National Inst. of Standards and Technology, USA;* [3]*Massachusetts Inst. of Technology, USA*. We present an experimental demonstration of quantum data locking as a quantum enigma machine that encrypts 6 bits per photon with less than 6 bits per photon of encryption key while remaining information-theoretically secure.

FW2C • Biomedical Optics—Continued

FW2C.4 • 11:30
Synthetic holographic phase imaging in confocal microscopy and applications, Martin Schnell[1,2], Sam Buercklin[3], Paulo Sarriugarte[1], Maria Jesus Perez-Roldan[1], Rainer Hillenbrand[4,5], P. Scott Carney[2,3]; [1]*CIC nanoGUNE Consolider, Spain;* [2]*Beckman Inst. for Advanced Science and Technology, Univ. of Illinois Urbana-Champaign, USA;* [3]*Department of Electrical and Computer Engineering, Univ. of Illinois Urbana-Champaign, USA;* [4]*CIC nanoGUNE Consolider and EHU/UPV, Spain;* [5]*IKERBASQUE, Basque Foundation for Science, Spain*. We present synthetic optical holography for amplitude and phase-resolved confocal imaging. We apply our technique to optical topography mapping and numerical refocusing of out-of-focus confocal data.

FW2C.5 • 11:45
Sensing pH in a Microfluidic Channel with a Lab-on-a-Smartphone Fluorescence Spectrometer, Jiajie Chen[1], Ruoyu Wang[1], Abhishek Renganathan[1], Anurag Rattan[1], Xiangyue Meng[1], Ranjith Rajasekharan Unnithan[1], Kenneth Crozier[1,2]; [1]*Electrical and Electronic Engineering, Univ. of Melbourne, Australia;* [2]*School of Physics, Univ. of Melbourne, Australia*. We demonstrate a smartphone unit for measuring pH. The dye-mixed sample is input to a microfluidic chip and inserted into the unit. The smartphone image sensor records the fluorescence spectrum, and an app determines pH.

FW2D • Symposium on Mesoscopic Optics of Disordered Media I—Continued

FW2D.3 • 11:30 Invited
Open Channels in Scattering Media: See the Light Inside, Allard Mosk[1]; [1]*Debye Inst. for Nanomaterials Science, Universiteit Utrecht, Netherlands*. Open channels are remarkable solutions of the wave equationthat carry light through a thick scattering sample. We measure the energy density and frequency width of open channels and use them as a sensitive probe of the scattering strength.

12:00–13:00 Lunch Break *(on your own)*

12:00–13:00 Environmental Sensing Technical Group Special Talk, *Genesee Suite G, Radisson Hotel Rochester Riverside*

FW2E • Exotic States and Applications I—Continued

FW2E.4 • 11:30
Dark Matter Optics, Humberto Michinel[1], Angel Paredes[1]; [1]*Universidad de Vigo, Spain.* We explain galactic offsets in the Abell 3827 cluster by considering Dark Matter as a coherent condensate of ultra-light axions forming solitons, which display interference properties similar to those observed in nonlinear optics.

FW2E.5 • 11:45
Measuring Exotic Looped Trajectories of Light, Omar S. Magana Loaiza[1], Israel de Leon[3,2], Mohammad Mirhosseini[1], Brian McIntyre[1], Brandon Rodenburg[3], Robert W. Boyd[1,2];[1]*Univ. of Rochester, USA;* [2]*Department of Physics and Max Planck Centre for Extreme and Quantum Photonics, Univ. of Ottawa, Canada;* [3]*School of Physics and Astronomy, Rochester Inst. of Technology, USA.* The probability of a photon to follow looped trajectories in a three-slit interferometer is extremely small and difficult to measure. We unveil the underlying physics and implications behind these trajectories and present their first observation.

FW2F • Optical Fibers for Space Projects—Continued

FW2F.3 • 11:30 Invited
Miniaturized Interferometric Fiber Optical Gyroscopes for Space Application, Jing Jin[1], Cai Wei[1], Song Jingming[1], Xiaobin Xu[1], Ningfang Song[1], Chunxi Zhang[1]; [1]*Beihang Univ., China.* The configurations of miniaturized interferometric fiber optical gyroscopes (IFOG), miniaturized components, high reliability techniques and performance test results of typical IFOG products are introduced in this paper.

FW2G • A Tribute to Steve Jacobs I—Continued

FW2G.3 • 11:30 Invited
Steve Jacobs: The Optics Outreach Innovator, Tanya Z. Kosc[2,1]; [1]*Univ. of Rochester, USA;* [2]*Laboratory for Laser Energetics, USA.* Steve Jacobs' achievements extended to the often overlooked realm of education and outreach when he developed the innovative, interactive Optics Suitcase. Initially conceived for local middle schoolers, the Optics Suitcase has expanded worldwide.

FW2H • Adaptive Optics and Interferometry—Continued

FW2H.5 • 11:45
Cost-Effective Adaptive Optics with the Digital Light Ophthalmoscope, Matthew S. Muller[1], Ann E. Elsner[2,1]; [1]*Aeon Imaging, LLC, USA;* [2]*School of Optometry, Indiana Univ., USA.* A novel adaptive optics system for imaging the retina is presented. The system uses a digital light projector and rolling shutter detector, permitting real-time adjustments to the confocal aperture and a compact and cost-effective layout.

LW2I • Integrated Quantum Photonics I—Continued

LW2I.3 • 11:30 Invited
Experimental Photonic Quantum State Transfer and Self-guided Tomography, Alberto Peruzzo[1], Andreas Boes[1], Robert Chapman[1], Zixin Huang[1], Akib Karim[1], Inna Krasnokutska[1], Jean-Luc Tambasco[1]; [1]*Quantum Photonics Laboratory, Royal Melbourne Inst. of Technology, Australia.* Integrated optics offers an attractive platform for generating, manipulating and detecting quantum states of light. We report on the experimental realization of the perfect state transfer protocol and the self-guided quantum tomography.

LW2I.4 • 12:00 Invited
High Performances Integrated Single Photon Sources, Pascale Senellart[1]; [1]*CNRS, Centre for Nanoscience and Nanotechnology – C2N – CNRS UMR9001, Site de Marcoussis, Route de Nozay, France.* Resonantly-excited quantum dots inserted in an electrically controlled pillar cavity are shown to produce single photons with a purity and indistinguishability exceeding 99% and a brightness 20 times higher than SPDC based single-photon sources.

12:00–13:00 Lunch Break *(on your own)*

12:00–13:00 Environmental Sensing Technical Group Special Talk, *Genesee Suite G, Radisson Hotel Rochester Riverside*

13:00–14:15
FW3A • Novel Design Concepts for Eye Correction and Vision Simulators II

Presider: Filipp Ignatovich, Lumetrics Inc., USA and Vyas Akondi, Consejo Sup Investigaviones Cientificas, Spain

FW3A.1 • 13:00 Invited

SimVis: See-through Simulation of Presbyopic Corrections, Carlos Dorronsoro[1], Aiswaryah Radhakrishnan[1], Jose Ramon Alonso-Sanz[1], Daniel Pascual[1], Enrique Gambra[1], Vyas Akondi[1], Susana Marcos[1]; [1]*INSTITUTO DE OPTICA - CSIC, Spain*. We developed a see-through portable binocular visual simulator capable of simulating presbyopic corrections. Subjects performed visual tests with 17 corrections (bifocal, trifocal, monovision). Perceived quality differed across patients/corrections.

13:00–14:30
FW3B • Quantum Communications II

Presider: To be Announced

FW3B.1 • 13:00 Tutorial

Quantum-crypto Systems in the Commercial Service Network, Jeong-sik Cho[2], Sean Kwak[1]; [1]*Univ. of Southampton, UK;* [2]*Quantum Tech Lab, SK Telecom, Korea*. Quantum-crypto system has to evolve to provide customers with substantial benefits such as low-cost, compactness and scalability as well as robustness, high service availability.

Biography: Jeong-sik Cho is an engineer and a manger in SK telecom. He has developed the optics part of the quantum key distribution system. Before he joined SK telecom, He worked in the optical fiber division of Samsung Electronics and in the optical communications lab of the Electronics and Telecommunications Research Institute. He received a Ph.D from the Korea Advanced Institute of Science and Technology, South Korea in 2008.

13:00–14:30
FW3C • Diffuse Imaging and Optical Properties

Presider: Christine Hendon, Columbia Univ., USA

FW3C.1 • 13:00 Invited

Bedside Mapping of Human Brain Function with High Density Diffuse Optical Tomography, Adam T. Eggebrecht[1]; [1]*Washington Univ. in St Louis, USA*. I will present our custom high density optical imaging system and analytical pipelines that enable optical mapping of human brain function in the intensive care unit, the operating room, and in sensitive populations including chidren with autism.

13:00–14:00
FW3D • Symposium on Mesoscopic Optics of Disordered Media II

Presider: Aristide Dogariu, CREOL, Univ. of Florida, USA

FW3D.1 • 13:00 Invited

Long Range Light Matter Interactions at Hyperbolic Meta Surface, Girish Agarwal[1]; [1]*Oklahoma State Univ., USA*. We show how long range light matter interactions can be realized at hyperbolic metasurfaces. We concentrate on the dipole-dipole interactions which are important for energy transfer studies and in quantum entanglement between qubits at metasurfaces.

Join the conversation.
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and #OSA100

13:00–14:30
FW3E • Plasmonics
Presider: Volker Sorger; George Washington Univ., USA

FW3E.1 • 13:00 Invited

Plasmonics - Ultra-Fast Communications at the Microscale, Juerg Leuthold[1]; [1]*ETH Zurich, Switzerland.* Plasmonics has emerged as a solution for monolithic integration of THz bandwidth photonic components at the microscale. In this talk we review recent advances in the field of optical communications and the microwave photonics enabled by plasmonics.

13:00–14:30
FW3F • Quantum Entanglement
Presider: Fabio Sciarrino; Univ degli Studi di Roma La Sapienza, Italy

FW3F.1 • 13:00

Multi-Photon Entanglement in High Dimensions, Mehul Malik[1,2], Manuel Erhard[1,2], Marcus Huber[3,4], Mario Krenn[1,2], Robert Fickler[1,2], Anton Zeilinger[1,2]; [1]*Inst. for Quantum Optics and Quantum Information, Austrian Academy of Sciences, Austria;* [2]*Faculty of Physics, Univ. of Vienna, Austria;* [3]*Universitat Autonoma de Barcelona, Spain;* [4]*ICFO-Institut de Ciencies Fotoniques, Spain.* We create the first entangled state of more than two particles entangled in greater than two dimensions. Our state consists of three photons entangled in 3 × 3 × 2 dimensions of their orbital angular momentum.

FW3F.2 • 13:15

Generation of multi-photon entangled states with integrated optical frequency comb sources, Christian Reimer[1], Michael Kues[1], Piotr Roztocki[1], Lucia Caspani[1,2], Yaron Bromberg[3], Benjamin Wetzel[1,7], Brent Little[4], Sai T. Chu[5], David J. Moss[6], Roberto Morandotti[1]; [1]*INRS-EMT, Canada;* [2]*Heriot-Watt Univ., UK;* [3]*Yale Univ., USA;*[4]*Xi'an Inst. of Optics and Precision Mechanics of CAS, China;* [5]*City Univ. Hong Kong, China;* [6]*Swinburne Univ. of Technology, Australia;* [7]*Univ. of Sussex, UK.* We demonstrate that four-photon entangled qubit states can be generated from an optical frequency combs source. This state generation is evidenced by four-photon quantum interference, and quantum state tomography reveals a fidelity above 64%.

13:00–14:00
FW3G • A Tribute to Steve Jacob II
Presider: Jonathan Zuegel, Univ. of Rochester, USA

FW3G.1 • 13:00 Invited

Nanomechanics in Optical Manufacturing, John C. Lambropoulos[1]; [1]*Univ. of Rochester, USA.* Nanomechanics addresses nm-level material properties, including fracture, mechanical-chemical interactions, and deformation. Nanomechanics applies to optical manufacturing from grinding, to finishing, to polishing, including magnetorheological finishing (MRF), as all these material removal mechanisms essentially break atomic bonds.

13:00–14:30
FW3H • Optical Design and GRIN Materials
Presider: Blair Unger, Rochester Precision Optics, USA

FW3H.1 • 13:00 Invited

Tolerance Eigenmode Analysis of Optical Systems, John R. Rogers[1]; [1]*Synopsys, Inc, USA.* We describe a tolerance eigenmode analysis for optical systems. This analysis indicates, in order of importance, the combinations of aberrations that will be induced by tolerances, thus allowing better tolerance assignment and compensator selection.

13:00–14:30
LW3I • Multiphoton Effects II
Presider: Lingyan Shi; CUNY City College, USA

LW3I.1 • 13:00 Invited

Non-linear wavelength extension of Fibre Laser Systems, J. R. Taylor[1]; [1]*Imperial College London, UK.* Spectral and temporal versatility is achieved using compact master oscillator power fibre amplifier schemes to drive nonlinear processes both fibre integrated and in bulk allowing power scaled operation throughout the visible and mid infra-red.

FW3A • Novel Design Concepts for Eye Correction and Vision Simulators II—Continued

FW3A.2 • 13:30
Surface-changing Accommodating Intraocular Lens for Presbyopia Correction, Andres De La Hoz[1], Eduardo Martinez-Enriquez[1], Carlos Dorronsoro[1], Nandor Bekesi[1], Nicolas Alejandre[1], Hrebesh Subhash [1], Daniel Pascual[1], Susana Marcos[1]; [1]*CSIC - Inst. of Optics, Spain*. An AIOL design that changes the shape of its surfaces thru application of equatorial forces is proposed. Its viability is evaluated using mechanical and optical simulations, and experimental measurements of focal length and surface shape change.

FW3A.3 • 13:45
Retina-simulating phantom produced by chemically amplified photolithography, Denise V. dos Santos[1], Brian Vohnsen[1]; [1]*Univ. College Dublin, Ireland*. To emulate photoreceptors for an eye model, an array of dielectric cylinders in a uniform matrix has been developed by photolithography. Preparation details and sample analysis are discussed in this work.

FW3A.4 • 14:00
Measuring Temporal Integration in Human Vision with Single Photons, Michelle M. Victora[1], Rebecca M. Holmes[1], Ranxio Frances Wang[1], Paul Kwiat[1]; [1]*Univ. of Illinois at Urbana-Champai, USA*. We discuss techniques using a heralded single-photon source to study the lower limit of human vision, specifically measuring temporal integration using multi-photon trials, and report preliminary results at the few-photon level.

FW3B • Quantum Communications II—Continued

FW3B.2 • 13:45
Generation and Reconstruction of Time-Bin Entangled Ququarts, Samantha Nowierski[1], Neal N. Oza[1], Prem Kumar[1], Gregory S. Kanter[1]; [1]*Northwestern Univ., USA*. We generate and reconstruct a maximally-entangled time-bin ququart using quantum state tomography and polarization-projective measurements. We measure a fidelity of 93.7 ± 0.4% to a maximally-entangled ququart with accidental coincidences subtracted.

FW3B.3 • 14:00
All-optical synchronization for quantum networks, Bruno Fedrici[1], Lutfi A. Ngah[1], Florian Kaiser[1], Olivier Alibart[1], Laurent Labonté[1], Virginia D'Auria[1], Sébastien Tanzilli[1]; [1]*Lab. de Physique de la Matière Condensée, France*. We report an all-optical realization of a quantum relay experiment at a telecom wavelength. Our synchronization scheme is validated by a two-photon interference visibility greater than 99% at the relay station.

FW3C • Diffuse Imaging and Optical Properties—Continued

FW3C.2 • 13:30 Invited
Diffuse Optics for Monitoring Bone Healing and Cancer Treatments, Regine Choe[1]; [1]*Univ. of Rochester, USA*. Diffuse optical and correlation tomography have a great potential to monitor and predict treatment efficacy. We demonstrate feasibility for chemotherapy on breast cancer and tissue engineering based treatments for bone healing using murine models.

FW3C.3 • 14:00
Precisely Discerning the Bilirubin Concentration of Turbid Samples Using Diffuse Reflectance Spectroscopy, Ying Y. Chen[1], Shih-Yu Tzeng[1], Kang-Yu Chu[1], Yi-Ling Lin[1], Sheng-Hao Tseng[1,2]; [1]*Biophotonics Lab, Department of Photonic, Taiwan;* [2]*Advanced Optoelectronic Technology Center, National Cheng-Kung Univ., Tainan, Taiwan 701, R.O.C., Taiwan*.We demonstrated the use of our diffuse reflectance spectroscopy system to determine the absorption spectra of turbid samples containing bilirubin. The absorption spectra at 500nm were found to be highly correlated with the bilirubin concentration.

FW3D • Symposium on Mesoscopic Optics of Disordered Media II—Continued

FW3D.2 • 13:30 Invited
Cellulose Bio-inspired Hierarchical Structures, Silvia Vignolini[1]; [1]*Cambridge Univ., UK*. In this talk the route for the fabrication of complex bio-mimetic cellulose-based photonic structures will be presented and the optical properties of artificial structures will be analysed and compared with the natural ones.

FW3E • Plasmonics—Continued

FW3E.2 • 13:30 Invited

Novel Applications of Plasmonic Bowtie Nanoantennas in the Presence of Enhanced Local Heating, Kimani C. Toussaint[1]; [1]*Univ of Illinois at Urbana-Champaign, USA.* Increased interests in optical nanoantennas have led to recent novel applications that exploit the enhanced local heating. We highlight select applications from low-input optical power density tweezing to fabrication of planar optical components.

FW3E.3 • 14:00

Real-space mapping of chiral antennas and metasurfaces, Martin Schnell[1,2], Paulo Sarriugarte[1], Tomas Neuman[3], Alexander B. Khanikaev[4], Gennady Shvets[5], Javier Aizpurua[3], Rainer Hillenbrand[6,7]; [1]*CIC nanoGUNE Consolider, Spain;* [2]*Beckman Inst. for Advanced Science and Technology, Univ. of Illinois Urbana-Champaign, USA;* [3]*Materials Physics Center CSIC-UPV/EHU and DIPC, Spain;* [4]*Department of Physics, Queens College of the City Univ. of New York, USA;* [5]*Department of Physics, The Univ. of Texas at Austin, USA;* [6]*CIC nanoGUNE Consolider and EHU/UPV, Spain;* [7]*IKERBASQUE, Basque Foundation for Science, Spain.* We apply near-field microscopy (s-SNOM) to infrared Archimedean spiral antennas and resolve circular polarization resolved nanofocusing. We near-field image chiral metasurfaces and connect the observed near-field response with circular dichroism.

FW3F • Quantum Entanglement—Continued

FW3F.3 • 13:30

Einstein-Podolsky-Rosen Position-Momentum Entanglement in a Quantum Memory Setup, Michal Dabrowski[1], Michal Parniak[1], Radoslaw Chrapkiewicz[1], Wojciech Wasilewski[1]; [1]*Faculty of Physics, Univ. of Warsaw, Poland.* Raman scattering emissive multimode quantum memory setup is presented. The memory enables storage of photonic position-momentum entanglement, demonstrating a time-delayed Einstein-Podolsky-Rosen paradox.

FW3F.4 • 13:45

Measuring Non-Commuting Observables of a Single Photon via Sequential Weak Values Evaluation, Marco Gramegna[1]; [1]*Physical Metrology, INRiM, Italy.* First experimental realization of a sequential weak value evaluation of two incompatible observable of a single photon.

FW3F.5 • 14:00

Few-photon induced transient entanglement in multi-qubit bi-directional chiral waveguide QED, Imran M. Mirza[1], John C. Schotland[1]; [1]*Univ. of Michigan, USA.* We study transient entanglement generation and control in multiple-qubit bi-directional waveguide QED utilizing single or two-photon Gaussian wavepackets. Particularly, we show how chirality can enhance the maximum generated multi-qubit entanglement.

FW3G • A Tribute to Steve Jacob II—Continued

FW3G.2 • 13:30 Invited

Materials Development in Magnetorheological Finishing: The work of Dr. Stephen Jacobs, Aric B. Shorey[1]; [1]*Corning Incorporated, USA.* The materials development in Magnetorheological Finishing (MRF) has been substantial over the past few decades. In this presentation, we will review the considerable contributions from Dr. Stephen Jacobs.

FW3H • Optical Design and GRIN Materials—Continued

FW3H.2 • 13:30

Implementation of a Scattering Method for Rough Surfaces in a Raytracing Software linked with a CAD (Computer-Aided Design) Toolbox, Florian Loosen[1], Carsten Backhaus[1], Norbert Lindlein[1], Jochen Zeitler[2], Jörg Franke[2]; [1]*Inst. of Optics, Information and Photonics (IOIP), Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany;* [2]*Inst. for Factory Automation and Production Systems (FAPS), Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany.* The design and simulation of printed polymer optical waveguides is a new approach in the field of raytracing techniques, to link the CAD routines with the simulation process of the waveguides via raytracing methods.

FW3H.3 • 13:45

Is the Maxwell-Shafer fish eye lens able to form super-resolved images?, Miguel A. Alonso[1]; [1]*Univ. of Rochester, USA.* The Maxwell-Shafer fish eye lens (a so-called absolute system) are studied theoretically to determine if it can form super-resolved images or obeys the diffraction limit. A modal analysis shows that the latter is true.

FW3H.4 • 14:00

Achromatic Design of Gradient Index Lenses using Ternary Blends, Guy Beadie[1], Joseph N. Mait[2], Richard A. Flynn[1], Predrag Milojkovic[2]; [1]*US Naval Research Laboratory, USA;* [2]*US Army Research Laboratory, USA.* The addition of a third material to a binary blend allows designers to specify refractive index and dispersion independently in gradient index optics. The effectiveness is demonstrated via a diffraction-limited, f/1 achromatic singlet design.

LW3I • Multiphoton Effects II—Continued

LW3I.2 • 13:30 Invited

Medical Applications of Mid-IR Fibre Laser Technologies, Giovanni Milione[1]; [1]*NEC Laboratories America Inc, USA.*

LW3I.3 • 14:00 Invited

Method for Transient Modulation of Refractive Index under Exposure to High-Power Laser Pulses, Stavros G. Demos[1]; [1]*Laboratory for Laser Energetics, Univ. of Rochester, USA.* Optical elements that enable tailored modification of their refractive index during exposure to laser pulses can help better control beam characteristics. Our approach is based on activation of defect centers in large-bandgap materials.

Grand Ballroom A (Radisson)	Grand Ballroom B (Radisson)	Grand Ballroom C (Radisson)	Grand Ballroom D (Radisson)
FiO			
FW3A • Novel Design Concepts for Eye Correction and Vision Simulators II—Continued	**FW3B • Quantum Communications II—Continued**	**FW3C • Diffuse Imaging and Optical Properties—Continued**	**FW3D • Symposium on Mesoscopic Optics of Disordered Media II—Continued**
	FW3B.4 • 14:15 **Withdrawn.**	**FW3C.4 • 14:15** **Development of an advanced model for determining the optical properties below and beyond 600 to 1000 nm wavelength range from frequency domain diffuse reflectance,** Yu-Wen Chen[1], Chien-Chih Chen[1], Po-Jung Huang[1], Sheng-Hao Tseng[1,2]; *[1]Department of Photonics, National Cheng-Kung Univ., Taiwan; [2]Advanced Optoelectronic Technology Center, National Cheng-Kung Univ., Taiwan.* We developed an artificial neural networks trained by frequency domain-based Monte Carlo simulation, which could work with a least-square optimized algorithm to recover an extensive range (below and beyond 600-1000nm) of sample's optical properties.	

14:00–16:00 Student Chaper Competition, *Empire Hall*

14:30–15:00 Coffee Break, *Empire Hall*

14:30–16:00 JW4A • Joint Poster Session I and Unopposed Exhibit Time, *Empire Hall (see page 23 for specific e-poster viewing times)*

15:30–17:00 Meet the Editors of the APS Journals Reception, *Riverside Court*

16:00–17:00 OIDA Members and Exhibitor Appreciation Reception *(OiDA members and exhibitors only), Empire Hall*

FW3E • Plasmonics—Continued

FW3E.4 • 14:15
Deep Subwavelength and Broadband Light Delivery using an All-Fiber Plasmonic Nanotip-Enhanced Near-Field Probe, Alessandro Tuniz[1], Mario Chemnitz[1,3], Jan Dellith[1], Stefan Weidlich[2], Markus Schmidt[1,3]; *[1]Inst. of Photonic Technology, Germany; [2]Heraeus Quarzglas GmbH & Co. KG, Quarzstr. 8, Germany; [3]Abbe School of Photonics and Faculty of Physics, Germany.* We experimentally demonstrate a monolithic nanowire-enhanced fiber-based plasmonic nanoprobe for broadband excitation (550-730 nm) of short range surface plasmons and delivery of subwavelength radiation to a gold nanotip with sub-100 nm apex radius.

FW3F • Quantum Entanglement—Continued

FW3F.6 • 14:15
Generation of Path-Entangled Photons Using an Arrayed Waveguide Grating, Nobuyuki Matsuda[1,2], Hidetaka Nishi[1,3], Peter Karkus[2], Tai Tsuchizawa[1,3], Koji Yamada[1,3], William J. Munro[2], Kaoru Shimizu[2], Hiroki Takesue[2]; *[1] NTT Nanophotonics Center, Japan; [2]NTT Basic Research Laboratories, Japan; [3]NTT Device Technology Laboratories, Japan.* We demonstrate the on-chip generation of path-entangled photon pairs using an arrayed-waveguide grating with nonlinear input waveguides. The scheme can be extended to the generation of high-dimensional entanglement.

FW3G • A Tribute to Steve Jacob II—Continued

FW3H • Optical Design and GRIN Materials—Continued

FW3H.5 • 14:15
Design and Fabrication of Gradient-Index Optical Elements for Beam Shaping, James R. Leger[1], Mint Kunkel[1], Glen Douglass[2], Simon Gross[2], Michael Withford[2]; *[1]Univ. of Minnesota Twin Cities, USA; [2]Physics and Astronomy, Macquarie Univ., Australia.* We describe a new method of generalized beam shaping based on gradient index optics in waveguides. Phase retrieval is used in the design and femtosecond laser writing is used in the fabrication of the waveguides.

LW3I • Multiphoton Effects II—Continued

14:00–16:00 Student Chaper Competition, *Empire Hall*

14:30–15:00 Coffee Break, *Empire Hall*

14:30–16:00 JW4A • Joint Poster Session I and Unopposed Exhibit Time, *Empire Hall (see page 23 for specific e-poster viewing times)*

15:30–17:00 Meet the Editors of the APS Journals Reception, *Riverside Court*

16:00–17:00 OIDA Members and Exhibitor Appreciation Reception *(OiDA members and exhibitors only), Empire Hall*

14:30–16:00
JW4A • Joint Poster Session I

JW4A.1
Simulating Phase-Only Pupil Plane Masks for Laser Suppression, Jacob H. Wirth[1], Abbie Watnik[2], Garreth Ruane[1], Grover A. Swartzlander[1]; [1]*Rochester Inst. of Technology, USA;* [2]*U.S. Naval Research Laboratory, USA.* A phase-only pupil plane mask is tested to protect sensors from powerful coherent radiation. Masks are simulated to reduce the peak irradiance of the point spread function while images are reconstructed in post processing.

JW4A.2
Scalable and Gray-Coded Optical M-ary QAM Using QPSK Modulators with Binary Electronic Driving Signals, Naji A. Albakay[1], Lim Nguyen[1]; [1]*Electrical and Computer Engineering, Univ. of Nebraska Lincoln, USA.* We present a novel square M-ary QAM transmitter using QPSK modulators driven by binary electronic signals. The proposed configuration generates Gray-coded symbol constellations and is scalable for high order optical M-ary QAM.

JW4A.3
Proposal for Generation of Hybrid Entangled States in Waveguide Using Polarization Convertor, Divya Bharadwaj[1], Krishna Thyagarajan[1]; [1]*Indian Inst. of Technology, Delhi, India.* In this paper we describe a scheme for generation of hybrid spatial modal– polarization entangled photon pairs using type-II spontaneous parametric down conversion process and the electro optic effect in a domain engineered KTP channel waveguide.

JW4A.4
Effect of Nonlinearity on the Formation of Spatial Optical Rogue Waves, Akbar Safari[1], Robert Fickler[1], Miles J. Padgett[2], Robert W. Boyd[1,3]; [1]*Univ. of Ottawa, Canada;*[2]*Univ. of Glasgow, UK;* [3]*The Inst. of Optics, Univ. of Rochester, USA.* Randomness plays a crucial role in the formation of optical seas. We observe that when the random phase shift is not strong enough, nonlinear propagation has a significant effect on the formation of rogue waves.

JW4A.5
On the Microscopic Origins of Optical Magnetism - Insight from Mie Theory, Mengren Man[1], Kevin J. Webb[1]; [1]*Purdue Univ., USA.* We identify the microscopic origins for optical magnetism in dielectric metamaterials. Features in the homogenized permeability are found to correspond to the magnetic dipole resonance of individual particles, which will have far-reaching impacts.

JW4A.6
Asymmetric Transport of Light through All-dielectric Structured Media, Roxana Rezvani Naraghi[1,2], Sergey Sukhov[1], Aristide Dogariu[1]; [1]*Univ. of Central Florida, CREOL, USA;* [2]*Department of Physics,, Univ. of Central Florida, USA.* Asymmetric transmission of light usually requires chiral materials or grating-like structures that make them sensitive to all parameters of incident light. Here we show asymmetric transport of light that is broadband and polarization-insensitive.

JW4A.7
Estimation of atom loading efficiency into a hollow core fiber, Taehyun Yoon[1,2], Michal Bajcsy[1,2]; [1]*Inst. for Quantum Computing, Univ. of Waterloo, Canada;* [2]*Department of Electrical and Computer Engineering, Univ. of Waterloo, Canada.* We simulate the motion of Cs atoms in a dipole potential created by a red detuned laser diverging from a hollow core photonic crystal fiber (HCPCF) and estimate the loading efficiency into the fiber.

JW4A.8
Generation of variable sized "perfect" vortex and its effect in parametric down conversion process, Jabir M. V.[1], Apurv Chaitanya Nellikka[1], A. Aadhi[1], Goutam K. Samanta[1];[1]*Physical Research Laboratory, India.* We report a novel scheme to generate variable sized "perfect" vortices, having radius and order as mutually independent parameters, and prove that angular-spectrum of down-converted-photons does not depend on OAM of pump vortices.

JW4A.9 ***E-Poster***
Experimental Observation of Second Harmonic Generation in polymeric Carbon Dioxide, Amartya Sengupta[1], Choong-Shik Yoo[2]; [1]*Indian Inst. of Technology Delhi, India;*[2]*Washington State Univ., USA.* Close to 20% efficiency of second harmonic generation is observed in polymeric CO_2 synthesized under novel conditions. This polymeric phase of CO_2 retains its non-linear optical properties over a broad range of pressures and temperatures.
This presentation will be presented as an E-Poster on Screen 2 from 15:15–16:00

JW4A.10
Diffraction Compensation of Finite Beams in Hyperbolic Metamaterials, Jisha C. Pannian[1], Alessandro Alberucci[2], Allan Boardman[3], Gaetano Assanto[2]; [1]*Univ. of Porto, Portugal;* [2]*Tampere Univ. of Technology, Finland;* [3]*Univ. of Salford, UK.* The propagation of finite size beams in a hyperbolic metamaterial is modeled as a moving particle of negative mass. We show the occurrence of anomalous diffraction, diffraction compensation and profile recovery for any input excitation.

JW4A.11
Modeling the Evolution of Spatial Entanglement with non-Gaussian Beams, Matthew Reichert[1], Xiaohang Sun[1], Jason W. Fleischer[1]; [1]*Princeton Univ., USA.* We study the dynamics of spatial entanglement during propagation and experimentally observe its migration between amplitude and phase. To accommodate non-Gaussian biphotons, we generalize the "beam quality factor" M^2 from classical laser theory.

JW4A.12
Nonperturbative Nonlinear Optics in Liquid Crystals, Alessandro Alberucci[2], Armando Piccardi[4], Nina Kravets[4], Oleksandr Buchnev[3], Jisha C. Pannian[1], Gaetano Assanto[2];[1]*Univ. of Porto, Portugal;* [2]*Tampere Univ. of Technology, Finland;* [3]*Univ. of Southampton, UK;* [4]*Univ. of Rome (RomaTre), Italy.* We show that reorientational nematic liquid crystals are an ideal workbench for the investigation of non-perturbative nonlinear optical effects and report light self-steering, power-controlled negative refraction and spontaneous symmetry breaking.

JW4A.13
Imaging Moving Objects Hidden in Arbitrarily Heavily ScatteringMedia, Qiaoen Luo[1], Jason A. Newman[1], Kevin J. Webb[1]; [1]*Purdue Univ., USA.* We show an image of a moving object (pi-shaped mask) embedded in heavily scattering media using a coherent imaging approach. Spatial speckle intensity correlation measurements in relation to object position are used to reconstruct the pi-shaped mask.

JW4A.14
Towards the generation of entangled photon pairs using a tapered fiber coupler, Lambert Giner[1,2], Xinru Cheng[1,2], Chams Baker[1], Jefferson Flórez[1,2], Duncan G. England[3], Philip J. Bustard[3], Benjamin J. Sussman[3], Xiaoyi Bao[1], Jeff Lundeen[1,2]; [1]*Department of Physics, Univ. of Ottawa, Canada;* [2]*Max Planck-uOttawa Center for Extreme and Quantum Photonics, Canada;* [3]*National Research Council of Canada, Canada.* We present the first steps towards the generation of entanglement photon pairs by spontaneous four wave mixing inside a microcoupler device made by tapering two touching silica fibers until their core diameter reaches a few micrometers.

JW4A.15
A Statistical Analysis of Spatial and Spectral Control with Binary Irregular Nanostructures, Yu-Chun Hsueh[1], Kevin J. Webb[1]; [1]*Purdue Univ., USA.* We study the degrees of freedom from a 2-D binary nanostructured material, as they impact the achievable spectral and spatial control. This statistical analysis provides design strategies for applications.

JW4A.16
Phase Sensitive Amplification in Metastable Helium at Room Temperature, Jasleen Lugani[1], Chitram Banerjee[1], Marie-Aude Maynard[1], Pascal Neveu[1], Ram Soorat[2], Rupamanjari Ghosh[2], Fabien Bretenaker[1], Fabienne Goldfarb[1]; [1]*Laboratoire Aime Cotton, France;* [2]*Shiv Nadar Univ., India.* We have performed phase sensitive amplification (PSA) in metastable helium. The maximum and minimum gain behaviors and their values compared to the gain for the Phase Insensitive Amplification (PIA), correspond to a very pure PSA.

JW4A.17
Mode Amplification and Nonlinear Mode Conversion in Few Mode Fibers, Abderrahmen Trichili[1], Mourad Zghal[1], Luca Palmieri[2], Marco Santagiustina[2]; [1]*Engineering School of Comm of Tunis, Tunisia;* [2]*Dipartimento di Ingegneria dell'Informazione, Università di Padova, Italy.* We demonstrate phase sensitive and insensitive amplification and nonlinear mode conversion in few mode fibers by studying the four wave mixing effect.

JW4A.18
Spectral narrowing in the propagation of unchirped pulses in two-core fibers, Nestor Lozano-Crisostomo[1,2], Julio Cesar Garcia Melgarejo[1,2], Miguel Torres Cisneros[4], Daniel Alberto May Arrioja[3], Javier Sanchez Mondragon[1]; [1]*Departamento de Óptica, Instituto Nacional de Astrofisica, Óptica y Electrónica, Mexico;* [2]*Universidad Autónoma de Coahuila, Mexico;*[3]*Centro de Investigaciones en Óptica, Mexico;* [4]*Departamento de Electrónica, Universidad de Guanajuato, Mexico.* We demonstrate spectral narrowing in the propagation of an initial unchirped optical pulse through a two-core fiber (TCF). Our results show that the linear coupling between both TCF cores induces that spectral narrowing.

JW4A.19
Characterizing a 10×10 OAM propagation matrix of few-mode fiber by a dual-interference pattern metho, Guoxuan Zhu[1], Yuehan Liu[1], Yujie Chen[1], Yuanhui Wen[1], Yanfeng Zhang[1], Hui Chen[1], Siyuan Yu[1]; [1]*Sun Yat-sen Univ., China.* A dual-interference pattern method is proposed for measuring OAM spiral spectrum, including amplitude and phase information. With this method, we characterize the output field of a few-mode fiber and obtain its 10×10 OAM propagation matrix.

JW4A.20
Portable Multiplexer Supporting Three Spatially Multiplexed Optical Channels , Syed H. Murshid[1], Saud Alanzi[1], Guilherme Cavalcante[1], Bilas Chowdhury[1], Rayan Enaya[1];[1]*Florida Inst. of Technology, USA.* Design of the input end of a portable spatial multiplexer supporting three spatially multiplexed optical channels over a multimode fiber is presented. Screen projection of the output beam and its intensity profile is also reported.

JW4A • Joint Poster Session I—Continued

JW4A.21
Demonstration of Optical Sensing with LPGs Inscribed on Polymer Functionalized Optical Microfibers, Yuhang Li[1], Zhongyang Xu[2], Lijun Wang[1]; [1]*Department of Precision Instrument, Tsinghua Univ., China;* [2]*3Shanghai Inst. of Laser Plasma, China.* We demonstrated LPG inscription on polymer functionalized optical microfibers via point-by-point ultraviolet laser exposure. Also presented are its potential applications in optical sensing of strain, axial force and temperature.

JW4A.22
Intensity Distribution of Spatially Multiplexed Architectures Supplementing Wavelength Division Multiplexing, Syed H. Murshid[1], Saud Alanzi[1], Bilas Chowdhury[1]; [1]*Florida Inst. of Technology, USA.* Intensity distribution of spatially multiplexed system complementing WDM channels is presented. Results show that energy distribution of SDM is independent of wavelength. They supplement each other and have potential to increase fiber data capacity.

JW4A.23
Mathematical Representation of Spatially Multiplexed Channels Using Azimuthal Index and Modified Laguerre Gaussian Beams, Syed H. Murshid[1], Ahmed Kadhim[1], Bilas Chowdhury[1], Gregory L. Lovell[1], Saud Alanzi[1]; [1]*Florida Inst. of Technology, USA.* This presents a mathematical model relating incident angle of a spatially multiplexed system to the azimuthal index of a modified Laguerre-Gaussian beam equation. Preliminary data shows good correlation between experimental results and the model.

JW4A.24
Modal Dispersion of Helically Propagating Spatially Multiplexed Optical Channels Operating at 1550nm, Syed H. Murshid[1], Gregory L. Lovell[1], Saud Alanzi[1], Bilas Chowdhury[1]; [1]*Florida Inst. of Technology, USA.* Modal dispersion for a two channel spatially multiplexed system is calculated using effective area based normalized frequency parameter (V_{eff}), which shows that such systems can significantly reduce modal delay of multimode optical fiber channels.

JW4A.25
Influence of Two Weak Continuous Wave Triggers on Picosecond Supercontinuum Generation, Ji Zhu[1], Cai Wen[1], Qian Li[1]; [1]*School of Electronic and Computer Engineering, Peking Univ., China.* We numerically demonstrate the improvement in the pulse-to-pulse stability in the picosecond supercontinuum generation by using two weak continuous wave triggers.

JW4A.26
Combination and compression of eight pulses in nonlinear fibers with exponentially decreasing dispersion, Ziyun Jian[1], Wei Lu[1], Qian Li[1]; [1]*School of Electronic and Computer Engineering, Peking Univ., China.* We demonstrate combination and compression of eight chirped raised cosine pulses. The initial 1 ps pulse can be compressed to 83 fs, and its peak power is nearly 51 times compared to the initial pulse.

JW4A.27
Measurement Dependence and Limited Detection Nonlocality, Djeylan Aktas[1], Gilles Pütz[2], Anthony Martin[2], Rob Thew[2], Bruno Fedrici[1], Nicolas Gisin[2], Sébastien Tanzilli[1]; [1]*LPMC, France;* [2]*GAP, Switzerland.* We investigate two approaches to attest quantum nonlocality. We assume, first, limited measurement dependence, and then introduce limited detection efficiency. In both cases, we show experimental violations of the corresponding Bell-type inequality.

JW4A.28
All Normal As_2S_5-Borosilicate Hybrid Photonic Crystal Fiber for Ultra Flat-Top Mid-Infrared Supercontinuum , Amine Ben Salem[1], Mbaye Diouf[2,1], Rim Cherif[1], Abderrahmen Trichili[1], Ahmadou Wague[2], Mourad Zghal[1]; [1]*Engineering School of Communication of Tunis (Sup'Com), Tunisia;* [2]*Univ. of Cheikh Anta Diop, Department of Physics, Laboratoire Atome-Laser, Dakar, Senegal, Senegal.* Ultra flat-top broadband supercontinuum spanning 1 to 5 μm with high spectral flatness of 8 dB is obtained in 4-mm-long all-normal-dispersion As_2S_5-Borosilicate hybrid photonic crystal fiber by injecting 50 fs-1.6 nJ pulses at 2.5 μm.

JW4A.29
D-Shaped Polarization Maintaining Fiber Sensor for Simultaneous Monitoring of Refractive Index and Temperature, Hummad Qazi[1], Abu B. Mohammad[1], Harith B. Ahmad[2], Mohd Z. Zulkifli[2]; [1]*Universiti Teknologi Malaysia, USA;* [2]*Univ. of Malaya, Malaysia.* A D-shaped PMF as fiber optic sensor is presented for simultaneous monitoring of RI and surrounding temperature. Experimental results show that proposed sensor has high sensitivity of 0.03nm/RIU and 0.13nm/°C for RI and temperature respectively.

JW4A.30
Dielectric-grating-coupled surface plasmon resonance for ultrasensitive sensing, Shaohua Pi[1,2], Xie Zeng[1], Nan Zhang[1], Dengxin Ji[1], Haomin Song[1], Suhua Jiang[2], Qiaoqiang Gan[1]; [1]*State Univ. of New York at Buffalo, USA;* [2]*Fudan Univ., China.* We proposed a dielectric grating that can launch surface plasmon resonance mode efficiently on the other side of flat metal films with normal incident light, which is suitable for the integration with optical fiber tips.

JW4A.31
Synchronous dual-wavelength pulse generation in an Er-doped fiber laser with near-zero dispersion, Guoqing Hu[1], Ruliu Wang[1], Yingling Pan[1], Xin Zhao[1], Meng Zhang[1], Zheng Zheng[1,2]; [1]*School of Electronic and Information Engineering, Beihang Univ., China;* [2]*Collaborative Innovation Center of Geospatial Technology, China.* We demonstrate synchronous dual-wavelength pulse generation in a CNT modelocked Er fiber laser with reduced dispersion based on polarization-dependent spectral filtering, and four-wave mixing between the synchronized pulses is observed.

JW4A.32
Factorable photon-pair generation in multimode optical fibers, Hamed Pourbeyram Kaleibar[1], Arash Mafi[1]; [1]*Univ. of New Mexico, USA.* We present a theoretical study of multiple factorable photon-pairs generation in SMF-28 optical fiber and show the capability of multimode optical fibers as sources for wavelength-tunable factorable photon pairs.

JW4A.33
Design of BCD to Excess 3 code converter using electro-optic effect of Mach-Zehnder Interferometers, Chanderkanta Chauhan[1], Santosh Kumar[1], Angela Amphawan[2,3]; [1]*DIT Univ., India, India;* [2]*School of Computing, Universiti Utara Malaysia, Malaysia;* [3]*Massachusetts Inst. of Technology, USA.* In this paper, a four bit BCD to Excess 3 code convertor using electro-optic effect of lithium niobate based Mach Zehnder interferometer (MZI) is proposed. The results are verified using beam propagation method and MATLAB simulation.

JW4A.34
Mode Conversion of Four-Mode Fiber with CO_2-Laser Written Long-Period Fiber Gratings, Yunhe Zhao[1], Yunqi Liu[1], Chenyi Zhang[1], Jianxiang Wen[1], Tingyun Wang[1]; [1]*Shanghai Univ., China.* We demonstrate the mode conversion between the fundamental core mode and different higher-order core modes of four-mode fiber with high efficiency of more than 98.5% by the CO_2-laser written long-period fiber gratings.

JW4A.35
Optimal Measure for the Polarization Estimation of Light with Arbitrary Photon Statistics, Lu Zhang[1], Kam Wai C. Chan[1], Pramode K. Verma[1]; [1]*Univ. of Oklahoma, USA.* We present an optimal measure for the estimation of the polarization of light with arbitrary photon statistics. The success probability and the mean fidelity are calculated, and comparisons against an adaptive measurement are made.

JW4A.36
Study on Toxic Chromium (VI) metal ion Sensing with Hydrogel Coated Fiber Bragg Grating, Pabbisetti Vayu Nandana Kishore[1], Madhuvarasu Sai Shankar[1], C Hari Krishna[1]; [1]*National Inst of Technology, Warangal, India.* The Paper discusses a chemo- mechanical- optical sensing approach for sensing harmful Chromium ions in environment. FBG is functionalized with a stimulus responsive hydrogel which swells or deswells depending on ambient chromium ion concentrations.

JW4A.37
An improved FRFT-based method for estimating physical parameters from Newton's rings, Jin-Min Wu[1,2], Ming-Feng Lu[1,2], Ran Tao[1,2], Feng Zhang[1,2]; [1]*Beijing Inst. of Technology, China;* [2]*Beijing Key Laboratory of Fractional Signals and Systems, China.* This paper proposes a novel method for estimating parameters from Newton fringe patterns often encountered in interferometry. The presented results demonstrate that the method is robust to noise and has applications in interferometric measurements.

JW4A.38
Polarization Independent Single-PD Coherent Receiver without Synchronous Processing for OOK System, Ke Wen[1], Junjie Tu[1], Yanli Zhao[1]; [1]*Wuhan Natianal Lab. for optoelectronics, China.* In this paper, we present a polarization-independent (PI) single-PD coherent receiver without synchronous processing. The proposed receiver can achieve PI in frequency domain and improve the performance without increasing system complexity.

JW4A.39
Analysis dynamics of optical speckles in the study pure liquids, Danylo Babich[1], Valentina Pobiedina[1], Artem Levchuk[1], Andrey Yakunov[1]; [1]*Taras Shevchenko National Univ., Ukraine.* Laser-speckle patterns dynamics caused by transmission irradiation through the liquid have been studied. Frame by frame analysis of speckle video has shown that the decaying of the amplitude of the correlation functions depends on liquids parameters.

JW4A.40
Numerical Modeling of a Mode Selective Photonic Lanterns using the Beam Propagation Method, Gisela Lopez-Galmiche[1], Jesús Escobedo-Alatorre[2], Miguel Basurto-Pensado[2], Javier Sanchez Mondragon[1]; [1]*Inst Nat Astrofisica Optica Electronica, Mexico;* [2]*Centro de Investigación en Ingeniería y Ciencias Aplicadas , Mexico.* A mode selective photonic lantern, which is able to generate the LP_{01}, LP_{11a} and LP_{11b} modes with a linear taper, is modeled using the beam propagation method. Modal analysis is also estimated.

JW4A • Joint Poster Session I—Continued

JW4A.41
Tailoring light by 3D direct laser-writing of micron-scale phase elements, Shlomi Lightman[1,2], Raz Gvishi[1], Ady Arie[2]; [1]*NRC, Israel;* [2]*Electrical Engineering, Tel-Aviv Univ., Israel.* We demonstrate experimentally phase modulation of light beams by fabricating arbitrary microstructures using a 3D-Direct Laser writing method. This approach produces complex structured light beams, in a compact, stable and cost effective manner.

JW4A.42
Square Holey Cladding Dielectric THz Waveguides for Chip-to-Chip Communication, Nafiseh Aflakian[1], Naixin Yang[2], Timothy LaFave[1], Rashaunda Henderson[2], Kenneth K. O[2], Duncan MacFarlane[1]; [1]*Electrical Engineering, Southern Methodist Univ., USA;* [2]*Electrical Engineering, Univ. of Texas at Dallas, USA.* The development of a square holey cladding dielectric waveguide for chip-to-chip THz communication is presented. Designed to operate in the range of 180-360GHz, measured and simulated mode profiles of fabricated waveguides are in good agreement.

JW4A.43 ***E-Poster***
Image Processing Applied to Photon Sparse Data, Lena Mertens[1], Matthias Sonnleitner[1], Jonathan Leach[2], Megan Agnew[2], Miles Padgett[1]; [1]*Univ. of Glasgow, UK;*[2]*Dept. of Physics, Heriot-Watt Univ. , UK.* We present an image reconstruction algorithm for producing grey-scale images derived from binary photon-sparse data. The algorithm is based upon a likelihood of Poissonian distribution combined with a measure of image smoothness.
This presentation will be presented as an E-Poster on Screen 4 from 14:30–15:15

JW4A.44
Solitonic Self-Spectral Compression of Noisy Supercontinuum Radiation, Hrach Toneyan[1,2], Minas Sukiasyan[1,2], Vardan Avetisyan[1], Aghavni Kutuzyan[1], Arsham Yeremyan[2], Levon Mouradian[1,2]; [1]*Yerevan State Univ., Armenia;* [2]*CANDLE Synchrotron Research Inst., Armenia.* We experimentally demonstrate solitonic self-spectral compression for noisy supercontinuum radiation in a single-mode fiber. The numerical modeling of the process shows the prospects of the noise nonlinear suppression for partially coherent pulses.

JW4A.45
Multiplexing three-dimensional optically encrypted data, Alejandro Velez[1], Roberto Torroba[1,3], John Fredy Barrera [2]; [1]*CIOp, Argentina;* [2]*Instituto de Física, Universidad de Antioquia, Colombia;* [3]*Facultad de Ingenieria, UNLP, Argentina.* We introduce a multiplexing method for three-dimensional data experimentally encrypted using a joint transform correlator. Encrypted data are individually filtered and added forming a multiplexed package. Each object is retrieved using a key object.

JW4A.46
Observation of two state behavior in the Supercontinuum Generation induced by insability in Saturable Nonlinear Media, Kanagaraj Nithyanandan[1], Porsezian Kuppusamy[1];[1]*Pondicherry Univ., India.* The supercontinuum generation is observed to behave in a unique in saturable nonlinearity, such that the broadband is observed at shortest distance for pumping at saturation power, in comparison to all other pump power configurations.

JW4A.47
Nonuniform Laguerre-Gaussian Correlated Partially Coherent Beam, Jiayi Yu[1]; [1]*Soochow Univ., China.* A new kind of partially coherent beam called a nonnuiform Laguerre-Gaussian correlated partially coherent beam have been introduced. It is found that the intensity distribution exhibits self-focusing, self-shifting and self-splitting effect.

JW4A.48
Scattered-Light Analysis of Birefringent Coatings for Distributed Polarization Rotators, Katelynn Sharma[1,2], Thomas Germer[3], Christopher Smith[2], Jonathan Zuegel[2], James Oliver[2], Thomas G. Brown[1]; [1]*Univ. of Rochester, USA;* [2]*Laboratory for Laser Energetics, Univ. of Rochester, USA;* [3]*Sensor Science Division, National Inst. of Standards and Technology, USA.* Novel, birefringent thin-film coatings have been developed for improved irradiation uniformity by polarization smoothing in direct-drive fusion. Forward scatter distribution of 351 nm radiation is characterized and its operational impact analyzed.

JW4A.49 ***E-Poster***
Lensless Measurements of Optical Field Correlations, Katelynn Sharma[1], Thomas G. Brown[1], Miguel Alonso[1]; [1]*Univ. of Rochester, USA.* We investigate a method to measure spatial coherence that uses no lenses in the measurement. Three variations of this method are compared, and we find one using three amplitude masks to be the most robust.
This presentation will be presented as an E-Poster on Screen 2 from 14:30–15:15

JW4A.50
A simple wavefront re-construction optical elements combination, Hai Lin[1]; [1]*Shanghai Inst of Optics & Fine Mechanics, China.* A simple wavefront re-construction optical element is designed.It uses uniaxial optical crystals to re-arrange a beam with transverse inhomogeneous intensity profile but homogeneous state-of-polarization.

JW4A.51
Withdrawn.

JW4A.52
Thermal Imaging Microscope and Applications to Microelectronic Devices, Ki Soo Chang[1]; [1]*Korea Basic Science Inst., Korea.* We demonstrate a thermal imaging microscope system that measures the temperature distribution over the surface of microelectronic devices. It enables hot spot detection and thermal analysis of microelectronics devices.

JW4A.53
Additive random noise in generalized phase-shifting algorithms, Gastón Ayubi[1], José A. Ferrari[1]; [1]*Universidad de la Republica, Uruguay.* The purpose of the present work is study the phase extraction from interferograms with additive random noise, and deduce the conditions to be satisfied for minimizing the phase-retrieval error. Simulations are presented.

JW4A.54
Microsphere Stabilized Plane-Parallel Resonators Fabricated via Convective Assembly, Jose A. Rivera[1], Tom Galvin[1], James G. Eden[1]; [1]*UIUC, USA.* An array of microspheres, situated near one mirror of a critically-stable cavity, stabilize the cavity at positions occupied by the spheres. Each microlaser in the resulting array exhibits strong mode confinement and unique spectral characteristics.

JW4A.55
Increasing the Speed of CCD-Based Thermoreflectance Imaging: Theory and Experiment, Mark Hallman[1], Kyle Allison[1], Janice A. Hudgings[1]; [1]*Physics and Astronomy, Pomona College, USA.* We experimentally and theoretically examine methods for increasing the image acquisition speed in CCD-based thermoreflectance measurements by increasing the sampling rate, for signal amplitudes both above and below the quantization limit.

JW4A.56
Discussions on advantages of ghost imaging compared to traditional optical imaging, WeiTao Liu[1]; [1]*College of Science, NUDT, China.* Ghost imaging promises higher spatial resolution, higher robustness against harsh environment, higher detection sensitivity, and more options in system designing due to the controllability of the source. Our results on this will be reported.

JW4A.57
The Origin of Asymmetric Transmission in Chiral Photonic Crystals, Nikhil Parappurath[1], Filippo Alpeggiani[1], Kobus Kuipers[1], Ewold Verhagen[1]; [1]*FOM Inst. AMOLF, Netherlands.* We present a fundamental limit to asymmetric transmission (AT) in strongly chiral photonic crystals. We develop a theory that fully predicts AT from eigenmode properties, and show that near-unity AT can be reached in suitable designs.

JW4A.58
Accurate Determination of Inner Diameter for X-Ray Mono-Capillary Optics, Kwon Su Chon[1], Yoshiharu Namba[2]; [1]*Catholic Univ. of Daegu, Korea;* [2]*Chubu Univ., Japan.* Small inner diameter of a mono-capillary optics was precisely measured by using synchrotron beamline which provided images of high resolution. The measurement accuracy was 0.67 μm, and diameters along the axis direction were also measured.

JW4A.59
Partially polarized speckle of light scattered from depolarizing media, Gabriel Soriano[1], Myriam Zerrad[2], Claude Amra[2]; [1]*Institut Fresnel, Aix-Marseille Université, France;* [2]*Institut Fresnel, CNRS, France.* The spatial distribution of the time-averaged intensity is theoretically and numerically studied when light of arbitrary partial polarization state is strongly scattered from a depolarizing medium.

JW4A.60
A Simple Method to Measure the Complex Refractive Index of Conducting Media, Fernando Arturo Araiza Sixtos[2], Maximino Avendaño-Alejo[1]; [1]*CCADET-UNAM, Mexico;*[2]*Faculty of Sciences, Mexico.* A simple method to measure the refractive index of metals considering the Fresnel coefficients for reflectance and expanding in Taylor's series is proposed. We present measurements, which could be in agreement with other optical methods.

JW4A.61
Determination of width of subapertures in Lattice design for stitching interferometry of aspheric surfaces, Junzheng Peng[1], Xiaoli Liu[1], Yingjie Yu[2], Xiang Peng[1]; [1]*Shenzhen Univ., China;* [2]*Shanghai Univ., China.* Determination of the width of subapertures is a key issue in stitching interferometry of aspheric surface. This paper proposed a method to solve this problem based on the slope resolution capability of interferometer.

JW4A • Joint Poster Session I—Continued

JW4A.62
Resting-State Functional Connectivity Measurement in the Mouse Brain using a Low Cost Photoacoustic Computed Tomography, Ali Hariri[1]; Parsa Omidi[1], Mohammadreza Nasiriavanaki[1]; *[1]BME, Wayne state Univ., USA.* We use photoacoustic technology to noninvasively image Resting-State Functional Connectivity (RSFC) in the mouse brain, with a high frame rate, large field of view and high spatial resolution at different depths.

JW4A.63
High Numerical Aperture Meta-lenses at Visible Wavelengths, Mohammadreza Khorasaninejad[1], Wei-Ting Chen[1], Alexander Zhu[1], Jaewon Oh[1,2], C. Roques-Carmes[1,3], Ishan Mishra[1], Rober Devlin[1], Federico Capasso[1]; *[1]Harvard Univ., USA; [2]Univ. of Waterloo, Canada; [3]École Polytechnique, France.* We report high numerical aperture meta-lenses in the visible spectrum with focal spots as small as 0.65λ. Meta-lenses are based on titanium dioxide metasurface phase masks.They operate in transmission mode and are polarization-insensitive.

JW4A.64
Enhanced Spectral Sensitivity of a Chip-Scale Photonic-Crystal Slow-Light Interferometer, Boshen Gao[2], Omar S. Magana Loaiza[2], Sebastian A. Schulz[1], Kashif M. Awan[3], Jeremy Upham[1], Ksenia Dolgaleva[1,3], Robert W. Boyd[2,1]; *[1]Department of Physics and Max Planck Centre for Extreme and Quantum Photonics, Univ. of Ottawa, Canada; [2]The Inst. of Optics, Univ. of Rochester, USA; [3]School of Electrical Engineering and Computer Science, Univ. of Ottawa, Canada.* By placing a slow-light photonic-crystal waveguide in one arm of a fiber-based Mach–Zehnder (MZ) interferometer, we experimentally demonstrate that structural slow light can be used to enhance the spectral sensitivity of the interferometer

JW4A.65
Compact hyper-spectrometer based on metasurfaces at visible wavelengths, Alexander Y. Zhu[1], Wei-Ting Chen[1], Mohammadreza Khorasaninejad[1], Jaewon Oh[1,2], Rober Devlin[1], Ishan Mishra[1,2], Federico Capasso[1]; *[1]John A Paulson School of Engineering and Applied Science, Harvard Univ., USA; [2]Univ. of Waterloo, Canada.* We present a compact hyper-spectrometer using only planar metasurface lenses and a CMOS camera. Spectral resolutions as small as approximately 300 pm (detector-limited) and an overall working range exceeding 130nm at visible wavelengths are achieved.

JW4A.66
Undergraduate Laboratory on Polarization Using Poincaré Beams, Joshua A. Jones[1], Anthony J. D'Addario[1], Enrique J. Galvez[1]; *[1]Colgate Univ., USA.* Gaussian and higher order Laguerre-Gauss mode beams are combined to form Poincaré beams having spatially varying polarization. We developed a new lab using Poincaré beams as an exercise to teach states of polarization.

JW4A.67
Multifilter Phase Imaging with Partially Coherent Light: Nonparaxial Case, Yijun Bao[1], Thomas K. Gaylord[1]; *[1]Georgia Inst. of Technology, USA.* The existing quantitative phase imaging method Multifilter Phase Imaging with Partially Coherent light (MFPI-PC) has been extended to nonparaxial case. Its improved accuracy has been verified using simulations and microlens experimental measurements.

JW4A.68
Light Scattering Spectroscopy of Nanosilica Particles Aggregating in Single, Freely Suspended Micrometer-Sized Evaporating Droplet, Mariusz P. Wozniak[1], Justice Archer[1], Daniel Jakubczyk[1], Gennadiy Derkachov[1], Krystyna Kolwas[1], Maciej Kolwas[1]; *[1]Inst. of Physics Polish Academy of Sciences, Poland.* The light scattering spectroscopy of single, micrometer-sized evaporating droplet was developed. We report a well-pronounced change in the visible spectrum of the nanosilica suspension corresponding to different stages of aggregate formation.

JW4A.69
Diffraction at the grating and appearance of "spirits" from the view of radiooptics, Vasily Kazakov[1], Oleg Moskaletz[1], Nadezhda Fironova[1]; *[1]St. Petersburg State Univ. of Aerospace Instrumentation, Russian Federation.* Diffraction at the grating from the view of radiooptics is considered. The properties of spectrum in different diffraction orders are established. The mathematical justification for appearance of "spirits" at diffraction on the grating is proposed.

JW4A.70
Negative Index in Chiral Metamaterials under Conductive Loss and First-Order Material Dispersion Using Lorentzian, Condon and Drude Models, Monish R. Chatterjee[1], Tarig Algadey[1]; *[1]Univ. of Dayton, USA.* Emergence of negative index (NIM) in chiral materials with conductive loss using standard dispersive models is reported. Positive and negative phase and group indices are realized as expected for NIM behavior for sidebands with opposite polarities.

JW4A.71
High-output-power third-harmonic generation at 355nm based on $La_2CaB_{10}O_{19}$ (LCB) crystal in yz plane, Lirong Wang[1]; *[1]Inst. of Semiconductors, China.* Third-harmonic generation based on LCB crystal was investigated in yz plane. The maximum output power at 355 nm was 11.5W . The angular bandwidth and temperature bandwidth were measured, which are larger than the previous reports also.

JW4A.72
Experimental study of the vortex phase induced-change of the polarization structure of a radially polarized beam, Lina Guo[1,2], Yangjian Cai[1], Fei Wang[1], Xianlong Liu[1], Lin Liu[1]; *[1]School of Physical Science and Technology and Collaborative Innovation Center of Suzhou Nano Science and Technology, Soochow Univ., China; [2]School of Electronics and Information, GuangDong Polytechnic Normal Univ., China.* We carried out the theoretical and experimental study on the propagation of a focused radially polarized vortex beam. It is found that the state of polarization of such beam rotates and changes on propagation.

JW4A.73
Nonlinear dynamics, bifurcation maps, signal encryption and decryption using acousto-optic chaos under a variable aperture illumination, Monish R. Chatterjee[1], Suman Chaparala[1]; *[1]Univ. of Dayton, USA.* Bragg cell nonlinear dynamics and bifurcation properties under first-order feedback with variable aperture are examined. Chaotic encryption and recovery of low-bandwidth signals, and optimal performance are evaluated for fixed and variable apertures.

JW4A.74
Revival of Hanbury Brown-Twiss Effect and Its Application on Single-Arm Ghost Imaging Based on Discrete Chaotic Light, Liming Li[1], Peilong Hong[2], Guoquan Zhang[1]; *[1]Nankai Univ., China; [2]Nanjing Univ. of Science and Technology, School of Science, China.* Based on a discrete chaotic light source, we demonstrated the revival effect of second-order spatial correlation pattern with multiple bunching peaks, which can be used to achieve ghost imaging in a single-arm configuration.

JW4A.75
In-line system for intensity and topological charge characterization of optical vortices, Edgar Rueda[1], Jorge Gomez[2], Dafne Amaya[3], Alberto Lencina[4]; *[1]Universidad de Antioquia, Colombia; [2]Politécnico Colombiano Jaime Isaza Cadavid, Colombia; [3]Centro de investigaciones ópticas, Argentina; [4]Universidad Nacional del Centro de la Provincia de Buenos Aires, Laboratorio de análisis de suelos, Argentina.* An in-line system to recover simultaneously topological charge and intensity of an optical-vortex is presented. It is based on adding a Fresnel lens to a vortex-producing lens. The need of an interferometer is eliminated.

JW4A.76
Withdrawn.

JW4A.77
Optical Vortex Microscope-Analytical Model and its Experimental Verification, Agnieszka Popiolek-Masajada[1], Jan Masajada[1], Lukasz Plociniczak[1]; *[1]Wroclaw Univ. of Technology, Poland.* Model of the microscopic optical system in which the optical vortex is embedded within the Gaussian beam and focused to the sample plane is considered. The analytical solutions are verified in the experimental setup.

JW4A.78
Withdrawn.

JW4A.79
Blueshift in the Near Band Edge Emission and in the Optical Band Gap of Sr Doped ZnO Films, Vandana Masih[1], Anchal Srivastava[1]; *[1]Univ. of Lucknow, Lucknow, India, India.* A blueshift in the near band edge emission in the strontium doped zinc oxide thin films deposited by sol-gel method is observed. The nanocrystalline films show an enhancement in the optical band gap by 6.6%.

JW4A.80
Imaging Darkness, Adam Selyem[1], Thomas W. Clark[1], Neal Radwell[1], Sonja Franke-Arnold[1]; *[1]Univ. of Glasgow, UK.* We present a technique for reconstructing bright and dark light sculptures. The method is based on recording fluorescence from a thermal rubidium gas directly or after atomic depletion respectively.

JW4A.81
Withdrawn.

JW4A.82
Persistence and fidelity of phase singularities in optical random waves, Lorenzo De Angelis[1], Filippo Alpeggiani[1], Andrea Di Falco[2], L. Kuipers[1]; *[1]Center for Nanophotonics, AMOLF, Netherlands; [2]SUPA, School of Physics and Astronomy, Univ. of St Andrews, UK.* As the wavelength is varied, phase singularities in random waves are created, diffuse and annihilate. With near-field experiments we map their trajectories as a function of wavelength and study correlations between creation and annihilation events.

JW4A • Joint Poster Session I—Continued

JW4A.83 ***E-Poster***

Formation of LIPSS in nanocomposites of Poly (ethylene terephthalate)/Expanded Graphite by using UV nanosecond laser pulses, Rene I. Rodriguez Beltran[1], Margarita Hernandez[2], Tiberio A. Ezquerra[2], Anna Szymczyk[3], Sandra Paszkiewicz[3], Zbigniew Roslaniec[3], Marta Castillejo[4], Pablo Moreno[1], Esther Rebollar[4]; [1]*Universidad de Salamanca, Spain;*[2]*Instituto de Estructura de la Materia (IEM-CSIC), Spain;* [3]*West Pomeranian Univ. of Technology, Poland;* [4]*Instituto de Química Física Rocasolano (IQFR-CSIC), Spain*. We report the formation of Laser Induced Periodic Surface Structures in Poly(ethylene terephthalate) and Poly(ethylene terephthalate)/Expanded Graphite films. Some physical properties of the surfaces improve in the presence of these nanostructures.

This presentation will be presented as an E-Poster on Screen 5 from 14:30–15:15

JW4A.84

A 10-GHz Optical Frequency Comb from a SCOWA-Based Mode-Locked Laser with 600-Hz Optical Mode Linewidth, Kristina Bagnell[1], Anthony Klee[1], Peter Delfyett[1];[1]*Univ. of Central Florida, CREOL, USA*. We present a harmonically mode-locked laser at 10-GHz repetition rate with high saturation power SCOWA gain, with a long external fiber cavity and intracavity etalon for supermode suppression, with optical mode linewidth of 600 Hz.

JW4A.85

Optical Nonlocal nonlinear properties in [EMIM][B_4], Israel Severiano Carrillo[1], Edgar Alvarado Méndez[1], Monica Trejo Durán[1]; [1]*DICIS, Universidad de Guanajuato, Mexico*. We used the nonlocal nonlinear model by the characterization of Ionics liquid ([EMIM][BF_4]) by the z-scan technique to nonlinear refraction and nonlinear absorption curves. Numerical and experimental results show ionic liquid as nonlocal medium.

JW4A.86

Spectral Analysis of Bragg and non-Bragg Orders in Dynamic Holography using Photorefractive Materials, Akash Kota[1], Ujitha Abeywickrema[1], Partha P. Banerjee[1]; [1]*Univ. of Dayton, USA*. Interaction of Bragg and non-Bragg orders in a photorefractive material during two-beam coupling is studied by numerically solving the coupled differential equations for the angular plane wave spectra of all interacting orders.

JW4A.87

Quantitative Measurement of the Average Orbital Angular Momentum of Light with a Cylindrical Lens, Samuel Alperin[1], Robert Niederriter[2], Juliet T. Gopinath[3,2], Mark Siemens[1]; [1]*Univ. of Denver, USA;* [2]*Physics, Univ. of Colorado, USA;* [3]*Electrical, Computer, and Energy Engineering, Univ. of Colorado, USA*. We show that the average orbital angular momentum (OAM) of twisted light can be measured with a single stationary cylindrical lens and camera. Our method can be calibrated absolutely and measure arbitrary (non-integer) average OAM.

JW4A.88

Diffraction Gratings Prepared by HR-LIPSS for New Surface Plasmon-Polariton Photodetectors & Sensors, Iaroslav Gnilitskyi[1], Sergiy Mamykin[2], Mykhaylo Dusheyko[3], Tatiana Borodinova[4], Nataliya Maksimchuk [3], Leonardo Orazi[1]; [1]*UNIMORE, Italy;* [2]*V. E. Lashkaryov Inst. of Semiconductor Physics, National Academy of Sciences of Ukraine, Ukraine;*[3]*National Technical Univ. of Ukraine "Kiev Polytechnic Inst.", Ukraine;* [4]*National Academy of Sciences of Ukraine, F. D. Ovcharenko Inst. of Biocolloid Chemistry, Ukraine*.New method based on HR-LIPSS for diffraction grating on preliminary fabricated p-n junction on Si substrate are suggested. This allows to produce surface plasmonic photodetectors based on periodically corrugated thin metal plasmon-carrying films.

JW4A.89

Raman spectroscopy for CVD monolayer graphene: Fermi levels depending on different substrates material, Solveyga Azbite[1], Alaudi Denisultanov[1], Mikhail Khodzitsky[1];[1]*Univ. ITMO, Russian Federation*. Energies of Fermi level of monolayer graphene on quartz, polyethylene terephthalate (PET) and Si were calculated using Raman spectroscopy data. The dependence of Fermi level energy on refractive index of the substrate was shown.

JW4A.90

Anisoplanatic Electromagnetic Image Propagation through Narrow or Extended Phase Turbulence using Altitude-Dependent Structure Parameter, Monish R. Chatterjee[1], Ali Mohamed[1]; [1]*Univ. of Dayton, USA*. The effects of turbulence on anisoplanatic imaging are often modeled through the use of a sequence of phase screens distributed along the optical path. We implement the split-step wave algorithm to examine turbulence-corrupted images.

JW4A.91

Self-Healing of Laguerre-Gauss Beams Described by Superposition of Conical-Like Traveling Waves, Jorge A. Ugalde-Ontiveros[1], Alfonso Jaimes-Najera[3], Job Mendoza-Hernández[4], Marcelo D. Iturbe-castillo[1], Sabino Chavez-Cerda[1,2]; [1]*Inst Nat Astrofisica Optica Electronica, Mexico;* [2]*Centro de Investigaciones en Optica, Mexico;* [3]*Departamento de Fisica, CINVESTAV, Mexico;* [4]*Facultad de Ciencias Fisico-Matematicas, Benemerita Universidad Autonoma de Puebla, Mexico*. We demonstrate that propagation of Laguerre-Gaussian beams has not been fully understood since some observed phenomena with them cannot be explained without the use of transverse traveling wave features similar to those of Bessel beams.

JW4A.92

Magnetic response of split nanotube type metamaterial at near infrared frequency, Nishant Shankhwar[2], Ravindra K. Sinha[1], Yogita Kalra[2]; [1]*CSIR-CSIO, India;* [2]*Department of Applied Physics, Delhi Technological Univ., India*. In this paper, we present the design of a split nanotube type metamaterial which shows strong magnetic resonance at infrared frequency. Its operation is similar to that of split ring resonator (SRR) but is easier to fabricate at nanoscale.

JW4A.93

Electro-optic dual-comb vibrometry, Vicente D. Durán[1], Elena L. Teleanu[1], Víctor Torres-Company[1]; [1]*Chalmers Univ. of Technology, Sweden*. We use an ultrafast electro-optic dual comb interferometer to perform single-point vibrometry on the submillisecond time scale. We resolve the vibration of an ultrasound speaker driven at 50 kHz, achieving a sub-nanometer axial resolution.

JW4A.94

New algorithm of adaptive focusing of laser beam developed on conservation laws of its propagation, V. A. Trofimov[1], Artem Kotkov[1], Tatiana Lysak[1]; [1]*M. V. Lomonosov Moscow State Univ., Russian Federation*. We propose a new algorithm of adaptive focusing of laser beam by using the conservation laws of optical radiation propagation in linear and non-linear medium.

JW4A.95

Withdrawn.

JW4A.96

A Point Spread Function for Fourier Telescopy, William T. Rhodes[1]; [1]*Florida Atlantic Univ., USA*. A spatial frequency domain point spread function for Fourier telescopy imaging is defined and its properties discussed. The function is given by the inverse Fourier transform of the object illumination intensity distribution.

JW4A.97

A system to control the energy of a high-power laser system and its application to x-ray generation at ultra-high intensity, Baozhen Zhao[1], Wenchao Yan[1], Ping Zhang[1], Sudeep Banerjee[1], Grigory Golovin[1], Colton Fruhling[1], Daniel Haden[1], Jun Zhang[1], Cheng Liu[1], Shouyuan Chen[1], Donald P. Umstadter[1]; [1]*Univ. of Nebraska Lincoln, USA*. We demonstrate a system to control the output energy of a high-energy, ultrashort pulse laser system by an order-of-magnitude. This technique is used to control the brightness of an Inverse-Compton x-ray source.

JW4A.98

Generation and Switching of Phase Vortices in Cylindrical Vector Beams, C Hari Krishna[1], Sourabh Roy[1]; [1]*Physics, National Inst. of Technology Warangal, India*. Cylindrical vector beams are generated using a two mode optical fiber. Vortex and anti-vortex are observed in interferograms formed by helical and plane wavefronts.Switching between them is achieved by changing input polarization state.

JW4A.99

Local and nonlocal nonlinear response of Ag nanocubes in solution as function of size and concentration, Emma V. García Ramírez[1], Jorge alejandro Reyes Esqueda[1], Daysi Ramírez Martínez[1], Sergio Sabinas Hernandez[1], Gabriela Díaz Guerrero [1]; [1]*Univ Nacional Autonoma de Mexico, Mexico*. Cubic silver nanoparticles were analyzed by Z-scan technique in the resonant and no-resonant regimes. These results were done with picosecond pulse as function of the size and concentration of the samples.

JW4A.100

Robust Statistical Parity-Time Symmetric Lasers in Fiber Cavities, Ali Kazemi Jahromi[1], Absar U. Hassan[1], Ayman Abouraddy[1], Demetrios Christodoulides[1]; [1]*Univ. of Central Florida, CREOL, USA*. We demonstrate that many features of PT-symmetric lasing, such as the lower predicted lasing threshold and PT-symmetric phase transition, are sufficiently robust to be observed in a long fiber cavity (>1 km) despite random phase fluctuations.

JW4A.101

Transparent Perfect Mirror via Non-Hermitian Systems, Ali Kazemi Jahromi[1], Soroush Shabahang[1], H. Esat Kondakci[1], Ayman Abouraddy[1]; [1]*Univ. of Central Florida, CREOL, USA*. We have experimentally demonstrated an optical device that provides 100% broadband reflection, yet transmits light. The device is a sub-lasing active cavity in which the resonances in reflection disappear at a critical gain threshold.

JW4A.102

ZnO Films Photoluminiscence and Nonlinear Optical Properties, Emma V. García Ramírez[1], Jorge Alejandro Reyes Esqueda[1], Roberto Lopéz[2], Enrique Vigueras-Santiago[2], Daysi Ramírez Martínez[1]; [1]*Univ Nacional Autonoma de Mexico, Mexico;* [2]*Universidad Autónoma del Estado de México, Mexico*. We study photoluminescence properties of direct-gap of ZnO films for different grain size and we obtained lasing threshold. The crystalline structure, surface morphology and optical properties of the thin films have been investigated.

JW4A • Joint Poster Session I—Continued

JW4A.103
Subluminal speed of higher orders of physical light beams, Nestor Jr. Bareza[1,2]; [1]*National Inst. of Physics, Philippines;* [2]*Univ. of the Philippines-Diliman, Philippines*. We report the dependence of light's speed delay to the mode indices of higher beam orders. We demonstrated this by calculating the group velocity of Laguerre Gauss beam with orbital order and radial order.

JW4A.104
Extending the high-order harmonic generation cutoff by means of self-phase-modulated chirped pulses, E. Neyra[1,2], F. Videla[1,3], J.A. Perez-Hernandez[4], M.F. Ciappina[5], L. Roso[4], Gustavo Torchia[1]; [1]*Centro de Investigaciones Opticas, Argentina;* [2]*Departamento de Física, Facultad de Ciencias Exactas Universidad Nacional de La Plata, Argentina;* [3]*Departamento de Ciencias Básicas,, Facultad de Ingeniería Universidad Nacional de La Plata, Argentina;* [4]*Centro de Láseres Pulsados (CLPU), Spain;* [5]*Max Planck Inst. of Quantum Optics, Germany.* In this work we propose a new approach to extend the cutoff in high-order harmonic generation (HHG) spectra beyond the well established limits.We achieved this extension by using driven pulses obtained by means of self-phase-modulation (SPM).

JW4A.105
Laser Quest : A Laser-Based Education and Outreach Program - Coupling Practice with Content (URACE), Sumit Ghosh[1,2]; [1]*Physics, Andhra Vidyalaya College, India;* [2]*Physics, Andhra Vidyalaya College - Osmania Univ., India*. More than five decades have passed since the first laser was demonstrated, it still continues to amaze and delight with its power and applications. An outreach program was organised to teach optics using laser light.

JW4A.106 ***E-Poster***
Alternative Fusing Algorithm for High Speed Gabor Domain Optical Coherence Microscopy, Panomsak Meemon[1], Pornthep Pongchalee[1], Joewono Widjaja[1], Jannick P. Rolland[2];[1]*School of Physics, Suranaree Univ. of Technology, Thailand;* [2]*Inst. of Optics, Univ. of Rochester, USA.* An alternative Gabor-based fusing algorithm that improves the processing speed of the GD-OCM is presented. The fusion is performed in spectral domain and hence could enable hardware-based fusion, which is promising for real time GD-OCM.
This presentation will be presented as an E-Poster on Screen 1 from 15:15–16:00

JW4A.107
Indirect Zinc Phthalocyanine excitation due nonradiative quantum dots couppling, Guilherme A. Alves[2,1], Arnaldo F. Reis[1], Adamo F. Monte[1], José Maria Villas-Bôas[1], Djalmir N. Messias [1]; [1]*Universidade Federal de Uberlândia, Brazil;* [2]*Instituto Federal de Ciência e Tecnologia de Goiás, Brazil*. This work reports the study of the energy transfer from CdSe/ZnS core-shell quantum dots to Zinc Phthalocyanine dye. It was found the ZnPc emitted wavelength which travels the longest distance along the samples.

JW4A.108
High-throughput Characterization of Nanoparticle Stability Using Near-field Optical Trapping, Perry Schein[1], David Erickson[1]; [1]*Cornell Univ., USA.* We show high-throughput measurements of the interactions between nanoparticles and surfaces, characterizing colloidal stability based on fluctuations in scattered light during interaction with a waveguide on particles with <100 nm diameters.

JW4A.109
Exploiting Optical Asymmetry for Frequency-controlled Guiding of Particles with Light, Ognjen Ilic[1], Ido Kaminer[1], Yoav Lahini[1], Hrvoje Buljan[2], Marin Soljacic[1];[1]*Massachusetts Inst. of Technology, USA;* [2]*Department of Physics, Univ. of Zagreb, Croatia.* We propose a novel method to guide particles that is controllable by the frequency of light. With detailed simulations, we demonstrate exceptional degree of control, independent of the direction of the light beam and insensitive to scattering.

JW4A.110
Beam Shaping through Turbid Media by Feedback-based Wavefront Shaping, Jixiong Pu[1], Lipeng Wan[1], Ziyang Chen[1], Huiling Huang[1]; [1]*College of Information Science and Engineering, Huaqiao Univ., China*. We demonstrate that the focusing of light into desired patterns through turbid media can be realized using feedback-based wavefront shaping. The desired focused patterns, such as a triangle-shape beam, are obtained.

JW4A.111
Superresolution Second Harmonic Generation Microscopy based on Point-scanning Structured Illumination, Szu-Yu Chen[1], Chia-Hua Yeh[1], Cheng-Zn Tan[1]; [1]*National Central Univ., Taiwan.* Since fluorescence-based superresolution techniques can't be applied to second harmonic generation microscopy (SHGM), a system combing structured illumination and SHGM was introduced to get a 1.41 resolution improvement factor in the chicken tendon.

JW4A.112
Raman Spectral Histopathology of Breast Cancer Recession Margins, Dustin W. Shipp[1], Kenny Kong[1], Emad Rakha[2], Ian Ellis[3], Ioan Notingher[1]; [1]*School of Physics and Astronomy, Univ. of Nottingham, UK;* [2]*Department of Pathology, Nottingham Univ. Hospitals NHS Trust, UK;* [3]*School of Molecular Medical Sciences, Univ. of Nottingham, UK.* We demonstrate a Raman spectroscopy system that quickly maps tumors in thick pieces of breast tissue immediately following excision. Diagnostic accuracy is high with the potential to increase with more database samples.

JW4A.113
Conditions Leading to Eryptosis in Erythrocytes: A Raman Tweezers Study, Surekha Barkur[1], Aseefhali Bankapur[1], Santhosh Chidangil[1]; [1]*Department of Atomic and Molecular Physics, Manipal Univ., India.* Raman tweezers was used to study eryptosis in erythrocytes induced by different reasons. Our study shows that, though the main cause of eryptosis may be oxidative stress, the consequences of different stressors may be different.

JW4A.114
Self-trapping of Light Through Red Blood Cell Suspensions, Rekha Gautam[1], Joshua Lamstein[1], Anna Bezryadina[1], Zhigang Chen[1]; [1]*San Francisco State Univ., USA.* We observe self-trapping and deep penetration of a laser beam in human red blood cell (RBC) suspensions under isotonic, hypotonic, and hypertonic conditions, in spite of the intrinsic absorption and scattering loss due to RBCs.

JW4A.115
Two-dimensional correlation between blood glucose and optical scattering for noninvasive blood glucose sensing with optical coherence tomography, Ya Su[1], Huiqing Liu[1], X. Steve Yao[1,2], Changjiang Wei[1], Zhihong Li[3]; [1]*Hebei Univ., China;* [2]*General Photonics Corporation, USA;* [3]*Suzhou Optoring Co. Ltd., China.* We propose an algorithm of using two-dimensional correlation analysis between blood glucose and optical scattering coefficient of skin tissues for the noninvasive blood glucose measurement with optical coherence tomography (OCT).

JW4A.116
Quantification of Fluorescence Enhancement Due to Dielectrophoresis and the Plasmonic Effect Using Time-Resolved Fluorescence, Ivan T. Lima[1], Logeeshan Velmanickam[1], Michael Fondakowski[2], Dharmakeerthi Nawarathna[1]; [1]*Department of Electrical and Computer Engineering, North Dakota State Univ., USA;* [2]*Department of Mechanical Engineering, North Dakota State Univ., USA.* We used time-resolved fluorescence to show that dielectrophoresis can increases the fluorescence emission due to the plasmonic effect near nanostructured metallic electrodes by a factor of 3, which can significantly reduce the detection sensitivity.

JW4A.117 ***E-Poster***
Filtering Doppler OCT Improves Unwrapping and Extends Range of Microscopic Fluid Velocity Measurement, Yang Xu[1,2], Donald Darga[2], Jason Smid[2], Adam Zysk[2], Daniel Teh[1], Stephen Boppart[1,2], P. Scott Carney[1,2]; [1]*Univ of Illinois at Urbana-Champaign, USA;* [2]*Diagnostic Photonics, Inc., USA.* Using the modified Robust Phase Tracker algorithm for denoising, we demonstrate DOCT velocity unwrapping of datasets with peak velocity up to 14.5 cm/s. This technique significantly extends the measureable range of DOCT velocity.
This presentation will be presented as an E-Poster on Screen 1 from 14:30–15:15

JW4A.118
Deep-Tissue Optical Imaging and Photoactivation Activities at Biophotonics@ Tyndall, Stefan Andersson-Engels[2,1], Monirehalsadat Mousavi[1], Haichun Liu[3], Andreas Walther[1], Lars Rippe[1], Stefan Kröll[1]; [1]*Lund Univ., Sweden;* [2]*Tyndall National Inst., Univ. College Cork, Ireland;* [3]*Biomedical Engineering, National Univ. of Singapore, Singapore*.Activities for deep tissue imaging and photoactivation will be presented. Wihin Biophotonics@Tyndall projects based on upconverting nanoparticles and ultrasound optical tomography will be pursued. Data from collaborative research will be given.

JW4A.119
Study of Photodynamic Therapy applied to the treatment and fluorescence-based diagnosis of infiltrative Basal Cell Carcinoma including gold nanoparticles, Félix Fanjul-Vélez[1], Jose L. Arce-Diego[1]; [1]*TEISA, Univ. of Cantabria, Spain.* Photodynamic Therapy dosimetry is an unresolved issue for treatment effectiveness, particularly when using nanoparticles. In this work the treatment and fluorescence-based diagnosis is analyzed when applied to infiltrative Basal Cell Carcinoma.

JW4A.120
Enhanced Scaffold Guided Cellular Motion Using Polarized Light, Colin Constant[1], Kiminobu Sugaya[2], Daniel Ng[2], Aristide Dogariu[1]; [1]*Univ. of Central Florida, CREOL, USA;* [2]*Burnett School of Biomedical Sciences, Univ. of Central Florida, USA.* Cellular motion along substrate channels confines the cellular motion linearly. The addition of an optical field linearly polarized parallel to the substrate channel enhances this motion due to optical torques applied to subcellular elements.

JW4A • Joint Poster Session I—Continued

JW4A.121
Super-Resolved Microscopy with Spatial Frequency-Modulated Imaging, Keith Wernsing[1], Jeffrey J. Field[1], Randy Bartels[1]; [1]*Colorado State Univ., USA.* We present a super-resolved imaging technique for real and virtual state interactions, which measures object spatial frequency projections at bandwidths exceeding the diffraction limit by a factor of approximately twice the interaction nonlinearity.

JW4A.122
Withdrawn.

JW4A.123
Surface Plasmon-enhanced Super-resolution Imaging Using Silver Nanoislands, Taehwang Son[1], Yougjin Oh[1], Wonju Lee[1], Donghyun Kim[1]; [1]*Yonsei Univ., Korea.* Surface plasmon-enhanced super-resolution imaging has been studied using silver nanoislands. The size of localized near-field was in the range of 100-150nm, which affects the resolution. Fluorescent actin filament of J774 cells was imaged.

JW4A.124
Driving force that controls a protein reaction for optogenetics, Masahide Terazima[1]; [1]*Chemistry, Kyoto Univ., Japan.* Driving force of a photo-reaction of a photosensor protein were investigated by a time-resolved transient grating method. The result indicates that the enhanced fluctuation of the conformation is a key factor.

JW4A.125
Magnetic field enhancement in dielectric island assisted by metal nanoslit arrays, Jeong-Geun Yun[1], Sun-Je Kim[1], Joonsoo Kim[1], Byoungho Lee[1]; [1]*Seoul National Univ., Korea.* In this paper, we propose a structure that consists of a dielectric island and a metal nanoslit array. In numerical simulation, the proposed structure shows a huge magnetic field enhancement up to a factor of 61.

JW4A.126
Single CdTe Nanowire Optical Correlator, Chenguang Xin[1], Limin Tong[1]; [1]*Zhejiang Univ., China.* Based on second harmonic generation in a 800-nm diameter CdTe nanowire, we demonstrated an optical correlator for femto-second pulse measurement. Benefitted from the high optical nonlinearity, pulse energy goes down to several femtojoules per pulse.

JW4A.127
Grating Design for 3-D Interconnections of Waveguides in Overlaid Chips Using the RCWA-EIS Method, Congshan Wan[1], Thomas K. Gaylord[1], Muhannad S. Bakir[1]; [1]*Georgia Inst. of Technology, USA.* The rigorous coupled-wave analysis–equivalent-index-slab (RCWA-EIS) method is used to determine the diffraction efficiencies of gratings for 3-D coupling between overlaid chips. The simulation results are validated by FDTD calculations.

JW4A.128
Fresnel coefficients of a two-dimensional atomic crystal, Michele Merano[1]; [1]*Universita degli Studi di Padova, Italy.* I compare the slab model and the surface conductivity model of graphene to interpret the most remarkable experiments in graphene optics. Only the surface conductivity model is able to explain the overall experimental data.

JW4A.129
Optical control with large-scale assembly of highly aligned silver nanowires, Yunsheng Fang[1], Yuanpeng Wu[2], Jun Zhou[1], Qing Yang[2], Bin Hu[1]; [1]*Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, China;* [2]*College of Optical Science and Engineering, Zhejiang Univ., China.* Large-scale aligned silver nanowires arrays was obtained using controlled capillary printing technology. Optical simulations were conducted to gain the single silver nanowire and nanowires arrays optical behaviors.

JW4A.130
Bragg Grating Encrypted Metal Clad Ridge Waveguide as an Highly Sensitive & Compact Bio-Sensor, Nabarun Saha[1], Arun Kumar[1]; [1]*Indian Inst. of Technology, Delhi, India.* It is shown that the RI sensitivity of a Bragg grating based ridge waveguide can be increased significantly by including a thin metal layer between the core and substrate.

JW4A.131
Transverse electric surface mode in atomically thin Boron-Nitride, Michele Merano[1]; [1]*Universita degli Studi di Padova, Italy.* Atomically thin Boron-Nitride is predicted to support a transverse electric non-radiating surface mode in the visible spectrum. This mode has a spatial confinement of 15 microns and an intensity-propagation distance greater than 2 cm.

JW4A.132 ***E-Poster***
Gain-Assisted Surface Plasmon Polaritons: Time Domain Analysis with Experimentally Fitted Organic Dye Models, Shaimaa Azzam[1], Nikita Arnold[2], Ludmila Prokopeva[3], Zhaxylyk Kudyshev[1], Alexander Kildishev[1]; [1]*Purdue Univ., USA;* [2]*Johannes Kepler Univ., Austria;* [3]*Novosibirsk State Univ., Russian Federation.* Kinetic parameters of a six-level model are obtained by matching the experimental data for a fluorescent dye to study loss-compensation in the surface plasmon-polariton propagating along a silver film covered with a gain layer.
This presentation will be presented as an E-Poster on Screen 5 from 15:15–16:00

JW4A.133
Withdrawn.

JW4A.134
Silicon On-chip Nanobeam Bandstop Filters for the Parallel Multiplexing of Integrated 1D Photonic Crystal Nanobeam Cavity Sensors Array, Daquan Yang[1]; [1]*Beijing Univ. of Posts and Telecom., China.* We propose a novel method for the dense integration of nanoscale 1D photonic crystal (1D-PC) sensors array, which can be interrogated simultaneously between a single input and output port. The footprint is ultra-compact of 4.5μm×50μm.

JW4A.135
Analysis of various ZrN plasmonic nanostructures and their effect on the absorption of organic solar cells, Sara Al Menabawy[1], Qiaoqiang Gan[2], Mohamed Swillam[1]; [1]*American Univ. in Cairo, Egypt;* [2]*Electrical Engineering, Univ. at Buffalo, The State Univ. of New York, USA.* We incorporated ZrN nanoparticles, nanocubes and nanoshells in organic solar cell and theoretically demonstrated broadband absorption enhancement due to high scattering and near field enhancement. Their extinction cross sections are also analyzed.

JW4A.136
Study of Energy Transfer between Quantum Dots and a Two-Dimensional Semiconductor, Kenneth M. Goodfellow[1], Chitraleema Chakraborty[1], Kelly Sowers[1], Pradeep Waduge[2], Meni Wanunu[2], Todd Krauss[1], Kristina Driscoll[3], A. Nick Vamivakas[1]; [1]*Univ. of Rochester, USA;* [2]*Northeastern Univ., USA;* [3]*Rochester Inst. of Technology, USA.* We explore the efficiency of energy transfer between colloidal quantum dots with a cadmium selenide core and cadmium sulfide shell and monolayer molybdenum diselenide ($MoSe_2$), separating them by thin layers of hexagonal boron nitride (h-BN).

JW4A.137
Plasmonic Nanoantenna Array with Single-Chip Integrated Metal-Organic Framework for Infrared Absorption Gas Sensing, Xinyuan Chong[1], Ki-Joong Kim[1], Erwen Li[1], Yujing Zhang[1], Paul Ohodnicki[2], Chih-Hung Chang[1], Alan X. Wang[1]; [1]*Oregon State Univ., USA;* [2]*National Energy Technology Lab, USA.* Plasmonics devices are usually not suitable for gas spectroscopy due to the limited enhancement length. Here, we demonstrate a plasmonic nanopatch array coated with metal-organic framework for CO2 sensing, with enhancement factor over 1100 times.

JW4A.138
Light extraction efficiency enhancement of organic light-emitting diodes fabricated on silica network substrate, Dong B. To[1]; [1]*National Chung Cheng Univ., Taiwan.* This research focuses on the improvement of internal light out-coupling of organic light emitting diodes (OLED) with enhancement factor about 2.25 times compared with a conventional OLED.

JW4A.139
Withdrawn.

JW4A.140
Surface-lattice resonances in 2d arrays of spheres: multipolar couplings and normal modes, Sylvia Swiecicki[1], John E. Sipe[1]; [1]*Univ. of Toronto, Canada.* We present a multipolar model of the surface - lattice resonances in arrays of spheres. We show the importance of couplings between multipoles of different polarity and characterize the dispersion of multipolar modes.

JW4A.141
Plasmon enhanced whispering gallery mode sensor using Nanostructure, Seunghun Lee[1], Hyerin Song[1], Tae Young Kang[1], Seonhee Hwang[1], Taerim Yoon[1], Heesang Ahn[1], Kyujung Kim[1]; [1]*NanoBioPhotonics Lab, Korea.* Whispering gallery mode optical sensor has detected sub-micron sized molecules by mornitoring the resonance peak shift. We described 'plasmonic enhanced' whispering gallery mode sensor using nanostructure and it confirmed by computer simulations.

JW4A.142
Mid-IR Resonant Cavity Detectors, Trevor A. O'Loughlin[1], Gregory Savich[1,2], Daniel Sidor[1], Brendan Marozas[3], Gary Wicks[1], Terry Golding[4], Keith Jamison[4], Leis Fredin[4], Bert Fowler[4], Weerasinghe Priyantha[4]; [1]*Inst. of Optics, USA;* [2]*Air Force Research Laboratory, USA;* [3]*Materials Science, Univ. of Rochester, USA;* [4]*Amethyst Research, Inc., USA.*Resonant cavity detectors have been grown by MBE. They offer a low noise, narrow response detector in the mid-infrared region, with possible applications in spectroscopy, gas sensing, and optical communications.

JW4A.143
Spontaneous emission studies of blue and green InGaN-based laser diode structure, Gyu-Jae Jeong[1], Sung-Nam Lee[1]; [1]*Korea Polytechnic Univ., Korea.*Blue/green LEDs represented higher efficiency droop than blue/green LDs under the same injection current density. Because of same epi-structures, we suggested that efficiency droop may be due to the difference of heat dissipation structure.

JW4A • Joint Poster Session I—Continued

JW4A.144
Design of a Wavefront Control Type Compact Silicon Wavelength Selective Switch, Fumi Nakamura[1], Kyosuke Muramatsu[1], Hiroyuki Tsuda[1]; [1]*Electronics and Electrical Engineering, Keio Univ., Japan*. A 200-GHz channel spacing, 16-channel, 1×2 wavefront control type silicon wavelength selective switch is designed, which have two-step etched rib structure to reduce loss in the boundary parts between the slab and the arrayed-waveguide.

JW4A.145
Phase-Resolved Characterization of Reflective Infrared Nanostructured Half- and Quarter-Wave Plates, Carol L. Baumbauer[1], Benjamin Moon[1], Andrew Hohne[1], Ethan Keeler[1], Marquette A. Stevenson[1], David L. Dickensheets[1], Wataru Nakagawa[1]; [1]*Electrical and Computer Engineering, Montana State Univ., USA*. Fabrication and characterization of both half- and quarter-wave plates operating in reflection at infrared wavelengths is presented. The phase delay between TE/TM polarization components can be controlled by the subwavelength grating fill factor.

JW4A.146
Strong coupling of hybrid and plasmonic resonances in liquid core plasmonic microbubble cavities, Liying Liu[1], Qijing Lu[1], Lei Xu[1], Sheng Liu[1], Xiang Wu[1]; [1]*Fudan Univ., China*. A novel thin wall fluidic plasmonic micro-bubble resonator is proposed and fabricated to manipulate coupling between various types of resonant modes by changing its wall thickness and refractive index of the liquid in the core.

JW4A.147
Full Particulars of Surface Plasmon Polariton Dispersion Relation in Multi-Layered Media, Huseyin S. Tetikol[1], M. Irsadi Aksun[1]; [1]*Koc Univ., Turkey*. We show that the wavevector and frequency of surface plasmon polaritons (SPPs) can simultaneously have complex values, providing better resolution/confinement. We analyze SPPs in layered media and provide the complete description of their dispersion.

JW4A.148
Design of SOI Rib Slot Waveguide with Enhanced Evanescent Field for Optical Sensing , Babita Kumari[1], Ravi K. Varshney[1], Bishnu P. Pal[2]; [1]*Physics Department, Indian Inst. of Technology, Delhi, India;* [2]*School of Natural Science, Mahindra École Centrale, India*. We propose a novel SOI rib horizontal slot waveguide geometry to achieve larger than 10% enhancement in evanescent field *vis-à-vis* a conventional horizontal slot waveguide and hence yielding higher sensitivity in its environment sensing applications.

JW4A.149
Thermo-optic Tuning of Silicon Photonic Multimode Waveguide for Post-Fabrication Optimization, Christine P. Chen[1], Brian Souhan[2], Richard M. Osgood[1], Keren Bergman[1];[1]*Columbia Univ., USA;* [2]*West Point, USA*. We examine the effect of thermo-optically varying the effective mode index of an asymmetric y-junction that multiplexes three modes. This work aims to optimize multimode operation, thereby improving performance.

JW4A.150
Generation and Characterization of Breather Solitons in an On-Chip Microresonator, Chengying Bao[1], Jose Jaramillo-Villegas[1], Yi Xuan[1], Daniel E. Leaird[1], Minghao Qi[1], Andrew M. Weiner[1]; [1]*Purdue Univ., USA*. We show the generation of breather solitons and characterization of the spectral dynamics in an on-chip SiN microresonator. The breather soliton exhibits asymmetric breathing with respect to the center of the spectrum.

JW4A.151
Large-Area Lithography-Free Metamaterial Thermophotovoltaic Emitters with Oxygen Tolerance, Zachary Coppens[1], Ivan Kravchenko[2], Jason Valentine[1]; [1]*Vanderbilt Univ., USA;* [2]*Oak Ridge National Laboratory, USA*. We present a large-area metamaterial thermal emitter that is fabricated using facile, lithography-free techniques. The device shows stable, selective emission after exposure to 1173 K for 22 hours in oxidizing and inert atmospheres.

JW4A.152
Phase-Sensitive Amplification with Net Gain in Low-Loss Integrated Waveguides, Young Zhang[1], Jenny Wu[1], Christian Reimer[1], Piotr Roztocki[1], Benjamin Wetzel[1,2], Brent Little[6], Sai T. Chu[3], David J. Moss[4], Michael Kues[1], Roberto Morandotti[1,5]; [1]*INRS, Canada;* [2]*Department of Physics and Astronomy, Univ. of Sussex, UK;* [3]*Department of Physics and Materials Science,, City Univ. of Hong Kong, Hong Kong;* [4]*Center for Micro-Photonics,, Swinburne Univ. of Technology,, Australia;* [5]*Inst. of Fundamental and Frontier Sciences, Univ. of Electronic Science and Technology of China, China;* [6]*Chinese Academy of Science, State Key Laboratory of Transient Optics and Photonics, China*. We demonstrate phase-sensitive amplification based on pump-degenerate four-wave mixing in highly nonlinear low-loss waveguides. A net gain of 6 dB (including propagation loss) is achieved, with an extinction ratio of 16 dB.

JW4A.153
New Architectures for Photonic Doppler Velocimetry: High Velocities at Lower Cost, Levi Neukirch[1], Amy M. Tainter[1], Dale Tupa[1], Philip J. Rae[2], David B. Holtkamp[1], Brian Glover[2]; [1]*Physics Division, Los Alamos National Laboratory, USA;* [2]*Explosive Science and Shock Physics Division, Los Alamos National Laboratory, USA*. Doppler velocimetry is used extensively to measure velocities in dynamic experiments, but Doppler shifts of ≈1.3 GHz/km/s demand expensive digitizers. We discuss methods leveraging frequency down-mixing to reduce digitization requirements and costs.

JW4A.154
Electric and magnetic hotspots in the Silicon Bow-Tie nanocavity, Reena Reena[2], Yogita Kalra[2], Ravindra K. Sinha[1,2]; [1]*CSIR-CSIO, India;* [2]*Delhi Technological Univ., India*. We report enhancement of electric and magnetic fields in the silicon bow-tie nanocavity at visible wavelength. For our design, electric and magnetic resonances have been optically induced at the wavelength of 620 nm.

JW4A.155
Enhanced nonlinear-optical response of composites based on plasmonic nanoparticles, Nikolai Mitetelo[1], Sergey Svyakhovskiy[1], Alexandra Gartman[1], Stanislav Evlashin[1], Anton Maydykovskiy[1]; [1]*Moscow State Univ., Russian Federation*. We demonstrate experimentally that introduction of plasmonic nanoparticles in dielectric materials (quartz, graphene-based films) leads to a strong and spectrally selective enhancement of local optical fields and increase nonlinear optical effects.

JW4A.156
Silicon/Graphene Oxide Hybrid Photonic Waveguide Filter, Chia-Wei Huang[1], Jyun-Fu Shih[1], Chong-Jia Wu[1], Tzu-Hsiang Yen[1], Chun-Hu Chen[2], Ya-Ching Liang[1], Yung-Jr Hung[1];[1]*Department of Photonics, National Sun Yat-sen Univ., Taiwan;* [2]*Department of Chemistry, National Sun Yat-sen Univ., Taiwan*. The enabling of graphene oxide nanopatterning prompts the realization of silicon/graphene oxide hybrid waveguide filters for the first time. A reflection bandwidth of 3 nm and an extinction ratio of 15 dB are experimentally obtained.

JW4A.157
Photon Entropy Control and Near-Field Radiative Coupling Improve Efficiency of Thermoradiative Cells, Wei-Chun Hsu[1], Jonathan Tong[1], Bolin Liao[1], Yi Huang[1], Svetlana V. Boriskina[1], Gang Chen[1]; [1]*Massachusetts Inst. of Technology, USA*. Efficiency of thermoradiative cells can be increased by selecting high-entropy infrared photons for radiative energy exchange. Near-field coupling to phonon polaritons in the heat sink further increases both conversion efficiency and power density.

JW4A.158 ***E-Poster***
Optimizing Third-Order Optical Nonlinearities Using Small Molecules, Michael Erickson[1], Marten Beels[1], Ivan Biaggio[1]; [1]*Lehigh Univ., USA*. Donor-acceptor substituted molecules can achieve record high third-order nonlinearities relative to the size of their conjugated system, reaching a maximum efficiency for a linear conjugated system of ~3 multiple bonds between donor and acceptor.
This presentation will be presented as an E-Poster on Screen 4 from 15:15–16:00

JW4A.159
Free-standing SU-8 optical waveguides for dense photonic integration, Alleksandrs Marinins[1], Nicolas Knudde[1], Sergei Popov[1]; [1]*Royal Inst. of Technology, Sweden*. Suspended polymeric waveguides of small footprint suitable for dense photonic integrated circuits were developed and evaluated. Low propagation and bending losses at 1550 nm reported. The waveguides are suitable for telecommunications applications.

JW4A.160
Conjugation-Length Dependence of the High Two-Photon Absorption of Small Donor-Acceptor Substituted Molecules, Michael Erickson[1], Marten Beels[1], Ivan Biaggio[1]; [1]*Lehigh Univ., USA*. We report on the exceptionally strong two-photon transition in an optimized family of small donor-acceptor substituted molecules and show how both strength and shape of the two-photon resonance varies with conjugation length.

JW4A.161
Design, develop and operation of an amplitude modulator fabricated by laser writing in Lithium Niobate, Gustavo Torchia[1,2], D. Presti[1,2], A. Fasciszewski[3], V. Guarepi[1]; [1]*Centro de Investigaciones Opticas, Argentina;* [2]*Departamento de Ciencia y Tecnología, Universidad Nacional de Quilmes Quilmes, Argentina;* [3]*Departamento de Nano y Microelectrónica, Comisión de Energía Atómica Sede Constituyentes, Argentina*. In this paper, we describe the design and development of a Mach Zehnder interferometer (MZI) fabricated in Lithium Niobate by means of fs laser writing.The main MZI working characteristics, as amplitude modulator, are also presented and discussed.

JW4A • Joint Poster Session I—Continued

JW4A.162
Perfect Light Absorption in Ultra-thin Silicon Optical Nanocavity and its Application for Color Filters, Seyed Sadreddin Mirshafieyan[1], Ting S. Luk[2], Junpeng Guo[1]; *[1]Department of Electrical and Computer Engineering, The Univ. of Alabama in Huntsville, USA; [2]Center for Integrated Nanotechnologies, Sandia National Laboratories, Albuquerque, USA.* We investigated perfect light absorption in silicon optical nanocavity comprising of ultrathin aluminum and silicon films deposited on an aluminum surface. The thickness of the silicon film cavity is 1/18 of the perfect absorption wavelength.

JW4A.163
Optimized Mid-Infrared Thermal Emitters for Applications in Aircraft Countermeasures, Simon Lorenzo[2,1], Chenglong You[2,1], Georgios Veronis[3,4], Jonathan Dowling[2,1];*[1]Louisiana State Univ., USA; [2]Hearne Inst. for Theoretical Physics and Department of Physics and Astronomy, Louisiana State Univ., USA; [3]Center for Computation and Technology, Louisiana State Univ., USA; [4]School of Electrical Engineering and Computer Science, Louisiana State Univ., USA.* An optimized aperiodic photonic crystal structure is capable of near-blackbody and broad angle thermal emission at aircraft engine temperatures over the three to five micron atmospheric transmission band.

JW4A.164
Feedback-induced Bistability of an Optically Levitated Nanoparticle: A Fokker-Planck Treatment, Wenchao Ge[1], Brandon Rodenburg[1], Mishkatual Bhattacharya[1]; *[1]Rochester Inst. of Technology, USA.* The Fokker-Planck equation for an optically levitated nanoparticle with feedback damping is investigated. We recover previous theoretical and experimental works in the low-damping regime and predict a bimodal distribution in the overdamped regime.

JW4A.165
Bistable mode of THG at non-zero amplitudes of incident waves, V. A. Trofimov[1], Pavel Sidorov[1], Igor Kuchik[1]; *[1]M. V. Lomonosov Moscow State Univ., Russian Federation.* We demonstrate and compare the numerical and analytical solutions of THG problem in the case of non-zero input intensity. Also we consider the solution on the boundaries of areas.

JW4A.166
Phase-contrast ghost imaging using an orbital angular momentum phase-filter , Peter A. Morris[1], Reuben Aspden[1], Ruiqing He[2], Qian Chen[2], Miles J. Padgett[1]; *[1]Univ. of Glasgow, UK; [2]Nanjing Univ. of Science and Technology, China.* Position and orbital angular momentum correlations are used to image phase-objects. Using a non-local phase-filter, ghost images show isotropic edge-enhancement allowing imaging using significantly fewer photons than standard phase-contrast imaging.

JW4A.167
Modeling Structural Features of Single-Mode, Q-Switched Pulse Ensembles, Graham Martin[1], Troy J. Siemers[1], John R. Thompson[1]; *[1]Virginia Military Inst., USA.* Stochastic, single-mode, rate equations are solved to generate pulse ensembles for comparison with experiments. Structural features of the ensembles depend on the switching time for cavity losses and the statistical characteristics of noise sources.

JW4A.168
Photonic Microwave Generation Using a VCSEL Subject to Orthogonal Optical Injection, Salim Ourari[1], Tianyao Huang[1], Hong Lin[1]; *[1]Bates College, USA.* We have generated tunable photonic microwave signals ranging from 6 to 62 GHz in a vertical-cavity surface-emitting laser operating with three transverse modes by using period one dynamics and dual-beam injection separately.

JW4A.169
A Novel Observation of Optical Bistability in Oppositely Directed Coupler, Kanagaraj Nithyanandan[1], A.K. Shafeeque Ali[1], Porsezian Kuppusamy[1]; *[1]Pondicherry Univ., India.*We observe that the oppositely directed coupler possesses Bistability. This property arises due to effective feedback mechanism as a result of opposite directionality of the phase velocity and energy flow in the negative index materials.

JW4A.170
Light Slowing Down and Chirped Soliton Formation in a Medium with Gold Nanorods, V. A. Trofimov[1], Tatiana Lysak[1]; *[1]M. V. Lomonosov Moscow State Univ., Russian Federation.* We show a possibility for light slowing down accompanied by a novel type soliton – chirped soliton - formation at a femtosecond pulse propagation in a medium with gold nanorods under the nanorods reshaping and negative phase-amplitude grating.

JW4A.171
Cavity QED with Collective Excitations of Warm, 3-Level Atoms, Garrett Hickman[1], Todd B. Pittman[1], James D. Franson[1]; *[1]Univ. of Maryland, Baltimore County, USA.* We derive a simplified Hamiltonian describing an ensemble of three-level room-temperature atoms in a two-mode cavity. If one transition is driven with a single photon, the ensemble behaves as if it were a single atom.

JW4A.172
Conservative Classical and Quantum Resolution Limits for Incoherent Imaging, Mankei Tsang[1]; *[1]National Univ. of Singapore, Singapore.* We propose classical and quantum limits to the resolution of two incoherent sources from the perspective of minimax estimation. Our limits are valid for any biased or unbiased estimator and numerically demonstrated to be approachable.

JW4A.173
Qubit-Detuning Impacted Entanglement Mediated by the Surface Plasmon, Fan Zhang[1], Dongxing Zhao[1], Ying Gu[1], Hongyi Chen[1], He Hao[1], Qihuang Gong[1,2]; *[1]Peking Univ., China; [2]Collaborative Innovation Center of Extreme Optics, Shanxi Univ., China.* We have theoretically demonstrated the influence of qubit entanglement induced by the detunings among two qubits and surface plasmons in a hybrid qubits-metallic nanoparticle system. Enhancement appears when nanoparticle is placed between qubits.

JW4A.174
Rapid Delay Modulation of Biphotons, Ogaga D. Odele[1], Joseph M. Lukens[1,2], Jose A. Jaramillo-Villegas[1,3], Poolad Imany[1], Carsten Langrock[4], Martin M. Fejer[4], Daniel E. Leaird[1], Andrew M. Weiner[1]; *[1]Purdue Univ., USA; [2]Oak Ridge National Laboratory, USA; [3]Universidad Tecnologica de Pereira, Colombia; [4]Stanford Univ., USA.* We demonstrate delay modulation of entangled photons over a full 32-ns span, utilizing pump frequency tuning and ultralong fiber Bragg gratings. Electro-optic modulators enable time-bin switching rates as fast as 2.5 MHz.

JW4A.175
Two-photon Absorption Induced Emission of InAs/GaAs Quantum Dots, Xian Hu[1,2], Dorel Guzun[2], Morgan E. Ware[3,2], Yuriy I. Mazur[2], Gregory J. Salamo[1,2]; *[1]Department of Physics, Univ. of Arkansas, USA; [2]Inst. of Nano Science and Engineering, Univ. of Arkansas, USA; [3]Department of Electrical Engineering, Univ. of Arkansas, USA.*Direct two-photon absorption induced emission of MBE grown undoped InAs/GaAs quantum dots (QDs) is investigated by power dependent photoluminescence and two-photon photoluminescence excitation study with excitation energy near the QDs half-bandgap.

JW4A.176
Withdrawn.

JW4A.177
Withdrawn.

JW4A.178
Fabrication and Second-harmonic Generation Imaging of Oriented Ion-shaped Nanoparticles, Abdallah Slablab[1], Léo Turquet[1], Tero Isotalo[2], Jouni Mäkitalo[1], Pierre Eugène Coulon[3], Tapio Niemi[2], Mathieu Kociak[4], Giancarlo Rizza[3], Martti Kauranen[1]; *[1]Tampere Univ. of Technology, Finland; [2]Optoelectronics Research Centre, Tampere Univ. of Technology, Finland; [3]Laboratoire des solides Irradiés, Ecole Polytechnique, France; [4]Laboratoire de Physique des Solides, Univ. Paris-Sud, France.* We use ion irradiation to fabricate anisotropic gold nanorods oriented in three dimensions. Their orientation is subsequently determined by second-harmonic generation microscopy relying on linear and radial polarizations.

JW4A.179
Boundary-concentrated Modes of a 2-D Optofluidic Random Laser Mapped Using a Pump-probe Technique, Anirban Sarkar[1], Jonathan Andreasen[2], Shivakiran Bhaktha B. N.[1];*[1]Indian Inst. of Technology Kharagpur, India; [2]Georgia Tech Research Inst., USA.* We spatially map the lasing modes of a weakly scattering 2-D optofluidic random laser by a pump-probe technique. We conclude that the lasing modes are concentrated at the boundaries of the gain region as predicted by computational analysis.

JW4A.180
Monoblock He-Ne/CH_4 laser with the short-term and long-term frequency stability better than 1×10^{-14}, Alexey N. Kireev[2], Alexander S. Shelkovnikov[2], Dmitry A. Tyurikov[2], Vladimir A. Lazarev[1], Mikhail A. Gubin[2,3]; *[1]Science and Education Center for Photonics and IR-Technology, Bauman Moscow State Technical Univ., Russian Federation;[2]Frequency Standards Laboratory, P. N. Lebedev Physical Inst. of the Russian Academy of Sciences, Russian Federation; [3]National Research Nuclear Univ. MEPhI, Russian Federation.* We reported on the optical frequency standard based on a compact monoblock He-Ne/CH_4 laser with the short-term and long-term frequency stability better than 1×10^{-14}, that was obtained form a direct comparison of two identical monoblock lasers.

JW4A • Joint Poster Session I—Continued

JW4A.181
Controlling Mandel's Q-parameter in Disordered Lattices via Excitation-Symmetry Breaking, Hasan E. Kondakci[1], Robert Keil[3], Armando Perez-Leija[2], Alexander Szameit[2], Ayman Abouraddy[1], Demetrios Christodoulides[1], Bahaa E. Saleh[1]; [1]*CREOL, Univ. of Central Florida, USA;* [2]*Inst. of Applied Physics, Friedrich-Schiller-Universitat Jena, Germany;* [3]*Institut fur Experimentalphysik, Universitat Innsbruck, Austria*. We experimentally demonstrate deterministic control of Mandel's Q-parameter in off-diagonal disordered lattices while the mean photon number remains fixed. We achieve this by gradually breaking the excitation symmetry of the chiral mode pairs.

JW4A.182
Quantum resources for optical phase estimation, Jaspreet Sahota[1], Nicolas Quesada[2], Daniel F. James[1]; [1]*Univ. of Toronto, Canada;* [2]*Physics, Universite de Sherbrooke, Canada*.We determine how phase sensitivity depends on quantum entanglement (particle entanglement and mode entanglement) by employing the particle description (first quantization) and the mode description (second quantization) of bosonic probe states.

JW4A.183
Electronic nature of new Ir(III)-complexes: linear spectroscopic and nonlinear optical properties, Salimeh Tofighi[1], Peng Zhao[1], Mykhailo Bondar[2], Ryan O'Donnell[3], Jianmin Shi[3], David Hagan[1], Eric Van Stryland[1]; [1]*CREOL Univ. of Central Florida, USA;* [2]*Inst. of Physics NASU, Ukraine;* [3]*US Army Research Laboratory, USA*. Linear photophysical properties and two-photon absorption spectra of new Ir(III)-complexes in liquid media are presented. The excited-state potential surface of new compounds was revealed by steady-state and time resolved spectroscopic data.

JW4A.184
Analytical Description of Nonlinear Refraction Index Measurements with the D4\sigma Technique, Anderson M. Amaral[1], Hans A. Mejía[2], Edilson L. Falcao-Filho[1], Cid B. de Araújo[1]; [1]*Universidade Federal de Pernambuco, Brazil;* [2]*Departamento de Física, Universidade Federal do Piauí, Brazil*. We obtained analytical expressions for the far-field beam width due to elliptical and astigmatic beams propagating inside Kerr media, and performed experiments with CS_2 and silica. A good agreement between theory and experiment was found.

JW4A.185
Evolution of Averaged Speckle Patterns, Xiaojun Cheng[1,2]; [1]*CUNY Queens College, USA;* [2]*Graduate Center, CUNY, USA*. We show that intensity maxima in speckle patterns averaged over a frequency interval diffuses with a diffusion coefficient decreasing linearly with the width of the frequency interval, providing a method in imaging for dynamic samples.

JW4A.186
Nonlinear Modal Interactions in PT-Symmetric Lasers, Li Ge[1,2], Ramy El-Ganainy[3]; [1]*College of Staten Island, CUNY, USA;* [2]*The Graduate Center, CUNY, USA;* [3]*Department of Physics and Henes Center for Quantum Phenomena, Michigan Technological Univ., USA*. We discuss nonlinear modal interactions in PT-symmetric laser systems under steady state conditions, and we demonstrate several gain clamping scenarios in both the PT-symmetric and PT-broken phases.

JW4A.187
Dynamic Ferroelectricity of Trojan Electrons on Face-Centered Square Lattice, Matt Kalinski[1]; [1]*Utah State Univ., USA*. We show that hydrogen atoms placed on the face-centered two-dimensional square lattice and excited to Trojan electron states exhibit dynamic ferroelectric order when all Trojan Wave Packets move coherently in phase
on circular orbits.

JW4A.188
Experimental and Numerical Study on Stimulated Raman Scattering in $AsSe_2$-As_2S_5 Microstructured Optical Fiber, Weiqing Gao[1,2], Xue Li[2], Qiang Xu[2], Xiangcai Chen[2], Chenquan Ni [2], Li Chen[2], Zhengqiang Wen[2], Tonglei Cheng[1], Xiaojie Xue[1], Takenobu Suzuki[1], Yasutake Ohishi[1]; [1]*Research Center for Advanced Photon Technology, Toyota Technological Inst., Japan;* [2]*School of Electronic Science & Applied Physics, Hefei Univ. of Technology, China*. We demonstrate the stimulated Raman scattering effect in $AsSe_2$-As_2S_5 microstructured optical fiber. The first-order Stokes wave is obtained with the conversion efficiency of -15.0 dB. The simulated results agree well with the experiments.

JW4A.189
Calculation of Power Spectral Density in Passively Modelocked Lasers with Slow Saturable Absorbers, Shaokang Wang[1], Curtis R. Menyuk[1]; [1]*Computer Science and Electrical Engineering, Univ. of Maryland, Baltimore County, USA*. We calculate the power spectral density for a passively modelocked fiber laser with a semiconductor saturable absorber using spectral methods. We obtained frequency sidebands that agrees with experimental observations.

JW4A.190
Observation of Ince-Gaussian beams and their polarizaions properties, Sean M. Nomoto[1], Adam Goldstein[1], Reeta Vyas[1], Surendra Singh[1]; [1]*Univ. of Arkansas, USA*. Ince-Gaussian (IG) beam solutions of Maxwell's equations and their polarization and propagation properties were studied experimentally for lower order IG beams for several different eccentricities.

JW4A.191
An efficient numerical method for the calculation of global discord of coupled quantum dots, Willa Rawlinson[1], Reeta Vyas[1]; [1]*Univ. of Arkansas, USA*. We present an efficient numerical method for calculating global discord for coupled quantum dots interacting with a quantized cavity field. Speed tests and interesting results are presented for two, three, and four quantum dots.

JW4A.192
Valley Trion Dynamics in Monolayer $MoSe_2$, Michael Titze[1], Feng Gao[1], Raybel Almeida[1], Yongji Gong[2,3], Pulickel M. Ajayan[2,3], Hebin Li[1]; [1]*Department of Physics, Florida International Univ., USA;* [2]*Department of Chemistry, Rice Univ., USA;* [3]*Department of Materials Science and NanoEngineering, Rice Univ., USA*. We report an ultrafast two-color pump-probe experiment measuring transient differential reflection of trions in monolayer MoSe2. We explain our results using a model
based on a set of rate equations.

JW4A.193
Self-healing optical beams with snake-like and spiral paths in free space, Ahmed Dorrah[1], Michel Zamboni-Rached[2], Mo Mojahedi[1]; [1]*Univ. of Toronto, Canada;* [2]*Electrical Engineering, State Univ. of Campinas, Brazil*. We experimentally demonstrate a class of non-diffracting beams, known as Frozen Waves, whose central spot can be made to follow an arbitrary off-axis curved path. These beams can be utilized in material processing and optical trapping applications.

JW4A.194
Quantum Multiple Phase Estimation Using Balanced Multi-mode Entangled States, Lu Zhang[1], Kam Wai C. Chan[1], Pramode K. Verma[1]; [1]*Univ. of Oklahoma, USA*. We present a generalized entangled state that can approach the Heisenberg limit in quantum metrology. We prove the entangled squeezed vacuum state can achieve a higher precision than entangled (squeezed) coherent state and NOON state.

JW4A.195
Electron spin interaction with the angular momentum of the electromagnetic field, Charles Paillard[2], Brahim Dkhil[2], Reeta Vyas[1], Laurent Bellaiche[1], Surendra Singh[1]; [1]*Univ. of Arkansas, USA;* [2]*Laboratoire SPMS, CentraleSupelec, CNRS-UMR 8580, Universite Paris-Saclay, France*. Consequences of the recently introduced interaction between the electron spin and the angular momentum of the electromagnetic field for atomic and optical physics are discussed.

JW4A.196
Multimode Solitons in Few-Mode Fiber, Zimu Zhu[1], Logan G. Wright[1], Demetrios Christodoulides[2], Frank W. Wise[1]; [1]*Cornell Univ., USA;* [2]*CREOL, College of Optics and Photonics, Univ. of Central Florida, USA*. We experimentally isolate and measure multimode Raman solitons in few-mode graded-index fiber. We show that these waves are spatiotemporal solitary waves, and are qualitatively distinct from stationary solutions of the NLSE in integer-dimensions.

JW4A.197
Construction of Arbitrary Vortex and Superoscillatory Fields, Matt Smith[1], Gregory J. Gbur[1]; [1]*Univ. of North Carolina at Charlott, USA*. A simple Fourier method for constructing superoscillatory fields with arbitrarily located optical vortices is presented. Examples are given and mathematical properties of the fields are explained.

JW4A.198
Optically Trapped Microscopic Particles in a Perfect Fractional Vortex Beam, Mingzhou Chen[1], Georgiy Tkachenko[1], Kishan Dholakia[1], Michael Mazilu[1]; [1]*Univ. of St Andrews, UK*. We experimentally generated a perfect vortex beam with fractional topological charges. The local orbital angular momentum density in such beams was probed with an optical trapped microscopic particle.

JW4A.199
Supercontinuum Generation in an AsSe2-As2S5 Step-Index Fiber, Weiqing Gao[1], Qiang Xu[1], Xue Li[1], Li Chen[1], Xiangcai Chen[1], Chenquan Ni [1], Zhengqiang Wen[1], Tonglei Cheng[2], Xiaojie Xue[2], Takenobu Suzuki[2], Yasutake Ohishi[2]; [1]*School of Electronic Science & Applied Physics, Hefei Univ. of Technology, China;* [2]*Research Center for Advanced Photon Technology, Toyota Technological Inst., Japan*. We demonstrate the supercontinuum generation in an AsSe2-As2S5 step-index fiber. The SCs are investigated by changing the pump wavelength and the fiber length. The maximum spectral range covers one octave from 1550 to 3300 nm.

16:00–17:00 Exhibitor Appreciation Reception, *Empire Hall*

16:00–17:30
FW5A • Understanding Myopia Development

Presider: Frank Schaeffel, Eberhard-Karls_ Universitat Tubingen, Germany and Earl Smith, Univ. of Houston, USA

FW5A.1 • 16:00 Invited

Control of Myopia Progression in Children: Inside and Outside, Donald O. Mutti[1]; [1]*Ohio State Univ. Optometry, USA*. Positive results using peripheral myopia-based optical therapies have motivated their evaluation in longer-term clinical trials. This presentation will review these studies and whether time outdoors alters risk of myopia onset and progression rate.

FW5A.2 • 16:30 Invited

Myopia Development inGuinea Pigs, Sally A. McFadden[1], Guang Zeng[1]; [1]*Univ. of Newcastle, Australia*. Myopia is induced when growing eyes are exposed to hyperopic defocus or reduced vision. The associated changes and factors that influence the development of myopia in the guinea pig eye are described.

16:00–18:15
FW5B • High-Power Fiber Lasers and Beam Combining

Presider: Iyad Dajani; US Air Force Research Laboratory, USA

FW5B.1 • 16:00 Invited

Coherent Beam Combining and Nonlinear Suppression of Multi-Kilowatt All-Fiber Amplifiers, Angel Flores[1], Iyad Dajani[1], Nader N. Naderi[1], Brian Anderson[1]; [1]*US Air Force Research Laboratory, USA*. We present multi-kW power scaling results of narrow line Yb-doped fiber amplifiers. Nonlinear suppression is attained through pseudo-random modulation. Subsequently, 5 pseudo-random modulated kW amplifiers were coherently combined into a 5kW beam.

FW5B.2 • 16:30

Singlemode Raman Lasing in Graded-Index Fiber Pumped by High-Power 915-nm Laser Diode, Ekaterina A. Zlobina[1], Sergey I. Kablukov[1], Alexey A. Wolf[1], Alexander V. Dostovalov[1,2], Sergey A. Babin[1,2]; [1]*Inst. of Automation and Electrometry, Russian Federation;* [2]*Novosibirsk State Univ., Russian Federation*. Raman lasing in graded-index fibers pumped by a multimode 915-nm laser diode enables single-transverse-mode output due to special FBG inscribed by femtosecond technique. 954-nm output power of >10 W with narrow spectrum has been obtained.

16:00–18:00
FW5C • Optical Coherence Tomograpy

Presider: Jerome Mertz, Boston Univ., USA

FW5C.1 • 16:00 Invited

Live Imaging of Reproductive and Developmental Events in Mouse Model with Optical Coherence Tomography, Irina Larina[1]; [1]*Baylor College of Medicine, USA*. Toward understanding of mammalian reproduction and early embryonic development, we are working on development of imaging tools based on structural and functional optical coherence tomography in mouse models.

FW5C.2 • 16:30 Invited

Monitoring and Guidance of Arrhythmia Therapy with Optics, Christine P. Hendon[1]; [1]*Columbia University, USA*. In this talk, I will describe my laboratory's efforts towards translation of optical coherence tomography and near infrared spectroscopy for monitoring and guidance of arrhythmia therapy.

16:00–18:00
FW5D • Integrated Photonics

Presider: Michael Fanto, Rochester Inst. of Technology, USA

FW5D.1 • 16:00 Invited

Nanophotonics Technology and Applications, Yeshaiahu Fainman[1]; [1]*Univ. of California, San Diego, USA*. We discuss integration of a photonic information processing system onto a single chip focusing on nanoscale engineered optical nonlinearities and metal-dielectric-semiconductor nanostructures and compositions to construct nanoemitters.

FW5D.2 • 16:30

Supra-octave-spanning single-mode and single-polarization operation in nanophotonic waveguides, Jeff Chiles[1], Sasan Fathpour[1]; [1]*Univ. of Central Florida, USA*.Nanophotonic anchored-membrane waveguides utilizing a semi-infinite and asymmetric geometry are fabricated and shown to exhibit single-mode and single-polarization operation over a record span exceeding 1.27 octaves.

16:00–18:00
FW5E • Ultrafast Lasers and Applications
Presider: Jake Bromage, Univ. of Rochester, USA

FW5E.1 • 16:00 Tutorial

High Power Fiber-laser Based High Harmonic Sources for Nanoscale Imaging and Spectroscopy, Jan Rothhardt[1,2], Steffen Hädrich[3], Robert Klas[1,2], Getnet Tadesse[1,2], Stefan Demmler[1,2], Maxim Tschernajew[1,2], Jens Limpert[2,3], Andreas Tünnermann[3,2]; [1]*Helmholtz Inst. Jena, Germany;* [2]*Inst. of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany;* [3]*Fraunhofer IOF, Germany.* We report on table-top XUV sources based on high harmonic generation with high average power fiber lasers delivering record average powers from 20 eV up to the water window for applications in imaging and spectroscopy.

Biography: Dr. Jan Rothhardt received his PhD in Physics in 2010 from the Friedrich-Schiller-University Jena. Since 2014 he is a Young Investigators Group leader at the Helmholtz-Institute Jena. His group is applying table-top coherent high photon flux XUV and soft X-ray sources to ultrafast nanoscale imaging and spectroscopy.

16:00–18:00
FW5F • Nonlinear Optics in Micro/Nano-Optical Structures II
Presider: Miles Padgett; Univ. of Glasgow, UK

FW5F.1 • 16:00 Invited

Optical Antenna Spontaneous Emission: How Much Faster Than Stimulated Emission?, Eli Yablonovitch[1]; [1]*Univ. of California Berkeley, USA.* With optical antennas, spontaneous light emission becomes faster than stimulated emission, but the enhancement is limited by optical losses through the "anomalous skin effect". Maintaining 50% efficiency, a 10x speedup beyond stimulated emission should be possible.

FW5F.2 • 16:30 Invited

Soliton Kerr Frequency Combs on a Chip, Tobias J. Kippenberg[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* The ability to generate optical frequency combs using dissipative soliton formation in microresonators will be reviewed. In addition higher order soliton effects discussed in views of generating an microwave to optical link on a chip.

16:00–18:00
FW5G • Optical Fabrication and Metrology
Presider: Ted Tienviri, Corning, USA

FW5G.1 • 16:00 Invited

Optical Fabrication Science & Technology for High Energy Laser Optics, Tayyab I. Suratwala[1]; [1]*Lawrence Livermore National Laboratory, USA.* Optical fabrication Science & Technology (specifically sub-surface damage, surface figure, & roughness) and its impact on fabricating economical high quality, laser damage resistant optics for use in high energy, high power lasers are reviewed.

FW5G.2 • 16:30

Brittle-Ductile Transition in Shape Adaptive Grinding (SAG), Peter Simon[1], Anthony Beaucamp[1], Phillip Charlton[2], Yoshiharu Namba[3]; [1]*Kyoto Univ., Japan;* [2]*Zeeko LTD, UK;* [3]*Chubu Univ., Japan.* Shape Adaptive Grinding (SAG) is novel process for rapid finishing of ceramic freeform optics. In this paper, we report results from an investigation into the brittle-ductile transition observable on ceramic materials such as silicon carbide.

16:00–18:00
FW5H • Freeform Design and Metrology
Presider: Joe Howard, NASA Goddard Space Flight Center, USA

FW5H.1 • 16:00

Compact Freeform Offner-Chrisp Imaging Spectrometer, Jacob Reimers[1], Kevin P. Thompson[1,2], Kevin L. Whiteaker[3], Dennis Yates[4], Jannick P. Rolland[1]; [1]*Univ. of Rochester, USA;* [2]*Synopsys Inc., USA;* [3]*Ball Aerospace & Technologies Corp., USA;* [4]*PerkinElmer Health Sciences, USA.* A freeform Offner-Chrisp imaging spectrometer is demonstrated to be 5x more compact than traditional surfaces. The performance was analyzed using spectral full-field display. Furthermore, we show distortion correction without decrease in performance.

FW5H.2 • 16:15

Sharp images from freeform optics and extended light sources, Matthew Brand[1], Aydan Aksoylar[2]; [1]*MERL, USA;* [2]*ECE, Boston Univ., USA.* We introduce a class of pictorial irradiance patterns that freeform optics can render sharply despite the blurring effect of extended light sources; show how to solve for the freeform geometry; and demonstrate a fabricated lens.

FW5H.3 • 16:30

Comparing Three-Mirror Freeform Telescopes to Traditional TMAs by Exploring TMA Solution Space, Eric M. Schiesser[1], Jonathan Papa[1], Kevin P. Thompson[1,2], Jannick P. Rolland[1]; [1]*Univ. of Rochester, USA;* [2]*Synopsis, USA.* Tilted freeform mirrors allow the removal of obscuration in otherwise 100% obscured coaxial designs. We explore the design space for three mirror freeform telescopes by reviewing the coaxial single-conic TMA space, including convex primary solutions.

16:00–18:00
LW5I • Integrated Quantum Photonics II
Presider: Alexander L. Gaeta; Columbia Univ., USA

LW5I.1 • 16:00 Invited

Title to be Announced, Milos Popovic[1]; [1]*Univ. of Colorado Boulder, USA.* Abstract not available.

LW5I.2 • 16:30 Invited

Nanophotonic Resonators for Quantum Frequency Conversion, Kartik Srinivasan[1], Qing Li[1,2], Marcelo Davanco[1]; [1]*Center for Nanoscale Science and Technology, National Inst. of Standards and Technology, USA;* [2]*Maryland Nanocenter, Univ. of Maryland, USA.* We present the development of nanophotonic resonators for quantum frequency conversion, including efficient, low-noise conversion of single-photon-level signals and progress towards use with quantum dot single-photon-sources.

FW5A • Understanding Myopia Development—Continued

FW5A.3 • 17:00
Modelling Cones in the Macula from AOSLO Data: Aging and Myopia, Ann E. Elsner[1], Christopher A. Clark[1], Burns A. Stephen[1]; *[1]Indiana Univ., USA*. Cone densities of both older and younger subjects are well fit by an exponential model in all meridians except nasal, where the optic nerve head has no photoreceptors. This permits modelling of cone contribution to myopia progression.

FW5A.4 • 17:15
Changes in anterior segment 3-D geometry in normal and myopic guinea pig eyes, Susana Marcos[1], Pablo Perez-Merino[1], Miriam Velasco-Ocana[1], Eduardo Martinez-Enriquez[1], Luis Revuelta[2], Sally A. McFadden[3]; *[1]Consejo Sup Investigaciones Cientificas, Spain; [2]School of Veterinary, Universidad Complutense de Madrid, Spain; [3]Univ. of Newcastle, Australia*.We quantified anterior segment geometry in both control and lens-treated eyes of a guinea pig model in vivo using custom-developed OCT. Myopic eyes showed longer axial lengths, thinner corneas, longer anterior chamber depth and steeper anterior lens.

FW5B • High-Power Fiber Lasers and Beam Combining—Continued

FW5B.3 • 16:45
~900W Single-mode CW Power From an 60µm-core Ytterbium-doped All-solid Photonic Bandgap Fiber Laser, Fanting Kong[1], Guancheng Gu[1], Thomas Hawkins[1], Maxwell Jones[2], Joshua Parsons[1], Monica Kalichevsky-Dong[1], Benjamin Pulford[3], Iyad Dajani[3], Liang Dong[1]; *[1]Clemson Univ., USA; [2]Nufern, USA; [3]Air Force Research Laboratory, USA*.~900W single-mode power was obtained from an Yb-doped, ~60µm-core all-solid photonic bandgap fiber with multiple-cladding-resonant design, with 90% efficiency vs. launched pump. This is a record single-mode power from a micro-structured fiber laser.

FW5B.4 • 17:00
Brillouin Gain Spectroscopy on LMA Yb-Doped Photonic Bandgap Fiber, Cody Mart[1,2], Benjamin Ward[3], Benjamin Pulford[2], Iyad Dajani[2], Liang Dong[4], Khanh Kieu[1]; *[1]Univ. of Arizona, College of Optical Sciences, USA; [2]Directed Energy Directorate, Air Force Research Laboratory , USA; [3]Department of Physics, USA Air Force Academy, USA;[4]Clemson Univ., Center for Optical Materials and Engineering Technology, USA*. We interrogate stimulated Brillouin scattering in large mode area photonic bandgap fiber. Theoretical and experimental studies reveal a g_B less than 0.7 cm/GW, which represents a significant reduction over commercial Yb-doped LMA step-index fibers.

FW5B.5 • 17:15
Power Scaling and Coherent Beam Combination of a Narrow-Linewidth, Monolithic Two-Tone Fiber amplifier, Nader N. Naderi[1], Angel Flores[1], Brian Anderson[1], Kenneth Rowland[1], Iyad Dajani[1]; *[1]US Air Force Research Laboratory, USA*. Power scaling results of a phase modulated two-tone fiber amplifier at clock rate of 2.5GHz are presented. Coherent beam combination performance of the two-tone amplifier yielded ~90% combining efficiency with no sign of linewidth broadening.

FW5C • Optical Coherence Tomograpy—Continued

FW5C.3 • 17:00
Long-range, wide-field, functional optical coherence tomography imaging for clinical otology in live patients and healthy normals, Dan MacDougall[1], Joshua Farrell[1], Nicholas Jufas[1], Manohar Bance[1], Jeremy Brown[1], Robert Adamson[1]; *[1]Dalhousie Univ., Canada*. We present results from a real-time, phase-sensitive swept-source OCT system used for middle ear imaging in live patients with co-registered functional Doppler vibrography. This is the first system to successfully produce such images *in vivo*.

FW5C.4 • 17:15
Broadband Swept-Source Laser in 1.1 to 1.3 µm with InAs Quantum Dot Gain Chip Devices, Ruizhe Yao[1], Nicholas Weir[1], Chi-Sen Lee[1], Zihao Wang[2], Stefan F. Preble[2], Wei Guo[1];*[1]Univ. of Massachusetts Lowell, USA; [2]Microsystems Engineering, Rochester Inst. of Technology, USA*. We have demonstrated mode-hopping-free broadband swept-source laser with ~ 100 nm wavelength tuning range centered at 1.2 µm by using novel InAs quantum dot (QD) gain chip devices.

FW5D • Integrated Photonics—Continued

FW5D.3 • 16:45
On-Chip Optical Neuromorphic Computing, Yichen Shen[1], Marin Soljacic[1], Nicholas Harris[1], Dirk . Englund[1]; *[1]Massachusetts Inst. of Technology, USA*. We propose a nanophotonic system that do the neural network computing in optical domain. Our system is able to give equivalent learning performance, while potentially achieve much better speed and efficiency than conventional computer.

FW5D.4 • 17:00 Invited
Towards an Integrated Quantum Photonics Platform on GaAs, Sven Höfling[1]; *[1]Univ. of St. Andrew, UK*. Integrated quantum photonics promises a chip-scale implementation of quantum circuits. We discuss recent progress towards the realization of a platform on GaAs, including single photon sources, detectors and other key elements towards a functional platform.

FW5E • Ultrafast Lasers and Applications—Continued

FW5E.2 • 16:45
Measuring ultrafast lighthouse effect in femtosecond pulses, Zhe Guang[1], Michelle Rhodes[1], Rick Trebino[1]; [1]*Georgia Inst. of Technology, USA*. Using the STRIPED FISH technique, we measured ultrafast lighthouse effect, which corresponds to pulse amplitude coupling in the spatial-frequency-temporal (*k*,*t*) domain. The effect was analyzed and displayed by a spatiotemporal movie in 3D.

FW5E.3 • 17:00
Harmonic Generation in Graphene and Carbon Nanotubes, Marco Taucer[1], T J. Hammond[1], Giulio Vampa[1], Nicolas Thire[3], Bruno Schmidt[3], Charles-Andre Couture[3], François Légaré[3], Paul Corkum[1,2]; [1]*Univ. of Ottawa, Canada;* [2]*National Research Council, Canada;* [3]*INRS, Canada*. We report experimental observations of non-perturbative harmonic generation from graphene and from thin films of aligned semiconducting carbon nanotubes. We investigate the dependence of harmonic generation on polarization of driving field.

FW5E.4 • 17:15
Amplification and Compression of Femtosecond Pulses by Fiber Parabolic Pre-Shaping, Walter P. Fu[1], Yuxing Tang[1], Timothy S. McComb[2], Tyson L. Lowder[2], Frank W. Wise[1];[1]*Cornell Univ., USA;* [2]*nLIGHT Corporation, USA*. We present a combined pulse amplification and compression scheme utilizing parabolic pre-shaping in optical fiber. Clean, near-transform-limited, 300 fs pulses are generated from 9 ps seeds, accompanied by amplification to the few-microjoule level.

FW5F • Nonlinear Optics in Micro/Nano-Optical Structures II—Continued

FW5F.3 • 17:00
Superconducting Nanowire Single-photon Detector with Spot-size Converter on Si platform, Tatsurou Hiraki[2,1], Tai Tsuchizawa[2,1], Tsuyoshi Yamamoto[1], Hiroyuki Shibata[3], Shinji Matsuo[2,1]; [1]*NTT Device Technology labs., Japan;* [2]*NTT Nanophotonics Center, Japan;* [3]*Kitami Inst. of Technology, Japan*. We have integrated an SNSPD with a spot-size converter on the Si photonics platform. A system detection efficiency of 32% and a dark count rate of 96 Hz are achieved with a fiber coupled module.

FW5F.4 • 17:15
Generation of non-classical light via self-induced transparency in mercury-filled hollow core photonic crystal fibers, Ulrich Vogl[1], Florian Sedlmeir[1], Nicolas Joly[1], Christoph Marquardt[1], Gerd Leuchs[1]; [1]*MPI for the Science of Light, Germany*. We successfully demonstrate squeezing of nanosecond pulses via self-induced transparency in a system of mercury vapor confined in a hollow core kagomé-style fiber.

FW5G • Optical Fabrication and Metrology—Continued

FW5G.3 • 16:45
A 12 decades goniometric instrument for the comprehensive characterization of the spectral properties of thin-film filters, Michel Lequime[1], Simona Liukaityte[1], Myriam Zerrad[1], Claude Amra[1]; [1]*Institut Fresnel - UMR 7249, France*. This paper describes an innovative instrument that allows to measure the optical features of a thin-film filter (transmission, reflection, blocking, steepness, scattering) with 12 decades detection range and sub-nanometer spectral resolution.

FW5G.4 • 17:00 Invited
Optical Metrology Systems Spanning the Full Spatial Frequency Spectrum, Dae Wook Kim[1], Maham Aftab[1], Heejoo Choi[1], Logan Graves[1], Isaac Trumper[1]; [1]*Univ. of Arizona, USA*. We present a collection of unique, collaborative optical metrology systems that are fully capable of measuring the extensive spectrum of low-to-mid-to-high spatial frequencies, corresponding to surface shape information.

FW5H • Freeform Design and Metrology—Continued

FW5H.4 • 16:45
Transverse Translation Diverse Phase Retrieval for Reflective and Freeform Surface Metrology, Aaron Michalko[1], James R. Fienup[1]; [1]*Univ. of Rochester, USA*. The performance of transverse translation diverse phase retrieval is assessed in two different scenarios. First, performance is compared between a hard-edged and soft-edged subaperture. Second, performance is analyzed on a highly aberrated wavefront.

FW5H.5 • 17:00
Optical Differentiation Wavefront Sensing for Freeform Optics Metrology, Jie Qiao[1,2], Zachary Mulhollan[1], Christophe Dorrer[2]; [1]*Rochester Inst. of Technology, USA;*[2]*Aktiwave LLC, USA*. High resolution, high dynamic range optical differentiation wavefront sensor using binary pixelated filters has been developed for the metrology of freeform optics. Wavefront reconstruction precision and accuracy will be presented.

FW5H.6 • 17:15
Scanning Customized Swept-source Optical Coherence Tomography (SS-OCT) for the Metrology of Freeform Optical Surfaces, Di Xu[1], Jianing Yao[1], Nan Zhao[1,2], Jannick P. Rolland[1]; [1]*The Inst. of Optics, Univ. of Rochester, USA;* [2]*Changchun Inst. of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, China*. A high-precision SS-OCT system with custom scanning configuration was developed for the point cloud metrology of freeform optical surfaces. Capabilities were demonstrated on an Alvarez surface and a measurement precision of λ/20 was achieved.

LW5I • Integrated Quantum Photonics II—Continued

LW5I.3 • 17:00 Invited
Advances in Silicon Quantum Photonics, D. Bonneau[1], J.W. Silverstone[1], J. Wang[1], P. Sibson[1], R. Santagati[1], C. Erven[1], J.L. O'Brien[1], M.G. Thompson1; [1]*Univ. of Bristol, UK*. Silicon quantum photonics has emerged as a promising approach to realising complex and compact quantum circuits for applications in communication and computation. Highlights include chip-to-chip quantum communications, programmable quantum circuits and chip-based quantum simulations.

FW5A • Understanding Myopia Development—Continued

FW5B • High-Power Fiber Lasers and Beam Combining—Continued

FW5B.6 • 17:30
Optimization of Coaxial Tm/Ho-Doped Fiber Lasers, Krysta Boccuzzi[1], G. A. Newburgh[2], John R. Marciante[1]; [1]*Univ. of Rochester, USA;* [2]*U.S. Army Research Laboratory, USA.* Simulations of a novel coaxial fiber having a Ho-doped core surrounded by a Tm-doped ring resulted in 52% laser efficiency. The conventional method, a Tm:fiber laser pumping a Ho:fiber laser, yielded a maximum 43% efficiency.

FW5B.7 • 17:45 Invited
All-fiber Combining Concepts in the Wavelength Range Around 2 µm, Hakan S. Sayinc[1], Katharina Hausmann[1], Christoph Ottenhues[1], Okan Isik[1], Michael Steinke[1], Saniye S. Yilmaz[1,2], Samir Lamrini[3], Jörg Neumann[1], Fatih Ömer Ilday[2], Dietmar Kracht[1]; [1]*Laser Zentrum Hannover e.V., Germany;* [2]*Department of Physics, Bilkent Univ., Turkey;* [3]*Laser Development, Lisa Laser OHG, Germany.* We investigated combining in the 2 µm wavelength range. Tapered fused bundles enabled multi-mode combining, while coupling of single-mode sources to a truly single mode fiber was performed employing cascades of wavelength division multiplexers.

FW5C • Optical Coherence Tomograpy—Continued

FW5C.5 • 17:30 Invited
Double-clad Fiber Couplers: Novel Devices for Multimodal Imaging., Caroline Boudoux[1]; [1]*Engineering Physics, Ecole Polytechnique Montreal, Canada.* Innovation in double-clad fiber couplers allow for efficient separation (or combination) of coherent and diffuse light, which makes them ideally suited to perform multimodal endoscopic optical imaging.

FW5D • Integrated Photonics—Continued

FW5D.5 • 17:30
Orbital Angular Momentum Multiplexing using Low-Cost VCSELs for Datacenter Applications, Mehdi Nouri[1], Hiva Shahoie[1], Timothy LaFave[1], Solyman Ashrafi[1], Duncan MacFarlane[1]; [1]*Electrical Engineering, Southern Methodist Univ., USA.* Development of 428 Gb/s free space data communications link based on OAM multiplexing using 850nm VCSELs is presented. Passive optical mode sorters are used for MUX (transmit) and DeMUX (receive).

FW5D.6 • 17:45
Wavelength Selective External Cavity Laser Using an InAs Quantum Dot Gain Chip and an Arrayed-Waveguide Grating for T-band Optical Communication, Yudai Okuno[1], Yasunori Tomomatsu[2], Yoshinori Sawado[3], Katsumi Yoshizawa[3], Hideaki Shibutani[1], Hiroyuki Tsuda[1]; [1]*Keio Univ., Japan;* [2]*Koshinkogaku Corporation, Japan;* [3]*Pioneer Micro Technology Corporation, Japan.* The wavelength selective external cavity laser using an InAs quantum dot gain chip and an arrayed-waveguide grating for T-band communication is proposed and the output wavelength can be tuned from 1041.8 nm to 1090.5 nm.

17:00–17:45 OSA Annual Business Meeting, *Hyatt Regency Rochester, Regency Ballroom C*

17:00–18:00 APS Division of Laser Science Annual Business Meeting, *Radisson Hotel Rochester Riverside, Genesee Suite F*

18:30–21:30 OSA 100 Year BASH, *The Sibley Building, 228 East Main Street, Rochester, New York*

FW5E • Ultrafast Lasers and Applications—Continued

FW5E.5 • 17:30 Invited

Prospects for Multi-kJ Plasma Amplifiers, Peter A. Norreys[1,2], James Sadler[1], Raoul M. Trines[2], Robert Bingham[2], Muhammad Kasim[1], Luke Ceurvorst[1], Naren Ratan[1]; [1]*Department of Physics, Univ. of Oxford, UK;* [2]*Central Laser Facility, STFC Rutherford Appleton Laboratory, UK.* Plasma amplifiers potentially offer a route to low cost, high efficiency, multi-kJ laser pulses. I will describe numerical simulations underpinning careful experiment design and interpretation to optimize this process at the Univ. of Rochester.

FW5F • Nonlinear Optics in Micro/Nano-Optical Structures II—Continued

FW5F.5 • 17:30

Comb-Like Frequency-Bin Entangled Photon Pair Generation in Silicon Nitride Microring Resonators, Jose A. Jaramillo-Villegas[1,2], Poolad Imany[1], Ogaga D. Odele[1], Xiaoxiao Xue[1], Yi Xuan[1], Kyunghun Han[1], Daniel E. Leaird[1], Minghao Qi[1], Andrew M. Weiner[1]; [1]*Purdue Univ., USA;* [2]*Universidad Tecnológica de Pereira, Colombia.* We report a comb-like frequency-bin entangled photon pair source with a high coincidence to accidental ratio in a silicon nitride microring resonator. We measured a Schmidt number of 4.0, thus verifying high degree of time-frequency entanglement.

FW5F.6 • 17:45

Direct Compressive Imaging of Joint Quantum States with Strong Projections, Samuel H. Knarr[1], Daniel Lum[1], James Schneeloch[2], John Howell[1]; [1]*Univ. of Rochester, USA;*[2]*Air Force Research Laboratory , USA.* We are performing an experiment to incorporate compressive sensing into a direct measurement protocol to measure general transverse joint-states using strong projections. We present simulation results of a 256 × 256 system using 9% sampling.

FW5G • Optical Fabrication and Metrology—Continued

FW5G.5 • 17:30

Windshield Metrology: Simultaneous measurement of wedge angle and layer thickness, Michael A. Marcus[1]; [1]*Lumetrics, Inc, USA.* An interferometric apparatus to simultaneously measure layer thickness and wedge angle profiles in multilayer windshields is described along with its measurement reproducibility. A hand-held probe simplifies alignment to the windshield surface.

FW5G.6 • 17:45

Multifunctional Optics Testing Using Wavefront Technology, Johannes Pfund[1], Christian Brock[1], Ralf Dorn[1]; [1]*Optocraft Metrology GmbH, Germany.* Consumer optics require multifunctional and high performance test equipment. Latest developments and examples are described and how multifunctional optics testing can be realized on basis of wave-front sensing combined with other techniques.

FW5H • Freeform Design and Metrology—Continued

FW5H.7 • 17:30

Zernike Coefficient Measurement Using Geometric Phase shifting Radial Shearing Interferometer, Chittur S. Narayanamurthy[1]; [1]*Indian Inst. of Space Sci & Tech, India.* Geometric phase shifting radial shearing interferometer method is used to determine Zernike Co-efficients of Kolmogorov type turbulence affected wavefront with detailed comparison with SHWS data.

FW5H.8 • 17:45

Achromatic Resonances in an Optical Microcavity, Soroush Shabahang[1], H. Esat Kondakci[1], Massimo L. Villinger[1], Joshua Perlstein[2], Ayman Abouraddy[1,2]; [1]*Univ. of Central Florida, CREOL, USA;* [2]*Materials Science and Engineering, Univ. of Central Florida, USA.* Achromatic transmission in a Fabry-Perot microcavity is demonstrated by angularly-multiplexed phase-matching. A 0.7-nm-wide resonance is broadened to 60nm, spanning multiple cavity FSRs, by assigning each wavelength to an appropriate incidence angle.

LW5I • Integrated Quantum Photonics II—Continued

LW5I.4 • 17:30

Subradiance in a nanofiber mode by an ensemble of a few cold Rb atoms, Pablo Solano[1], Burkley Patterson[1], Steve L. Rolston[1], Luis A. Orozco[1], Fredrik K. Fatemi[2], James Clemens[3], Perry Rice[3], Pablo Barberis Blostein[5], Howard Carmichael[4]; [1]*Univ. of Maryland at College Park, USA;* [2]*Army Research Laboratory, USA;* [3]*Physics, Miami Univ., USA;* [4]*Physics, Univ. of Auckland, New Zealand;* [5]*IIMAS, UNAM, Mexico.* The excitation-decay from a few cold Rb atoms into the mode of an optical nanofiber shows two distinct time-scales: First the normal lifetime, and then a longer subradiant lifetime that scales linearly with optical density.

LW5I.5 • 17:45

Frequency Modes of Ultrafast Pumped, High-Gain Modulational Instability: Chirp Tuning & Characterization, Martin A. Finger[1], Nicolas Joly[2,1], Philip S. Russell[1,2], Maria V. Chekhova[1,2]; [1]*Max Planck Inst for the Science of Light, Germany;* [2]*Department of Physics, Univ. of Erlangen-Nuremberg, Germany.* The effective number of frequency modes for twin beams generated in a gas-filled PCF can be continuously tuned via the pump-pulse chirp. Spectral covariance measurements yield the shapes and relative weights of the modes.

17:00–17:45 OSA Annual Business Meeting, *Hyatt Regency Rochester, Regency Ballroom C*

17:00–18:00 APS Division of Laser Science Annual Business Meeting, *Radisson Hotel Rochester Riverside, Genesee Suite F*

18:30–21:30 OSA 100 Year BASH, *The Sibley Building, 228 East Main Street, Rochester, New York*

07:00–17:00 Registration, *Galleria*

08:00–09:30 JTh1A • Joint Plenary Session II, *Lilac Ballroom*

09:30–14:00 Exhibits Open, *Empire Hall*

09:30–14:00 Glass Art Contest, *Empire Hall*

09:30–10:00 Coffee Break, *Empire Hall*

09:30–10:30 Unopposed Exhibit Only Time, *Empire Hall*

Empire Hall

JOINT FiO/LS

09:30–11:00
JTh2A • Joint Poster Session II

JTh2A.1
Optical surface profilometry using Fresnel diffraction from a 2D array of reflective phase-steps, Pegah Asgari[1], Yousef Pourvais[2], Ahmad Darudi[1]; [1]*Zanjan Univ., Iran*[2]*Physics, Univ. of Tehran, Iran*. In this paper, a novel method is presented for optical surface profilometry, based on phase-step diffractometry. The technique combines the advantages of Hartamnn and Fizeau methods and is tolerant with environmental noises.

JTh2A.2
Spatial Squeezing in Bright Twin Light Beams using a CCD Camera, Ashok Kumar[1], Hayden Nunley[1], Alberto Marino[1]; [1]*The Univ. of Oklahoma , USA*. We report the direct measurement of 2 dB of spatial squeezing with an EMCCD camera. We use bright twin beams of light generated through four-wave mixing in a double-lambda configuration in Rb atomic vapor.

JTh2A.3
Stimulated Low-Frequency Raman Scattering, Anna Kudryavtseva[1], Nikolay V. Tcherniega[1], Konstantin I. Zemskov[1]; [1]*P.N. Lebedev Physical Inst., Russian Federation*. Stimulated low-frequency Raman scattering, caused by laser pulses interaction with acoustic vibrations of nanoparticles, has been studied in the wide range of nanoobjects both in high-ordered and random materials, in inorganic and organic substances.

JTh2A.4
Constant intensity waves and transmission through non-Hermitian disordered media, Konstantinos Makris[1], Andre Brandstotter[2], Phillip Ambichl[2], Ziad Musslimani[3], Stefan Rotter[2]; [1]*Univ. of Crete, Greece;* [2]*Inst. for Theoretical Physics, Vienna Univ. of Technology, Austria;* [3]*Mathematics, Florida State Univ., USA*. By using the concept of constant-intensity waves, we show that perfect transmission through the disordered media is possible. Such scattering states can exist in non-Hermitian scattering landscapes with suitably engineered gain-loss distributions.

JTh2A.5
Zero Rabi Flopping in the presence of a Field, Julio Cesar Garcia Melgarejo[1,2], Edgar Samuel Arroyo Rivera[2], Ricardo Martínez Martínez[2], José Alfredo Ramírez Flores[2], Javier Sanchez Mondragon[1]; [1]*Inst Nac Astrofisica Optica Electronica, Mexico;* [2]*Universidad Autónoma de Coahuila, Mexico*. The idle role of the photonic dark state of the X-Cavity JCM is quite an interesting feature because arises from dipole orientation. We discuss the zero Rabi flopping in its presence and discuss its evidence.

JTh2A.6
Plasmonic Effect of Low-Dimensional Electron Gas in Core-Shell Nanowires, Kiana Montazeri[1], Zhihuan Wang[1], Bahram Nabet[1]; [1]*Drexel Univ., USA*. We analyze the plasmonic effect of core-shell nanowires explaining how metallic layers and low-dimensional electron gas formed at the heterojunction of the core and the shell affect the optical cavity and mode generations.

JTh2A.7
An Experimental study of Odd-Order Dispersion Effects in Propagation of Long-Range Surface Plasmon Polaritons Using a Hong-Ou-Mandel Interferometer, Naoto Namekata[1], Ryo Kobayashi[1], Takahide Sakaidani[1], Shuichiro Inoue[1]; [1]*Nihon Univ., Japan*. Higher-order dispersion effects on long-range surface-plasmon-polariton waveguide have been investigated using a quantum interferometer. We observed degradation of the quantum indistinguishability which originated from the odd-order dispersions.

JTh2A.8
Withdrawn.

JTh2A.9
Ambient-condition growth of high-pressure phase centrosymmetric crystalline KDP microstructures for efficient optical second harmonic generation, Y. Ren[2], Lu Deng[1], E.W. Hagley[1], X. Zhao[2]; [1]*National Inst of Standards & Technology, USA;* [2]*State Key Laboratory of Crystal Materials, Shandong Univ., China*. We report ambient-condition growth of one-dimensional, self-assembled, single-crystalline KDP hexagonal hollow/solid core microstructures having molecular structure and symmetry identical to the type-IV KDP monoclinic crystal phase.

JTh2A.10
Nonlinear absorption in WS_2 and MoS_2 mono- and few-layer films, Saifeng Zhang[1], Yuanxin Li[1], Niall McEvoy[2], Jun Wang[1]; [1]*Shanghai Inst of Optics & fine Mechanics, USA;*[2]*Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN) and Advanced Materials and BioEngineering Research (AMBER) Centre, Trinity College Dublin, Ireland.*WS_2 and MoS_2 mono- and few-layer films were fabricated by vapor phase sulfurization or chemical vapor deposition method. The nonlinear absorption (saturable absorption, two-photon absorption) properties in VIS to NIR range were investigated.

JTh2A.11
Nonlinear optical response of a two-dimensional atomic crystal, Michele Merano[1]; [1]*Universita degli Studi di Padova, Italy.* The theory of Bloembergen and Pershan for the light waves at the boundary of nonlinear media is extended to a nonlinear two-dimensional atomic crystal. A comparison with experimental results is reported.

JTh2A • Joint Poster Session II—Continued

JTh2A.12
Optical Pumping of Alkali Hyperfine States via Free-Free Molecular Absorption: Demonstration of Circularly Polarized Stimulated Emission on the Alkali D_2 Lines, Andrey Mironov[1], James G. Eden[1]; [1]*Electrical and Computer Engineering, Univ. of Illinois at Urbana-Champaign, USA.* We report a novel method for the pumping of alkali hyperfine states by using circularly polarized pump light absorbed by alkali-rare gas atomic pairs.

JTh2A.13
Effect of Purcell Enhancement on Internal Quantum Efficiency of InGaN Green Light-Emitting Diode Structures, Han-Youl Ryu[1], Guen-Hwan Ryu[1], Young-Hwan Choi[1]; [1]*Inha Univ., Korea.* We theoretically investigate the modification of internal quantum efficiency (IQE) in InGaN green flip-chip LED structures as a result of the Purcell effect that is found to be quite advantageous for improving the IQE InGaN green LEDs.

JTh2A.14
Non-local angular double-slit ghost diffraction with thermal light, Lu Gao[1], J.P. Zhao[2], Omar S. Magaña-Loaiza[2], Seyed Mohammad Hashemi Rafsanjani[2], Mohammad Mirhosseini[2], Yiyu Zhou[2], Robert W. Boyd[2]; [1]*School of Science, Univ. of Geosciences (Beijing), China;* [2]*The Inst. of Optics, Univ. of Rochester, USA.* We report an experimental observation of ghost diffraction with non-local angular double-slit by making use of thermal light OAM correlation measurement. Correlated angular interference patterns of the distributed angular double-slit are measured.

JTh2A.15
The Effect of Misaligned Modal Loss on Entangled Qubits, Brian T. Kirby[1], Michael Brodsky[1]; [1]*US Army Research Laboratory, USA.* Quantum Networks require the ability to distribute entanglement to remote nodes, which could be degraded by the mode dependent loss in transmission channels. We offer an elegant way to account for the mode loss impact.

JTh2A.16
Effect of Spin Squeezing Followed by Anti-Squeezing in a Collective State Atomic Clock, Resham Sarkar[1], Minchuan Zhou[1], Renpeng Fang[1], Selim Shahriar[1]; [1]*Northwestern Univ., USA.* Two-axes counter-twist (TACT) spin-squeezing can significantly reduce the quantum projection noise in an ensemble of two-level atoms. Here, we investigate the effect of TACT followed by an anti-TACT pulse in a collective state atomic clock.

JTh2A.17
Entanglement Constraints with Quantum Background Parties, Xiao-Feng Qian[1], Miguel A. Alonso[1], Joseph H. Eberly[1]; [1]*Univ. of Rochester, USA.* We include the usually neglected unidentified non-interacting quantum background in the analysis of open system dynamics. A set of generic inequalities of entanglement dynamics is discovered and their novel geometric representations are presented.

JTh2A.18
Control of spatial distribution of entangled photons by the spatial structure of classical pump beam, Jabir M. V.[1], N. Apurv Chaitanya[1,2], Goutam K. Samanta[1]; [1]*Physical Research Laboratory, India;* [2]*Indain Inst. of Technology, India.* We control the spatial distribution of entangled photons generated through SPDC process by manipulating spatial structure of classical pump beam. Using vortex pump beam, we show that the entangled photons have doughnut spatial distribution.

JTh2A.19
Wideband Suppression of Local Density of States in Random Waveguides, Xiaojun Cheng[1,2]; [1]*CUNY Queens College, USA;* [2]*Graduate Center of CUNY, USA.* We find the local density of states inside quasi-1D random waveguide is increasingly suppressed in the middle of the sample over a wide frequency range with increasing sample length and decreasing waveguide cross section.

JTh2A.20
Revivals in the Jaynes-Cummings model in terms of characteristic functions, Hudson Pimenta[1], Daniel F. James[1]; [1]*Univ. of Toronto, USA.* Through the periodicity of characteristic functions, we find that atomic population revivals in the Jaynes-Cummings model are replicas of each other that have experienced dispersion akin to that of free particles in quantum mechanics.

JTh2A.21
The cross-cavity micromaser., Julio Cesar Garcia Melgarejo[1,2], Nestor Lozano-Crisostomo[1,2], José Alfredo Ramírez Flores[1], Ricardo Martínez Martínez[1], Javier Sanchez Mondragon[1]; [1]*Inst Nac Astrofisica Optica Electronica, Mexico;* [2]*Universidad Autónoma de Coahuila, Mexico.* The experimental and QED dynamics of a JCM micromaser relies on the JCM fully solvability. We discuss an analogous case, an X-cavity, where a new quantum feature produced by the x-cavity has not been accounted.

JTh2A.22
The cross-cavity photon dark state., Julio Cesar Garcia Melgarejo[1,2], Edgar Samuel Arroyo Rivera[1], Daniel Alberto May Arrioja[3], Miguel Torres Cisneros[4], Javier Sanchez Mondragon[1]; [1]*Inst Nac Astrofisica Optica Electronica, Mexico;* [2]*Universidad Autónoma de Coahuila, Mexico;* [3]*Centro de Investigaciones en Óptica, A. C., Mexico;* [4]*Universidad de Guanajuato, Mexico.* The photonic dark state of the X-Cavity JCM is one of the interesting joint features of the orthogonal single cavity modes pair. We test its quantum nature by introducing a second Two Level Atom.

JTh2A.23
Choice of the Detection Location in a Three-Party Measurement-Device-Independent Quantum Key Distribution System, Yucheng Qiao[1], Zhengyu Li[1], Ziyang Chen[1], Bin Luo[2], Xiang Peng[1], Hong Guo[1]; [1]*Peking Univ., China;* [2]*Beijing Univ. of Posts and Telecommunications, China.* We propose a method of choosing the detection location for a three-party measurement-device-independent quantum key distribution system, which can simplify the parameter optimization problem for practical applications.

JTh2A.24
Highly-sensitive detection of the lattice distortion in single bent ZnO nanowires by second-harmonic generation microscopy, Xiaobo Han[1], Kai Wang[1], Peixiang Lu[1]; [1]*HUST, China.* A high detection sensitivity of ~0.001 nm on the bending distortion is obtained by measuring the SHG polarimetric patterns. The twisting distortion can also be detected by observing the extraordinary non-axisymmetrical SHG polarimetric patterns.

JTh2A.25
Optical Image Cloning based on Electromagnetically Induced Absorption, Shamaila Manzoor[1], Ulices F. Apolinario[1], Luis E. Araujo[1]; [1]*Instituto de Física "Gleb Wataghin," Universidade Estadual de Campinas, Brazil.* We experimentally demonstrate, for the first time, imaging cloning of the spatial profile of a strong coupling beam onto that of a weak probe beam via electromagnetically induced absorption in a warm Rb vapor cell.

JTh2A.26
Nondegenerate Nonlinear Refraction in Semiconductors, Peng Zhao[1], Matthew Reichert[2], David Hagan[1], Eric Van Stryland[1]; [1]*CREOL Univ. of Central Florida, USA;* [2]*Princeton Univ., USA.* The dispersion of nondegenerate nonlinear refraction in semiconductors is measured using our beam-deflection method. With high nondegeneracy, n_2 is significantly enhanced over degenerate case, and rapidly switches sign to negative near the bandgap.

JTh2A.27
Withdrawn.

JTh2A.28
Caustic and wavefronts produced by arbitrary reflecting surfaces, Maximino Avendaño Alejo[1]; [1]*Universidad Nacional Autonoma de México, Mexico.* We provide a simple formulas for reflected caustics and wavefronts through smooth surfaces considering an incident plane wavefront propagating along the optical axis, having a wide potential of non-imagining optical systems for solar concentrators.

JTh2A.29
Numerical Algorithm for Finding Optimal Experimental Setup for Arbitrary Unitary Operator, Sushovit Adhikari[1], Jonathan Dowling[1]; [1]*Louisiana State Univ., USA.* A numerical algorithm to generate an optimal experimental setup for arbitrary unitary matrix has been developed. Given an unitary operator, the algorithm designs the experiment with the least number of beam splitters used.

JTh2A.30
Optimal Architectures for Single Photon Metrology, Margarite L. LaBorde[1], Jonathan P. Olson[1], Keith R. Motes[2], Patrick Birchall[3], Nick M. Studer[1], Todd Moulder[1], Peter P. Rohde[4], Jonathan Dowling[1]; [1]*Hearne Inst. for Theoretical Physics and Department of Physics & Astronomy, Louisiana State Univ., USA;* [2]*Department of Physics and Astronomy, Macquarie Univ., Australia;* [3]*Centre for Quantum Photonics, H. H. Wills Physics Laboratory and Department of Electrical and Electronic Engineering, Univ. of Bristol, UK;* [4]*Centre for Quantum Computation and Intelligent Systems, Faculty of Engineering & Information Technology, Univ. of Technology, Australia.* Passive linear optics are utilized to determine an interferometer with single-photon inputs capable of high phase sensitivity. This structure was optimized to maximize phase sensitivity and furthermore to explicitly compute this sensitivity.

JTh2A.31
Dark gap polariton solitons in a one-dimensional periodic potential, Ting-Wei Chen[1], Szu-Cheng Cheng[1]; [1]*Chinese Culture Univ., Taiwan.* The dark polariton solitons are investigated in a 1D periodic potential. The effective-mass approximation is used to obtain the numerical dark solitons in the zone center and edge under a diversity of potential depths and pump powers.

JTh2A • Joint Poster Session II—Continued

JTh2A.32
Highly Efficient Self-Q-Switched Erbium-Ytterbium Fiber Laser Operating at High Output Powers, Luis F. Samano Aguilar[1], Juan C. Hernandez Garcia [1,2], Julian Moises Estudillo Ayala[1], Roberto Rojas Laguna[1], Olivier Pottiez[3], Jose David Filoteo Razo[1], Jesus Pablo Lauterio Cruz[3], Daniel Jauregui Vazquez[1]; [1]*Universidad De Guanajuato, Mexico;* [2]*CONACYT, Mexico;* [3]*CIO, Mexico.* Ring self-Q-switched Er^{3+}/Yb^{3+} fiber laser operated at 1565 nm is presented. The configuration has: high efficient (~62%), high output power (10 W) and short pulses generation (ns), allowing a stable multiple pulsing regime.

JTh2A.33
Optical reversible gate based on lithium niobate based Mach Zehnder Interferometers, Chander kanta[1], Santosh Kumar[1], Angela Amphawan[2,3]; [1]*DIT Univ., India;* [2]*School of Computing, Universiti Utara Malaysia, Malaysia;* [3]*Massachusetts Inst. of Technology, USA.* In this paper, basic reversible logic gate (Peres gate) using the lithium niobate based Mach-Zehnder Interferometer is proposed. The results are verified using beam propagation method and MATLAB simulations.

JTh2A.34
Atom-photon interface using the higher order modes of an ultrathin optical fiber, Thomas Nieddu[1], Jinjin Du[1], Sile Nic Chormaic[1]; [1]*Okinawa Inst. of Science and Technology Graduate School, Japan.* We create an atom-photon interface using the higher order modes (HOM) of an ultrathin optical fiber. We explore interactions between HOMs and a cold atomic ensemble, with aim to transfer and store orbital angular momentum.

JTh2A.35
High power phase-locked four cores fiber laser, Liu YeHui[1], Wang Yibo[1], Liao Lei[1], Li Haiqing[1], Peng jinggang[1], Yang Ivyun[1], Li Jinyan[1]; [1]*Huazhong Univ. of Science&Technolog, China.* We demonstrate a high power 4 cores Yb-doped fiber amplifier which is operated in an in-phase supermode and does not need other mode selection mechanisms.The maximum output power is 9.75 W.

JTh2A.36
Design and Analysis of high bandwidth Bragg Fiber having Triangular Refractive Index Core Profile for Broadband Applications, Vikram Palodiya[1], Sanjeev K. Raghuwanshi[1];[1]*Indian School of Mines, Dhanbad, India.* In this paper, we have studied performance of Bragg fiber having different type of core profile. Its dispersion, power confinement, group delay, bending losses, effective nonlinear refractive index and polarization mode dispersion are studied.

JTh2A.37
Tunable wavelength Thulium-doped fiber laser based in a Hi-Bi Fiber Optical Loop Mirror, Manuel Duran-Sanchez[1,2], Ricardo Iván Alvarez-Tamayo[1], Baldemar Ibarra-Escamilla[1], Evgeny Kuzin[1], Antonio Barcelata-Pinzón[3]; [1]*INAOE, Mexico;* [2]*CONACyT, Mexico;* [3]*UTP, Mexico.* A tunable wavelength operation of a linear cavity Thulium-doped fiber laser based on the use of a fiber optical loop mirror with high birefringence (Hi-Bi) fiber in the loop is experimentally demonstrated.

JTh2A.38
Mid-infrared Dispersive Waves Generation in an All-solid $AsSe_2$-As_2S_5 Microstructured Optical Fiber, Tonglei Cheng[1], Hoang Tuan Tong[1], Lai Liu[1], Xiaojie Xue[1], Morio Matsumoto[2], Hiroshige Tezuka[2], Takenobu Suzuki[1], Yasutake Ohishi[1]; [1]*ofmlab, Japan;* [2]*Furukawa Denshi Co., Ltd., Japan.* We design an all-solid chalcogenide microstructured optical fiber with four rods in the cladding in order to generate the mid-infrared dispersive waves.

JTh2A.39
Chromatic dispersion engineering in chalcogenide multi-step index fiber for mid-infrared supercontinuum generation, Kenshiro Nagasaka[1], Hoang Tuan Tong[1], Lai Liu[1], Takenobu Suzuki[1], Yasutake Ohishi[1]; [1]*Research Center for Advanced Photon Technology, Toyota Technological Inst., Japan.* Chalcogenide multi-step index fiber with zero-flattened chromatic dispersion is developed to realize mid-infrared supercontinuum generation. We simulate mid-infrared supercontinuum generation covering 2-19 μm in the designed fiber.

JTh2A.40
Tomographic studies of polymer optical bridges produced by photopolymerization, Michal Dudek[1], Malgorzata Kujawinska[1]; [1]*Inst. of Micromechanics and Photonics, Warsaw Univ. of Technology, Poland.* The studies of 3D refractive index distribution in polymer optical bridges are presented. Digital holographic system in shearing interferometer configuration for projections capture and detailed procedure of tomographic reconstruction are described.

JTh2A.41
Polarization Evolution of Vector Wave Pulses in Twisted Fibers Pumped by Single and Coupled Solitons, Mohammad Almanee[1], Joseph Haus[1], Ivan Armas-Rivera[3], Georgina Beltran-Perez[3], Baldemar Ibarra-Escamilla[2], Manuel Duran-Sanchez[2], Ricardo I. Álvarez-Tamayo[2], Evgeny Kuzin[2], Yazmin Bracamontes-Rodríguez[4], Olivier Pottiez[4]; [1]*Univ. of Dayton, USA;* [2]*Optics, Instituto Nacional de Astrofisica, Optica y Electronica, Mexico;* [3]*Benemérita Universidad Autónoma de Puebla, Mexico;* [4]*Centro de Investigaciones en Optica, Mexico.* Nonlinear polarization dynamics of single and coupled solitons in twisted fibers is experimentally and numerically studied. The output polarization for two solitons evolves towards a circular polarization and shows a jump at linear input ellipticity.

JTh2A.42
Fabrication and characterization of a tellurite all-solid photonic bandgap fiber with three rings of high index rods, Hoang Tuan Tong[1], Kenichi Hashimoto[1], Shunta Tanaka[1], Kenshiro Nagasaka[1], Takenobu Suzuki[1], Yasutake Ohishi[1]; [1]*Optical Functional Materials Laboratory, Toyota Technological Inst., Japan.* We demonstrate a tellurite all-solid photonic bandgap fiber (AS-PBF) with three rings of high-index rods. It has lower confinement loss and better performance as compared with the previously reported tellurite AS-PBF.

JTh2A.43
Guided Acoustic Wave Brillouin Scattering (GAWBS) and Slow Light in Optical Fibers, Christopher K. Horne[1], Chung Yu[1], Zhijian Xie[1]; [1]*North Carolina A&T State Univ., USA.* We report the nonlinear effects of Guided Acoustic Wave Brillouin Scattering on pulse delay and distortion in a special low light device.

JTh2A.44
Molecular Imprinting and SPR Based Fiber Optic Sensor for 1-Naphthol, Banshi D. Gupta[1], Anand M. Shrivastav[1], Sruthi P. Usha[1]; [1]*Indian Inst. of Technology, Delhi, India.* We introduce an approach to develop an optical fiber sensor for 1-naphthol using molecular imprinting and SPR phenomenon. Wavelength interrogation method is used for sensor characterization. The sensor operates for concentration range of 0-100μM.

JTh2A.45
Narrow-linewidth monolithic CW 2 kW fiber laser with near diffraction-limited beam quality, Wei Shi[1]; [1]*Tianjin Univ., China.* We demonstrate a monolithic CW fiber laser source at 1070.25 nm, producing 2 kW laser power with very narrow spectral linewidth (<0.3 nm) and near diffraction-limited beam quality (M^2 =~1.3).

JTh2A.46
Strain Manipulation of Hybrid Graphene-Microfiber Waveguide, Jin-hui Chen[1], Fei Xu[1]; [1]*Nanjing Univ., China.* Here the strain characteristics of a hybrid graphene-microfiber waveguide structure is first investigated. By in-line loading strain, we can achieve modulating transmission of the device as high as 30% with ~5% strain.

JTh2A.47
Soliton Interaction in Nearly Degenerate Modes of a Multimode Fiber, Shaival Buch[1], Govind P. Agrawal[1]; [1]*Univ. of Rochester, USA.* We numerically investigate soliton interaction in nearly degenerate modes of a multimode fiber. Periodic intermodal power transfer is observed and its dependence on phase, temporal delay, propagation constant and group velocity difference is studied.

JTh2A.48
Hybrid Fiber Optic Probe for Fluidized Gas-Solid Beds, Jorge Galvis[1], Pedro Torres[1], Alejandro Molina[1]; [1]*Universidad Nacional de Colombia-Medelli, Colombia.* We present the concept of hybrid fiber optic probe for fluidized gas-solid beds. We found that the hybrid fiber optic probes are promising to simultaneously measure solids concentration and particle velocity.

JTh2A.49
Optically Bound Micro-Particle Arrays near Ultrathin Optical Fibers, Aili Maimaiti[1], Daniela Holzmann[2], Viet Giang Truong[1], Helmut Ritsch [2], Sile Nic Chormaic[1]; [1]*Okinawa Inst of Science & Technology, Japan;* [2]*Univ. of Innsbruck, Austria.* Particles trapped in the evanescent field of ultrathin optical fibers can interact via scattering of the fiber-guided light fields. Here, we study the difference between fundamental and higher order mode optical binding of polystyrene beads.

JTh2A.50
Soliton-Mediated Dispersive Wave Reflection for Multimode Supercontinuum Generation, Vishwatosh Mishra[1,2], Satya P. Singh[1], Raktim Haldar[2], Shailendra K. Varshney[1,2];[1]*Department of Physics, IIT Kharagpur, India;* [2]*Department of E&ECE, IIT Kharagpur, India.* Femtosecond pulse propagation in multi-mode PCF has been studied numerically including azimuthally symmetric modes LP_{01} and LP_{02}. The presence of LP_{02}-mode facilitates partial reflection of dispersive wave by the soliton in LP_{01}-mode.

JTh2A.51
Self-similar Propagation in a Dispersion Managed and Highly Nonlinear Segmented Bandgap Fiber in the mid-IR, Piyali Biswas[1], Somnath Ghosh[1], Abhijit Biswas[1], Bishnu P. Pal[2]; [1]*Univ. of Calcutta, India;* [2]*Mahindra École Centrale, School of Natural Sciences, India.* Rapidly varying but of nearly-mean-zero longitudinal dispersion profile has been adopted to achieve self-similar propagation of parabolic optical pulses through a chalcogenide glass based and segmented highly-nonlinear bandgap optical fiber at 2.8 μm.

JTh2A.52
FO-LMR Based Chlorine Gas Sensor Using Zinc Oxide Nanostructure, Sruthi P. Usha[1], Anand M. Shrivastav[1], Banshi D. Gupta[1]; [1]*Indian Inst. of Technology, Delhi, India.* Lossy mode resonance based fiber optic chlorine gas sensor using ZnO nanoparticles is reported. A shift of 14 nm in peak absorbance wavelength is observed for the change in chlorine concentration from 10 to100 ppm.

JTh2A • Joint Poster Session II—Continued

JTh2A.53
Optical Fiber SPR Sensor for Simultaneous Determination of Cu(II) and Pb(II) Ions Using Molecular Imprinting, Anand M. Shrivastav[1], Sruthi P. Usha[1], Banshi D. Gupta[1];[1]*Indian Inst. of Technology, Delhi, India.* Fabrication and characterization of SPR based fiber optic sensor for detection of copper and lead ions using molecular imprinting in the operating range of 0-10 mg/L and 0.100µg/L for Cu(II) and Pb(II) ions are reported

JTh2A.54
Measurement of Back-reflection and Back-scattering Noise in High Sensitivity Photonic Crystal Fibre-optic Gyroscope, Teng Fei[1], Jing Jin[1], Zuchen Zhang[1], Chunxi Zhang[1];[1]*Beihang Univ., USA.* The incoherent back-reflected and backscattered light in PCF IFOG was investigated. A more accurate noise model for PCF IFOG which takes incoherent back-reflection and backscattering noise into account was proposed and verified by experiments.

JTh2A.55
Projective Measurement of the Lagueurre-Gaussian Spectrum, Seyed Mohammad Hashemi Rafsanjani[1], Omar S. Magana Loaiza[1], Mohammad Mirhosseini[1], Robert W. Boyd[1];[1]*Univ. of Rochester, USA.* We propose a protocol for measuring the radial index of Laguerre-Gaussian modes, and provide evidence of lossless and unitary transformation of these modes into a Gaussian mode.

JTh2A.56
Hybrid Wireless Communication Networks: Integrating Free-Space Optics and WiFi, Spencer T. Liverman[1], Qiwei Wang[1], Yu-Jung Chu[1], Arun Natarajan[1], Thinh Nguyen[1], Alan X. Wang[1]; [1]*Oregon State Univ., USA.* We describe WiFO: A hybrid free-space optical and radio frequency system, which will provide downlink speeds of up to 60Mbps over a distance of three meters using light emitting diodes while maintaining a high level of mobility via a WiFi uplink.

JTh2A.57 ***E-Poster***
Spatial Frequency Modulated Imaging (SPIFI) in Amplitude with a Spatial Light Modulator, Michael D. Young[1], Jeffrey J. Field[2], Randy Bartels[2], Jeff Squier[1]; [1]*Colorado School of Mines, USA;* [2]*Colorado State Univ., USA.* Previous work has demonstrated modulated imaging with binary masks. We present a new microscope that provides continuous modulation with a spatial light modulator, which can modulate through multiple methods: amplitude, phase, polarization, etc.
This presentation will be presented as an E-Poster on Screen 4 from 10:15–11:00

JTh2A.58
Withdrawn.

JTh2A.59
Evaluation Of Transverse Aberration By Spatial Modulators, Maria Elizabeth Percino[1]; [1]*INAOE, Mexico.* The evaluation process of concave surfaces, some methods used are Hartmann and Ronchi test, which use spatial modulators. This paper presented the comparison between them evaluationsalong the diameter perpendicular to the patterns fringes.

JTh2A.60
Withdrawn.

JTh2A.61
Withdrawn.

JTh2A.62
Relationship Between Hermite-Gaussian and Ince-Gaussian Laser Beams, Allison Hine[1], Jessica P. Conry[1]; [1]*Arkansas Tech Univ., USA.* We generate Ince-Gaussian (IG) laser beams from Hermite-Gaussian (HG) laser beams using an astigmatic mode converter (AMC). The relationship between the HG order, IG order and ellipticity, and the rotation of the AMC is discussed.

JTh2A.63
Photon sieve on an optical fiber tip for improved light coupling into a submicron silicon waveguide, Ricardo Janeiro[1], Raquel Flores[1], Pabitra Dahal[1], Jaime Viegas[1]; [1]*Masdar Inst., United Arab Emirates.* The superior performance over a commercial tapered fiber for light coupling at 1550 nm into a silicon waveguide has been demonstrated using a photon sieve fabricated by focused ion beam on an optical fiber tip.

JTh2A.64 ***E-Poster***
Pico-watt radiant flux detection by smartphone, Youngkee Jung[1,2], Iyll-Joon K. Doh[2], Euiwon Bae[2]; [1]*graduate student, USA;* [2]*Mechanical engineering, Purdue Univ., USA.* We present a smartphone based analytical device for detecting sub nano-watt level of radiant flux. A 3D printed optical cradle and a new algorithm to improve SNR level is suggested.
This presentation will be presented as an E-Poster on Screen 5 from 10:15–11:00

JTh2A.65
Twist phase-induced changes of the polarization degree and state of a stochastic electromagnetic beam, Lin Liu[1]; [1]*Soochow Univ., China.* A radially polarized partially coherent twist beam propagating in uniaxial crystal have been explored based on the unified theory of coherence and polarization.The twist factor and the anisotropy induced the change of the statistical properties.

JTh2A.66
Employing the Ichikawa-Takeda's Method Applied to Irradiance Transport Equation (ITE): Filtering and Tilt Grid Analysis, Jesús A. Arriaga Hernández[1], Alejandro Cornejo Rodriguez[1], Elizabeth Percino Zacarias[1], Fermin S. Granados[1]; [1]*INAOE, Mexico.* From Irradiance Transport Equation, derived by Teague [1]. A detailed analysis was realized to the Ichikawa [2], arrangement for lens testing; the aspects studied were filters shape, period and tilt of ruling used experimentally.

JTh2A.67
Reconstruction of refractive index profile of photonic crystal fiber using intensity based optical diffraction tomography, Jem Teresa John[1], Ram M. Vasu[1], Rajan Kanhirodan[1];[1]*Indian Inst. of Science, India.* An iterative Gauss-Newton algorithm which uses normal derivative of intensity(without estimating phase) as the measurement, to reconstruct the cross-sectional refractive index profile of a photonic crystal fiber.

JTh2A.68
Refraction-compensating algorithm for a 3D glass structure exhibiting multiple 2D images, Ryuji Hirayama[1], Hirotaka Nakayama[2], Atsushi Shiraki[3], Takashi Kakue[1], Tomoyoshi Shimobaba[1], Tomoyoshi Ito[1]; [1]*Graduate School of Engineering, Chiba Univ., Japan;* [2]*Center for Computational Astrophysics, National Astronomical Observatory of Japan, Japan;*[3]*Inst. of Management and Information Technologies, Chiba Univ., Japan.* The 3D structure designed by our algorithm exhibits multiple 2D images to different directions. However, refraction at the curved surface of glasses causes the deterioration in the image quality. We proposed a refraction-compensating algorithm.

JTh2A.69
Experimental Validation of Nodal Aberration Theory with a Customized Ritchey–Chrétien Telescope, Nan Zhao[1,2], Kevin P. Thompson[1,3], Jun Zhu[1,4], Michael Pomerantz[1,5], Jannick P. Rolland[1]; [1]*The Inst. of Optics, Univ. of Rochester, USA;* [2]*Changchun Inst. of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, China;* [3]*Synopsys, Inc., USA;* [4]*Tsinghua Univ., China;* [5]*Department of Mechanical Engineering, Univesity of Rochester, USA.* To experimentally validate Nodal Aberration Theory, third order spherical, coma, and astigmatism are investigated in a custom Ritchey–Chrétien telescope with precisely controlled misalignments achieved with a secondary mirror mounted on a hexapod.

JTh2A.70
Laser-induced localized photothermal conversion of vanadium into vanadium oxides, Giwan Seo[1], Jong-Bum You[1], Shin ho Kim[1], Bong-Jun Kim[2], Kyoungsik Yu[1]; [1]*Korea Advanced Inst of Science & Tech, Korea;* [2]*Mobrik Co. Ltd., Korea.* In situ laser patterning by localized photothermal heating is proposed for facile fabrication of vanadium oxide devices with phase transition property. Optically-controlled resistance switching properties of the synthesized devices are investigated.

JTh2A.71
Withdrawn.

JTh2A.72
Analysis of Hollow Core De-multiplexer for Spatially Multiplexed Systems, Syed H. Murshid[1], Gregory L. Lovell[1]; [1]*Florida Inst. of Technology, USA.* Analysis and simulated results of hollow core, all optical de-multiplexer architecture is presented that tests the coupling efficiency of the structure as the bevel angle of the design is varied for common optical indices.

JTh2A.73
A design approach of the image mapper for the image mapping spectrometer (IMS), Xiaoming Ding[1], Yan Yuan[1], Lijuan Su[1]; [1]*Beihang Univ., China.* A design approach of the image mapper used in the image mapping spectrometer (IMS) is introduced to reduce the cross talk and improve the quality of the reconstructed images and spectral information.

JTh2A.74 ***E-Poster***
Testing cylindrical lenses placing a CCD sensor inside the caustic region, Gabriel Castillo-Santiago[2], Maximino Avendaño-Alejo[1]; [1]*CCADET-UNAM, Mexico;* [2]*Facultad de Ingenieria, UNAM, Mexico.* A method to evaluate the shape of fast plano-convex cylindrical lenses is presented, by using null bi-Ronchi type screens, which allows to have uniform patterns at detection's plane inside the caustic region.
This presentation will be presented as an E-Poster on Screen 4 from 09:30–10:15

JTh2A • Joint Poster Session II—Continued

JTh2A.75
Quasicylindrical waves at dielectric interfaces, Oliver Higbee[1], Choon H. Gan[2], Geoff R. Nash[1]; [1]*College of Engineering, Mathematics and Physical Sciences, Univ. of Exeter, UK;* [2]*Seagate, UK.* The contribution of quasicylindrical waves to beam collimation is investigated at a dielectric interface. A subwavelength aperture surrounded by 1D resonant nanogrooves is patterned into a dielectric stack and its far field radiation pattern measured.

JTh2A.76
Quantitative analysis of stainless steel corrosion by reflective digital holographic microscopy, Yousef Pourvais[2], Pegah Asgari[1], Pedram Abdollahi[1], Ali-Reza Moradi[1], Ramin Khamedi[1], Ahmad Darudi[1]; [1]*Zanjan Univ., Iran (the Islamic Republic of);* [2]*Physics, Univ. of Tehran, Iran (the Islamic Republic of).* Using digital holographic microscopy technique, we suggest a novel quantitative criterion to distinguish between intergranular and transgranular corrosion in stainless steels. The method can be used to study several other metallurgical phenomena.

JTh2A.77
A New Photoanisotropic-copies-based Pattern Recognition System, Barbara N. Kilosanidze[1], George Kakauridze[1], Irina Kobulashvili[1]; [1]*Laboratory of Hologarphic Recording and Processing of Information, Georgian Technical Univ., Inst. of Cybernetics, Georgia.* A new pattern recognition method is suggested based on determining the parameters of the integral polarization ellipse at the Fraunhofer diffraction of nonactinic circularly polarized light on the photoanisotropic copy of the object image.

JTh2A.78 ***E-Poster***
Dynamic surface profiling with synthetic holographic confocal microscopy, Martin Schnell[1,2], P. Scott Carney[2,3], Rainer Hillenbrand[4,5]; [1]*CIC nanoGUNE Consolider, Spain;* [2]*Beckman Inst. for Advanced Science and Technology, Univ. of Illinois Urbana-Champaign, USA;* [3]*Department of Electrical and Computer Engineering, Univ. of Illinois Urbana-Champaign, USA;* [4]*CIC nanoGUNE Consolider and EHU/UPV, Spain;* [5]*IKERBASQUE, Basque Foundation for Science, Spain.* We present vibration mode mapping of a micrometer sized cantilever with confocal microscopy which is based on the combination of synthetic optical holography with fast light detection.
This presentation will be presented as an E-Poster on Screen 3 from 09:30–10:15

JTh2A.79
Enhancement in Light-Matter Interaction within Atomic MoS_2 Monolayers on Nanocavities, Corey Janisch[1], Haomin Song[2], Chanjing Zhou[1], Zhong Lin[1], Ana Laura Elías[1], Dengxin Ji[2], Mauricio Terrones[1], Qiaoqiang Gan[2], Zhiwen Liu[1]; [1]*The Pennsylvania State Univ., USA;* [2]*Univ. at Buffalo, USA.* We report a fundamental strategy to enhance light-matter interaction of atomically-thin films based on strong interference in planar nanocavities, which is validated experimentally by absorption and photoluminescence enhancement of MoS_2 monolayers.

JTh2A.80
3D Printed Long Period Grating Filters, Victor Lambin Iezzi[1], Jean-Sébastien Boisvert[1], Sébastien Loranger[1], Raman Kashyap[1]; [1]*Polytechnique Montreal, Canada.* We have created affordable tunable optical fiber filters using 3D printed periodic structures acting as long fiber period grating.

JTh2A.81
Scattering in PT and RT Symmetric Multimode Waveguides: Generalized Conservation Laws beyond 1D, Li Ge[1,2], Konstantinos Makris[3], Demetrios Christodoulides[4], Liang Feng[5]; [1]*College of Staten Island, CUNY, USA;* [2]*The Graduate Center, CUNY, USA;* [3]*Crete Center for Quantum Complexity and Nanotechnology, Univ. of Crete, Greece;* [4]*College of Optics and Photonics - CREOL, Univ. of Central Florida, USA;* [5]*Department of Electrical Engineering, The State Univ. of New York at Buffalo, USA.* We derive generalized conservation laws for light propagating in a multimode system with Parity-Time (PT) or Rotation-Time (RT) symmetry. These conservation laws can be expressed as scalar equalities for generalized transmittance and reflectance.

JTh2A.82
Introducing an Innovative Active Learning Technique: Flipping Optics Classroom, Sumit Ghosh[1]; [1]*Physics, Andhra Vidyalaya College, Osmania Univ., India.* A higher order thinking, self-regulated methodology – Flipped classroom has been employed for teaching optics to the undergraduate students. Qualitative analysis on the efficacy of this model within the Indian context has been presented.

JTh2A.83
Invisible Structures as Particular Solutions of Devaney-Wolf Theorem on Non-Radiating Sources, Giuseppe Labate[1], Ladislau Matekovits[1]; [1]*Politecnico di Torino, Italy.* Starting from Devaney-Wolf theorem on non-radiating sources, a general theory for invisible structures is presented, compactly deriving non-scattering devices based on Directional Invisibility, Plasmonic Cloaking, Mantle Cloaking and Anapole modes.

JTh2A.84
Raman - EDS Coupling for identification of unknown substances in Archaeology applied to the Turin Shroud, Jean-Pierre Laude[1]; [1]*Laude Consulting, France.* Coupled Raman and Energy Dispersive Spectra show a substance fully compatible with oxidative ring cleavage products of the heme of blood, namely biliverdin-derived compounds. A weak line is tentatively attributed to amide I of proteins.

JTh2A.85
Coherent Frequency Combs for Dual-Comb Spectroscopy Spanning 3 to 5.2 μm, Daniel Maser[1,2], Gabriel Ycas[1], Flavio Cruz[1,3], Scott Diddams[1]; [1]*National Inst. of Standards & Tech, USA;* [2]*Physics, Univ. of Colorado Boulder, USA;* [3]*Instituto de Fisica Gleb Wataghin, Universidade Estadual de Campinas, Brazil.* A tunable mid-infrared frequency comb was created via difference frequency generation. Pulses between 1 and 1.5 μm were mixed to make idlers of 3-5.2 μm. Two such combs were heterodyned at 5 μm to show their coherence and potential for spectroscopy.

JTh2A.86
Mimicking explosive heating profiles: feedback controlled sub-second laser heating using a three-color NIR pyrometer, Benjamin R. Anderson[1], Patrick Price[1], Ray Gunawidjaja[1], Hergen Eilers[1]; [1]*Washington State Univ., USA.* We develop a feedback controlled sub-second laser heating system to subject materials to temperature profiles mimicking those inside of explosive fireballs.

JTh2A.87
Measurements of the Temperature Dependence of the Optical Anisotropy Parameter of CaF_2, BaF_2 and SrF_2 Crystals, Alexey Yakovlev[1], Ilya Snetkov[1], Oleg Palashov[1]; [1]*Inst. of Applied Physics RAS, Russian Federation.* The temperature dependence of the material constant – parameter ξ of CaF_2, BaF_2 and SrF_2 crystals in range (80 – 300) °K at wavelength 1070 nm was measured, also, Euler angles of «zero depolarization» orientation were determined.

JTh2A.88
Ultrafast intramolecular charge transfer dynamics in low band gap Isoindigo based copolymers, Newayemedhin A. Tegegne[1]; [1]*Univ. of Stellenbosch, South Africa.* Ultrafast Charge transfer dynamics of a low band gap copolymer in solution was studied by *fs*-transient absorption spectroscopy. Intramolecular charge transfer characteristics (ICT) were observed. The intersystem conversion time to ICT state was 13ps.

JTh2A.89
Clausius-Mossotti Lorentz-Lorenz relations and retardation effects for two-dimensional crystals, Michele Merano[1], Luca Dell'Anna[1]; [1]*Universita degli Studi di Padova, Italy.* We model a single-layer two dimensional atomic crystal as a distribution of electric dipoles on a regular lattice. We evidence a manifestation of retardation-field effects in the optical response of these crystals.

JTh2A.90
Spectroscopic Changes of Cr^{3+} Doped Al_2O_3 Precursors Due to Irreversible Phase Changes During Subsecond Laser Heating, Benjamin R. Anderson[1], Ray Gunawidjaja[1], Patrick Price[1], Hergen Eilers[1]; [1]*Washington State Univ., USA.* We measure the subsecond laser-heating-induced spectroscopic changes of $Cr:Al_2O_3$ precursors and find that $Cr:Al_2O_3$ is a promising candidate for an ex-situ temperature sensor.

JTh2A.91
Optical properties of heterogeneous systems with Ag nanoparticles, Ievgen Brytavskyi[1], Valentyna Skobeeva[2], Valentyn Smyntyna[1], Nikolay Malushin[2], Klara Vergeles[1]; [1]*Odessa National I. I. Mechnikov Univ., Ukraine;* [2]*Research Inst. of Physics, Odessa National I. I. Mechnikov Univ., Ukraine.* The optical properties of heterogeneous systems, including organic (dye) and inorganic (Ag and CdS) compounds were studied. The effect of Ag nanoparticles influence on molecular structuring and on luminescence intensity of quantum dots was found.

JTh2A.92
Tailoring Accelerating Beams with Wigner Distribution Function, Yuanhui Wen[1], Yujie Chen[1], Guoxuan Zhu[1], Yanfeng Zhang[1], Hui Chen[1], Siyuan Yu[1]; [1]*Sun Yat-sen Univ., USA.* We proposed a Wigner distribution function to construct accelerating beams along both 2D and 3D curves. We unify previous caustic methods in real space and Fourier space, and also introduce a class of 3D caustics.

JTh2A • Joint Poster Session II—Continued

JTh2A.93
Enhanced modulation of spontaneous emission via gap plasmon with low index metamaterials and liquid crystals, He Hao[1], Ying Gu[1], Juanjuan Ren[1], Hongyi Chen[1], Iam C. Khoo[2], Qihuang Gong[1]; *[1]Peking Univ., China; [2]Pennsylvania State Univ., USA.* We theoretically demonstrate an active modulation of spontaneous emission in LC-metal-LIM structure. With gap plasmon, the spontaneous emission rate can be modulated from 105γ0 to 5741γ0.

JTh2A.94
liquid crystal-tuned spontaneous emission via plasmon waveguide cladded with low index metamaterials, He Hao[1], Ying Gu[1], Juanjuan Ren[1], Hongyi Chen[1], Iam C. Khoo[2], Qihuang Gong[1]; *[1]Peking Univ., China; [2]Pennsylvania state Univ., USA.* Using the liquid crystal-metal-low index metamaterial waveguide which supports surface plasmon polaritons, we theoretically demonstrate an active modulation of spontaneous emission. It can be modulated from 131γ0 to 327γ0 by varying optical axis.

JTh2A.95
Designed and Developed Low Cost Raman Spectroscopic System, Andrew Huzortey[1], Benjamin Anderson[1], Alfred Owusu[1]; *[1]Laser and Fibre Optics Centre, College of Agriculture and Natural Sciences, Univ. of Cape Coast, Ghana.* A simple Raman setup which offers a cost-efficient alternative to a commercial Raman system has been developed. The results obtained from the analysis showed good correlation with literature.

JTh2A.96
Enhancement in Energy of THz Emission From Gas Plasma Induced By Two-Color Chirped Laser Pulses, Vera A. Andreeva[1], Tie-Jun Wang[2], Nikolay A. Panov[1], Daniil E. Shipilo[1], Mikhail N. Esaulkov[3], Aleksander P. Shkurinov[1,3], Vladimir A. Makarov[1], Ruxin Li[2], Olga G. Kosareva[1], See Leang Chin[4]; *[1]M. V. Lomonosov Moscow State Univ., Russian Federation; [2]Shanghai Inst. of Optics and Fine Mechanics, Chinese Academy of Sciences, China; [3]Inst. on Laser and Information Technologies of the Russian Academy of Sciencies (ILIT RAS), Russian Federation; [4]Centre d'Optique, Photonique et Laser (COPL), Université Laval, Canada.* Enhancement in THz emission energy is observed both experimentally and theoretically by creating gas plasma with two-color (800nm+400nm) chirped laser pulses. THz yield increases when laser pulse is chirped positively.

JTh2A.97
Ultra-Realistic Imaging and *OptoClones*™, Hans I. Bjelkhagen[1], Alkiviadis Lembessis[2], Andreas Sarakinos[2]; *[1]CURI, Glyndwr Univ., UK; [2]Hellenic Inst. of Holography, Greece.* CW RGB lasers, nano-size SH recording materials and special RGB LED lights for recording and displaying Denisyuk color holograms (*OptoClones*™) are described. Mobile equipment at the museum was used to record the famous Fabergé Eggs.

JTh2A.98
Enhancing THz radiation from two-color laser-induced air-plasma by using abruptly autofocusing beams, Kang Liu[1], Anastasios D. Koulouklidis[2,3], Dimitrios G. Papazoglou[2,3], Stelios Tzortzakis[2,3], Xi-Cheng Zhang[1]; *[1]The Inst. of Optics, Univ. of Rochester, USA; [2]Inst. of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, Greece; [3]Department of Material Science and Technology, Univ. of Crete, Greece.* By using abruptly autofocusing beams, as opposed to the conventional Gaussian beams, to generate plasma in the ambient air, an enhancement of the terahertz radiation from the plasma in the low frequency region is observed.

JTh2A.99 ***E-Poster***
Optical Properties of MoS_2/$MoSe_2$ Heterostructures, Tianren Fan[1], Ali Eftekhar[1], Hossein Taghinejad[1], Pulickel Ajayan[2], Ali Adibi[1]; *[1]Georgia Inst. of Technology, USA; [2]Rice Univ., USA.* We present MoS_2/$MoSe_2$ heterostructures formed through dry transfer method. We report significant quenching of the photoluminescence in MoS_2 and a red shift of the photoluminescence in $MoSe_2$ as signs of interlayer charge transfer.
This presentation will be presented as an E-Poster on Screen 5 from 09:30–10:15

JTh2A.100
Luminescent Properties of Nd^{3+}/Cr^{3+}-doped $LiCaAlF_6$ Flower-like Microcrystals, Xiaojie Xue[1], Tonglei Cheng[1], Takenobu Suzuki[1], Yasutake Ohishi[1]; *[1]Toyota Technological Inst., Japan.* Under the excitation of a 650 nm laser, the Nd^{3+}/Cr^{3+}-doped $LiCaAlF_6$ flower-like microcrystals showed an intense near-infrared emission at 1045 nm attributed to sufficient energy transfer from Cr^{3+} to Nd^{3+}.

JTh2A.101
ArF Excimer Laser Filamentation Induced Damage in Fused Silica, Haibo Zhang[1], Zhijun Yuan[1], Ren Ye[1], Jun Zhou[1]; *[1]Shanghai Inst of Optics and Fine Mech, China.* Filamentation induced damage in the fused silica excited by nanosecond DUV laser pulses with microscope objective lens are demonstrated. The evaluation of damage growth and that of mitigation on fused silica are investigated.

JTh2A.102
Realization of a superluminal Raman laser using adjacent transitions in two isotopes of Rb, Zifan Zhou[1], Joshua Yablon[1], Selim Shahriar[1,2]; *[1]Electrical Engineering and Computer Science, Northwestern Univ., USA; [2]Physics and Astronomy, Northwestern Univ., USA.* We show how to realize a superluminal Raman laser using adjacent transitions in two isotopes of Rb, with an enhancement in sensitivity due to change in cavity length by a factor of nearly a million.

JTh2A.103
Universality of optical-field-induced semimetallization in dielectrics, Ojoon Kwon[1,2], Vadym Apalkov[3], Mark Stockman[3], D. Kim[1,2]; *[1]Department of Physics, Center for Attosecond Science and Technology, POSTECH, Korea; [2]Max Planck Center for Attosecond Science, Max Planck POSTECH/Korea Res. Init., Korea; [3]Center for Nano-Optics and Department of Physics and Astronomy, Georgia State Univ., USA.* The transition of dielectrics into semimetallic states by light field is studied. Despite distinction among substances, the generality of semimetallization is observed, agreeing with theoretical prediction, taking intraband transition into account.

JTh2A.104 ***E-Poster***
The phase structure evolution of singular beams spreading in uniaxial crystal, Bohdan V. Sokolenko[1]; *[1]V I Vernadsky Crimean Federal Univ, Russian Federation.* A process of coherent optical vortex beams propagation and their transformation in anisotropic media is studied. Structural disturbance of phase and intensity distribution in anisotropic media is implemented by shift at the beam polarization states.
This presentation will be presented as an E-Poster on Screen 1 from 10:15–11:00

JTh2A.105
Sub-100 fs All-PM Er-doped Soliton Mode-Locked Fiber Oscillator Based on Graphene Saturable Absorber, Jaroslaw Z. Sotor[1], Grzegorz Sobon[1], Aleksandra Przewolka[2], Aleksandra Krajewska[2], Iwona Pasternak[2], Wlodek Strupinski[2], Krzysztof Abramski[1]; *[1]Politechnika Wroclawska, Poland; [2]Inst. of Electronic Materials Technology, Poland.* We demonstrate a self-starting Er-doped mode-locked fiber laser generating soliton pulses with: duration, repetition frequency and output power of 95 fs, 99.6 MHz, 8 mW, respectively. As a saturable absorber a PMMA/graphene composite was used.

JTh2A.106
Withdrawn.

JTh2A.107
A Self-Consistent Method for the Determination of the Complex Refractive Index of Arbitrary Absorptance Thin Films, Serge Gauvin[1], Jean Desforges[1]; *[1]Université de Moncton, Canada.* A self-consistent formalism that accurately gives the complex index of arbitrary absorptance thin films, on an arbitrary substrate, is described. This method only requires a single transmittance curve. The only source of uncertainty is experimental.

JTh2A.108
Freestyle laser traps as a perfect tool for all-optical transport of small particles, Jose A. Rodrigo[1], Tatiana Alieva[1]; *[1]Universidad Complutense de Madrid, Spain.* We introduce the freestyle 3D laser traps which are strongly focused curved beams of arbitrary form with independent phase control. This tool paves the way for simultaneous all-optical trapping and transport of small particles along 3D trajectories.

JTh2A.109
Hydrophobic Surface Production by Laser Ablation on Titanium Alloy, Ivan Kam[2,1], Jonas Jakutis Neto[2]; *[1]Universidade Federal de São Paulo, Brazil; [2]Departamento de Ciência e Tecnologia da Aeronáutica, Instituto de Estudos Avançados (IEAv), Brazil.* The present work studies the production of super hydrophobic surfaces with laser ablation on Ti6Al4V. After a few hours of low pressure exposure, the textured surface showed a contact angle above 150°.

JTh2A.110
On the performance of β-BaB2O4 and BiB3O6 as an intra-cavity frequency-doubling element in optical parametric oscillators, Mukesh K. Shukla[1], Partha Maji[1], Ritwick Das[1]; *[1]National Inst of Sci Education & Res., India.* We report a comparison on the performance of β-BaB_2O_4 and BiB_3O_6 as intra-cavity second-harmonic-generation of single-frequency, high-power visible radiation in singly-resonant MgO-doped periodically-poled $LiNbO_3$ based optical-parametric-oscillator.

JTh2A.111
Mobius Polarization in Non-collinear Poincare-beam Superpositions, Enrique J. Galvez[1], Kory Beach[1], Jonathan J. Zeosky[1], Ishir Dutta[1], Joshua A. Jones[1], Behzad Khajavi[1,2]; *[1]Colgate Univ., USA; [2]Physics and Astronomy, Florida Atlantic Univ., USA.* We investigated the noncollinear superposition of optical beams bearing optical vortices in orthogonal states of circular polarization. Projective measurements are consistent with the polarization ellipse describing Mobius loops in 3 dimensions.

JTh2A.112
Dual-wavelength, dual-comb fiber laser based on a nearly-adiabatic fiber-taper filter, Jie Chen[1], Tianlei Zhang[1], Ruliu Wang[1], Guoqing Hu[1], Xin Zhao[1], Jiansheng Liu[1], Zheng Zheng[1,2]; *[1]School of Electronic and Information Engineering, Beihang Univ., China; [2]Collaborative Innovation Center of Geospatial Technology, China.* A simple, turn-key dual-comb laser is realized by leveraging a fiber-taper filter based on multi-mode interference. The low modulation depth of the filter with a nearly adiabetic profile improves the bandwidth of the generated pulses.

JTh2A.113
Formation and Application of highly-regular LIPSS on Surface of Silicon Crystals, Iaroslav Gnilitskyi[1], Leonardo Orazi[1], Nadezhda Bulgakova[2], Vitaly Gruzdev[3]; *[1]UNIMORE, Italy; [2]HiLASE Centre, Inst. of Physics ASCR, Czech Republic; [3]Department of Mechanical & Aerospace Engineering, Univ. of Missouri, USA.* Femtosecond laser pulses of sub-MHz repetition rate induce highly regular periodic surface structures on silicon by combining electron emission and ultrafast heating. They are favorable for photovoltaic, optoelectronic, and biomedical applications.

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JTh2A.114
Aluminum nitride microring resonator for efficient frequency comb doubling, Hojoong Jung[1], Xiang Guo[1], Na Zhu[1], Scott Papp[2], Scott Diddams[2], Hong Tang[1]; [1]*Yale Univ., USA;* [2]*NIST, USA*. We demonstrate efficient frequency-comb doubling of input IR mode locked fiber comb with a high-Q phase matched AlN microring resonator. The sinusoidal phase dependent interference is well matched with theory.

JTh2A.115
Withdrawn.

JTh2A.116
Improving the signal-to-noise ratio of ghost imaging with thermal light background by narrow band optical filtering, Dongyue Yang[1], Junhui Li[3], Guohua Wu[1], Bin Luo[2], Longfei Yin[3], Hong Guo[3]; [1]*School of Electronic Engineering, Beijing Univ. of Posts and Telecommunications, China;* [2]*State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ. of Posts and Telecommunications, China;* [3]*State Key Laboratory of Advanced Optical Communication Systems and Networks, School of Electronics Engineering and Computer Science, and Center for Quantum Information Technology, Peking Univ., China*. In ghost imaging with narrow-band pseudo-thermal signal embedded in thermal light background, signal-arm narrow band optical filters bring higher value and converging upper limit of the imaging signal-to-noise ratio (SNR).

JTh2A.117
Femtosecond optical tweezers as sensitive nano-thermometer, Dipankar Mondal[1], Debabrata Goswami[1]; [1]*Indian Inst. of Technology, Kanpur, India*. Nanovolume temperature around optical trap is measured by exploiting nonradiative relaxation in solvents. Copropagating 1560nm femtosecond laser pulses change solvent temperature and viscosity while trap-stiffness is unaffected during 780nm trapping.

JTh2A.118
Presentation of OSA student chapter Cameroon, Murielle Vanessa Tchakui[1]; [1]*Universite de Yaounde I, Cameroon*. In this poster we present the OSA student chapter Cameroon. We focus on its mission and its organigram. Some outreach and recruitment activities done recently are also developed.

JTh2A.119
Optics Research Activity in LAMSEBP, Murielle Vanessa Tchakui[1]; [1]*Universite de Yaounde I, Cameroon*. In this poster we start by presenting the LAMSEBP group at the Univ. of Yaounde1 Cameroonon and the staff members. After that many topics investigated there in the area of optics and photonics are given.

JTh2A.120
Withdrawn.

JTh2A.121
Withdrawn.

JTh2A.122
Localization analysis and dimensional scaling in a disordered optical waveguide, Behnam Abaie[1], Arash Mafi[1]; [1]*Univ. of New Mexico, USA*. Anderson localization properties of a disordered optical waveguide are studied using the mode-width probability density function (PDF). The scaling and convergence of the PDF with the transverse size of the waveguide is explored.

JTh2A.123
Optical Study of Dual-width Plasmonic Nanogap Gratings for Biosensor Applications, Stephen Bauman[1], Ahmad A. Darweesh[1], David A. French[2], Joseph B. Herzog[2,1]; [1]*Microelectronics & Photonics, Univ. of Arkansas, USA;* [2]*Physics, Univ. of Arkansas, USA*. Plasmonic grating (1D) and grid (2D) structures with two unique widths and sub-10 nm gaps have been fabricated, and electromagnetic simulations and Raman spectroscopy results have been performed to optimize the geometry for optical enhancement.

JTh2A.124
***In Vivo* Assessment of Molecular Aging by Quasi-Elastic Light Scattering in the Human Lens,** Olga V. Minaeva[1,2], Srikant Sarangi[3,1], Juliet A. Moncaster[3,1], Danielle M. Ledoux[2,4], Caitlin A. Rook[2], Frank J. Weng[2], John I. Clark[5], David G. Hunter[2,4], Lee E. Goldstein[1,3]; [1]*Boston Univ., USA;* [2]*Boston Children's Hospital, USA;* [3]*Boston Univ. School of Medicine, USA;* [4]*Harvard Medical School, USA;* [5]*Univ. of Washington, USA*. Quasi-elastic light scattering analysis of long-lived lens proteins provides a practical, noninvasive technique and quantitative biomarker for objective, point-of-care assessment of molecular aging in a human body.

JTh2A.125
New Trend in Terahertz Medicine, Vyacheslav I. Fedorov[1,2]; [1]*Inst. of Laser Physics RAS, Russian Federation;* [2]*ITMO Univ., Russian Federation*. Fundamental study of biological effects of terahertz radiation may be the basis for therapeutic and diagnostic use of laser terahertz radiation in medicine. Examples of application for treatment and diagnostics will be presented.

JTh2A.126
The Nuclear Refractive Index from Quantitative Phase Imaging: Corrupting Factors and Application to a/LCI, Zachary A. Steelman[1], William J. Eldridge[1], Han Sang Park[1], Adam Wax[1]; [1]*Duke Univ., USA*. Recent Quantitative Phase Microscopy experiments have measured the refractive index of a cell nucleus to be lower than the cytoplasm. We suggest a potential error capable of corrupting these measurements.

JTh2A.127
Detection of Organic Matter in Simulant Martian Soil using Plasmonic-Biosilica SERS Substrate, Kenneth Squire[1], Xianming Kong[1], Paul Leduff[1], Gregory Rorrer[1], Suning Tang[2], Bin Chen[3], Christopher McKay[3], Rafael Navarro-Gonzalez[4], Alan X. Wang[1]; [1]*Oregon State Univ., USA;* [2]*Crystal Research, USA;* [3]*NASA, USA;* [4]*UNAM, Mexico*. We fabricate a surface-enhanced Raman spectroscopy (SERS) substrate using plasmonic-biosilica diatoms and gold nanoparticles to detect organic matter down to part-per-billion levels in soil samples that simulate conditions of soil on Mars.

JTh2A.128
Video-rate volume imaging confocal microscope based on wavelength / space conversion by use of multichannel spectrometer, Shuji Miyamoto[1], Eiji Hase[1,2], Takeo Minamikawa[1,2], Takeshi Yasui[1,2], Hirotsugu Yamamoto[3]; [1]*Tokushima Univ., Japan;* [2]*ERATO Intelligent Optical Synthesizer Project, JST, Japan;* [3]*Utsunomiya Univ., Japan*.Video-rate volume imaging confocal microscopy employing line-focused confocal microscopy, wavelength/1D-space conversion and a PZT objective scanner was proposed. The system enables 1.4 volumes/s (13 slices) with the axial resolution of 8.4 μm.

JTh2A.129
Galvanometer Scanning for Optical Coherence Tomography, Virgil-Florin Duma[1,2], Patrice Tankam[3], Jinxin Huang[3], Jungeun Won[3], Jannick P. Rolland[3]; [1]*Universitatea Aurel Vlaicu Arad, Romania;* [2]*Doctoral School, Polytechnic Univ. of Timisoara, Romania;* [3]*The Inst. of Optics, Univ. of Rochester, USA*. Galvanometer scanning was optimized for maximum duty cycle and distortion-free mosaic images in Gabor Domain Optical Coherence Microscopy (GD-OCM). Mathematical models for sawtooth and triangular scanning were obtained and confirmed experimentally.

JTh2A.130
FRET-Modulated Cell Lasers, Qiushu Chen[1], Michael Ritt[2], Biming Wu[1], Rhima Coleman[1], Sivaraj Sivaramakrishnan[2], Xudong Fan[1]; [1]*Biomedical Engineering, Univ. of Michigan, USA;* [2]*Genetics, Cell Biology, and Development, Univ. of Minnesota, USA*. Lasing from living cells expressing fluorescent protein FRET pairs were studied. Experimental results and theoretical analysis showed that difference in FRET energy transfer efficiency resulted in distinct cell lasing behavior.

JTh2A.131 ***E-Poster***
Optical Coherence Elastography of the Cornea by Tracking the Propagation of Surface Acoustic Waves, Jose F. Zvietcovich[1], Jianing Yao[1], Jannick P. Rolland[1], Kevin Parker[1];[1]*Univ. of Rochester, USA*. We measure the speed of surface acoustic waves propagating in a porcine cornea using optical coherence tomography since it provides of depth-resolved elastic modulus which is important for the study of ocular diseases and treatments.
This presentation will be presented as an E-Poster on Screen 1 from 09:30–10:15

JTh2A.132
Z-scan technique: A new concept for Diagnosis of Prostate Cancer in blood, Camila T. Nabeshima[2], Flávia R. Silva[3], Antonio M. Neto[4], Sarah I. Alves[2], Ricardo E. Samad[5], Lilia C. Courrol[1,2]; [1]*Ciências Exatas e da Terra, Universidade Federal de São Paulo, Brazil;* [2]*Departamento de Ciências Exatas e da Terra, Universidade Federal de São Paulo, Brazil;* [3]*Centro de Ciência e Tecnologia de Materias, Instituo de Pesquisas Energéticas e Nucleares, Brazil;* [4]*Instituto de Física, Universidade de São Paulo, Brazil;* [5]*Centro de Lasers e Aplicações, Instituto de Pesquisas Energéticas e Nucleares, Brazil*. Porphyrin accumulate substantially more in tumors than in normal tissues. The optical nonlinearity of the blood porphyrin was analyzed using Z-scan technique. The results showed a decrease in nonlinear refractive index value for tumor blood.

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JTh2A.133
High-Speed Stimulated Brillouin Scattering Profilometry, Itay Remer[1], Lear Cohen[1], Alberto Bilenca[1,2]; *[1]Biomedical Engineering Department, Ben-Gurion Univ. of the Negev, Israel; [2]Ilse Katz Inst. for Nanoscale Science and Technology, Ben-Gurion Univ. of the Negev, Israel.* We show high-speed stimulated Brillouin scattering (SBS) profilometry of layered liquids at 30 ms pixel-dwell-time – 100-fold faster than current backward SBS methods. This is a step forward to rapid SBS profilometry in biomedical mechanics.

JTh2A.134
An achromatic system for multi-wavelength fluorescence lifetime imaging of the lung in intensive care units, Fiona M. Kenny[1], Laura Young[1], Timothy Morris[1], Chris Saunter[1], John M. Girkin[1]; *[1]Durham Univ., UK.* This work used an endoscopic fiber bundle for lifetime imaging of lung tissue which provided information on bacterial infections. The system was designed with reflective optics to maximise efficiency of emission detection and wavelength range.

JTh2A.135
Multi-Species Coherent Anti-Stokes Raman Spectroscopy in Gas-Filled Hollow-Core Photonic Crystal Fiber, Robert J. Hupfer[1], Barbara M. Trabold[1], Amir Abdolvand[1], Philip S. Russell[1]; *[1]Max Planck Inst. for the Science of Light, Germany.* Coherent anti-Stokes Raman spectroscopy is conducted on gas-mixtures in kagomé-PCF. Pressure-tunable dispersion enables broadband phase-matching which, combined with broadband Stokes seeding, allows simultaneous detection of multiple trace gases.

JTh2A.136
Optimized Endoscopic Laser Surgery in Colon Tumors, Félix Fanjul-Vélez[1], Jose L. Arce-Diego[1]; *[1]TEISA, Univ. of Cantabria, Spain.* Common colonoscopic techniques present disadvantages. Laser surgery, including ablation and thermal effects, is analyzed, considering several wavelengths, pulse durations and irradiances. A short pulse Nd:YAG laser is considered to be optimum.

JTh2A.137
Quantitative Phase Microscopy of Live Cells Flowing in a Micro-Channel Using Flipping Interferometry, Natan T. Shaked[1], Bahram Javidi[2], Nir Turko[1], Darina Roithstain[1]; *[1]Tel-Aviv Univ., Israel; [2]Univ. of Connecticut , USA.* We present wide-field off-axis interferometry for rapid quantitative phase microscopy of biological cells during flow in microfluidic channel, with potential of integration into cell sorting devices. Various experimental demonstrations are presented.

JTh2A.138
Nanometer-class Optical Coherence Tomography for *In Vivo* Tear Film Thickness Estimation, Jinxin Huang[1], Holly B. Hindman[1], Jannick P. Rolland[1]; *[1]Univ. of Rochester, USA.* To advance the Dry Eye management, we developed a technique to simultaneously estimate the thickness of both the lipid and aqueous layers of the tear film *in vivo* using optical coherence tomography and maximum-likelihood estimation.

JTh2A.139
Withdrawn.

JTh2A.140
Investigating Corneal Disease Using High Resolution Gabor-domain Optical Coherence Microscopy, Patrice Tankam[1], Zhiguo He[2], Gilles Thuret[2], Holly B. Hindman[3], Thierry Lepine[4], Cristina Canavesi[5], Philippe Gain[2], Jannick P. Rolland[1,5]; *[1]Univ. of Rochester, USA; [2]Faculty of Medicine, Jean Monnet Univ., France; [3]Ophthalmology, Univ. of Rochester Medical Center, USA; [4]Institut d'Optique, France; [5]LighTopTech, USA.* We demonstrate the capability of Gabor-domain optical coherence microscopy in identifying key features of the structural modification of the cornea in three diseases including Fuchs' endothelial corneal dystrophy, lattice dystrophy and keratoconus.

JTh2A.141
Optical Simulation of Nonlinear Twisted-Ring Defect States with Planar Waveguide Arrays, Alexander A. Dovgiy[1], Andrey E. Miroshnichenko[1], Alexander Moroz[2], Alexander Szameit[3], Demetrios Christodoulides[4], Andrey A. Sukhorukov[1]; *[1]Nonlinear Physics Centre, RSPE, Australian National Univ., Australia; [2]Wave-scattering.com, Germany; [3]Inst. of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universitat Jena, Germany; [4]CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA.* We introduce a concept of universal optical simulators based on experimentally accessible planar waveguide arrays, where the light evolution exactly replicates nonlinear defect state dynamics governed by topologically nontrivial Hamiltonians.

JTh2A.142
Withdrawn.

JTh2A.143
Vertical Split-Ring Resonator based Metasurface for Light Manipulation, Mu Ku Chen[1], Wei-Lun Hsu[1], Pin Chieh Wu[1], Jia-Wern Chen[1], Ting-Yu Chen[1], Wei Ting Chen[1], Yao-Wei Huang[1], Chun Yen Liao[1], Greg Sun[2], Din Ping Tsai[3,1]; *[1]National Taiwan Univ., Taiwan; [2]Department of Engineering, Univ. of Massachusetts Boston, USA; [3]Research Center for Applied Sciences, Academia Sinica, Taiwan.* We used e-beam process for the deposition of 3D nanostructures called vertical split-ring resonators to explore the functionality of beam steering with phase modulation by tuning only the vertical dimension.

JTh2A.144
Electro-Absorption Modulators Based on Carrier Depletion in Epsilon-Near-Zero Films, Kaifeng Shi[1], Peichuan Yin[1], Zhaolin Lu[1]; *[1]Rochester Inst. of Technology, USA.* We report field effect electro-absorption modulators, made of a thin epsilon-near-zero (ENZ) film sandwiched in a silicon or plasmonic waveguide. The significant bias-induced reduction of absorption of the ENZ film may promise nanoscale modulators.

JTh2A.145
An efficiency breakthrough in perovskite solar cells realized by Al-coated Cu nanoparticles, Xi Chen[1,2], Min Gu[2,1]; *[1]Swinburne Univ. of Technology, Australia; [2]RMIT Univ., Australia.* Al-coated Cu nanoparticles with strong light-trapping effects were synthesized. An efficiency boost of 21% in perovskite solar cells has been demonstrated, which is significantly higher than those from other plasmonic nanostructures.

JTh2A.146
Interactions of two counter-propagating waveguides in the dry photopolymer material using fibre optics, Ra'ed A. Malallah[1], Inbarasan Muniraj[1], Haoyu Li[1], Derek Cassidy[1], John T. Sheridan[1]; *[1]Univ. College Dublin, Ireland.* Self-Writing optical waveguides (SWWs) have been demonstrated in the photopolymerizable materials. Nonlinearity and diffraction limit of a propagated wave in nonlinear-materials effectively compensated by light diffusion during the creation of SWWs.

JTh2A.147
High Stability and Higher Poling Efficiency for Electro-Optic Polymer/TiO_2 Vertical Slot Waveguide Modulators, Yasufumi Enami[1], Jingdong Luo[2], Alex Jen[2]; *[1]School of System Engineering, Kochi Univ. of Technology, Japan; [2]Department of Materials Science and Engineering, Univ. of Washington, USA.* We demonstrate stable half wave voltage (V_π) and electrode length (L) product for a electro-optic (EO)/TiO_2 vertical slot waveguide modulator. $V_\pi L$ product of 2.5 Vcm for the modulators shows the same value for two years.

JTh2A.148
Focusing grating coupler for integration of a liquid-crystal spatial light modulator onto a Si photonic circuit, Takahiro Inaba[1], Ryutaro Eguchi[1], Hiroyuki Tsuda[1]; *[1]Keio Univ., Japan.* Focusing grating couplers for integrating a liquid-crystal spatial light modulator to Si optical circuit were designed, which had the total loss of 4.6 dB.

JTh2A.149
Nano-scatter enabled Optical Mapping of Orbital Angular Momentum of Broadband Light, Haoran Ren[1], Min Gu[2,1]; *[1]Centre for Micro-Photonics, Faculty of Science, Engineering and Technology, Swinburne Univ. of Technology, Australia; [2]Artificial Intelligence Nanophotonics Laboratory, School of Science, RMIT Univ., Australia.* We demonstrate a nano-scatter enabled single-path wavefront sensing approach capable of distinguishing of arbitrary integer or fractional topological charges of orbital angular momentum of broadband light.

JTh2A.150
Numerical modeling of the generation of a Kerr comb in a coupled cavity system using coupled mode equations, Yusuke Okabe[1], Takumi Kato[1], Shun Fujii[1], Ryo Suzuki[1], Takasumi Tanabe[1]; *[1]Keio Univ., Japan.* We show the modeling of Kerr comb generation in a coupled cavity system and perform a numerical simulation in a normal dispersion regime. We show the repetition rate is selectable and soliton generation is possible.

JTh2A.151
An Electrostatic Actuated 2-D MEMS Scanner for Potential Image Display Application, Weichih Wang[1,2], Kebin Gu[1]; *[1]Univ. of Washington, USA; [2]National Tsinghua Univ., Taiwan.* Paper presents an electrostatic actuated 2-D cantilever waveguide scanner. A 2-D scanning motion has been successfully demonstrated with two fundamental resonances found at 202(V) and 536(H) Hz with corresponding FOV of 0.062 and 0.009 rad.

JTh2A.152
Long-Range Higher-Order Surface-Plasmon Polaritons, Andreas Norrman[1], Tero Setälä[1], Ari T. Friberg[1]; *[1]Univ. of Eastern Finland, Finland.* We show how a higher-order metal-slab mode turns into a strongly confined long-range surface-plasmon polariton in situations where the fundamental long-range mode does not exist.

JTh2A • Joint Poster Session II—Continued

JTh2A.153
Giant circular dichroism enhancement and strong superchiral field in hybrid molecule-plasmonic nanostructures, Yi N. Liu[1]; [1]*Xiamen Univ., China*. We have demonstrated a direct correlation between the strong chirality of the local field and the giant CD response at the plasmon resonance bands induced by chiral molecules in the hot spots.

JTh2A.154
Design of Compact Plasmonic Polarimeter Based on Polarization-Sensitive Nano-Grooves, Kyookeun Lee[1], Joonsoo kim[1], Sang-Eun Mun[1], Gun-Yeal Lee[1], Byoungho . Lee[1]; [1]*Seoul National Univ., USA*. A compact plasmonic polarimeter is proposed. The polarization state of the incident light is measured using interference between surface plasmon polaritons, excited by nano-grooves. The design method and simulation results will be shown.

JTh2A.155
Eu-doped ZnO-HfO_2 hybrid nanocrystals embedded glass-ceramic waveguides as blue-light emitting source, Subhabrata Ghosh[1], Shivakiran Bhaktha B. N.[1]; [1]*Indian Inst. of Technology Kharagpur, India*. Eu-doped SiO_2-HfO_2-ZnO hybrid glass-ceramic waveguides have been fabricated for on-chip blue-light emitting source application. The reduction of $Eu^{3+} \rightarrow Eu^{2+}$ in the presence of ZnO nanocrystals leads to enhanced blue-emission in the low-loss waveguides.

JTh2A.156
High-Q and Small Mode-Volume Oxide-Cladding Aluminum Nitride Photonic Crystal Nanocavity, Emerson G. Melo[1], Marcelo N. Carreño[1], Marco I. Alayo[1]; [1]*Univ. of São Paulo, Brazil*. A high bandgap material is very attractive in some photonic applications. Therefore, we propose a high-quality-factor and small mode-volume oxide-cladding AlN photonic crystal nanocavity and assess the effects of fabrication induced disorder.

JTh2A.157
Adjusting Spectrum of MIM Optical Filters by Stub Inclination, Shuhao Wu[1], Dingxin Wu[1]; [1]*Columbia Univ., USA*. We analyze the stub inclination on stub-based MIM optical filters. Analytical analysis and simulation results show that inclination of stub generally causes a blue shift to the transmission spectrum, while emphasizing certain resonances.

JTh2A.158
Si-ITO solar cells with CdTe quantum dots, Marianna Kovalova[1], Serhiy Kondratenko[1], Vasyl Lendel[1]; [1]*Taras Shevchenko National Univ. of Kyiv, Ukraine*. We've investigated p-Si/ITO with CdTe quantum dots. The J-V characteristics was found to be nonlinear. The photocurrent spectra in spectral range above band gap of Si is caused by presence of CdTe quantum dots.

JTh2A.159
Radiative lifetime changes in the vicinity of a nanofiber: dielectric, and alignment effects, Pablo Solano[1], Jeffrey Grover[1], Burkley Patterson[1], Steve L. Rolston[1], Luis A. Orozco[1], Yunlu Xu[1], Jeremy N. Munday[1]; [1]*Univ. of Maryland at College Park, USA*. We measure the radiative lifetime of the D_2 line of atomic rubidium in the evanescent mode of a nanofiber and find enhancements and suppressions depending on the nanofiber size and the atomic-dipole orientation.

JTh2A.160
Optical Bistability in a VCSEL Connected Across Serially-Coupled PIN Photodiodes, Sanaz Faryadras[1], Azad Siahmakoun[1]; [1]*Department of Physics and Optical Engineering, Rose-Hulman Inst. of Technology , USA*. Two serially-coupled PIN-PDs connected to a VCSEL is theoretically modeled and experimentally demonstrated to exhibit optical bistability. The bistable device operates in MHz range mainly due to parasitic inductance and capacitance of the circuit.

JTh2A.161
Bent Metal-Clad Waveguides for Fiber-to-Waveguide and 3D Chip-to-Chip Light Coupling Applications, Zhaolin Lu[1], Peichuan Yin[1], Kaifeng Shi[1]; [1]*Rochester Inst. of Technology, USA*. We report efficient fiber-to-waveguide and 3D chip-to-chip light coupling devices based on bent metal-clad waveguides. According to our FDTD simulation, the coupling efficiency is over 80% within a broad range of working wavelengths.

JTh2A.162
Dual-Layer Plasmonic Metasurfaces for Phase-Hologram Generation, Yohan Lee[1], Joonsoo Kim[1], Byoungho Lee[1]; [1]*Seoul National Univ., USA*. A dual-layer plasmonic metasurface which offers effective control of the phase of the transmitted wave by simple translational motion is proposed. It can operate on phase-mode and is controlled by adjusting the lateral shift of lower surface.

JTh2A.163
Supercontinuum generation beyond 2μm in GeSbS waveguides, Ju Won Choi[1], Zhaohong Han[2], Byoung-Uk Sohn[1], George F. R. Chen[1], Lionel C. Kimerling[2], Kathleen A. Richardson[3], Anuradha M. Agarwal[2,4], Dawn T. H. Tan[1]; [1]*Engineering Product Development, Singapore Univ. of Technology and Design, Singapore;* [2]*Department of Materials Science and Engineering, Massachusetts Inst. of Technology, USA;* [3]*College of Optics and Photonics, Univ. of Central Florida, USA;* [4]*Materials Processing Center, Massachusetts Inst. of Technology, USA*. SPM-induced nonlinear phase shift in GeSbS chalcogenide waveguides allows us to extract a nonlinear parameter of ~7 W^{-1}/m. Supercontinuum is generated with a 14 fold spectral broadening with respect to the input spectrum, which is close to an octave.

JTh2A.164
Low-loss and low-crosstalk Si polarization splitters with two-step etching, shigeaki sakai[1], Hiroyuki Tsuda[1], Naotaka Iwamoto [1]; [1]*Keio Univ., Japan*. The waveguide-type three-line Si polarization splitter is designed and it has a polarization extinction ratio of more than 40dB and a loss of less than 0.4 dB for the wavelength range from 1.45μm to 1.65μm.

JTh2A.165
Avoided Resonance Crossing and Non-Reciprocal Nearly Perfect Absorption in Plasmonic Nanodisks with Near-field and Far-field Couplings, Shih-Hui G. Chang[1]; [1]*National Cheng Kung Univ., Taiwan*. Avoided resonance crossings in plasmonic nanodisk structures due to near field or far field couplings were numerically demonstrated. The observed non-reciprocal absorption spectra are well explained by a FSS-Fabry-Perot model.

JTh2A.166
Thermo-optic oscillatory behavior in on-chip lithium-niobate microdisk resonators, Jie Wang[1], Bowen Zhu[2], Zhenzhong Hao[1], Fang Bo[1], Xiaolei Wang[2], Guoquan Zhang[1], Jingjun Xu[1]; [1]*The MOE Key Laboratory of Weak Light Nonlinear Photonics, TEDA Applied Physics Inst. and School of Physics, Nankai Univ. , China;* [2]*Key Laboratory of Optical Information Science and Technology, Ministry of Education, Inst. of Modern Optics,, Nankai Univ. , China*. We report the first experimental observation of an oscillatory behavior of transmission of on-chip lithium-niobate microdisk resonators, which was attributed to the competition between a fast thermo-optic effect and a slow heat dissipation process.

JTh2A.167
Withdrawn.

JTh2A.168
A Compact and Highly Sensitive Bio-sensor using Directional Coupling between Metal Clad Ridge Waveguides, Ranjeet Dwivedi[1], Arun Kumar[1]; [1]*Indian Inst. of Technology, Delhi, India*. We propose a compact and highly sensitive bio-sensor based on directional coupling between two metal under-clad ridge waveguides. The sensitivity of the proposed sensor is found to be 6500 nm/RIU for the ambient RI ~1.33.

JTh2A.169
Mid-Infrared TE-pass and TM-pass polarizer based on Silicon on Sapphire (SOS) waveguide, Raghi El Shamy[1], Hany Mossad[1], Mohamed Swillam[1]; [1]*The American Univ. in Cairo, USA*. An easy to fabricate, wideband and compact silicon-based TE-pass and TM-pass integrated MIR polarizers are proposed. The polarizers covers the whole mid-infrared transparency region of the SOS waveguide.

JTh2A.170
Design and Fabrication of Heterogeneously Integrated Planar Triplexer for Optical Networks, Pallav Kanukuntla[1], Ayodeji Kuti[1], Geddis Demetris[1]; [1]*Norfolk State Univ., USA*.We report the design and fabrication of heterogeneously integrated silicon based planar triplexer, using a self-assembly integration technique which can be used in data centers and access networks for short wavelength applications.

JTh2A.171
A Linearization Technique in Silicon Modulators for Analog Signal Processing, Lingjun Jiang[1], Pengfei Wu[1], Young H. Kim[1], Stephen Anderson[1], Weimin Zhou[2], Zhaoran R. Huang[1]; [1]*Rensselaer Polytechnic Inst., USA;* [2]*Sensors &Electron Devices Directorate, US Army Research Laboratory, USA*. We investigate a linearization technique in silicon electro-optic (EO) modulator for spur-free dynamic range (SFDR) improvement. Using 3rd-order derivative of the transfer function, an optimal DC bias is applied to get a maximum SFDR.

JTh2A.172
Coherent perfect absorption in chiral materials, Yuqian Ye[2,1], Darrick Hay[1], Zhimin Shi[1]; [1]*Department of Physics, Univ. of South Florida, USA;* [2]*Department of Physics, Hangzhou Normal Univ., China*. We derive analytically the coherent perfect absorption condition of a transversely isotropic chiral structure. We use a THz chiral metamaterial structure to numerically demonstrate coherent absorption and polarization control.

JTh2A.173
Nanocoatings of Cerium Oxide and Platinum on Black Silicon Substrate for Enhanced Photocurrent Generation, Pabitra Dahal[1], Dionísio Pereira[1], Elangovan Elamurugu[1], Jaime P. Viegas[1]; [1]*Masdar Inst. of Science and Tech, United Arab Emirates*. We demonstrate a 32-times photocurrent improvement on nanolayers of platinum and cerium oxide on black silicon due to the combined plasmonic effect with the multiple pathway photon scattering events leading to significant absorption improvement.

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JTh2A.174
Optically reconfigurable chirp in micro/nano-fiber Bragg gratings, Wei Luo[1], Fei Xu[1], Yanqing Lu[1]; [1]*Nanjing Univ., China.* We theoretically demonstrate the optomechanical effect of optically reconfigurable chirp in silica micro/nano-fiber Bragg gratings. The fiber grating devices utilizing the optically reconfigurable chirp may offer a means for all-optical.

JTh2A.175
Withdrawn.

JTh2A.176
Self-Assembled Plasmonic Core-Shell Clusters for Infrared Resonators, Kan Yao[1], Yongmin Liu[1]; [1]*Northeastern Univ., USA.* Infrared resonators are key building blocks of optical devices for widespread applications. We show that self-assembled core-shells exhibit unique spectral features determined by the number, configuration, and dielectric properties of the particles.

JTh2A.177
Right-Angle Bends and Splitters for Interlayer Optical Links of Transverse Electric Waves, Peichuan Yin[1], Kaifeng Shi[1], Zhaolin Lu[1]; [1]*Rochester Inst. of Technology, USA.* We demonstrate the implementation of Metal-Dielectric-Metal structures to design wavelength size H-plane waveguide bends and power splitters for TE modes. These designs can be implemented as layer-to-layer links or sharp bends in the same layer.

JTh2A.178
Estimation and Compensation of Coupling Loss between Bend and Straight Silicon Waveguides, Vikash Kumar[1], Nishit Malviya[1], Vishnu Priye[1]; [1]*Indian School of Mines, Dhanbad, India.* To optimize space utilization in interconnects of Photonic Integrated Circuits, estimation and compensation of coupling loss between junction of straight and bend waveguide using Multiple Scaling Method having great effect on the data transceiver.

JTh2A.179
Nonlinear Waveguides Based on III-V Semiconductors, Shayan Saeidi[1], Kashif M. Awan[1], Lilian Sirbu[1], Ksenia Dolgaleva[1]; [1]*Univ. of Ottawa, Canada.* We propose nonlinear integrated waveguide designs based on semiconductors not widely used for nonlinear photonics previously. The materials belong to the group III-V and are expected to demonstrate interesting nonlinear optical properties.

JTh2A.180
Elastic Scattering from a Sapphire Microsphere in the THz Region, Syed Sultan Shah Bukhari[1], Muhammad Rehan Chaudhry[1], Mustafa Mert Bayer[1], Ali Serpengüzel[1]; [1]*KOC Univ., Turkey.* We analyze numerically TE and TM polarization 0° transmission and 90° elastic scattering from a sapphire microsphere with a radius of 2000 μm in terahertz region from 790 μm to 850 μm by utilizing generalized Lorenz-Mie theory.

JTh2A.181
***In Vitro* Neuronal Depolarization And Increased Synaptic Activity Induced By Infrared Neural Stimulation,** Blake Entwisle[1], Simon McMullan[1], Phillip Bokiniec[1], Simon Gross[1], Roger Chung[1], Michael Withford[1]; [1]*Macquarie Univ., Australia.* Neural responses to infrared laser stimulation are explored in single cells. We examined synaptic events of Sprague-Dawley rat neurons, stimulated using an 1890 nm laser. We show that infrared radiation increased spontaneous synaptic event frequency.

JTh2A.182
Simulation of Vision Corrected by the Light Sword Lens., Karol Kakarenko[1], Krzysztof Petelczyc[1], Andrzej Kolodziejczyk[1], Zbigniew Jaroszewicz[2,3], Alejandro Mira-Agudelo[4], John Fredy Barrera [4], Rodrigo Henao[4]; [1]*Warsaw Univ. of Technology Faculty of Physics, Poland;* [2]*Inst. of Applied Optics, Poland;* [3]*National Inst. of Telecommunications, Poland;*[4]*Grupo de Óptica y Fotónica, Instituto de Física, Colombia.* The monofocal vision corrected by LSL provide a homogenous performance in a wide range of defocus. We show the simulated visual performance by means of objective and subjective assessment of images created in optical system emulating the human eye.

JTh2A.183
In-Vivo Three-Photon Excited Fluorescence Imaging in the Spinal Cord of Awake, Locomoting Mouse, Yu-Ting Cheng[1], SallyAnne L. Ness[2], Sofia H. Hu[3], Jared Raikin[3], Lillyan D. Pan[3], Tianyu Wang[4], Dimitre G. Ouzounov[4], Jean C. Cruz-Hernandez[3], Isle M. Bastille[3], Nozomi Nishimura[3], Joseph R. Fetcho[1], Chris Xu[4], Chris B. Schaffer[3]; [1]*Neurobiology and Behavior, Cornell Univ., USA;* [2]*Veterinary Medicine, Cornell Univ., USA;* [3]*Meinig School of Biomedical Engineering, Cornell, USA;* [4]*School of Applied and Engineering Physics, Cornell Univ. , USA.* We constructed a system for in-vivo three-photon deep imaging in the spinal cord of awake, locomoting mice that facilitates detailed studies of neural firing patterns correlated with rhythmic locomotion.

JTh2A.184
Challenges in appearance characterization of coatings with effect pigments, Alejandro Ferrero[1], Joaquin Campos[1]; [1]*CSIC, Spain.* New methods to characterize coatings with effect pigments are necessary to quantify their complex appearance. A description of the challenges faced by their characterization is given in this contribution.

JTh2A.185
Optical Fiber based Methods for Deep Brain Calcium Signal Measurements in Behaving Mice, Ling Fu[1]; [1]*Wuhan National Lab for Optoelectronics, China.* The traditional optical systems are not suitable for recording of neuronal activity. Here a multichannel fiber photometry and a GRIN lens based confocal microscope are developed to acquire calcium signals in deep brain of behaving mice.

JTh2A.186
Age- and Glaucoma-Related Changes in Corneal Deformation Dynamics Utilizing Scheimpflug Imaging, Marta E. Musial[1]; [1]*Department of Biomedical Engineering, Wroclaw Univ. of Science and Technology, Poland.* Our experimental and statistical research have shown that high speed Scheimpflug imaging is a potential tool to determine and register changes in corneal biomechanics associated with age and glaucoma occurrence.

JTh2A.187
Simultaneous CW three laser wavelengths generation using precise gain control by VBGs , Ching-Nien Chen[1], Yu-Hua Hsieh[1], Te-Yuan Chung[1]; [1]*National Central Univ., Taiwan.* Three wavelength operation of a diode pumped Nd-based laser was constructed using three volume Bragg gratings (VBGs) as the output couplers. By precisely controlling the temperatures of the VBGs, the laser output wavelengths and power are stable.

JTh2A.188
Superfluid in helical container as a sensor of metric disturbances, Alex Okulov[1]; [1]*Russian Academy of Sciences, Russian Federation.* The quantum fluid in double-helix pipe is analyzed in accelerated reference frame. The slow rotations and small modulations of free-fall acceleration are taken into account.

JTh2A.189
Characterization of C-band SOA-based bidirectional tunable fiber laser with two nested fiber ring cavities, Simeon Bikorimana[1], Muhammad A. Ummy[2], Nicholas Madamopoulos[1], Roger Dorsinville[1]; [1]*Electrical Engineering, CUNY City College, USA;* [2]*Electrical & Telecommunications Engineering Technology, New York City College of Technology, USA.* We report a simple, stable, inexpensive SOA-based bidirectional tunable fiber laser, which consists of three SOAs and two nested fiber ring cavities. A beam combining gain of more than + 4.77 dB is demonstrated.

JTh2A.190
Spatio-temporal dynamics of broad-area semiconductor lasers, Stefan Bittner[1], Brandon Redding[1], Hui Cao[1], Daehwan Jung[1], Minjoo Larry Lee[1]; [1]*Yale Univ., USA.* We study experimentally the spatio-temporal dynamics of broad-area semiconductor lasers. Fast random and periodic oscillations of the laser emission are observed. Their dependence on the pump strength and cavity size are investigated.

JTh2A.191
Theoretical Analysis of Temperature Characteristics of Coupled Quantum Dot Lasers, Zhiyuan Lin[1], Guohui Yuan[1], Zhuoran Wang[1]; [1]*UESTC, China.* Spectra of coupled quantum dot lasers at different temperatures are calculated using a probabilistically coupled model. Calculated results show that the spectra at low temperatures are much flatter than the ones at high temperatures.

JTh2A.192
Nanosecond passively mode-locked laser with a hundred megahertz spectral bandwidth, Michael Kues[1], Christian Reimer[1], Benjamin Wetzel[1,2], Piotr Roztocki[1], Brent Little[3], Sai T. Chu[4], David J. Moss[5], Roberto Morandotti[1,6]; [1]*INRS-EMT, Canada;* [2]*School of Mathematical and Physical Sciences, Univ. of Sussex, UK;* [3]*Xi'an Inst. of Optics and Precision Mechanics, Chinese Academy of Science, China;* [4]*Department of Physics and Materials Science, City Univ. of Hong Kong, Hong Kong;* [5]*Center for Micro-Photonics, Swinburne Univ. of Technology, Australia;* [6]*Inst. of Fundamental and Frontier Sciences, Univ. of Electronic Science and Technology of China, China.* We demonstrate a passively mode-locked laser emitting 4.3 nanosecond quasi-Fourier-limited pulses with a record low (104.9 MHz) spectral bandwidth, based on simultaneous filtering and cavity-enhanced nonlinear interactions in an on-chip microcavity.

JTh2A.193
Multiplexing and Amplification of 2 μm Vortex Beams, Yuan Li[1], Wenzhe Li[1], Keith Miller[1], Eric G. Johnson[1]; [1]*Clemson Univ., USA.* The multiplexing and amplification of optical vortices with orbital angular momentum (OAM) is demonstrated in a Ho:YAG rod amplifier. The phase of the amplified vortex is also studied and proven to be well maintained.

JTh2A.194
Theoretical analysis on fast saturable-absorber effects in a mode-locked laser with an intra-cavity nonlinear medium, Toru Sato[1], Sakae Kawato[1]; [1]*Fukui Univ., Japan.* We analyzed fast saturable-absorber effects in a mode-locked laser with an intra-cavity highly nonlinear medium. The nonlinear effects were required to obtain shorter output pulse widths below the Fourier-transform-limit of the gain spectra.

JOINT FiO/LS

JTh2A • Joint Poster Session II—Continued

JTh2A.195
Theoretical Investigation of Laser-diode-pumped High Efficiency CW Ti:sapphire Laser, Motoki Morioka[1]; [1]*Fukui Univ., Japan.* The efficiency of laser-diode-pumped cw Ti:sapphire laser was investigated theoretically. The optical to optical conversion efficiency was obtained to be higher than 19%.

JTh2A.196
Spectral selectivity in capillary dye lasers, Esmaeil Mobini[1], Behnam Abaie[1], Arash Mafi[1]; [1]*Univ. of New Mexico, USA.* The free spectral range (FSR) of the spectral features in a fluidic capillary dye laser appears considerably larger than what is expected from a Fabry-Perot cavity analysis. We theoretically explain the reason behind this phenomenon.

JTh2A.197
Withdrawn.

JTh2A.198 ***E-Poster***
Surface Profilometry Using Vortex Beams, Alejandra Serrano[1], Jan L. Chaloupka[2], Matthw ANderson[3]; [1]*Universidad Autónoma de Baja California, Mexico;* [2]*Physics, Univ. of Northern Colorado, USA;* [3]*Physics, San Diego State Univ., USA.* We explore the use of scanning vortex beams to reveal the surface profile of sub-micron scale topological features. It is shown that a 200 nm step is easily discernible using this technique.
This presentation will be presented as an E-Poster on Screen 2 from 09:30–10:15

11:00–12:30 JTh3A • Light the Future Speaker Series featuring Michio Kaku, *Lilac Ballroom*

12:30–14:00 Free Lunch (provided by OSA), *Exhibit Hall, Empire Hall*

12:30–14:00 VIP Industry Leaders Networking Event: Connecting Corporate Executives, Young Professionals & Students, *Hyatt Regency Rochester, Grand Ballroom B-C*

Thank you for attending FiO/LS. Look for your post-conference survey via email and let us know your thoughts on the program.

NOTES

14:00–16:00
FTh4A • Symposium on Mid-Infrared Fiber Sources I
Presider: Morten Ibsen; Univ. of Southampton, UK

FTh4A.1 • 14:00 Invited

Highly Nonlinear Fibre for Applications in the Mid-IR, Brandon Shaw[1]; [1]*US Naval Research Laboratory, USA*. Highly nonlinear fibre for applications in the Mid-IR are explored.

FTh4A.2 • 14:30 Invited

Generation and Applications of High Average Power Mid-IR Supercontinuum in Chalcogenide Fibres, Christian Rosenberg Petersen[1]; [1]*Denmark*. Mid-infrared supercontinuum with up to 54.8 mW average power, and maximum bandwidth of 1.77-8.66 μm is demonstrated as a result of pumping tapered chalcogenide photonic crystal fibers with a MHz parametric source at 4 μm.

14:00–16:00
FTh4B • Optical Vortices
Presider: Carlos Lopez Mariscal, Underwater Photonics, Mexico

FTh4B.1 • 14:00 Tutorial

Spinning Light on the Nanoscale, Natalia M. Litchinitser[1], Jingbo Sun[1], Mikhail Shalaev[1]; [1]*State Univ. of New York at Buffalo, USA*. We discuss fundamental optical phenomena at the interface of singular and nonlinear optics in engineered optical media and show that the unique optical properties of metamaterials and metasurfaces open unlimited prospects to "engineer" light itself.

Biography: Natalia Litchinitser is a Professor of Electrical Engineering at University at Buffalo, The State University of New York. Her research focuses on fundamental properties and applications structured light in engineered nanosctructures, biomedical imaging, optical communications and nonlinear optics. She previously held a position of a Member of Technical Staff at Bell Laboratories, Lucent Technologies and of a Senior Member of Technical Staff at Tyco Submarine Systems. She authored 7 invited book chapters and over 150 research papers. She is a Fellow of the Optical Society of America, Fellow of the American Physical Society, and a Senior Member of the IEEE.

14:00–16:00
FTh4C • Computational Imaging I
Presider: Marc Christensen, SMU, USA

FTh4C.1 • 14:00 Invited

Nanoparticle and Virus Sensing Enabled by Computational Lensfree Imaging, Euan McLeod[1]; [1]*Optical Sciences, Univ. of Arizona, USA*. More than 10^5 individual viruses and nanoparticles <40 nm are detected using on-chip digital lensfree holography. The weak scattered waves from these objects are enhanced by self-assembled liquid polymer nanolenses that boost signal-to-noise ratio.

FTh4C.2 • 14:30

Improvement of experimental methods for studying dust plasma and colloidal systems, Nikita P. Kryuchkov[1], Anatoly Kislov[1], Egor Yakovlev[1], Kirill Zaytsev[1], Stanislav Yurchenko[1]; [1]*Bauman Moscow State Technical Univ., Russian Federation*. Software package for real-time post-processing of the dusty plasma systems experiments is designed. This package able to perform automatic particle tracking on the video stream from the experimental station and calculate different parameters.

14:00–16:00
FTh4D • Optics Meets Neuroscience I
Presider: Elizabeth Hillman, Columbia Univ., USA

FTh4D.1 • 14:00 Invited

Multi Scale Morpho-functional Characterization of Damage and Rehabilitation after Stroke, Francesco S. Pavone[1]; [1]*European Lab for Non-Linear Spectroscopy, Italy*. Here we use a multi-level approach to investigate complementary aspects of brain plasticity after stroke.

FTh4D.2 • 14:30 Invited

Chemical Sectioning: High Throughput Imaging Brain Networks ex vivo at Synaptic Resolution, Shaoqun Zeng[1,2]; [1]*Huazhong Univ of Science & Technology, China;* [2]*Biomedcial Potonics, Wuhan National Lab for Optoelectronics, China*. We present Chemical Sectioning (CS) method to systematically reconstruct the integral morphology of a neuron. This method will pave the way towards single cell projectome, and other studies involving neuronal organization.

14:00–16:00
FTh4E • High-Capacity Optical Communications and Data Centers I
Presider: Fernando Guiomar; Politecnico di Torino, Italy

FTh4E.1 • 14:00 Invited

Advanced Techniques for Digital Nonlinear Compensation in Multi-carrier Optical Transmission Systems, Fernando Guiomar[1]; [1]*Politecnico di Torino, Italy.* High-capacity optical communications are currently evolving towards multi-carrier transmission. We review the new challenges and opportunities for digital nonlinear mitigation in these systems, optimizing the performance versus complexity trade-off.

FTh4E.2 • 14:30

Diffractive Orbital Angular Momentum Demultiplexing Elements for Underwater Optical Communications, Indumathi R. Srimathi[1], Keith Miller[1], Wenzhe Li[1], Kaitlyn S. Morgan[1], Joshua Baghdady[1], Eric G. Johnson[1]; [1]*Clemson Univ., USA.* Diffractive elements based on coordinate transformations have been realized at 450 nm for demultiplexing orbital angular momentum states and can be applied to an underwater communications link. System efficiency of ~80% was obtained experimentally.

14:00–16:00
FTh4F • Quantum Communication and Networking I
Presider: Natalia Litchinitser; State Univ. of New York at Buffalo, USA

FTh4F.1 • 14:00 Invited

Quantum Teleportation across the Calgary Fibre Network, Wolfgang Tittel[1], Raju Valivarthi[1], Marcel.li Grimau Puigibert[1], Qiang Zhou[1], Gabriel Aguilar[1], Daniel Oblak[1], Varun Verma[2], Francesco Marsili[3], Matthew Shaw[3], Sae Woo Nam[2]; [1]*Univ. of Calgary, Canada;* [2]*NIST, USA;* [3]*JPL, USA.* We report quantum teleportation between telecom and 795 nm photons. This improves the distance over which teleportation takes place from 818 m to 6.2 km and constitutes a milestone towards a global quantum internet.

FTh4F.2 • 14:30 Invited

Interference for Quantum Time-Bin States in Satellite Channels, Giuseppe Vallone[1], Daniele Dequal[1], Marco Tomasin[1], Matteo Schiavon[1], Francesco Vedovato[1], Vincenza Luceri[2], Giuseppe Bianco[3], Paolo Villoresi[1]; [1]*Universita degli Studi di Padova, Italy;* [2]*E-GEOS, Italy;* [3]*MLRO, Agenzia spaziale Italiana, Italy.* The single photon interference of states that propagate in Space along a 5000km channel is reported. The modulation phase is dependent on the satellite velocity, expanding the degree-of-freedom available in Space Quantum Communications and Metrology.

14:00–16:00
FTh4G • Integrated Nonlinear Optics I
Presider: Stefan Preble; Rochester Inst. of Technology, USA

FTh4G.1 • 14:00 Invited

An Unspoofable Ultrafast Silicon Photonic Physical Key, Mark A. Foster[1]; [1]*Johns Hopkins Univ., USA.* Physical keys store secret information in their structure. Here we demonstrate an unclonable key based on a nonlinear reverberant silicon photonic microcavity. Beyond cloning this key also cannot be emulated due to its ultrafast response.

FTh4G.2 • 14:30

Nonlinear optic induced transparency and frequency conversion on a chip, Chang-Ling Zou[1], Xiang Guo[1], Hojoong Jun[1], Hong Tang[1]; [1]*Yale Univ., China.* Nonlinear optic induced transparency by second order optical nonlinearity on an aluminum nitride photonic chip is demonstrated experimentally, with a 14% external efficiency frequency conversion between visible and telecom photons.

14:00–16:00
FTh4H • Probing Ocular Biomechanics with Imaging Techniques / Novel Applications of Femtosecond Lasers in Ophthalmology
Presider: Andy Yun, Harvard Medical School, USA

FTh4H.1 • 14:00 Invited

Air-puff Swept-Source Optical Coherence Tomography, Maciej Wojtkowski[1,2], Ewa Mączyńska[1], Bartłomiej Kałużny[3], Ireneusz Grulkowski[1]; [1]*Nicolaus Copernicus Univ., Inst. of Physics, Poland;* [2]*Polish Academy of Sciences, Inst. of Physical Chemistry, Poland;* [3]*Nicolaus Copernicus Unive., Collegium Medicum, Poland.* We studied the response of porcine eyes to air pulse at well-controlled levels of intraocular pressure (IOP) using air-puff OCT instrument. We observed significant changes of hysteresis after cross-linking for higher levels of IOP.

FTh4H.2 • 14:30 Invited

Brillouin Microscopy for Ocular Biomechanics, Seok-Hyun A. Yun[1]; [1]*Harvard Medical School and Massachusetts General Hospital, USA.* We will review the progress and prospect of Brillouin microscopy, which combines confocal imaging and Brillouin light scattering spectroscopy to map the hydromechanical properties of ocular tissues to help improve diagnosis and treatments.

14:00–16:00
FTh4I • Symposium on 100 Years of Vision at OSA: Most Cited Vision Papers in OSA Journals
Presider: Susana Marcos, Consejo Sup Investigaciones Cientificas, Spain and Scott Carney, Univ. of Illinois at Urbana-Champaign, USA

FTh4I.1 • 14:00 Invited

Emerging Ocular Applications of Wavefront Correction, David R. Williams[1]; [1]*Univ. of Rochester, USA.* The correction of the eye›s wave aberration is enabling advances ranging from laser refractive surgery without removing tissue to retinal imaging tools capable of capturing retinal function at a cellular spatial scale.

FTh4I.2 • 14:30 Invited

Visual Sensitivity and Object Recognition, Denis G. Pelli[1]; [1]*New York Univ., USA.* The limits to human visual sensitivity can be factored into equivalent input noise, mostly due to unreliable communication, and efficiency, mostly due to suboptimal algorithms.

FTh4A • Symposium on Mid-Infrared Fiber Sources I—Continued

FTh4B • Optical Vortices—Continued

FTh4B.2 • 14:45
Fractional Vortex Hilbert's Hotel, Gregory J. Gbur[1]; [1]*Physics and Optical Science, Univ of North Carolina at Charlotte, USA.* We demonstrate theoretically how the unusual mathematics of infinite sets appears in the propagation of light through fractional vortex spiral waveplates. It is shown how Hilbert's famous hotel is manifested in a singularity of vortices.

FTh4C • Computational Imaging I—Continued

FTh4C.3 • 14:45
Motion Artefact Detection in Structured Illumination Microscopy, Ronny Förster[1,2], Kai Wicker[3], Walter Müller[1,2], Aurélie Jost[1,2], Rainer Heintzmann[1,2]; [1]*Microscopy, Leibniz Inst. of Photonic Technology, Germany;* [2]*Friedrich Schiller Univ. Jena, Germany;* [3]*Corporate Research and Technology, Carl Zeiss AG, Germany.* The necessary image processing in structured illumination microscopy generates high resolution artefacts if the sample has moved during the acquisition. Our algorithm locates motion and distinguishes artefacts from real high resolution cell features.

FTh4D • Optics Meets Neuroscience I—Continued

Thursday, 20 October

FTh4A.3 • 15:00 Tutorial
Mid-infrared Wavelength Conversion in Chalcogenide Optical Microfibers, Thibaut Sylvestre[1], Thomas Godin[1], John M. Dudley[1], Raja Ahmad[2], Martin Rochette[2]; [1]*Optics, CNRS FEMTO-ST Inst., France;* [2]*Department of Electrical and Computer Engineering, McGill Univ., Canada.* Chalcogenide fibers have been identified as very attractive nonlinear waveguides for mid-infrared applications. We review our recent achievements on mid-IR frequency conversion and supercontinuum generation in chalcogenide tapered optical fibers.

Biography: Thibaut Sylvestre is leading the nonlinear photonics group at the Femto-ST institute in France and he is supervising studies of nonlinear optical phenomena in specialty fibers with the aim of investigating potential applications to telecommunications, lasers and sensors.

FTh4B.3 • 15:00
Spatio-Temporal Optical Vortices, Nihal Jhajj[1], Ilia Larkin[1], Eric Rosenthal[1], Sina Zahedpour[1], Jared Wahlstrand[1], Howard Milchberg[1]; [1]*Univ. of Maryland at College Park, USA.*We present the first measurements of spatio-temporal optical vortices (STOVs). STOV generation/propagation is a universal feature of nonlinear pulse collapse and collapse arrest.

FTh4B.4 • 15:15
Partially Coherent Vortex Beams of Arbitrary Order, Charlotte Stahl[1], Gregory J. Gbur[1]; [1]*Univ of North Carolina at Charlotte, USA.* We derive analytic solutions for an infinite set of partially coherent vortex beams of any azimuthal order. Such beams may be useful for free space optical communication and understanding them is a necessary first step.

FTh4C.4 • 15:00
Integrating sphere based speckle generation for wavelength determination and laser stabilization, Nikolaus K. Metzger[1], Roman Spesyvtsev[1], Bill Miller[2], Gareth Maker[2], Graeme Malcolm[2], Michael Mazilu[1], Kishan Dholakia[1]; [1]*Univ. of St Andrews, UK;* [2]*M-Squared Lasers, UK.* An integrating sphere generates wavelength dependent speckle patterns that realizes an ultra-sensitive wavemeter with sub-femtometre resolution. Utilizing this wavemeter, we stabilize a laser for atom cooling of Rubidium to better than 1 MHz.

FTh4C.5 • 15:15
Withdrawn.

FTh4D.3 • 15:00 Invited
Imaging Activity in the Spinal Cord, Daniel C. Cote[1]; [1]*Universite Laval, Canada.* We will show various strategies (both for surgery and imaging techniques) to image activity in the spinal cord using genetically encoded calcium indicators for neuronal activity and monitoring dendrites for microglial activity.

FTh4E • High-Capacity Optical Communications and Data Centers I—Continued

FTh4E.3 • 14:45
Pump-Phase-Noise Tolerant Wavelength Multicasting for Coherent Communications using Kerr Frequency Combs, Peicheng Liao[1], Changjing Bao[1], Arne Kordts[2], Maxim Karpov[2], Martin Hubert Peter Pfeiffer[2], Lin Zhang[3], Yinwen Cao[1], Ahmed Almaiman[1], Amirhossein Mohajerin-Ariaei[1], Morteza Ziyadi[1], Tobias J. Kippenberg[2], Alan Willner[1];[1]*Univ. of Southern California, USA;* [2]*Ecole Polytechnique Federale Lausanne, Switzerland;* [3]*Tianjin Univ., China*. We experimentally demonstrate the pump-phase-noise-tolerant wavelength multicasting for 20 GBaud/s QPSK signals using Kerr frequency combs. The EVM of multicasted copy almost stays unchanged when the pump linewidth is broadened to 2 MHz.

FTh4E.4 • 15:00
Underwater Optical Communication Link Using Wavelength Division Multiplexing, Polarization Division Multiplexing and Orbital Angular Momentum Multiplexing, Joshua Baghdady[1], Kaitlyn Morgan[1], Keith Miller[1], Joseph Kelly[1], Indumathi R. Srimathi[1], Wenzhe Li[1], Eric G. Johnson[1]; [1]*Clemson Univ., USA*. We report on the direct modulation of blue laser diodes for underwater optical communication utilizing wavelength, polarization and space division multiplexing. Using this scalable architecture, we demonstrate an effective data rate of 10 Gbit/s.

FTh4E.5 • 15:15
Modal Properties of Perturbed Few-Mode Optical Fibers, Werner Klaus[1], Katsunori Imamura[2], Ryuichi Sugizaki[2], Yoshinari Awaji[1], Naoya Wada[1]; [1]*National Inst of Information & Comm Tech, Japan;* [2]*Furukawa Electric Co. Ltd., Japan*. We examine the modal properties of few-mode optical fibers with respect to two common fiber perturbations, birefringence and core non-circularity, and investigate the relationship of the fiber's true and LP modes in a quantitative way.

FTh4F • Quantum Communication and Networking I—Continued

FTh4F.3 • 15:00 Invited
Quantum Networks with Optical Frequency Combs, Nicolas Treps[1], Clément Jacquard[1], Young-Sik Ra[1], Adrien Dufour[1], Francesco Arzani[1], Valentina Parigi[1], Claude Fabre[1];[1]*Laboratoire Kastler Brossel, France*. The intrinsic multimode character of optical frequency combs is demonstrated to be an ideal candidate for quantum information processing. Generation of on demand quantum networks and versatile mode-dependant non-gaussian operations are demonstrated.

FTh4G • Integrated Nonlinear Optics I—Continued

FTh4G.3 • 14:45
Photonic-chip based widely tunable microwave source using a Brillouin opto-electronic oscillator, Moritz Merklein[1], Birgit Stiller[1], Irina Kabakova[2], Udara Mutugala[3], Khu Vu[4], Stephen Madden[4], Benjamin J. Eggleton[1], Radan Slavik[3]; [1]*Centre for Ultrahigh bandwidth Devices for Optical Systems (CUDOS), The Univ. of Sydney, Australia;* [2]*Blacket Laboratory, Imperial College London, UK;* [3]*Optoelectronics Research Centre (ORC), Univ. of Southampton, UK;* [4]*CUDOS, Australian National Univ., Australia*. We demonstrate the first widely tunable chip-based opto-electronic microwave source based on stimulated Brillouin scattering. The output frequency can be tuned over 40 GHz and the phase-noise performance is comparable to high-range RF sources.

FTh4G.4 • 15:00
Asymmetric Light-Light Interaction by Non-Hermitian Photonics, Han Zhao[1], William Fegadolli[2], Jiaka Yu[1], Zhifeng Zhang[1], Li Ge[3], Axel Scherer[2], Liang Feng[1]; [1]*SUNY Buffalo, USA;* [2]*Department of Physics and Kavli Nanoscience Inst., California Inst. of Technology, USA;* [3]*Department of Engineering Science and Physics, CUNY, USA*. Effective light-light interaction enables energy-efficient optical networks. By non-Hermitian on-chip engineering, we demonstrate asymmetric light control where intense laser field is manipulated by weak control with an extinction ratio up to 60 dB.

FTh4G.5 • 15:15
Wideband spectral broadening in ultra-short ultra-silicon rich nitride waveguides, Ju Won Choi[1], George F. R. Chen[1], D. K. T. Ng[2], Kelvin J. A. Ooi[1], Dawn T. H. Tan[1];[1]*Engineering Product Development, Singapore Univ. of Technology and Design, Singapore;* [2]*Data Storage Inst., Agency for Science, Technology and Research (A*STAR), Singapore*. Ultra-silicon rich nitride (USRN) waveguide with 1-mm-length possessing high Kerr nonlinearity and low two photon absorption achieved femtosecond spectral bandwidth of 225 nm at near-infrared wavelength range, which is a 4 fold spectral broadening.

FTh4H • Probing Ocular Biomechanics with Imaging Techniques / Novel Applications of Femtosecond Lasers in Ophthalmology—Continued

FTh4H.3 • 15:00 Invited
Multiphoton Retinal Imaging, Jennifer J. Hunter[1]; [1]*Univ. of Rochester, USA*. Cellular-scale non-linear imaging of the living retina has made it possible to non-invasively image the ganglion cell mosaic and to interrogate molecular processes such as the visual cycle within rods and cones.

FTh4I • Symposium on 100 Years of Vision at OSA: Most Cited Vision Papers in OSA Journals—Continued

FTh4I.3 • 15:00 Invited
Motion, Early Vision, and the Plenoptic Function, Edward H. Adelson[1]; [1]*Massachusetts Inst. of Technology, USA*. If you generalize edge detection to space-time, you get motion. If you keep generalizing you get color opponency, stereopsis, flicker, and much more. The plenoptic function captures everything that can be seen; its derivatives yield early vision.

FTh4A • Symposium on Mid-Infrared Fiber Sources I—Continued

FTh4A.4 • 15:30 Invited

Mid-Infrared Photonics in Healthcare, Angela Seddon[1]; [1]*Univ. of Nottingham, UK*. We set a record in demonstrating extreme broad-band supercontinuum generated light 1.4 to 13.3 microns in a specially engineered MIR fibre, a key first step towards bright, portable, broadband MIR sources for applications in healthcare.

FTh4B • Optical Vortices—Continued

FTh4B.5 • 15:30 Invited

Quantum and Classical Properties of Vector Modes, Andrew Forbes[1], Bereneice Sephton[2]; [1]*Univ. of Witwatersrand, South Africa*, [2]*CSIR Natiional Laser Centre, South Africa*. Vector beams are non-separable light fields. By borrowing tools from quantum mechanics, we show how to create, define and measure them, and demonstrate how they may be used to simulate quantum processes.

FTh4C • Computational Imaging I—Continued

FTh4C.6 • 15:30

Imaging Quality of Intensity-Interferometric Spectral-Domain Optical Coherence Tomography with Dispersion Insensitivity, Tomohiro Shirai[1]; [1]*Natl Inst of Adv Industrial Sci & Tech, Japan*. We demonstrate that unwanted artifacts observed in dispersion-insensitive optical coherence tomography based on spectral intensity interferometry can be reduced by means of a relative displacement between the detector and the spectrum to be captured.

FTh4C.7 • 15:45

Digital refocusing of fluorescent light intensity with spatial frequency modulated imaging, Jeffrey J. Field[1], Randy Bartels[1]; [1]*Colorado State Univ., USA*. We present an imaging method that transfers the spatial phase difference between two coherent illumination beams into temporal modulations of fluorescent light emission collected on a single-pixel detector, enabling refocusing of fluorescent light.

FTh4D • Optics Meets Neuroscience I—Continued

FTh4D.4 • 15:30

A Miniaturized Optical System for Monitoring Cerebrovascular Perfusion during Deep Brain Stimulation, Linhui Yu[1], M. Sohail Noor[1,2], Zelma H. Kiss[2], Kartikeya Murari[1,2]; [1]*Electrical and Computer Engineering, Schulich School of Engineering, Univ. of Calgary, Canada;* [2]*Hotchkiss Brain Inst., Department of Clinical Neurosciences, Cumming School of Medicine,, Univ. of Calgary, Canada*. We present the design of a miniaturized optical system to measure changes in cortical perfusion in response to deep brain stimulation. The system design and preliminary results are presented.

FTh4D.5 • 15:45

A diamond-based, hybrid optrode for multisite optogenetics, Antoine Boudet[1], Robert Scharf[1], Martin Dawson[1], Keith Mathieson[1]; [1]*Univ. of Strathclyde, UK*. Ideal for multi-depth optogenetics, current monolithic LED neuroprobes show inherent limits, notably for heat extraction. Here we present a diamond optrode integrating transfer-printed GaN µLEDs, allowing extended/high-power emission and versatility.

16:00–16:30 Coffee Break, *West Corridor and Skyway Lobby (Radisson)*

FTh4E • High-Capacity Optical Communications and Data Centers I—Continued

FTh4E.6 • 15:30 Invited

Ultra-broadband Nonlinear Optical Signal Processing for Optical Communications, Hao Hu[1], Francesco Da Ros[1], Minhao Pu[1], Michael Galili[1], Kresten Yvind[1], Toshio Morioka[1], Leif Katsuo Oxenløwe[1]; [1]*DTU Fotonik, Technical Univ. of Denmark, Denmark.* Nonlinear optics enables ultra-broadband, ultra-fast and phase-preserving applications that can be very useful in optical communications. A single-source frequency comb can enable a large number of WDM channels, reducing required number of lasers.

FTh4F • Quantum Communication and Networking I—Continued

FTh4F.4 • 15:30

Multi-user Quantum Key Distribution with Entangled Photons from a Semiconductor Chip, Claire Autebert[1], Julien Trapateau[2], Adeline Orieux[2], Aristide Lemaître[3], Carme Gomez-Carbonnel[3], Eleni Diamanti[2], Isabelle Zaquine[2], Sara Ducci[1]; [1]*Université Paris Diderot-Paris7, France;* [2]*Laboratoire traitement et communication de l'information, Télécom ParisTech, France;* [3]*Laboratoire de Photonique et Nanostructure, France.* We experimentally demonstrate a multi-user quantum key distribution scheme based on polarization entangled photons emitted from an AlGaAs chip and standard telecom wavelength division multiplexers.

FTh4F.5 • 15:45

Generation and analysis of correlated pairs of photons on a satellite, Alexander Ling[1], Zhongkan Tang[1], Rakhitha Chandrasekara[1], Yue Chuan Tan[1], Cliff Cheng[1], Daniel Oi[2]; [1]*Centre for Quantum Technologies, Singapore;* [2]*SUPA Dept of Physics, Univ. of Strathclyde, UK.* We report the operation of a photon pair source on board a nanosatellite: an important milestone towards compact entangled photon pair sources for future space-based quantum communication.

FTh4G • Integrated Nonlinear Optics I—Continued

FTh4G.6 • 15:30

3C Silicon Carbide Nanophotonics, Francesco Martini[1], Alberto Politi[1]; [1]*Univ. of Southampton, UK.* The development of novel photonic materials can offer new capabilities for nonlinear and quantum optics. We demonstrate key components for a photonic platform in 3C-SiC, including high-confinement waveguides, grating couplers and high-Q resonators.

FTh4G.7 • 15:45

On-chip Turing pattern formation for coherent high-power THz radiation, Shu-Wei Huang[1], Jinghui Yang[1], Shang-Hua Yang[2], Mingbin Yu[2], Dim-Lee Kwong[2], Mona Jarrahi[1], Chee Wei Wong[1]; [1]*UCLA, USA;* [2]*The Inst. of Microelectronics, Singapore.* We report efficient on-chip Turing pattern formation, uniquely enabled by mode-hybridization induced phase matching. The robustness, tunability, coherence, and efficiency lend itself to an excellent pump for high-power narrow-linewidth THz radiation.

FTh4H • Probing Ocular Biomechanics with Imaging Techniques / Novel Applications of Femtosecond Lasers in Ophthalmology—Continued

FTh4H.4 • 15:30 Invited

IRIS – A New Paradigm in Laser Refractive Correction, Jonathan D. Ellis[1,2], Gustavo A. Gandara-Montano[2], Daniel R. Brooks[2], Kaitlin T. Wozniak[2], Sara M. Gearhart[2], Len A. Zheleznyak[2,3], Paul D. Funkenbusch[1], Wayne H. Knox[2], Krystel R. Huxlin[4]; [1]*Dept. of Mechanical Engineering, Univ. of Rochester, USA;* [2]*The Inst. of Optics, Univ. of Rochester, USA;* [3]*Clerio Vision, Inc., USA;* [4]*Flaum Eye Inst., Univ. of Rochester, USA.* Altering the refractive index of both hydrogel materials and living cornea shows promise for ophthalmic applications. Here we show our recent developments in the use of femtosecond lasers in a mode that induces nonlinear multi-photon absorption and alters the refractive index of transparent materials.

FTh4I • Symposium on 100 Years of Vision at OSA: Most Cited Vision Papers in OSA Journals—Continued

FTh4I.4 • 15:30 Invited

Fourier, Gabor, Reichardt, Hilbert: Guides on the Path to a Model of Human Motion Perception, Andrew B. Watson[1]; [1]*NASA Ames Research Center, USA.* The visual motion sensing model developed by Albert Ahumada and myself relied on four concepts: motion in the frequency domain; localization in space, time, and frequency; comparing space and time; and the Hilbert transform.

16:00–16:30 Coffee Break, *West Corridor and Skyway Lobby (Radisson)*

16:30–18:30
FTh5A • Symposium on Mid-Infrared Fiber Sources II
Presider: Morten Ibsen; Univ. of Southampton, UK

FTh5A.1 • 16:30 Invited
All-fiber Sources Operating in the Mid-infrared, Martin Bernier[1]; [1]*Université Laval, Canada.* The architecture of an all-fiber laser operating at 2.94 microns at a continuous output power of 30W will be detailed. Different recent technical achievements based on the same mastered technology will also be discussed.

FTh5A.2 • 17:00 Invited
Power Scaling Concepts for Mid-infrared Fibre Lasers Using Fluoride Glass, Stuart D. Jackson[1]; [1]*Engineering, Macquarie Univ., Australia.* I will briefly overview the field of mid-infrared fibre lasers with a focus on recent developments aimed at increasing the output power. I will mainly focus on fibre gain elements involving fluoride glass as the host material.

16:30–18:30
FTh5B • Optical Vortices, Polarization and Mode Shaping
Presider: Greg Gbur, Univ. of North Carolina at Charlotte, USA

FTh5B.1 • 16:30 Invited
Towards Chiral Materials Science Based on Optical Vortices Illumination, Takashige Omatsu[1]; [1]*Chiba Univ., Japan.* Illumination of optical vortoces enables us to twist melted materials to establish chiral strutures on a nanoscale. Such structured materials will open the door to develop chirality sensors, chiral chemical reactors, and metamaterials.

FTh5B.2 • 17:00
Generation of tunable orbital angular momentum in polarization maintaining fiber, Robert Niederriter[1], Mark Siemens[3], Juliet T. Gopinath[1,2]; [1]*Department of Physics, Univ. of Colorado at Boulder, USA;* [2]*Department of Electrical, Computer, and Energy Engineering, Univ. of Colorado Boulder, USA;* [3]*Department of Physics and Astronomy, Univ. of Denver, USA.* We demonstrate tunable orbital angular momentum (OAM) in two-mode polarization-maintaining optical fiber. The OAM and spatial beam profile can be varied as the relative phase and coherence between fiber modes is adjusted.

16:30–18:30
FTh5C • Computational Imaging II
Presider: David Hasenauer, Synopsys, USA

FTh5C.1 • 16:30 Invited
Imaging Beyond the Limits: Active Imaging for Enhancing Resolution, 3D Information, and Indirect Imaging, Marc P. Christensen[1], Prasanna Rangarajan[1]; [1]*Southern Methodist Univ., USA.* We present a technique of utilizing active illumination to surpass the limitations of passive imaging systems alone. An approach to combine super resolution and profilometery is presented. Recent applications to indirect imaging will be discussed.

FTh5C.2 • 17:00
Experimental x-ray ghost imaging, Daniele Pelliccia[1,2], David M. Paganin[2]; [1]*Science, RMIT Univ., Australia;* [2]*Physics and Astronomy, Monash Univ., Australia.* We report the experimental demonstration of x-ray ghost imaging using synchrotron emission. Our experiment opens a clear path towards low dose x-ray medical diagnostics, and also towards single-molecule diffraction imaging at Free Electron Lasers.

16:30–18:30
FTh5D • Optics Meets Neuroscience II
Presider: Ann E. Elsner, Indiana Univ., USA

FTh5D.1 • 16:30 Invited
Cone Signals, Adaptive Optics, and the Brain, Lawrence Sincich[1]; [1]*Optometry and Vision Science, Univ. of Alabama at Birmingham, USA.* Cone-targeted microstimulation using adaptive optics provides access to the processing of single cone signals in the visual system. Recent progress revealing cone signal variability and summation in the human and macaque brain will be presented.

FTh5D.2 • 17:00 Invited
Parallel Processing in the Visual System, Bart Borghuis[1]; [1]*Univ. of Louisville, USA.* Optical imaging is transforming the study of neural circuit function in the brain, including the retina. Here, I will show how 2-photon fluorescence imaging revealed key properties of information processing in retinal bipolar cell pathways.

FiO | LS

16:30–18:30
FTh5E • High-Capacity Optical Communications and Data Centers II
Presider: Benyuan Zhu; OFS Laboratories, USA

FTh5E.1 • 16:30 Invited
Large-data Center Interconnect: Emerging Technologies and Scaling Challenges, Xiang Zhou[1]; [1]*Google, USA*. In this talk I will present a high-level review on emerging technologies and scaling challenges for large-scale data center interconnection networks.

FTh5E.2 • 17:00
Can information Capacity be Increased with Orbital Angular Momentum?, Mingzhou Chen[1], Kishan Dholakia[1], Michael Mazilu[1]; [1]*Univ. of St Andrews, UK*. We demonstrate that using orbital angular momentum (OAM) does not increase the telecommunication capacity of an optical system.

16:30–18:30
FTh5F • Quantum Communication and Networking II
Presider: Paolo Villoresi; Universita degli Studi di Padova, Italy

FTh5F.1 • 16:30 Invited
Nonlinear Light-Matter Interactions in Engineered Optical Media, Natalia M. Litchinitser[1], Wiktor Walasik[1], Salih Silahli[1], Jingbo Sun[1], Yun Xu[1]; [1]*State Univ. of New York at Buffalo, USA*. Here, we discuss novel opportunities for structured light manipulation in nonlinear soft-matter, gaseous and negative-index media.

FTh5F.2 • 17:00 Invited
Practical Continuous Variable QKD in Fiber and Free Space Systems, Christoph Marquardt[2,1]; [1]*Department of Physics, Univ. of Erlangen-Nuremberg, Germany;* [2]*Max Planck Inst. for the Science of Light, Germany.* I will review recent activities in continuous variable QKD that aims for the deployment of QKD equipment compatible with current telecom standards and research in satellite QKD that will make it possible to bridge long distances.

16:30–18:30
FTh5G • Integrated Nonlinear Optics II
Presider: Sasan Fathpour; CREOL, Univ. of Central Florida, USA

FTh5G.1 • 16:30 Invited
Soliton Mode Locking in Optical Microcavities, Kerry J. Vahala[1]; [1]*California Inst. of Technology, USA*. Progress on soliton frequency microcombs is described including review of dissipative Kerr cavity soliton physics. Dispersive-wave generation and Raman self-frequency shift will be discussed. Progress towards octave-spanning microcombs is overviewed.

FTh5G.2 • 17:00
Experimental Demonstration of Inserting Phase-Locked Lines into Kerr Combs using Electro-Optical Modulation, Changjing Bao[1], Peicheng Liao[1], Yinwen Cao[1], Guodong Xie[1], Arne Kordts[2], Lin Zhang[3], Maxim Karpov[2], Martin Hubert Peter Pfeiffer[2], Cong Liu[1], Morteza Ziyadi[1], Yan Yan[1], Ahmed Almaiman[1], Amirhossein Mohajerin-Ariaei[1], Fatemeh Alishahi[1], Tobias J. Kippenberg[2], Alan Willner[1]; [1]*Univ. of Southern California, USA;* [2]*Ecole Polytechnique Federale de Lausanne (EPFL) Lausanne, Switzerland;* [3]*School of Precision Instrument and Opto-electronics Engineering, Tianjin Univ., China.* We experimentally demonstrate the flexibility of inserting one or two lines into Kerr combs. The effect of the spacing between two sidebands (260 KHz and 770 KHz) from EO modulation on the communication system is studied.

16:30–18:30
LTh5H • Topological Photonics I
Presider: Mohammad Hafezi, Univ. of Maryland, College Park, USA

LTh5H.1 • 16:30 Invited
Majorana-like Zero Modes in a Two-dimensional Photonic Topological Insulator, Jiho Noh[1], Wladimir Benalcazar[2], Sheng Huang[3], Kevin Chen[3], Taylor Hughes[2], Mikael C. Rechtsman[1]; [1]*Physics, The Pennsylvania State Univ., USA;* [2]*Physics, Univ. of Illinois, USA;* [3]*Electrical Engineering, Univ. of Pittsburgh, USA*. Constructing highly confined defect modes in photonic crystal slabs and fibers is a major challenge in photonics. We use a photonic topological insulator to realize mid-gap (maximally confined) disorder-insensitive defect modes.

LTh5H.2 • 17:00 Invited
Title to be Announced, Shanhui Fan[1]; [1]*Stanford Univ., USA*. Abstract not available.

16:30–18:30
LTh5I • High Harmonic Generation I
Presider: David Reis; Stanford Univ., USA

LTh5I.1 • 16:30 Invited
Extreme Ultraviolet Generation in Bulk Solids: Linking Multi-PHz Electronics and Photonics, Eleftherios Goulielmakis[1]; [1]*Max-Planck-Institut fur Quantenoptik, Germany.* We will present how electron motion in solids, driven by intense, precisely-sculpted, optical fields give rise to controllable electric currents, of multi-Petahertz frequency, advancing lightwave electronics to new realms of speed and precision.

LTh5I.2 • 17:00 Invited
Plasmonic-enhanced High Harmonic Generation from Bulk Silicon, Giulio Vampa[1]; [1]*Univ. of Ottawa, Canada*. The near-field of a surface plasmon polariton generates high harmonics of an infrared laser from the silicon substrate that hosts an array of gold nanoantennas.

FTh5A • Symposium on Mid-Infrared Fiber Sources II—Continued

FTh5A.3 • 17:30 Invited

Mid-Infrared Sources for Ultra-Broadband Cavity Enhanced Spectroscopy, Caroline G. Amiot[1,2], Piotr Ryczkowski[1], Antti Aalto[1], Juha Toivonen[1], Goëry Genty[1]; [1]*Tampere Univ. of Technology, Finland;* [2]*Institut FEMTO-ST, France*. We developed an all-fiber based supercontinuum source spanning from 900 to 3700 nm. We performed incoherent broadband cavity enhanced absorption spectroscopy using that source and were able to detect multicomponent simultaneously.

FTh5B • Optical Vortices, Polarization and Mode Shaping—Continued

FTh5B.3 • 17:15

Radial poarisation and more from a glass cone., Neal Radwell[1], Ryan D. Hawley[1], Joerg B. Goette[1], Sonja Franke-Arnold[1]; [1]*Univ. of Glasgow, UK*. Beams with polarisation structure are interesting due to their ability to produce unconventional light fields. Here we show that a simple glass cone can create such beams and we explore the mechanisms behind this, as well as its potential uses.

FTh5B.4 • 17:30

High-Order Monstar Disclinations in the Polarization of Light, Enrique J. Galvez[1], Behzad Khajavi[1,2]; [1]*Colgate Univ., USA;* [2]*Physics and Astronomy, Florida Atlantic Univ., USA*. We investigated high-order polarization disclinations using a beam prepared in a non-separable superposition of high-order spatial and polarization modes. Our findings include high-order monstar patterns that have a negative index.

FTh5B.5 • 17:45

Nonlinear Generation of High Power and Higher order Hollow Gaussian Beam, Apurv Chaitanya Nellikka[1], Jabir M. V.[1], Jay Banerji[1], Goutam K. Samanta[1]; [1]*Physical Research Laboratory, India*. We demonstrate novel experimental scheme generating high-power, higher-order hollow-Gaussian-Beam (HGB) through annihilation of OAM of interacting photons in nonlinear process. Also, report a new and only method for characterizing the order of HGBs.

FTh5C • Computational Imaging II—Continued

FTh5C.3 • 17:15

Shape Reconstruction and Orientation Estimation of Transparent Microscopic Object using Light Field Microscopy, Xiaopeng Peng[1], Grover A. Swartzlander[1]; [1]*Rochester Inst. of Technology, USA*. This paper reports a framework for high speed volumetric imaging and orientation estimation of transparent microscopic objects using light field microscopy.The framework provides a potentiality for kinetic characterization of microscopic objects.

FTh5C.4 • 17:30

Multi-spectral visible-to-shortwave infrared smart camera built on a compressive sensing platform, Lenore McMackin[1], Matthew A. Herman[1], Tyler Weston[1]; [1]*InView Technology Corporation, USA*. We describe development of a multi-spectral camera built on a compressive sensing platform. Its novel yet simple design takes advantage of the diffractive properties of a micromirror array used in the well-known single-pixel camera architecture.

FTh5C.5 • 17:45

Computational imaging with adaptive spatially-variable resolution, David B. Phillips[1], Ming-Jie Sun[1], Matthew Edgar[1], Jonathan Taylor[1], Graham Gibson[1], Stephen Barnett[1], Miles Padgett[1]; [1]*Univ. of Glasgow, UK*. We describe a single-pixel imaging system with an enhanced frame-rate, achieved by reconstructing images with a variable resolution across the field-of-view. Resolution can be adaptively changed from frame to frame to track moving objects.

FTh5D • Optics Meets Neuroscience II—Continued

FTh5D.3 • 17:30 Invited

Imaging Microglia in the Physiological Brain, Anna Majewska[1]; [1]*Univ. of Rochester, USA*. Microglia are traditionally thought to be the immune cells of the brain. Here we present evidence from in vivo imaging experiments, that microglia have critical roles in normal brain function.

FTh5E • High-Capacity Optical Communications and Data Centers II—Continued

FTh5E.3 • 17:15
Effective Area Measurement of Few-Mode Fiber Using Far Field Scan Technique with Hankel Transform Generalized for Circularly-Asymmetric Mode, Tetsuya Hayashi[1], Yoshiaki Tamura[1], Takuji Nagashima[1], Kazuhiro Yonezawa[1], Toshiki Taru[1], Koji Igarashi[2], Daiki Soma[2], Yuta Wakayama[2], Takehiro Tsuritani[2]; [1]*Sumitomo Electric Industries, Ltd., Japan;* [2]*KDDI R&D Laboratories, Inc., Japan*. We developed an A_{eff} measurement method for the few-mode fiber. A newly derived NFP–FFP transform equation enabled A_{eff}measurement of circularly-asymmetric modes using high-dynamic-range far-field scan technique and low-crosstalk mode multiplexer.

FTh5E.4 • 17:30
Energy equalization of a set of coherent OAM states by means of optimal phase gratings, Jaime A. Anguita[1], Jaime E. Cisternas[1], Gustavo L. Funes[1]; [1]*Universidad de los Andes - Chile, Chile*. We propose a method to design phase gratings that will generate a uniform energy distribution among the constituent OAM states after illumination, while minimizing the content of radial modes.

FTh5E.5 • 17:45 Tutorial
Recent Advances on Fibers for Optical Communications, Benyuan Zhu[1]; [1]*OFS Laboratories, USA*. In this tutorial, we will review recent advances on optical fibers including ultra-low-loss ultra-large-area fibers for systems, multicore fibers and few-mode fibers for space-division-multiplexing transmissions. Their optical fiber properties and performance are provided.

(continued on page 109)

FTh5F • Quantum Communication and Networking II—Continued

FTh5F.3 • 17:30 Invited
Optical Realisation of Communication Protocols with a Quantitative Quantum Communication Advantage, Norbert Lutkenhaus[1]; [1]*Univ. of Waterloo, Canada*. Quantum Fingerprinting offers a exponential advantage over classical protocols in comparing two remote files by a referee in the simultaneous message passing protocol. We show how to realize this advantange using optical communication techniques.

FTh5G • Integrated Nonlinear Optics II—Continued

FTh5G.3 • 17:15
Silica-Chip-Based Continuum Generation for Frequency Comb Self-Referencing, Connor Frederick[1], Dong Yoon Oh[2], Ki Youl Yang[2], Gabriel Ycas[1], Kerry J. Vahala[2], Scott Diddams[1]; [1]*Time and Frequency Division, National Inst. of Standards and Technology, USA;* [2]*T. J. Watson Laboratory of Applied Physics, California Inst. of Technology, USA*.Dispersion-engineered silica ridge waveguides are employed for dispersive wave generation from 275 nm to 575 nm. When placed at the pump harmonic, the dispersive wave enables frequency comb self-referencing in a collinear, zero delay geometry.

FTh5G.4 • 17:30
On-chip photon pair source based on spontaneous parametric down conversion, Xiang Guo[1], Chang-Ling Zou[1], Carsten Schuck[1], Hojoong Jung[1], Risheng Cheng[1], Hong Tang[1];[1]*Yale Univ., USA*. We demonstrate an on-chip parametric down conversion photon pair source based on second order nonlinearity. High brightness, low noise, high purity photon pairs are generated in a microring resonator on Aluminum nitride-on-Insulator platform.

FTh5G.5 • 17:45
Blue light emission via harmonic generation by stimulated Raman scattering in a silica toroid microcavity, Shun Fujii[1], Takumi Kato[1], Atsuhiro Hori[1], Yusuke Okabe[1], Akihiro Kubota[1], Takasumi Tanabe[1]; [1]*Keio Univ., Japan*. We experimentally investigate blue light emission in a silica toroid microcavity. We show the blue light as the harmonic generation from anti-Stokes light of higher order stimulated Raman scattering.

LTh5H • Topological Photonics I—Continued

LTh5H.3 • 17:30 Invited
Mixing and Matching Photonic Topological Phases: From Robust Delay Lines to Topological Cavities, Tsuhsuan Ma[1]; Kueifu Lai[1,2]; Gennady Shvets[1,2]; [1]*Dept. of Physics, Univ. of Texas at Austin, USA;* [2]*School of Applied and Engineering Physics, Cornell Univ., USA*. I will describe our recent work on the photonic emulation of three topological phases corresponding to quantum Hall, spin-Hall, and valley-Hall interactions. New topology-enabled paradigms for a variety of photonic devices are proposed.

LTh5I • High Harmonic Generation I—Continued

LTh5I.3 • 17:30 Invited
Strong-Field High Harmonic and Sideband Generation in Solids and Atoms, Stephan W. Koch[1], Mackillo Kira[1], Ulrich Huttner[1]; [1]*Philipps Universitat Marburg, Germany*. High-harmonic and sideband generation in solids and atoms is analyzed using a microscopic many-body theory. Solid-state HHG exhibits a novel quantum-interference of electrons which is absent in atomic systems.

FTh5A • Symposium on Mid-Infrared Fiber Sources II—Continued

FTh5A.4 • 18:00 Invited

Mid-IR Ultrafast Fibre Laser Sources, Khanh Kieu[1]; [1]*Univ. of Arizona, USA*. I will review mid-IR fiber laser sources and present different schemes to generate ultrafast pulses in this spectral range. Some interesting applications of ultrafast mid-IR sources will be also discussed.

FTh5B • Optical Vortices, Polarization and Mode Shaping—Continued

FTh5B.6 • 18:00

Generation of wavelength-independent and sub-wavelength Bessel beams by meta-axicons, Wei-Ting Chen[1], Mohammadreza Khorasaninejad[1], Alexander Y. Zhu[1], Jaewon Oh[1,2], Rober Devlin[1], Aun Zaidi[1], Federico Capasso[1]; [1]*Harvard Univ., USA;* [2]*Univ. of Waterloo, Canada*. We report meta-axicons with high numerical aperture for generating Bessel beams with λ/3 spot size. The spot size of the generated Bessel beams is independent of wavelength of incident light because of tailored phase profile.

FTh5B.7 • 18:15

Custom-Tailored Sorting of Structured Light by Controlled Scattering, Robert Fickler[1], Robert W. Boyd[1,2]; [1]*Univ. of Ottawa, Canada;* [2]*Institut of Optics, Univ. of Rochester, USA*. Light with a complex structure is interesting for foundations and applications in classical and quantum optics. We investigate controlled scattering processes to realize novel transformations such as custom-tailored sorting of structured photons.

FTh5C • Computational Imaging II—Continued

FTh5C.6 • 18:00

Single Shot Time Domain Ghost Imaging using Wavelength Multiplexing, Piotr Ryczkowski[1], Margaux Barbier[1], Ari Tapio Friberg[2], John M. Dudley[3], Goëry Genty[1]; [1]*Optics Laboratory, Tampere Univ. of Technology, Finland;* [2]*Inst. of Photonics,, Univ. of Eastern Finland, Finland;* [3]*Institut FEMTO-ST, CNRS–Université de Franche-Comté, France*. We report on the first demonstration of computational ghost imaging in the time domain using wavelength multiplexing. The wavelength-multiplexed Hadamard patterns used to probe a time-varying waveform enables image reconstruction in real time.

FTh5C.7 • 18:15

Image Quality of Compressive Imaging with Quantum Light, Kam Wai C. Chan[1], Vamsi Manthapuram[1], Lu Zhang[1]; [1]*Univ. of Oklahoma - Tulsa, USA*. Several common reconstruction algorithms were used to perform compressive quantum imaging with Fock states, coherent states, and squeezed light. It was found that the different light sources gave the same scaling law for the root-mean-squared error.

FTh5D • Optics Meets Neuroscience II—Continued

FTh5D.4 • 18:00

Mapping the birefringence of amyloid deposits found in retinas in association with Alzheimer's disease, Tao Jin[1], Laura Emptage[1], David DeVries[1], Melanie C. Campbell[1,2]; [1]*Department of Physics and Astronomy, Univ. of Waterloo , Canada;* [2]*School of Optometry and Visual Science, Univ. of Waterloo, Canada*. A new method is established for mapping birefringence of the amyloid plaques found in the retinas of subjects in association with Alzheimer's disease using fluorescence confocal microscopy and Mueller matrix polarimetry.

FTh5D.5 • 18:15

Hyperspectral Imaging in Live Mouse Cortex Using a 48-Channel Multiphoton Microscope, Amanda Bares[1], Mitchell A. Pender[1], Menansili A. Mejooli[1], Steven Tilley[1], Kuang E. Chen[1], Jingyuan Dong[1], Peter C. Doerschuk[1], Chris B. Schaffer[1]; [1]*Cornell Univ., USA*. We constructed a hyperspectral multiphoton microscope collecting 48 channels of excitation/emission spectral data, while retaining the imaging depth of nonlinear microscopy. We demonstrate imaging of multiple overlapping fluorophores in vivo.

FiO | LS

FTh5E • High-Capacity Optical Communications and Data Centers II—Continued

Biography: Benyuan Zhu joined Bell Laboratories, Lucent Technologies in Holmdel, NJ USA as a Member of Technical Staff (MTS) in 1999, then became a MTS at OFS Labs in 2002, and he was promoted to a Distinguished Member of Technical Staff in 2011. His research interests include DWDM transmission, advanced modulation, novel fibers and optical amplifier technologies. He has authored/coauthored +180 journal/conference papers, one book chapter, and he has +18 US patents. He has served as TPC members or chair for the conferences of OFC, IPC, WOCC, ACP. He is an Associate Editor of the *Electronics Letters*. Benyuan Zhu received Ph.D. degree in Physics from Bath University, UK.

FTh5F • Quantum Communication and Networking II—Continued

FTh5F.4 • 18:00
Chip-scale MOT for Microsystems Technology, Argyrios Dellis[1], Matthew T. Hummon[1], Songbai Kang[1], Elizabeth A. Donley[1], John Kitching[1]; [1]*NIST, USA*. We are developing a micro-fabricated platform to support the creation of laser cooled samples. We are able to cool and trap ~5x10^5 atoms. We are in the process of replacing the actively pumped cell with a passively pumped cell.

FTh5F.5 • 18:15
Optical quantum computing with spectral qubits, Joseph M. Lukens[1], Pavel Lougovski[1]; [1]*Oak Ridge National Laboratory, USA*. We formulate a universal platform for optical quantum information processing based on spectral qubits, pulse shapers, and electro-optic modulators. Our approach is compatible with fiber networks and offers new potential for interfacing matter qubits.

FTh5G • Integrated Nonlinear Optics II—Continued

FTh5G.6 • 18:00
Ultraviolet Second Harmonic Generation in Aluminum Nitride Microring Resonators, Michael I. fanto[1,2], Jeffrey A. Steidle[1], Tsung-ju J. Lu[3], Stefan F. Preble[1], Dirk Englund[3], Christopher C. Tison[2], A. Matthew Smith[2], Gregory A. Howland[2], Kathy-Anne Soderberg[2], Paul Alsing[2]; [1]*Rochester Inst. of Technology, USA;* [2]*Information Directorate, Air Force Research Laboratory, USA;* [3]*Massachusetts Inst. of Technology, USA*. Aluminum nitride, with a bandgap of 6.2 eV, and a $\chi^{(2)}$ of ~10's of pm/V can generate ultraviolet photons. This article describes using aluminum nitride microring resonators to produce second harmonic photons below 400nm.

FTh5G.7 • 18:15
Second-Hamonic Generation in Periodically-Poled Thin Film Lithium Niobate on Silicon, Ashutosh Rao[1], Marcin Malinowski[1], Amirmahdi Honardoost[1], Javed Rouf Talukder[1], Payam Rabiei[2], Peter Delfyett[1], Sasan Fathpour[1]; [1]*CREOL, Univ Central Florida, USA;* [2]*Partow Technologies LLC, USA*. Thin films of lithium niobate are wafer-bonded onto oxidized silicon substrates and periodically poled for quasi-phase matching to demonstrate second-harmonic generation in submicron waveguides with a record-high conversion efficiency of 730%$W^{-1}cm^{-2}$.

LTh5H • Topological Photonics I—Continued

LTh5H.4 • 18:00 Invited
Topological Theory of Disallowed Couplings, Bo Zhen[1,2], Hengyun Zhou[1], Chia Wei Hsu[3], Ling Lu[1], A. . Stone[3], Mordechai Segev[2], John Joannopoulos[1], Marin Soljacic[1]; [1]*MIT, USA;*[2]*Technion, Israel;* [3]*Yale Univ., USA*. We reveal the topological nature of disallowed couplings. We first show "bound states in the continuum" are fundamentally vortices in the polarization directions carrying topological charges. We then reveal their connections to Chern numbers.

LTh5I • High Harmonic Generation I—Continued

LTh5I.4 • 18:00 Invited
Upper Limits to Near-field Radiative Heat Transfer: Generalizing the Blackbody Concept, Owen Miller[1]; [1]*Yale Univ., USA*. I describe energy-conservation principles that answer a basic question: what is the maximum radiative heat transfer rate between closely separated bodies? The new bounds offer the possibility for significant future enhancements, for thermophotovoltaics and beyond.

07:30–16:30 Registration, *Galleria*

08:00–10:00
FF1A • Imaging and Therapy Inside the Human Body
Presider: Irene Georgakoudi, Tufts Univ., USA

FF1A.1 • 08:00 Invited

Chemophototherapy with Porphyrin-Phospholipid Liposomes: A Treatment Possibility for Solid Tumors, Jonathan Lovell[1]; [1]*SUNY Buffalo, USA.* Liposomes containing small amounts of porphyrin-phospholipid are developed that otherwise have similar composition and pharmacokinetics to FDA-approved liposomal doxorubicin. Laser irradition potently induces tumor ablation via chemophototherapy.

FF1A.2 • 08:30 Invited

Kagome Fiber Based Ultrafast Laser Microsurgery Probes, Adela Ben-Yakar[1]; [1]*Univ. of Texas at Austin, USA.* I will present our efforts towards achieving a fully hand-held, 5 mm, ultrafast laser scalpel for microsurgery with a capability to deliver energies in excess of 5 μJ per pulse using large-area, hollow-core kagome fibers.

08:00–10:00
FF1B • Optical Fiber Sensors I
Presider: Armando Ricciardi; Univ. of Sannio, Italy

FF1B.1 • 08:00 Tutorial

New Opportunities with, and Future Challenges of, Optical Fiber Sensor Technology, Jose Luis Santos[1]; [1]*Universidade do Porto, Portugal.* Optical sensing has been associated with high performance and recent developments indicate this trend will continue. The talk elaborates on challenges and opportunities facing this field, in particular when the sensor platform is the optical fiber.

Biography: José Luís Santos received his graduation in Physics from University of Porto, Portugal, and Ph.D. degree from the same University, benefiting from collaboration with the University of Kent at Canterbury, UK. He is currently a Professor of Physics at the Physics and Astronomy Department of Faculty of Sciences of University of Porto, Portugal. Optical fiber sensing is the main area of his research, with focus on interferometric and wavelength encoded devices. He is author or co-author of more than 230 scientific articles and co-author of 5 patents. With Professor Faramarz Farahi of University of North Carolina was Editor of *Handbook of Optical Sensors,* CRC Press 2014.

08:00–10:00
FF1C • Quantum Information Processing in Integrated Systems
Presider: Andrew White; Univ. of Queensland, Australia

FF1C.1 • 08:00 Invited

Implementation and Certification of Boson Sampling with Integrated photonics, Fabio Sciarrino[1]; [1]*Univ degli Studi di Roma La Sapienza, Italy.* Boson sampling is a computational task hard for classical computers, but efficiently solvable via bosonic interference in a specialized quantum computer. We report several experiments of boson sampling implemented with integrated quantum photonics.

FF1C.2 • 08:30 Invited

Boson Sampling with Continuous Variable Measurements, Timothy C. Ralph[1]; [1]*Univ. of Queensland, Australia.* We show that it is classically hard to sample the output distribution of certain continuous variable measurements from a BosonSampling device. Our argument is presented for exact BosonSampling. We discuss extending this result to approximate sampling.

08:00–10:00
FF1D • Quantum Optical Technologies
Presider: Alexander Sergienko; Boston Univ., USA

FF1D.1 • 08:00 Invited

The Promise of Quantum Imaging, Robert W. Boyd[1]; [1]*Univ. of Ottawa, Canada.* Quantum Imaging strives to form improved images based on quantum phenomena. We give examples of how these quantum images can be superior to conventional images in terms of sharpness, signal-to-noise ratio, and low-light-level image formation.

FF1D.2 • 08:30 Invited

First-Photon 3D Imaging with a Single-Pixel Camera, Matthew Edgar[1], Ming-Jie Sun[1], Gabriel Spalding[1], Graham Gibson[1], Miles J. Padgett[1]; [1]*Univ. of Glasgow, UK.* We use an ultrashort-pulsed laser and a high-speed spatial light modulator to illuminate a scene with a series of patterns. A photomultiplier and fast electronics are used to histogram the first-photon backscattered from which a computer algorithm can reconstruct 3D images.

07:30–16:30 Registration, *Galleria*

08:00–10:00
FF1E • Symposium on Integrated Photonic Manufacturing I
Presider: Stefan Preble; Rochester Inst. of Technology, USA

FF1E.1 • 08:00 Invited
AIM Photonics – Manufacturing Challenges for Photonic Integrated Circuits, Michael Liehr[1,2]; [1]*AIM Photonics, USA;* [2]*SUNY Polytechnic Inst., USA.* The recently established American Inst. for Manufacturing Photonics is a manufacturing consortium headquartered in NY, to advance the state of the art in the design, manufacture, testing, assembly, and packaging of integrated photonic devices.

FF1E.2 • 08:30 Invited
Silicon Photonics Platforms: to Standardize or to Diversify?, Roel G. F. Baets[1,2]; [1]*Photonics Research Group, Ghent Univ., Belgium;* [2]*IMEC, Belgium.* Silicon photonics has emerged as a major PIC-technology because it builds on the maturity and infrastructure of the CMOS world. But where is the middle ground between yield- and cost-driven standardization and application-driven diversification?

08:00–10:00
FF1F • Strongly Confined Nanoscale Waveguides, Photonic Crystals and Resonator Devices
Presider: Andrew Poon; Hong Kong Univ of Science & Technology, Hong Kong

FF1F.1 • 08:00 Invited
High-Q Photonic Crystal Resonators for Nonlinear Optics, Aude Martin[2,1], Gregory Moille[1], Sylvain Combrié[1], Gaelle Lehoucq[1], Thierry Debuisschert[1], Allard, P. Mosk[3], Alfredo De Rossi[1,2]; [1]*Thales Research & Technology, France;* [2]*Laboratoire de Photonique et de Nanostructures, CNRS UPR 20, France;* [3]*Physics of Light in Complex Systems(LINX), Debye Inst. for Nanomaterials Science,, Utrecht Univ., Netherlands.* Small volume cavities and cavity arrays made of III-V semiconductor with large electronic gap allow very large optical fields to be established. The spectral alignment of a triplet of resonances results into ultra-efficient four-wave-mixing.

FF1F.2 • 08:30
Exceptional contours and band structure design in parity-time symmetric photonic crystals, Alexander Cerjan[1], Aaswath Raman[1], Shanhui Fan[1]; [1]*Stanford Univ., USA.* We investigate the properties of 2D parity-time symmetric periodic systems whose periodicity is an integer multiple of the underlying Hermitian system's periodicity. Such systems possess novel band structure engineering, and yield supercollimation.

08:30–10:00
FF1G • Wavefront Sensing and Phase Retrieval
Presider: Len Zheleznyak, Univ. of Rochester, USA

FF1G.1 • 08:00 Invited
Withdrawn.

FF1G.2 • 08:30
Multi-plane Phase Retrieval in Generalized Two-Path Interferometry, Wesley Farriss[1], James R. Fienup[1], Tanya Malhotra[1], A. Nick Vamivakas[1]; [1]*Univ. of Rochester, USA.* Generalized interferometry is a novel technique that decomposes fields into transverse basis set components and weighting coefficient magnitudes. Nonlinear optimization phase retrieval algorithms using multiple intensity planes are developed.

08:00–10:00
FF1H • General Optical Sciences I
Presider: To be Announced

FF1H.1 • 08:00
KALEXUS - a Potassium Laser System with Autonomous Frequency Stabilization on a Sounding Rocket, Aline N. Dinkelaker[1], Max Schiemangk[1], Vladimir Schkolnik[1], Andrew Kenyon[1], Markus Krutzik[1], Achim Peters[1,2]; [1]*Institut für Physik, Humboldt-Universität zu Berlin, Germany;* [2]*Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, Germany.* Autonomous laser frequency stabilization is a prerequisite for future space-borne atomic physics experiments. The KALEXUS experiment performed frequency stabilization of two 767 nm extended cavity diode lasers onboard the TEXUS 53 sounding rocket.

FF1H.2 • 08:15
Controlling the Direction of Optical Power Flow in an Active Photonic Cavity, Ali Kazemi Jahromi[1], Ayman Abouraddy[1]; [1]*Univ. of Central Florida, CREOL, USA.* We demonstrate experimentally that the direction of Poynting's vector and thus power flow in an optical cavity provided with net gain can be controllably reversed by modulating a passive intra-cavity loss element.

FF1H.3 • 08:30
Optical Characteristics of Bio-Inspired Lasers Based on Fluorescent Biomaterials and Bioconjugates, Jose A. Rivera[1], James G. Eden[1]; [1]*UIUC, USA.* Changes in the chemical environment of a biolaser were detected by analyzing spectral, temporal, and polarization properties. Such detailed characterizations are fundamental for biolasers to realize their potential as diagnostics tools.

08:00–10:00
LF1I • Nanophotonics II
Presider: Yichen Shen; MIT, USA

LF1I.1 • 08:00 Invited
Enhanced Lasing Through Tailoring of Photonic Density of States, Marin Soljacic[1]; [1]*Massachusetts Inst. of Technology, USA.* Nanophotonics offers unprecedented opportunities for tailoring photonic density of states. Weyl and Dirac dispersions could thus enable single-mode lasing for substantially larger lasers. Novel gain media can be enabled as well.

LF1I.2 • 08:30 Invited
Recent Progress in Photonic Crystals, Susumu Noda[1]; [1]*Kyoto Univ., Japan.* I will report on recent progresses in manipulation of photons by photonic crystals. They include (1) ultrahigh-Q nanocavities and their applications, (2) thermal emission control with a very fast modulation speed, and (3) broad-area coherent photonic-crystal lasers with a high output-power.

FF1A • Imaging and Therapy Inside the Human Body—Continued

FF1A.3 • 09:00 Invited

Scanning Fiber Endoscopy with New Technologies and Forward-Viewing Applications, Eric Seibel[1]; [1]*Univ. of Washington, USA*. Scanning fiber endoscopy with new technologies and forward-viewing applications are discussed.

FF1B • Optical Fiber Sensors I—Continued

FF1B.2 • 08:45

Fast-light Enhanced Brillouin Laser Based Active Fiber Optics Sensor for Simultaneous Measurement of Rotation and Acceleration, Minchuan Zhou[1], Zifan Zhou[1], Mohammad Fouda[1], Jacob Scheuer[2], Selim Shahriar[1]; [1]*Northwestern Univ., USA;* [2]*Tel Aviv Univ., Israel*. We show an enhancement of ~358 for two counter-propagating Brillouin lasers in the sensitivity of an Active Fast Light Fiber Optic Sensor, which performs as a gyroscope and a sensor for acceleration, strain and temperature.

FF1B.3 • 09:00

A Kind of Mechanical Robust Photonic Crystal Fiber with Dual Luna Buffer Structure for Fiber Optic Gyroscope, Song Jingming[1], Weile Li[1], Cai Wei[1], Wenyong Luo[2], Wei Li[2];[1]*Beihang Univ., China;* [2]*FiberHome Telecommunication Technologies CO., Ltd, China*. A kind of mechanical robust photonic crystal fiber with dual luna buffer structure for fiber optic gyroscope (FOG) is proposed, which offers a new possibility to further optimize the condition characteristics of FOG.

FF1B.4 • 09:15 Tutorial

3D Shape Sensing using Optical Fiber, Brian Soller, *Luna Innovations, Inc., USA*. 3D shape sensing using optical fibers is discussed.

Biography: Dr. Soller joined the executive team as Vice President in April 2014. Prior to joining Luna he served as Vice President of Marketing for Micron Optics & VP of global sales and business development for Lightpath Technologies. Previously he spent ten years in fiber optics with Luna, beginning as a scientist and ultimately moving up through the organization to General Manager of the Products Division. Dr. Soller co-developed the instrumentation for fiber optic devices manufactured by Luna today. He has over 15 issued patents in optics with an expertise in the interferometric measurement field. He received a bachelor's and master's degree in mathematics and physics from the University of Wisconsin– La Crosse, and a doctoral degree from the Institute of Optics, University of Rochester.

FF1C • Quantum Information Processing in Integrated Systems—Continued

FF1C.3 • 09:00

A Quantum Fredkin Gate, Raj Patel[1], Joseph Ho[1], Franck Ferreyrol[1,2], Timothy C. Ralph[3], Geoff J. Pryde[1]; [1]*Griffith Univ., Australia;* [2]*Laboratoire Photonique, Institut d'Optique, France;* [3]*School of Mathematics and Physics, Univ. of Queensland, Australia*. We report the first demonstration of a quantum Fredkin gate using linear optics. In addition to excellent performance in the logical basis, the gate can generate high-fidelity GHZ states and is used in small-scale algorithms.

FF1C.4 • 09:15

Detection-loophole-free heralded quantum steering over a high-loss quantum channel, Sergei Slussarenko[1], Morgan M. Weston[1], Helen M. Chrzanowski[1,2], Sabine Wollmann[1], Geoff J. Pryde[1]; [1]*Griffith Univ., Australia;* [2]*Clarendon Laboratory, Univ. of Oxford, UK*. We demonstrate a single step quantum relay, allowing quantum steering for verifying entanglement between distant parties with detection loophole closed even in the presence of very high channel loss.

FF1D • Quantum Optical Technologies—Continued

FF1D.3 • 09:00

A Variable Partially-Polarizing Beamsplitter, Jefferson Florez[1], Codey Nacke[1], Nathan John Carlson[1], Lambert Giner[1], Jeff S. Lundeen[1]; [1]*Univ. of Ottawa, Canada*. We present a variable partially-polarizing beamsplitter that allows for the complete and independent control of the horizontal and vertical polarization splitting ratios. It is based on a Sagnac interferometer and two liquid crystal cells.

FF1D.4 • 09:15

Spectral Compression of Single Photon Wavepackets by an Electro-optic Time Lens, Michal Jachura[1,2], Michal Karpinski[1,2], Brian J. Smith[2,3]; [1]*Department of Physics, Univ. of Warsaw, Poland;* [2]*Clarendon Laboratory, Univ. of Oxford, UK;* [3]*Department of Physics, Univ. of Oregon, USA*. We demonstrate sixfold spectral bandwidth compression of a single photon by employing electro-optic time lens. The device increases photon flux through a narrowband spectral feature, making a key step in developement of hybrid quantum networks.

FF1E • Symposium on Integrated Photonic Manufacturing I—Continued

FF1E.3 • 09:00 Invited

Providing Silicon-Photonic Transceivers with an Efficient Laser Source: Where does "III-V/Silicon Heterogeneous Integration" Stand?, Sylvie Menzo[1]; [1]*CEA-LETI, France.* Packaging of finished III-V-chips (SOAs and DFB Lasers) is the strategy adopted for providing Si-Photonic-transceivers with a laser source. With the capability for increased integration and reduced cost, where does heterogeneous-integration stand?

FF1F • Strongly Confined Nanoscale Waveguides, Photonic Crystals and Resonator Devices—Continued

FF1F.3 • 08:45

Highly Directional Radiation from Photonic Crystal Slabs, Hengyun Zhou[1], Bo Zhen[1,2], Chia Wei Hsu[3], Owen Miller[1], Steven G. Johnson[1], John Joannopoulos[1]; [1]*MIT, USA;* [2]*Technion, Israel;* [3]*Yale Univ., USA.* We develop a general temporal coupled-mode theory formalism to derive bounds on the asymmetric radiation from a photonic crystal slab for arbitrary geometries and wavevectors, and present designs with asymmetry ratios exceeding 10^4.

FF1F.4 • 09:00 Invited

Diamond Photonics, Marko Loncar[1]; [1]*Harvard Univ., USA.* I will review advances in nanotechnology that have enabled fabrication of nanoscale optical devices in diamond, as well as discuss the applications of diamond photonic platform in nonlinear and quantum nanophotonics, optomechanics, and high-power optics.

FF1G • Wavefront Sensing and Phase Retrieval—Continued

FF1G.3 • 08:45

Transmission of Individual Optical Signals through a Multimode Fiber Using Digital Optical Phase Conjugation, Lars Buettner[1], Daniel Haufe[1], Nektarios Koukourakis[1], Jürgen Czarske[1]; [1]*Technische Universität Dresden, Germany.* Transmission through a multimode fiber is demonstrated using phase conjugation. Using multiple windows of a spatial light modulator allows asynchronous imaging through the fiber. Potential for optogenetics and communications engineering is outlined.

FF1G.4 • 09:00

Wide-Field Imaging Interferometer Testbed Phase Retrieval, Alexander S. Iacchetta[1], James R. Fienup[1], David T. Leisawitz[2], Matthew R. Bolcar[2]; [1]*Univ. of Rochester, USA;*[2]*NASA Goddard Space Flight Center, USA.* We discuss the results of an experiment to recover system aberrations from Wide-field Imaging Interferometer Testbed images. We model the system with a unifying wavefront for all wavelengths, allowing slowly varying axial chromatic aberrations.

FF1G.5 • 09:15

Towards Wavefront Sensing with Metamaterials, Brian Vohnsen[1], Denise Valente[1], Rucha A. Deshpande[2], Anders Pors[2], Sergey Bozhevolnyi[2]; [1]*Univ. College Dublin, Ireland;*[2]*Department of Technology and Innovation, Univ. of Southern Denmark, Denmark.* Rapid phase variations caused by higher-order aberrations contain information that may not be captured using standard wavefront sensing techniques. We examine the possibilities for ultradense wavefront sensing using nanostructured metamaterials.

FF1H • General Optical Sciences I—Continued

FF1H.4 • 08:45

Flat, High Power VUV (hν ≈ 7.2 eV) Lamp Tiles Comprising Large Arrays of Microcavity Plasmas, Sung-Jin Park[1,2], Cyrus Herring[2], James G. Eden[1,2]; [1]*Univ of Illinois at Urbana-Champaign, USA;* [2]*Eden Park Illumination, Inc., USA.* Flat lamps generating more than 20 W of average power in the vacuum ultraviolet with an efficiency above 10% have been realized. These narrowband lamps produce > 500 W of peak power in ~100 ns FWHM pulses at a repetition frequency up to 135 kHz.

FF1H.5 • 09:00

An Orbiting Laserport for Low Mass Sailcraft Propulsion, Grover A. Swartzlander[1]; [1]*Rochester Inst. of Technology, USA.* Navigating a sailcraft by means of lasers on an orbiting "laserport" afford an opportunity to launch hundreds of miniaturized kilogram scale science packages to Mars and other Earth neighbors.

FF1H.6 • 09:15

Withdrawn.

LF1I • Nanophotonics II—Continued

LF1I.3 • 09:00 Invited

Combinatorial Optimization with Coherent Ising Machines based on Degenerate Optical Parametric Oscillators, Yoshihisa Yamamoto[2,1], Peter McMahon[1]; [1]*Stanford Univ., USA;* [2]*Japan Science and Technology Agency, Japan.* The basic concept, principle and implementation of coherent Ising machines are presented. A fully programmable 100 spin machine with all-to-all connections solves ground states and randomly samples low-energy excited states of NP-hard Ising problems.

Thank you for attending FiO/LS. Look for your post-conference survey via email and let us know your thoughts on the program.

FF1A • Imaging and Therapy Inside the Human Body—Continued

FF1A.4 • 09:30
Multispectral Endoscopic Imaging Enabled by Mapping Spectral Bands into the Time Domain, Sarah A. Locknar[1], John B. Barton[1], Gary E. Carver[1]; [1]*Omega Optical, Inc., USA.* Rapid multispectral confocal imaging is performed with a single shot-limited detector. This approach uses fiber delay lines to map spectral bands into the time domain, and has been integrated with fiber bundles for endoscopic applications.

FF1A.5 • 09:45
Single-Shot Polarimetry Imaging of Multicore Fibers, Miguel A. Alonso[1], Siddharth Sivankutty[2], Esben R. Andresen[3], Géraud Bouwmans[3], Thomas G. Brown[1], Hervé Rigneault[2];[1]*Univ. of Rochester, USA;* [2]*Institut Fresnel, France;* [3]*Université Lille 1, France.* We report an experimental test of single-shot polarimetry to monitor in real time the output polarization of multicore fibers. With this technique we characterize the Jones matrices of up to 180 fiber cores simultaneously.

FF1B • Optical Fiber Sensors I—Continued

FF1C • Quantum Information Processing in Integrated Systems—Continued

FF1C.5 • 09:30
Photon-pair generation and sum-frequency conversion in nonlinear dielectric nanoresonators, Alexander S. Solntsev[1], Luca Carletti[2], Lei Xu[1], Alexander Poddubny[3,4], Costantino De Angelis[2], Giuseppe Leo[5], Yuri S. Kivshar[1], Dragomir N. Neshev[1], Andrey A. Sukhorukov[1]; [1]*Nonlinear Physics Centre, Australian National Univ., Australia;* [2]*Department of Information Engineering, Univ. of Brescia, Italy;* [3]*ITMO Univ., Russian Federation;* [4]*Ioffe Physical-Technical Inst. of the Russian Academy of Science, Russian Federation;*[5]*Univ. Diderot-CNRS, France.* We predict photon-pair generation with non-classical angular correlations through spontaneous parametric down-conversion in quadratic nonlinear AlGaAs nanoresonators, and establish a quantum-classical correspondence with sum-frequency conversion.

FF1C.6 • 09:45
Measurement of Incompatible Observables via the Cloning of Quantum States, Rebecca Saaltink[1,2], Lambert Giner[1,2], Jeff S. Lundeen[1,2]; [1]*Univ. of Ottawa, Canada;* [2]*Max Planck Centre for Extreme and Quantum Photonics, Canada.* We experimentally measure a complementary pair of observables, one on each of two optimally cloned photons. Just as in a classical version of this procedure, the results give the original state of the photon.

FF1D • Quantum Optical Technologies—Continued

FF1D.5 • 09:30
Demonstration of a Bit-Flip Correction for Enhanced Sensitivity Measurements, Lior Cohen[1], Yehuda Pilnyak [1], Daniel Istrati[1], Alex Retzker[1], Hagai Eisenberg[1]; [1]*Hebrew Univ. of Jerusalem, Israel.* Error correction can be used to recover the sensitivity in a noisy environment. We implement such correction after a bit-flip error. Our results show 87% recovery of the sensitivity, independent of the noise rate.

FF1D.6 • 09:45
Weak Values and Balanced Homodyne Detection Working Together, Julian Martinez[1], Weitao Liu[2], Gerardo Viza[1], John Howell[1]; [1]*Univ. of Rochester, USA;* [2]*National Univ. of Defense Technology, China.* We present a metrological technique which, without discarding of data, resembles a larger anomalous amplification than weak-value-amplification (WVA). The protocol surpasses WVA techniques by amplifying an almost-balanced homodyne signal.

10:00–10:30 Coffee Break, *West Corridor and Skyway Lobby (Radisson)*

FF1E • Symposium on Integrated Photonic Manufacturing I—Continued

FF1E.4 • 09:30 Invited

Manufacturing Silicon Photonics for High-performance Datacom Systems, Keren Bergman[1]; [1]*Columbia Univ., USA*. Manufacturing silicon photonics for high-performance datacom systems is discussed.

FF1F • Strongly Confined Nanoscale Waveguides, Photonic Crystals and Resonator Devices—Continued

FF1F.5 • 09:30 Invited

Silicon Optomechanical Structures and Coherent Microwave-to-optical Converters, Amir Safavi-Naeini[1]; [1]*Stanford Univ., USA*. In this talk I will outline on-going experiments at the intersection of optomechanics, nonlinear optics, and quantum electromechanics.

FF1G • Wavefront Sensing and Phase Retrieval—Continued

FF1G.6 • 09:30

Segmented Spherical Space Telescope, Samuel T. Thurman[1], Richard Kendrick[2]; [1]*Lockheed Martin Coherent Technologies, USA;* [2]*Lockheed Martin Advanced Technology Center, USA*.We present a space telescope concept based on a spherical primary mirror that is composed of segments mounted on small satellites that dock together. The telescope design and an on-orbit alignment approach will be discussed.

FF1G.7 • 09:45

A Water Phase Mask for Optical Encryption Applications, David R. Schipf[1], Wei-Chih Wang[1,2]; [1]*Univ. of Washington, USA;* [2]*National Tsinghua Univ., Taiwan*. A new analog optical encryption scheme is presented that uses a parametrically driven shallow fluid as an oscillating phase mask in the Fourier domain. A simulation of the proposed encryption scheme is presented.

FF1H • General Optical Sciences I—Continued

FF1H.7 • 09:30

Nonisochronism of Material Vibrations in Stimulated Raman Scattering, Valeri I. Kovalev[1,2]; [1]*P.N. Lebedev Physical Inst., Russian Federation;* [2]*National Research Nuclear Univ. (MEPhI), Russian Federation*. Evidence is found for decrease of the Raman shift in stimulated Raman scattering with increase of the pump intensity. It is shown that in fused silica the nonisochronism corresponds to saturation-type nonlinearity of material vibrations.

FF1H.8 • 09:45

Realization of Gain with Electromagnetically Induced Transparency using Zeeman Sublevels in ^{87}Rb for Gravitational Wave Detection, Minchuan Zhou[1], Zifan Zhou[1], Selim Shahriar[1]; [1]*Northwestern Univ., USA*. We show how to realize a negative dispersion medium using Zeeman sublevels in ^{87}Rb, which produces a broad gain with an electromagnetically induced transparency dip, for enhancing the sensitivity-bandwidth product of a gravitational wave detector.

LF1I • Nanophotonics II—Continued

LF1I.4 • 09:30 Invited

Title to be Announced, Takashi Yabe[1]; [1]*Tokyo Inst. of Technology, Japan*. Abstract not available.

10:00–10:30 Coffee Break, *West Corridor and Skyway Lobby (Radisson)*

Grand Ballroom A (Radisson)	Grand Ballroom B (Radisson)	Grand Ballroom C (Radisson)
FiO		
10:30–12:30 **FF2A • Postdeadline Session I**	**10:30–12:30** **FF2B • Postdeadline Session II**	**10:30–12:30** **FF2C • Postdeadline Session III**

Please check the Program Update Sheet for the Postdeadline abstracts.

NOTES

10:30–12:30
LF2D • General Laser Science I
Presider: Joanna M. Atkin; Univ. of North Carolina-Chapel Hill, USA

LF2D.1 • 10:30
Ultrafast XANES of Excited State Dynamics in Vitamin B_{12}, Nicholas A. Miller[1], Roseanne J. Sension[1]; *[1]Univ. of Michigan, USA.* Ultrafast x-ray and UV-visible transient absorption spectroscopies were used to characterize the excited state dynamics of vitamin B_{12} cobalamin compounds. Polarized XANES was used to separate in-plane and out-of-plane contributions.

LF2D.2 • 10:45
Single-pulse 2D Raman spectroscopy and improved coupling analysis using sparsity-based algorithms, Hadas Frostig[1], Tim Bayer[1,3], Nirit Dudovich[1], Yonina C. Eldar[2]; *[1]Weizmann Inst., Israel; [2]Technion, Israel; [3]Uni Oldenburg, Germany.* We present a single-pulse 2D Raman spectroscopy scheme, which is both simpler than the conventional scheme and rejects a strong background signal. We achieve quantitative analysis of the coupling strength using a sparsity-based signal analysis method.

LF2D.3 • 11:00
Two-Photon Absorption Spectrum of Fluorenone-based Molecules, Jessica Dipold[1], Rebeca J. Batista[2], Ruben D. Fonseca[1], Daniel L. Silva[3], Alfredo M. Simas[2], Leonardo de Boni[1], Cleber R. Mendonça[1]; *[1]Instituto de Física de São Carlos, Brazil; [2]Departamento de Química Fundamental, Universidade Federal de Pernambuco, Brazil; [3]Departamento de Ciências da Natureza, Matemática e Educação, Universidade Federal de São Carlos, Brazil.* Two-photon absorption cross-section spectra of 9 Fluorenone composites were measured using the open-aperture Z-Scan technique. Their maxima cross-sections values are between 100-230 GM at 710 nm, which are desired for applications as cellular probes.

10:30–12:30
LF2E • General Laser Science II
Presider: Owen Miller; Yale Univ. USA

LF2E.1 • 10:30
Brillouin scattering induced transparency and non-reciprocal light storage, Chunhua Dong[2], Zhen Shen[2], Chang-Ling Zou[2,1], Yan-Lei Zhang[2], Wei Fu[2,1], Guang-Can Guo[2]; *[1]Yale Univ., China; [2]Univ. of Science and Technology of China, China.* The Brillouin scattering induced transparency in a high quality optical microresonantor is experimentally demonstrated. Due to the phase matching condition, the circulating acoustic phonon leads to non-reciprocal light storage and retrieval.

LF2E.2 • 10:45
Controllable Unidirectional Anti-Laser, Hamidreza Ramezani[1,2], Yuan Wang[1], Eli Yablonovitch[1], Xiang Zhang[1]; *[1]Univ. of California, Berkeley, USA; [2]Physics, Univ. of Texas,Rio Grande Valley, USA.* We propose controllable unidirectional anti-laser in a one dimensional coupled cavities where an interplay between Fano resonances and a judicious absorption mechanism leads to a unidirectional perfect absorber.

LF2E.3 • 11:00
Optomechanical nonreciprocity and magnetic-free photonic isolation, Freek Ruesink[1], Mohammad A. Miri[2], Andrea Alu[2], Ewold Verhagen[1]; *[1]FOM Inst. AMOLF, Netherlands;[2]Univ. of Texas at Austin, USA.* Optomechanical interactions can break optical time-reversal symmetry, allowing non-reciprocal light transmission. We demonstrate a multimode system that breaks Lorentz-reciprocity without an applied magnetic field, yielding a 10 dB optical isolator.

10:30–12:30
LF2F • Quantum Light Sources II
Presider: TSusumu Noda; Kyoto Univ., Japan

LF2F.1 • 10:30 Invited
Quantum Light From Individual Defects in Atomically Thin Semiconductors, Chitraleema Chakraborty[1], Kenneth M. Goodfellow[1], Sajal Dhara[1], Anthony Yoshimura[2], Vincent Meunier[2], A. Nick Vamivakas[1]; *[1]Univ. of Rochester, USA; [2]Rensselaer Polytechnic Inst., USA.* 2D materials are being actively investigated for novel optoelectronic devices. We present single photon emission from localalized defects in monolayers of WSe_2. We perform optical spectroscopy and demonstrate Stark effect in these emitters.

LF2F.2 • 11:00 Invited
Coherent Polariton Lasing in a Designable Microcavity, Hui Deng[1], Seonghoon Kim[1], Zhaorong Wang[1], Bo Zhang[1], Sebastian Brodbeck[2], Christian Schneider[2], Martin Kamp[2], Sven Höfling[2]; *[1]Univ. of Michigan, USA; [2]Univ. of Wuerzberg, Germany.* We demonstrate a single-mode polariton laser with Poisson intensity noise and intrinsic phase coherence using a designable cavity. Strong interactions in the polariton condensate manifest in Gaussian dephasing at high condensate densities.

10:45–12:30
LF2G • General Laser Science III
Presider: Andy Aquila; Stanford Univ. USA

LF2G.1 • 10:30
Withdrawn.

LF2G.2 • 10:45
Predictability of Optical Rogue Waves in Optically Injected Semiconductor Lasers, Nuria Martinez Alvarez[1], Jose Reinoso[1], Cristina Masoller[1]; *[1]Universitat Politecnica de Catalunya, Spain.* The predictability of ultra-high pulses emitted by optically injected semiconductor lasers is studied by using symbolic time-series analysis. Pulse patterns that are likely to occur before the rogue wave are identified.

LF2G.3 • 11:00
Spatial coherence degradation in high power external-cavity diode laser arrays, Mario Niebuhr[1], Axel Heuer[1]; *[1]Univ. of Potsdam, Germany.* The low inter-emitter coherence still excludes efficient diode laser arrays as scalable competitors in several high power applications. We present an experimental approach to quickly measure and better understand these typical coherence properties.

10:30–12:30
LF2H • High Harmonic Generation II
Presider: Eleftherios Goulielmakis; Max-Planck-Inst. fur Quantenoptik, Germany

LF2H.1 • 10:30 Invited
Strong Field Physics in the Condensed Matter Phase, Ch. McDonald[1]; Thomas Brabec[1]; *[1]Univ. of Ottawa, Canada.* Recent experiments have opened the path to extending attosecond science from atomic gases to solids. In this talk the basic mechanisms driving strong field processes in solids, such as ionization and HHG, will be discussed.

LF2H.2 • 11:00 Invited
HHG in Solids: Multi-band Couplings Leading to Multiple Plateaus, Mette Gaarde[1]; *[1]Louisiana State Univ., USA.* We discuss the theory of HHG in solids, relevant to recent experimental observations of multiple plateaus in HHG from solid argon. A multi-band model explains the cutoff energies and relative strengths of the different plateaus.

LF2D • General Laser Science I—Continued

LF2D.4 • 11:15
Wide-band-gap semiconductor oxide optical microcavities, Hongxing Dong[1], Yang Liu[1], Zhanghai Chen[2], Long Zhang[1]; [1]*Shanghai Inst. of Optics and Fine Me, China;* [2]*Fudan Univ., China*. High quality ZnO microstructure optical cavities with different morphologies were fabricated by various physical/chemical vapor deposition methods. Optical resonant modes were directly observed experimentally.

LF2D.5 • 11:30
Phase Mask-Based Superresolution Nonlinear Microscopy, Ryan Beams[1], Stephan J. Stranick[1]; [1]*National Inst of Standards & Technology, USA*. We experimentally and theoretically explore various phase-masks for superresolution nonlinear microscopy. By engineering the excitation and collection volumes, we can achieve resolutions of ≈λ/7 for a wide range of nonlinear processes.

LF2D.6 • 11:45
Plasmonic Bowtie Nanoantennas with Nanocrystal Quantum Dots for Single-Photon Source Applications, Svetlana G. Lukishova[1], Dilyana Mihaylova[1], Huiqing Zhu[1], Andreas Liapis[1,2], Robert W. Boyd[1,3]; [1]*Univ. of Rochester, USA;* [2]*Brookhaven National Laboratory, USA;* [3]*Dept. of Physics and School of Electrical Engineering, Univ. of Ottawa, Canada*. Photon antibunching was observed from CdSeTe nanocrystal quantum dots within gold bowtie plasmonic nanoantennas. We also showed polarization selectivity in photoluminescence of gold bowtie nanoantennas.

LF2E • General Laser Science II—Continued

LF2E.4 • 11:15
Theory of Loss in a Distributed Feedback Cavity-Enhanced Single-Photon SPDC Source, Michael G. Raymer[1], Dileep V. Reddy[1]; [1]*Univ. of Oregon, USA*. A nonlinear-optical waveguide with distributed optical feedback serves as a compact, high-brightness, narrowband SPDC source if the losses are low enough. A new theoretical formalism shows how to include distributed loss in such systems.

LF2E.5 • 11:30
Turning Forbidden Transitions into Dominant Transitions: Towards Efficient Sources of Entangled Light, Nicholas Rivera[1], Ido Kaminer[1], Marin Soljacic[1]; [1]*Massachusetts Inst. of Technology, USA*. We demonstrate that using phonon-polaritons in thin (quasi-2D) polar dielectrics, it is possible to turn forbidden transitions into dominant transitions, allowing for emitters of entangled light with quantum efficiencies exceeding 90%.

LF2E.6 • 11:45
Nonlinear Interferometic Plasmonic Sensing, Emily M. Layden[1,2], Tabitha Coulter[3], Joseph M. Lukens[1], Nicholas Peters[1], Benjamin Lawrie[1], Raphael Pooser[1]; [1]*Quantum Information Science Group, Oak Ridge National Laboratory, USA;* [2]*Department of Physics and Astronomy, Univ. of Tennessee, USA;* [3]*Department of Physics, Furman Univ., USA*. The sensitivity of plasmonic sensors is limited by photon statistics, which are thermally constrained under typical probe powers. We will demonstrate improved sensitivity for constant probe power with nonlinear interferometric plasmonic sensors.

LF2F • Quantum Light Sources II—Continued

LF2F.3 • 11:30 Invited
Quantum Light on Silicon Photonic Chips, Qiang Lin[1]; [1]*Univ. of Rochester, USA*. In this talk, we will discuss our recent progress in developing silicon photonic devices for producing non-classical light for quantum photonic applications.

LF2G • General Laser Science III—Continued

LF2G.4 • 11:15
Temporal Superoscillatory Pulse Generation, Hao Chenglong[2,1], Hao Li[2], Xia Yu[2], Ying Zhang[2], Changyuan Yu[3,1], ChengWei Qiu[1]; [1]*National Univ. of Singapore, Singapore;* [2]*Singapore Inst. of Manufacturing Technology, Singapore;* [3]*The Hong Kong Polytechnic Univ., Hong Kong*. We report the design of temporal superoscillatory pulse (TSP) generation. Theoretical model is analyzed. Simulation shows that a TSP with full width at half maximum (FWHM) is 65% of Fourier transform limited pulse is generated.

LF2G.5 • 11:30
Single Longitudinal Mode Green Diode Laser, Yi-Hsi Chen[1], Wei-Chen Lin[1], Jow-Tsong Shy[2], Hsiang-Chen Chui[1]; [1]*National Cheng Kung Univ., Taiwan;* [2]*National Tsing Hua Univ., Taiwan*. We observed that a green diode laser shows single longitudinal mode output at low operation current, and can be frequency tuned by adjusting the operation temperature and current. The behavior of laser modes with operational current was investigated.

LF2G.6 • 11:45
Absolute Measurements of the Electronic, Rotational, and Rovibrational Optical Nonlinearity in Gases, Jared K. Wahlstrand[1], Sina Zahedpour[1], Yu-Hsiang Cheng[1,2], John Palastro[1,3], Howard Milchberg[1]; [1]*Univ. of Maryland at College Park, USA;* [2]*National Inst. for Standards and Technology, USA;* [3]*Naval Research Laboratory, USA*. Absolute, ultrafast measurements of the optical nonlinearity in gases are performed using spectral interferometry in thin targets. Notably, we are able to isolate the rovibrational component of the nonlinearity using resonant two-beam coupling.

LF2H • High Harmonic Generation II—Continued

LF2H.3 • 11:30 Invited
Intense Laser-cluster Interactions in Mid-infrared Wavelengths, Louis F. DiMauro[1]; [1]*Ohio State Univ. , USA*. High-order harmonic generation and electron energy distribution are investigated in rare gases from atom to nano-scale clusters using intense mid-infrared fields. We discuss the size dependence of the harmonics and photoelectrons at various wavelengths.

LF2D • General Laser Science I—Continued

LF2D.7 • 12:00
The Influence of an Electric Field on Reversible Photodegradation of a Dye-Doped Polymer, Benjamin R. Anderson[1], Mark G. Kuzyk[1]; [1]*Washington State Univ., USA*. We generalize the statistical mechanical domain model of self healing dye-doped polymers to include the effects of an electric field and find that it predicts all experimental observations.

LF2D.8 • 12:15
Ionization Dynamics in Intense Two-Color Circularly Polarized Laser Fields, Jan L. Chaloupka[1], Daniel D. Hickstein[2], Christopher A. Mancuso[2], Kevin M. Dorney[2], Henry C. Kapteyn[2], Margaret M. Murnane[2]; [1]*Department of Physics and Astronomy, Univ. of Northern Colorado, USA;* [2]*JILA - Department of Physics, Univ. of Colorado and NIST, USA.*Ionization in intense two-color circularly polarized laser pulses is explored numerically and experimentally. Double ionization is enhanced with counterrotating fields, and diverse dynamics are uncovered that are impossible with linear polarization.

LF2E • General Laser Science II—Continued

LF2E.7 • 12:00
Giant Enhancement in Nonlinear Optical-Atomic Magnetometry, Lu Deng[1], F Zhou[1,2], E.W. Hagley[1]; [1]*National Inst of Standards & Technology, USA;* [2]*Wuhan Inst. of Physics & Mathematics, Chinese Academy of Sciences, China*. We demonstrate a cross-polarization wave-mixing nonlinear atomic magnetometer that results in >500X optical signal signal-to-noise ratio enhancement with perfect field sensitivity preservation and significant reduction of laser power.

LF2E.8 • 12:15
White-light laser based on an organo–inorganic photonic structure, Yu-Cheng Hsiao[1], Jui-Chieh Huang[1], Yu-Ting Lin[1], Wei Lee[1]; [1]*National Chiao Tung Univ., Taiwan.* This study demonstrates the lasing modes in organo–inorganic photonic (OIP) structure. The OIP is composed of dye-doped cholesteric liquid crystal and photonic crystals. Through this device, a white-light laser source can be produced.

LF2F • Quantum Light Sources II—Continued

LF2F.4 • 12:00 Invited
Single Photons from Weakly Nonlinear Photonic Structures, Vincenzo Savona[1], Hugo Flayac[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* It was predicted that a quantum optical system with arbitrarily weak nonlinearities can generate strongly subpoissonian light. I will review this phenomenon, present recent results, and discuss possible implementations in photonic platforms.

LF2G • General Laser Science III—Continued

LF2G.7 • 12:00
Toward BCF on small molecules, Scott E. Galica[1], Leland Aldridge[1], Donal Sheets[1], Edward E. Eyler[1]; [1]*Univ. of Connecticut , USA.* Theoretical work suggests that the optical bichromatic force (BCF) should be an effective method for slowing molecular species. We describe this together with progress on experimental application of the BCF to the diatomic molecule CaF.

LF2G.8 • 12:15
Radiance Enhancement of Diode Laser Arrays Using Advanced Micro-optics and Passive Phase-locking Techniques, Sheldon S. Wu[1], Frank Ravizza[1], Raymond J. Beach[1], Kurt Cutter[1], Michael A. Johnson[1], William Molander[1], Mark Rotter[1]; [1]*Lawrence Livermore National Laboratory, USA.* Significant advancements were made in the last decade in area of optical radiance conditioning for laser diode arrays. We present experimental results on single-bar arrays leveraging recent advances in several external-cavity phase-locking schemes.

Generation II—Continued

LF2H.4 • 12:00 Invited
Title to be Announced, David A. Reis[1]; [1]*Stanford Univ., USA.* Abstract not available.

12:30–13:30 Lunch Break *(on your own)*

13:30–15:30
FF3A • Advanced Microscopy Methods and Applications

Presider: Daniel C. Cote, Universite Laval, Canada

FF3A.1 • 13:30 Invited

High Dynamic Range Imaging in Brain Tissue, Jerome C. Mertz[1], Rouhui Yang[1], Timothy Weber[1], Ian Davison[1]; [1]*Boston Univ., USA.* An electronic add-on is described that vastly improves the dynamic range of a multiphoton microscope while reducing potential photodamage. The add-on provides real-time feedback to regulate the laser power delivered to the sample.

FF3A.2 • 14:00

Higher-Order Multiphoton Microscopy of the Beating Mouse Heart Using Resonant Scanning, Jason S. Jones[1], David M. Small[1], Nozomi Nishimura[1]; [1]*Cornell Univ., USA.* Contractile motion and tissue light-scattering properties make in vivo microscopy studies of the heart difficult. We have developed a microscopy platform that uses 3PE excitation and fast acquisition techniques to make this possible.

13:30–15:30
FF3B • Optical Fiber Sensors II

Presider: Jose Luis Santos, Universidade do Porto, Portugal.

FF3B.1 • 13:30 Invited

Lab-on-Fiber Technology for Biological Sensing Applications, Armando Ricciardi[1], Andrea Cusano[1]; [1]*Univ. of Sannio, Italy.* Lab-on-Fiber technology is an emerging research field envisaging the integration of functionalized materials and devices with optical fibers, aimed at developing a new generation of advanced all-in-fiber probes exploitable for biosensing applications.

FF3B.2 • 14:00

Integrated FBG Sensor Interrogator in SOI Platform using Passive Phase Demodulation, Yisbel Marin[1], Tiziano Nannipieri[1], Fabrizio Di Pasquale[1], Claudio Oton[1]; [1]*Scuola Superiore Sant'Anna, Italy.* We present a Fiber Bragg Grating sensor interrogator in silicon-on-insulator (SOI) platform based on interferometric wavelength-shift detection. A commercial FBG readout unit is used as a reference for validation of dynamic strain measurement.

13:30–15:30
FF3C • Quantum Electronics I

Presider: Christoph Marquardt; Max-Planck-Inst Physik des Lichts, Germany

FF3C.1 • 13:30 Invited

Towards attosecond pulse generation in the X-ray regime, Hanieh Fattahi[1], Ferenc Krausz[1]; [1]*Max-Planck-Institut fur Quantenoptik, Germany.* A laser architecture based on the frequency synthesis of optical parametric chirped-pulse amplifiers is demonstrated. The apparatus keeps promise to generate multi-TW, high-power, light-transients, presenting a new route toward keV attosecond pulses.

FF3C.2 • 14:00

Holographic Reconstruction of Single Photon Spatial Wavefunction, Michal Jachura[1], Radoslaw Chrapkiewicz[1], Konrad Banaszek[1], Wojciech Wasilewski[1]; [1]*Department of Physics, Univ. of Warsaw, Poland.* We experimentally show that the complex transversal wavefunction of the unknown photon can be fully recovered from the spatially-resolved coincidence pattern resulting from its two-photon interference with the reference photon.

13:30–15:30
FF3D • Quantum Optical Measurement and Quantum Technologies I

Presider: Nicolas Treps; Laboratoire Kastler Brossel, France

FF3D.1 • 13:30 Invited

New Frontiers in Quantum Optomechanics: From Levitation to Gravitation , Markus Aspelmeyer[1]; [1]*Universitat Wien, Austria.* The quantum optical control of levitated massive systems may enable a completely new class of experiments at the interface between quantum physics and gravity.

FF3D.2 • 14:00 Invited

Putting the Photon into Photonics, Andrew G. White[1]; [1]*Univ. of Queensland, Australia.* Realising the disruptive applications offered by quantum photonics requires efficient production, processing, and detection of single photons. Here we review significant recent progress in efficient photon generation and processing—using quantum-dot systems—and discuss attractive near-term applications.

13:30–14:30
FF3E • Symposium on Integrated Photonic Manufacturing II
Presider: Stefan Preble; Rochester Inst. of Technology, USA

FF3E.1 • 13:30 Invited

Silicon Photonics: Applications and High Volume Manufacturing Platform, Peter de Dobbelaere[1]; [1]*Luxtera, USA.* We start with an introduction on applications of silicon photonics in high speed data connectivity and highlight the advantages compared with other technologies. After that we will present our silicon photonics technology platform and how it enables high volume, high performance manufacturing of silicon photonics products. Amongst others we will address: wafer manufacturing, device libraries, light source integration, packaging and assembly. We will illustrate the technology with some examples.

FF3E.2 • 14:00 Invited

Development of Integrated Photonic Packaging Standards and Foundry Capabilities, Peter A. O'Brien[1]; [1]*Photonics, Tyndall National Inst., Ireland.* An overview of PIC packaging standards and foundry capabilities led by researchers at the Tyndall Inst. in collaboration with European partners will be presented. Details of optical and electrical packaging technologies will be reviewed.

13:30–15:30
FF3F • Ultrafast Dynamics and Laser Ion Acceleration
Presider: Christian Reimer; NRS_ EMT, Canada

FF3F.1 • 13:30 Tutorial

Molecular Dynamics Simulations of Laser-Materials Interactions, Leonid V. Zhigilei[1]; [1]*Univ. of Virginia, USA.* In this lecture, the atomistic and coarse-grained computational methods developed for simulation of laser-materials interactions will be reviewed and the capabilities of these methods will be illustrated by the results of recent simulation studies.

Biography: Leonid V. Zhigilei studied materials science at the Leningrad Polytechnic Institute, Russia, and did is Ph.D. dissertation work on the structure of metallic glasses at Tomsk State University and St. Petersburg State University, Russia (Ph.D. degree 1991). After several years of industrial work in Russia and Lithuania, and postdoctoral work at the Department of Chemistry at the Pennsylvania State University, in 2000 he joined the Department of Materials Science and Engineering at the University of Virginia. His research interests are in the general area of computational materials science. Zhigilei gave more than 80 invited talks and authored more than 100 journal papers that have been cited more than 7000 times (his current h-index is 44).

13:30–15:30
FF3G • Polarization Control and Measurements
Presider: Katelynn Sharma; Univ. of Rochester, USA

FF3G.1 • 13:30 Invited

Propagation-invariant Beams: A Ray-optical Perspective, Miguel A. Alonso[1]; [1]*Univ. of Rochester, USA.* A ray-based description of beams whose transverse shape is preserved under propagation (e.g. HG, LG, IG, Airy, Mathieu and Bessel beams) is given, which clarifies their sometimes strange behavior and shows their surprising hidden geometry.

FF3G.2 • 14:00

Hilbert-Space Analyzers: Basis-Neutral Modal Analysis via Generalized Optical Interferometry, Lane Martin[1], Walker D. Larson[1], Hasan E. Kondakci[1], Davood Mardani[2], Soroush Shabahang[1], Ali Jahromi[1], Tanya Malhotra[3], A. Nick Vamivakas[4], George Atia[2], Ayman Abouraddy[1]; [1]*CREOL, Univ. of Central Florida, USA;* [2]*Dept. Electrical Engineering and Computer Science, Univ. of Central Florida, USA;* [3]*Department of Physics and Astronomy, Univ. of Rochester, USA;* [4]*Inst. of Optics, Univ. of Rochester, USA.* We demonstrate a 'Hilbert-space analyzer' capable of projecting optical beams onto any modal basis by exploiting an inherently stable interferometer in which the traditional delay is replaced by optical implementations of fractional transforms.

13:30–15:30
FF3H • General Optical Sciences II
Presider: To be Announced

FF3H.1 • 13:30

Removing Pulse Jitter with Temporal Waveguides, Brent Plansinis[1,2], Govind P. Agrawal[1,2], William R. Donaldson[2]; [1]*Inst. of Optics, Univ. of Rochester, USA;* [2]*Laboratory for Laser Energetics, Univ. of Rochester, USA.* A pair of temporal boundaries separated in time acts as the temporal analog of planar waveguides. We show numerically how such a waveguide can be used to remove pulse jitter and synchronize two pulses.

FF3H.2 • 13:45

Experimental Demonstration of Reflection and Refraction of Optical Pulses from Temporal Boundaries, Bethany J. Little[1], Brent Plansinis[1], Govind P. Agrawal[1], John Howell[1];[1]*Univ. of Rochester, USA.* We experimentally implement the proposal of Plansinis et al. [PRL 115, (2015)] using slow light in Rb vapor. Time-dependent frequency shifts on probe pulses behave like angles in the analogous spatial reflection and refraction from classical optics.

FF3H.3 • 14:00

A new waveguiding mechanism based upon geometric phase, Alessandro Alberucci[2,1], Jisha C. Pannian[3], Sergei Slussarenko[5,4], Bruno Piccirillo[5], Enrico Santamato[5], Lorenzo Marrucci[5,6], Gaetano Assanto[2,1]; [1]*Tampere Univ. of Technology, Finland;* [2]*Univ. Roma Tre, Italy;* [3]*Univ. of Porto, Portugal;* [4]*Griffith Univ., Australia;* [5]*Univ. of Naples Federico II, Italy;* [6]*CNR ISASI, Italy.* We demonstrate light guiding in a locally twisted anisotropic medium in the absence of a refractive index gradient. The transverse phase modulation required to compensate diffraction is provided by the Pancharatnam-Berry phase.

13:30–15:30
LF3I • X-ray and XUV III
Presider: Barry Bruner, Weizmann Inst. of Science, Israel

LF3I.1 • 13:30 Invited

Influence of the Material Band Structure on Attosecond Electron Dynamics in Transition Metals, Zhensheng Tao[1], Cong Chen[1], Adra carr[1], Piotr Matyba[1], Tibor Szilvási[2], Sebastian Emmerich[3], Martin Piecuch[3], Mark Keller[4], Dmitriy Zusin[1], Steffen Eich[3], Markus Rollinger[3], Wenjing You[1], Stefan Mathias[3], Uwe Thumm[4], Manos Mavrikakis[2], Martin Aeschlimann[3], Peter M. Oppeneer[5], Henry C. Kapteyn[1], Margaret M. Murnane[1]; [1]*Univ. of Colorado at Boulder, USA;* [2]*Dept. of Chemical and Biological Engineering, Univ. of Wisconsin-Madison, USA;* [3]*Dept. of Physics and Research Center OPTIMAS, Univ. of Kaiserlautern, Germany;* [4]*Dept. of Physics, Kansas State Univ., USA;* [5]*Dept. of Physics and Astronomy, Uppsala Univ., Sweden.* We use attosecond pulse trains to directly measure photoelectron lifetimes in Ni(111) and Cu(111). We observe a strong influence of material band structure on the measured lifetimes, which reveal attosecond timescale electron screening and scattering.

LF3I.2 • 14:00 Invited

Time-Resolved XUV and X-Ray Spectroscopy at the Free-Electron Laser Facility FLASH, Wilfried Wurth[1,2]; [1]*Universität Hamburg, Germany;* [2]*DESY Photon Science, Germany.*Recent results from time-resolved spectroscopy studies in the XUV and soft x-ray regime on ultrafast dynamics in solids and at surfaces obtained at FLASH at DESY in Hamburg will be presented.

FF3A • Advanced Microscopy Methods and Applications—Continued

FF3A.3 • 14:15
Disease Modeling in Human Induced Pluripotent Stem Cell Derived Cardiomyocytes Using High-Throughput All-Optical Dynamic Cardiac Electrophysiology, Aleks Klimas[1,2], Yiyang Wu[3,4], Christina Ambrosi[1,2], Jinzhu Yu[2], John Williams[2], Harold Bien[2], Gholson Lyon[3,4], Emilia Entcheva[1,2]; [1]*Biomedical Engineering, George Washington Univ., USA;*[2]*Biomedical Engineering, Stony Brook Univ., USA;* [3]*Cold Spring Harbor Laboratory, USA;* [4]*Department of Molecular Genetics and Microbiology, Stony Brook Univ., USA.* We present an all-optical high-throughput system for phenotyping and monitoring iPSC-CMs, with capabilities for performing personalized cardiotoxicity screening. We demonstrate the system's utility for characterizing a new disease model in iPSC-CMs.

FF3A.4 • 14:30
Cell Ablation in a Single Plane Illumination Microscope, John M. Girkin[1], Charlotte Buckley[2], Mariana Torres-Carvalho[1], Laura Young[1], Sebastien Rider[2], Clare McFadden[2], Caroline Berlarge[1], Rachel Verdon[2], Jonathan Taylor[3], John Mullins[2]; [1]*Physics, Univ. of Durham, UK;* [2]*Queen's Medical Research Inst., Edinburgh Univ., UK;* [3]*Physics, Glasgow Univ., UK.* We have developed a SPIM system with the ability to ablate single or groups of cells either through a photo-activated dye or direct cell ablation. Results will be presented demonstrating cellular ablation in the heart and kidney.

FF3A.5 • 14:45
Fast DMD based super-resolution structured illumination microscopy, Ming Lei[1]; [1]*Xi'an Inst of Optics and Precision Mech, China.* We propose an alternative reconstruction algorithm based on image recombination transform (IRT), which provides an alternative solution to address this problem even in a weak modulation depth.

FF3B • Optical Fiber Sensors II—Continued

FF3B.3 • 14:15
A fiber-optic probe based on quantum dots integrated cavity for temperature sensing, Qi Zhang[1], Hai Xiao[1], Lei Yuan[1]; [1]*Clemson Univ. COMSET, USA.* We report a trumpet-shape micro-cavity probe based on quantum dots for temperature sensing. By analyzing the fluorescence signals generated from the quantum dots, the temperature of the micro-cavity structure could be correlated.

FF3B.4 • 14:30
Dual-LSPR based Optical-Fiber Sensor Platform for Multiplexed Biosensing Application, Nirmal S. Punjabi[1], Soumyo Mukherji[1]; [1]*Indian Inst. of Technology, Bombay, India.*Gold and silver nanoparticle decorated LSPR based fiber-optic probe has been designed for multiplexing. The dual nanoparticle coated probe is evaluated for RI sensitivity and multiplexed biosensing is demonstrated.

FF3B.5 • 14:45 Tutorial
Distributed Vibration Sensing: Principles, Techniques and Applications, Vincent Handerek[1]; [1]*Fotech Solutions Ltd., UK.* This tutorial introduces the fundamental principles of distributed vibration sensing and technical elements that have enabled commercial development. Some limitations of the technology and possible ways to overcome them will also be discussed.

FF3C • Quantum Electronics I—Continued

FF3C.3 • 14:15
Enhanced Second-Order Optical Nonlinearity in Doped Graphene on a Two-Dimensional Diffraction Grating, Tetsuyuki Ochiai[1]; [1]*National Inst. for Materials Science, Japan.* Doped graphene placed on a diffraction grating can exhibit a strong modulation of graphene plasmon polariton in the THz range. We present a theoretical analysis of the enhanced second-harmonic generation in doped graphene for plane-wave irradiation.

FF3C.4 • 14:30
Linear Amplifier Noise and Which-Path Information, James D. Franson[1], Richard A. Brewster[1]; [1]*Univ. of Maryland Baltimore County, USA.* Linear amplifiers are generally assumed to add noise that is independent of the signal. We show that which-path information left in the idler mode can produce decoherence effects that cannot be described by that model.

FF3C.5 • 14:45
Center-Of-Mass Interpretation for Bi-Partite Purity Analysis of N-Party Entanglement, Miguel A. Alonso[1], Xiao-Feng Qian[1], Joseph H. Eberly[1]; [1]*Univ. of Rochester, USA.* We provide a graphical description of multi-party entanglement based on a center-of-mass analogy. This description clarifies the existence of entanglement restrictions in the form of inequalities. Connections with optical polarization are discussed.

FF3D • Quantum Optical Measurement and Quantum Technologies I—Continued

FF3D.3 • 14:30
Overcoming Vacuum Noise: The Unforeseen Benefits of Quantum Heterodyne Detection, Christian R. Mueller[1,2], Christian Peuntinger[1,2], Thomas Dirmeier[1,2], Imran Khan[1,2], Ulrich Vogl[1,2], Christoph Marquardt[1,2], Gerd Leuchs[1,2], Luis L. Sánchez-Soto[3,1], Yong Siah Teo[4], Zdenek Hradil[4], Jaroslav Rehacek[4]; [1]*Max-Planck-Inst Physik des Lichts, Germany;* [2]*Inst. of Optics, Information and Photonics, Univ. of Erlangen-Nuremberg, Germany;* [3]*Departamento de Óptica, Facultad de Física, Universidad Complutense, Spain;* [4]*Department of Optics, Palacký Univ., Czech Republic.* We experimentally demonstrate that heterodyne detection outperforms homodyne tomography for almost all Gaussian states. Our results reveal the operational differences between the theoretically equivalent concepts of Wigner- and Husimi Q-functions.

FF3D.4 • 14:45
Linear Mode-Mixing of Trapped Ion Motion: can a Hong-Ou-Mandel experiment be performed with phonons?, Kevin A. Marshall[1], Daniel F. James[1]; [1]*Univ. of Toronto, Canada.* We propose a method to manipulate the normal modes in a chain of trapped ions using two lasers. The internal levels mediate a second-order interaction to construct the acoustic equivalent of a beam splitter.

(continued on page 124)

14:30–15:30
FF4A • Symposium on Integrated Quantum Optics I

Presider: Stefan Preble, Rochester Inst. of Technology, USA

FF4A.1 • 14:30 Invited

Title to be Announced, Jeremy L. O'Brien[1]; [1]*Univ. of Bristol, UK.* Abstract not available.

FF3F • Ultrafast Dynamics and Laser Ion Acceleration—Continued

FF3F.2 • 14:15

Ultrafast Terahertz Scanning Tunneling Microscopy with Atomic Resolution, Vedran Jelic[1], Krzysztof Iwaszczuk[2], Peter Nguyen[1], Christopher Rathje[3], Graham Hornig[1], Haille Sharum[1], James Hoffman[1], Mark Freeman[1], Frank Hegmann[1]; [1]*Department of Physics, Univ. of Alberta, Canada;* [2]*Department of Photonics Engineering, Technical Univ. of Denmark, Denmark;* [3]*4th Physical Inst., Univ. of Göttingen, Germany.* We demonstrate that THz-STM can probe single atoms on a silicon surface with simultaneous sub-nm and sub-ps resolution. THz-STM is established as a new technique for exploring high-field nonequilibrium tunneling phenomena with single atom precision.

FF3F.3 • 14:30

Study on THz-Radiation-Enhanced Emission of Fluorescence from plasma in a counter-propagating geometry, Kang Liu[1], Fabrizio Buccheri[1], Xi-Cheng Zhang[1]; [1]*The Inst. of Optics, Univ. of Rochester, USA.* We studied THz-Radiation-Enhanced Fluorescence from air plasma with THz pulse traveling in the opposite direction of the optical excitation pulses. Comparison between the co-propagation and the counter-propagation geometries is reported.

FF3F.4 • 14:45

The steering of THz pulses using thin emitters excited by tilted optical pulse-fronts, Bradley Smith[1], John Whitaker[1], Stephen Rand[1]; [1]*Univ. of Michigan, USA.* A potentially scalable, efficient, and rapid method of steering THz pulses emitted from thin media using optical pulse-front tilt is developed theoretically and verified in a proof-of-concept experiment. This method can also measure pulse-front tilt.

FF3G • Polarization Control and Measurements—Continued

FF3G.3 • 14:15

Probing Spatial Disorder with Light Polarization, Claude Amra[1,2], Myriam Zerrad[3], Gabriel Soriano[3]; [1]*Fresnel Inst., France;* [2]*CNRS, France;* [3]*Institut Fresnel, Aix-Marseille Université, France.* Enpolarization and depolarization histograms are calculated and measured within different speckle patterns. The results are related to the samples microstructures. Spatial depolarization is investigated in regard to temporal enpolarization.

FF3G.4 • 14:30

Polarization-sensitive Off-null Measurements Applied to Process Monitoring Using Focused Beam Scatterometry, Anthony Vella[1], Stephen Head[1], Thomas G. Brown[1], Miguel A. Alonso[1]; [1]*Univ. of Rochester, USA.* We present a scatterometry experiment for the simultaneous retrieval of multiple parameters of a subwavelength structure. The input beam is tailored with a spatially varying input polarization state to enhance the sensitivity of the measurement.

FF3G.5 • 14:45

Wavefront-Aberration Correction Using Binary Amplitude and Polarization Modulation, Yunqi Li[1], Christophe Dorrer[1]; [1]*Univ. of Rochester, USA.* We investigate a simple method to correct aberrations using binary-amplitude and binary-polarization pupil masks. A Cr-on-quartz mask and liquid crystal device experimentally lead to a significant Strehl ratio improvement for an aberrated laser beam.

FF3H • General Optical Sciences II—Continued

FF3H.4 • 14:15

Optical Energy Transfer from Relative Motion, Alexandra B. Artusio-Glimpse[1], Jacob H. Wirth[1], Grover A. Swartzlander[1]; [1]*Rochester Inst. of Technology, USA.* By intersecting a moving optical potential, a small particle may gain or loss kinetic energy. We describe this energy transfer for a Gaussian beam gradient potential and a Rayleigh particle smaller than the beam radius.

FF3H.5 • 14:30

Scattering properties of one-dimensional non-hermitian dispersive heterostructures, Oksana V. Shramkova[1], Konstantinos G. Makris[1], Giorgos P. Tsironis[1], Demetrios Christodoulides[2]; [1]*Department of physics, CCQCN, Univ. of Crete, Greece;* [2]*College of Optics & Photonics-CREOL, Univ. of Central Florida, USA.* The optical properties of scattering non-Hermitian systems with material dispersion are examined. We demonstrate that an on-average lossy heterostructure can amplify an incident plane wave, and analyse the exceptional points of the scattering matrix.

FF3H.6 • 14:45

Examination of the nonlinear dynamics and possible chaos encryption in a zeroth-order acousto-optic Bragg modulator with feedback, Fares S. Almehmadi[1], Monish R. Chatterjee[2]; [1]*Univ. of Tabuk, Saudi Arabia;* [2]*Univ. of Dayton, USA.* Zeroth-order chaos modulation in a Bragg cell is examined such that tracking problems due to spatial deflections of the first-order AO beam at the receiver may be avoided by switching to the undeviated zeroth-order beam.

LF3I • X-ray and XUV III—Continued

LF3I.3 • 14:30 Invited

Soft X-ray Free Electron Laser Science at LCLS and Opportunities at LCLS II, William F. Schlotter[1]; [1]*Linac Coherent Light Source, SLAC National Accelerator Laboratory, USA.* The Linac Coherent Light Source (LCLS) is an X-ray Free Electron Laser that generates ultrafast x-ray pulses for myriad science experiments. A planned upgrade (LCLS-II) will extend the energy range to 25 keV and increase the average intensity by 10^4.

FF3A • Advanced Microscopy Methods and Applications—Continued

FF3A.6 • 15:00
Linking Cellular Disorder Strength and Shear Stiffness using Quantitative Phase Imaging, William Eldridge[1], Brianna Loomis[1], Adam Wax[1]; [1]*Duke Univ., USA*. Quantitative phase imaging (QPI) was implemented to image cells before and during subjugation of shear flow. Simultaneous evaluation of disorder strength and cellular stiffness showed a correlation between the two metrics.

FF3A.7 • 15:15
Simultaneous Determination of 3D Orientation and 3D Localization in Single Emitter Microscopy Imaging, Miguel A. Alonso[1], Sophie Brasselet[2], Thomas G. Brown[1]; [1]*Univ. of Rochester, USA;* [2]*Institut Fresnel, France*. We present a microscopy technique that encodes molecule orientation and fluctuations as well as off-plane displacements into the PSF, allowing the simultaneous determination of six spatial/directional properties for many molecules simultaneously.

FF3B • Optical Fiber Sensors II—Continued

Biography: Vincent Handerek studied electrical engineering at Imperial College London, gaining a B.Sc.(Eng.) in 1975 and a PhD on polarised light in optical fibres. After researching fibre measurements in UK industry, he moved to the USA to work on polarisation maintaining components and fibre gyroscopes. In 1988, he joined King's College London, concentrating on distributed optical fibre sensor research. In 1999, he returned to industry, developing optical amplification, communication, and sensing systems. Dr. Handerek joined Fotech Solutions Ltd. in 2008 to develop distributed acoustic vibration sensing systems. He has authored over 90 publications, three book chapters and a range of patents.

FF3C • Quantum Electronics I—Continued

FF3C.6 • 15:00
Novel Single-photon Fringes from Momentum-Correlated Photon Pairs, Mayukh Lahiri[2], Armin Hochrainer[2], Gabriela Lemos[3], Radek Lapkiewicz[1], Anton Zeilinger[3,2]; [1]*Faculty of Physics, Univ. of Warsaw, Poland;* [2]*Faculty of Physics, Univ. of Vienna, Austria;* [3]*IQOQI, Austrian Academy of Science, Austria*. We create a novel single-photon fringe pattern using non-degenerate photon pairs. Although one photon in each pair is not detected, its wavelength characterizes the fringe shift. The fringe visibility depends on the two-photon momentum correlation.

FF3C.7 • 15:15
Directly Measuring the Density Matrix Using Weak Measurements, Guillaume S. Thekkadath[1], Lambert Giner[1], Yamn Chalich[1], Matthew Horton[1], Jash Banker[1], Jeff Lundeen[1];[1]*Univ. of Ottawa, Canada*. We demonstrate a method to measure any chosen density matrix element of a quantum system. We determine a photon's mixed or pure polarization state by sequentially weakly measuring three observables, each complimentary to the last.

FF3D • Quantum Optical Measurement and Quantum Technologies I—Continued

FF3D.5 • 15:00
Non-linear Optomechanical Measurement in Sliced Photonic Crystal Nanobeams, Rick Leijssen[1], Lars Freisem[1], Giada La Gala[1], Juha Muhonen[1], Ewold Verhagen[1]; [1]*FOM Inst. AMOLF, Netherlands*. We develop silicon sliced photonic crystal nanobeams with extreme coupling between light and motion. We demonstrate that measurements of the nanoscale thermal motion in these structures enter a new regime, where the readout is highly non-linear.

FF3D.6 • 15:15
Quantum correlations in measurement-based control of a mechanical oscillator, Vivishek Sudhir[1], Dalziel Wilson[1], Sergey Fedorov[1], Ryan Schilling[1], Hendrik Schuetz[1], Amir Ghadimi[1], Andreas Nunnenkamp[2], Tobias J. Kippenberg[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland;* [2]*Cambridge Univ., UK*. Quantum correlations are distilled by feedback on a mechanical oscillator. Feedback back-action is observed to destroy these correlations. A generalized uncertainty relation characterizes this transition between efficient and inefficient feedback.

15:30–16:00 Coffee Break, *West Corridor and Skyway Lobby (Radisson)*

FF4A • Symposium on Integrated Quantum Optics I—Continued

FF4A.2 • 15:00 Invited

Quantum information processing with photon temporal modes, Christine Silberhorn[1]; [1]*Deparment of Physics,, Universitaet Paderborn, Germany.* We present quantum information coding based on temporal modes of pulsed quantum light with different spectral-temporal shapes. These span a high-dimensional Hilbert space and are ideally suited for efficient quantum information coding in networks.

FF3F • Ultrafast Dynamics and Laser Ion Acceleration—Continued

FF3F.5 • 15:00 Invited

Recent advances in laser-driven ion acceleration research, Marco Borghesi[1]; [1]*Queen's Univ. of Belfast, UK.* We will present recent experimental progress in ion acceleration driven by ultra-intense laser pulses, including optimization of the established Target Normal Sheath Acceleration process, as well as investigations of Radiation Pressure Acceleration.

FF3G • Polarization Control and Measurements—Continued

FF3G.6 • 15:00

Highly Asymmetric Polarization-Independent Near Infrared Light Transmission In An All-Dielectric Photonic Structure, Lukasz J. Zinkiewicz[1], Michal Nawrot[1], Jakub Haberko[2], Piotr Wasylczyk[1]; [1]*Faculty of Physics, Univ. of Warsaw, Poland;* [2]*Faculty of Physics and Applied Computer Science, AGH Univ. of Science and Technology, Poland.* We designed and 3D-printed a dielectric structure, exhibiting significant difference in transmittance for the opposite incident wave vectors. Measured asymmetry is polarization-independent and spans over 70 nm in the near infrared (780 nm).

FF3G.7 • 15:15

The Phenomenon of Vector Polyphotochromism in Polarization-sensitive Materials, Barbara N. Kilosanidze[1], Irakli Chaganava[1], George Kakauridze[1], Luis Oriol[2], Milagros Piñol[2], Alfonso Martinez-Felipe[2]; [1]*Laboratory of Holographic Recording and Processing of Information, Georgian Technical Univ., Inst. of Cybernetics, Georgia;* [2]*Faculty of Science., Inst. of Materials Science of Aragon (ICMA), Univ. of Zaragoza-CSIC, , Spain.* Phenomenon of vector polyphotochromism was observed in some high-efficient polarization-sensitive materials dependent on the radiant exposure when material is illuminated with linearly polarized actinic light. The phenomenon has purely vector nature.

FF3H • General Optical Sciences II—Continued

FF3H.7 • 15:00

Ghost Imaging with Atoms, Roman I. Khakimov[1]; [1]*Research School of Physics and Engineering, Australian National Univ., Australia.* Here we report the first realisation of ghost imaging of using atoms. The correlated pairs of ultracold metastable helium atoms are originating from two colliding (BECs) to generate the correlated atom pairs required for creation of a ghost image.

FF3H.8 • 15:15

A liquid of optical vortices in a photonic sea of vector waves, Lorenzo De Angelis[1], Filippo Alpeggiani[1], Andrea Di Falco[2], L. Kuipers[1]; [1]*Center for Nanophotonics, AMOLF, Netherlands;* [2]*SUPA, School of Physics and Astronomy, Univ. of St Andrews, UK.* Phase singularities arise in scalar random waves, with spatial distribution reminiscent of particles in liquids. Supporting near-field experiment with analytical theory we show how such spatial distribution changes when considering vector waves.

LF3I • X-ray and XUV III—Continued

LF3I.4 • 15:00 Invited

Opportunities for Research at the SwissFEL Hard X-ray Free Electron Laser, Christopher J. Milne[1]; [1]*Paul Scherrer Inst., Switzerland.* In this talk I will present an overview of the design of SwissFEL and examples of some of our recent XFEL research, including nonlinear hard X-ray spectroscopy and time-resolved serial femtosecond crystallography.

15:30–16:00 Coffee Break, *West Corridor and Skyway Lobby (Radisson)*

16:00–18:00
FF5A • In-vivo Spectroscopy, Metabolism and Raman

Presider: Jonathan Lovell, SUNY Buffalo, USA

FF5A.1 • 16:00 Invited

Integrated Dual-modal Microscope for Imaging of Key Metabolic and Vascular Endpoints in Preclinical Cancer models, Caigang Zhu[1], Amy F. Martinez[1], Fangyao Hu[1], Martin Li [1], Megan C. Madonna[1], Marianne Lee[1], Helen Murphy[1], Nirmala Ramanujam[1]; [1]*Biomedical Engineering, Duke Univ., USA.* We have developed and utilized a wide field, high resolution microscope to capture multiple key metabolic and vascular endpoints to different indolent from metastatic disease.

FF5A.2 • 16:30 Invited

Unraveling Tissue Metabolism using Endogenous, Two-photon Imaging: Mechanisms and Diagnostic Biomarkers, Irene Georgakoudi[1]; [1]*Tufts Univ., USA.* Changes in optical metabolic signals related to the intensity, lifetime and spatial localization of endogenous fluorescence are associated with alterations in specific biosynthetic and bioenergetic cellular pathways, which can serve as diagnostic and therapeutic targets.

16:00–18:00
FF5B • Optical Manipulation, Processing and Applications

Presider: Shivanand, Purdue Univ., USA

FF5B.1 • 16:00

Optical Manipulation of Thermally Generated Microbubbles in a Liquid, Arjun Krishnappa[1], Ujitha abeywickrema[1], Partha P. Banerjee[1], Uttam Sinha[2]; [1]*Univ. of Dayton, Electro-Optics, USA;* [2]*Keck School of Medicine, USA.* The behavior of thermally generated microbubbles in the presence of a weakly focused laser beam is theoretically studied by developing an equivalent force model. Possible applications of these bubbles are also discussed.

FF5B.2 • 16:15

Microkelvin Control of an Optically Levitated Nanoparticle, Vijay Jain[1,2], Felix Tebbenjohanns[1], Lukas Novotny[1]; [1]*Photonics Laboratory, ETH Zürich, Switzerland;* [2]*Physics, Univ. of Rochester, USA.* Here, a high-power photodetector is used in conjunction with parametric feedback in an optical tweezer trap to cool the center-of-mass motion of a levitated nanoparticle from room temperature to 145 μK, or n = 21.

FF5B.3 • 16:30

Quantifying Defect Densities in Monolayer Graphene Using Near-field Coherence Measurements., Roxana Rezvani Naraghi[1,2], Luiz Gustavo Cançado[3], Félix Salazar-Bloise[4], Aristide Dogariu[1]; [1]*Univ. of Central Florida, CREOL, USA;* [2]*Department of Physics, Univ. of Central Florida, USA;* [3]*Departamento de Física,, Universidade Federal de Minas Gerais (UFMG), , Brazil;* [4]*Departamento de Energia y Combustibles, Universidad Politécnica de Madrid, Spain.* We show that defect density in 2D crystalline lattices determines the extent of near-field spatial coherence. Measurements show the relationship between the spatial coherence length of scattered light and that of photo-excited electrons in graphene.

16:00–18:00
FF5C • Quantum Electronics II

Presider: Nickolas Vamivakas, Univ. of Rochester, USA

FF5C.1 • 16:00

Tailoring of Four-Wave Mixing by Ground-State Coherence and Resonant Dispersion, Michal Parniak[1], Adam Leszczynski[1], Wojciech Wasilewski[1]; [1]*Faculty of Physics, Univ. of Warsaw, Poland.* Quantum light-atom interface with internal frequency conversion facilitating storage of light based on four-wave mixing in atomic vapor is presented. Phase-matching in the four-wave mixing process is shown to enable subtle control of light emission.

FF5C.2 • 16:15

Opto-coherent-electronics in graphene: photocurrent direction switching based on illumination wavelength, Mahbub Alam[1,2], Paul L. Voss[1,2]; [1]*Georgia Inst. of Technology, France;* [2]*GT-CNRS, UMI 2958, Georgia Tech Lorraine, France.* Recent plasmonics experiments focus light to 10 nm focal spots. We show that with such illumination, electrostatically gated graphene nanoribbon photoconductors produce photocurrents whose direction depends on illumination wavelength.

FF5C.3 • 16:30

Thick-crystal regime in photon pair sources, Alexander Ling[1], James Grieve[1], Kadir Durak[1], Brigitta Septriani[1]; [1]*Centre for Quantum Technologies, Singapore.* We present a thorough exploration of photon pair sources built around thick crystals, achieving concurrently high brightness and efficiency, despite pump beam walk-off. This surprising result is important when designing practical sources.

16:00–18:00
FF5D • Quantum Optical Measurement and Quantum Technologies II

Presider: Paolo Villoresi, Universita degli Studi di Padova, Italy

FF5D.1 • 16:00 Invited

Title to be Announced, Andreas Wallraff[1]; [1]*ETH Zurich, Switzerland.* Abstract not available.

FF5D.2 • 16:30

Quantum controlled phase shift with a single 4π mirror, Lucas Alber[1,2], Martin Fischer[1,2], Bharath Srivathsan[1], Markus Weber[1], Markus Sondermann[1,2], Gerd Leuchs[1,2]; [1]*Max Planck Inst. for the Science of Light, Germany;* [2]*Department of Physics, Univ. Erlangen-Nürnberg, Germany.* We report on the experimental implementation of a free-space setup for phase shifts controlled by a single ion. We determine the phase shift of a weak coherent beam to 2.2°.

16:00–17:30
FF5E • Symposium on Integrated Quantum Photonics II
Presider: Stefan Preble, Rochester Inst. of Technology, USA

FF5E.1 • 16:00 Invited

Quantum Information Processing Using Programmable Silicon Photonic Integrated Circuits, Dirk Englund[1]; [1]*Massachusetts Inst. of Technology, USA.* Photonic integrated circuits (PICs) provide a stable, compact, and potentially scalable architecture for generating, manipulating, and measuring optical quantum states. We describe recent progress on programmable silicon PICs for quantum communications and quantum simulation.

FF5E.2 • 16:30 Invited

Multiplexing of Integrated Single Photon Sources, Benjamin J. Eggleton[1]; [1]*Univ. of Sydney, Australia.* We present recent progress on increasing the probability of heralded single photon generation from integrated photonic devices through active spatial and temporal multiplexing.

16:00–18:15
FF5F • Hybrid Integration
Presider: Liang Feng, Caltech, USA

FF5F.1 • 16:00 Invited

3D Hybrid Integration for Silicon Photonics, Jonathan Klamkin[1]; [1]*Univ. of California Santa Barbara, USA.* A 3D hybrid integration platform for silicon photonics is discussed. This platform merges indium phosphide and silicon photonics in an elegant and effective manner, providing a path to low cost, high yield, and high performance.

FF5F.2 • 16:30

Monolithic High-Index-Contrast Stretchable Photonics, Hongtao Lin[1], Lan Li[1], Yizhong Huang[1], Junying Li[1], Carlos Ramos[2], Laurent Vivien[2], Jason Lonergan[3], Kathleen A. Richardson[3], Juejun Hu[1]; [1]*Materials Science and Engineering, Massachusetts Inst. of Technology, USA;* [2]*Institut d'Electronique Fondamentale, France;* [3]*The College of Optics & Photonics, Univ. of Central Florida, USA.* We demonstrated stretchable, high-index-contrast photonic devices monolithically integrated on a PDMS elastomer substrates. The devices can sustain 42% strain and 3,000 stretching cycles without measurable optical performance degradation.

16:00–18:00
FF5G • Beams and Optical Coherence
Presider: Miguel Alonso, Univ. of Rochester, USA

FF5G.1 • 16:00 Invited

Generation and propagation of a partially coherent beam, Yangjian Cai[1], Lin Liu[1], Jiayi Yu[1]; [1]*College of Physics, Optoelectronics and Energy, Soochow Univ., China.* Partially coherent beams with prescribed correlation function, phase and state of polarization display many extraordinary properties. In this talk, we present a review of recent progress on generation and propagation of a partially coherent beam.

FF5G.2 • 16:30

Optical beam spatial modal analysis using a two-path generalized Michelson interferometer, Tanya Malhotra[1], Wesley Farriss[2], James R. Fienup[2], Ayman Abouraddy[3], A. Nick Vamivakas[2]; [1]*Department of Physics and Astronomy, Univ. of Rochester, USA;* [2]*Inst. of Optics, Univ. of Rochester, USA;* [3]*CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA.* A spatial mode-sorting two-path generalized Michelson interferometer based on a fractional Fourier Transform generalized delay line is experimentally implemented. Progress on recovering the phase of the modal coefficients will be reported.

16:00–18:00
FF5H • Exotic States and Applications II
Presider: Greg Gbur, Univ. of North Carolina at Charlotte, USA

FF5H.1 • 16:00

Generation of Surface Plasmon Polaritons with Controlled States of Partial Coherence, Andreas Norrman[1], Sergey Ponomarenko[2], Ari Tapio Friberg[1]; [1]*Univ. of Eastern Finland, Finland;* [2]*Dalhausie Univ., Canada.* We formulate a framework to generate polychromatic surface plasmon polaritons with any states of partial electromagnetic coherence at a metal-air interface by controlling the correlations of the exciting stationary or pulsed light beam.

FF5H.2 • 16:15

Room temperature exciton polaritons in thin WS_2 flakes, Liaoxin Sun[1], Qi Wang[2], changqing Chen[2], Bo Zhang[1], Xuechu Shen[1], Wei Lu[1]; [1]*Shanghai Inst. of Technical Physics, China;* [2]*Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology,, China.* The anti-crossing behavior of exciton polaritons in WS_2 thin layers was spectrally observed. Giant Rabi splitting of ~270 meV for A exciton and ~780 meV for B exciton were obtained from the fitting of the cavity polariton dispersions.

FF5H.3 • 16:30

Generation of path-polarization hyperentanglement using quasi-phase-matching in quasi-periodic nonlinear photonic crystal , Chengrui Zhu[1], Xikun Chen[1], Linxi Hu[1], Jietai Jing[2], Guangqiang He[1]; [1]*Shanghai Jiaotong Univ., China;* [2]*East China Normal Univ., China.* A compact scheme for the generation of path-polarization entangled photon pairs is proposed by using a quasi-periodic nonlinear photonic crystal to simultaneously accomplish four spontaneous parametric down-conversion processes.

16:00–18:00
LF5I • Topological Photonics II
Presider: Hui Deng; Univ. of Michigan, USA

LF5I.1 • 16:00 Invited

Topological Cavity QED: Landau Levels in Curved Space to Microwave Chern Insulators, Jonathan Simon[1]; [1]*Univ. of Chicago, USA.* We demonstrate Landau levels for optical photons in a twisted cavity and explore the impact of placing these photons in curved space. We further realize a microwave Chern-insulator. We conclude with work to mediate photon-photon interactions.

LF5I.2 • 16:30 Invited

All-dielectric Photonic Topological Insulators and Metasurfaces, Alexander B. Khanikaev[1,2]; [1]*City Univ. of New York, USA;* [2]*Graduate Center of the City Univ. of New York, USA.* Symmetry protected topological phases are engineered in all-dielectric metamaterials in the presence of electromagnetic duality. Synthetic gauge field induced by magneto-electric coupling gives rise to Dirac-like surface states in two and three dimensions.

FF5A • In-vivo Spectroscopy, Metabolism and Raman—Continued

FF5A.3 • 17:00 Invited

Raman Spectroscopic Tools for Medical Applications, Nicholas Stone[1,2]; [1]*Univ. of Exeter, UK;* [2]*Royal Devon and Exeter Hospital, UK.* Raman spectroscopy can provide unlabelled discrimination of early and late malignancies. Various novel methodologies are being developed for minimally invasive tissue analysis. Here we demonstrate a novel Raman clinical toolbox.

FF5B • Optical Manipulation, Processing and Applications—Continued

FF5B.4 • 16:45

Structural Fire Forensics: Using Optically Active Nanoparticles to Determine a Fire's Thermal Impulse, Benjamin R. Anderson[1], Ray Gunawidjaja[1], Natalie J. Gese[1], Gediminas Markevicius[1], Helena Diez-y-Riega[1], Hergen Eilers[1]; [1]*Washington State Univ., USA.* One difficulty in structural fire forensics is accurately determining a fire's thermal impulse. To address this difficulty we develop optically active nanoparticles whose spectral properties irreversibly change when heated.

FF5B.5 • 17:00

Far-field super-resolution recording and reading towards petabyte optical discs, Zongsong Gan[1], Richard Evans[3], Min Gu[1,2]; [1]*Centre for Microphotonics, Faculty of Science, Engineering and Technology, Swinburne Univ. of Technology, Australia;* [2]*Artifical-Intelligence Nanophotonics Laboratory, School of Science, RMIT Univ., Australia;* [3]*CSIRO, Manufacturing, Australia.* To significantly increase the capacity of optical discs for petabyte data storage, we report a dual-beam super-resolution approach to break the diffraction limit barrier for both far-field super-resolution data recording and reading.

FF5B.6 • 17:15

Ferroelectric nanoparticles tailored for electro-optical and nano-imaging applications, Olena Zribi[1], Yuriy Garbovskiy[1], Anatoliy Glushchenko[1]; [1]*Univ of Colorado at Colorado Springs, USA.* We report an implementation of the ball milling method to produce stable colloids of ferroelectric nanoparticles tailored for electro-optical and nano-imaging applications. Optical and ferroelectric properties of the produced colloids are discussed.

FF5C • Quantum Electronics II—Continued

FF5C.4 • 16:45

Quantum-Coherence Emergent Self-Organized Criticality and Nonequilibrium Light Localization, Pankaj K. Jha[1], Kosmas Tsakmakidis[1], Yuan Wang[1], Xiang Zhang[1]; [1]*Univ. of California, Berkeley, USA.* We introduce a quantum-coherence driven many-body photonic nanostructure, in which we observe self-organized phase-transitions to a new type of non-potential light localization, resilient to dissipation, fluctuations, and nonlinear interactions.

FF5C.5 • 17:00

Photo-electron streaking for synchronization of laser pulses with radiofrequency fields, Thomas Juffmann[1], Brannon B Klopfer[1], Mark A. Kasevich[1]; [1]*Stanford Univ., USA.*Synchronization of cavity enhanced RF fields with laser triggered electron pulses is crucial in electron acceleration and temporal refocussing. We propose to measure jitter in situ and with femtosecond accuracy based on photo-electron streaking.

FF5C.6 • 17:15

Time ordering in nonlinear interferometers, Enno Giese[1], Samuel Lemieux[1], Robert Fickler[1], Robert W. Boyd[1,2]; [1]*Univ. of Ottawa, Canada;* [2]*Univ. of Rochester, USA.* In high-gain parametric down-conversion the Hamiltonian generating light with macroscopic photon numbers is time dependent. We therefore investigate the influence of time ordering on nonlinear interferometers and the emitted radiation properties.

FF5D • Quantum Optical Measurement and Quantum Technologies II—Continued

FF5D.3 • 16:45

Entangled-State Quantum Gates With Directionally Unbiased Linear-Optical Multiports, Alexander V. Sergienko[1], David S. Simon[2], Casey A. Fitzpatrick[1]; [1]*Electrical and Computer Engineering, Boston Univ., USA;* [2]*Physics and Astronomy, Stonehill College, USA.* The concept of directionally unbiased optical multiport is introduced, in which photons may reflect back out the input direction. It acts as universal Bell-state processor to implement probabilistic quantum gates acting on state symmetries.

FF5D.4 • 17:00

High-dimensional quantum cloning of orbital angular momentum qudits, Frederic Bouchard[1], Robert Fickler[1], Robert W. Boyd[1], Ebrahim Karimi[1]; [1]*Univ. of Ottawa, Canada.* We present high-dimensional quantum cloning of orbital angular momentum quantum states of light. Moreover, we characterize the cloning machine for various dimensions and by performing full quantum state tomography on the cloned states.

FF5D.5 • 17:15

Light-Matter Interactions using a Nanofiber-Segment Ring Resonator, Todd B. Pittman[1], Daniel E. Jones[1], Garrett Hickman[1], James D. Franson[1]; [1]*Univ. of Maryland Baltimore County, USA.* We describe work on a nanofiber-based ring resonator that enables strong interactions between the cavity-enhanced field and atoms near the nanofiber surface. This ``all fiber'' cavity has applications in nonlinear spectroscopy and quantum optics.

FF5E • Symposium on Integrated Quantum Photonics II—Continued

FF5E.3 • 17:00 Invited

Quantum Nanophotonics: From Inverse Design to Implementations, Jelena Vuckovic[1]; [1]*Stanford Univ., USA*. By exploring the full parameter space in nanophotonics design, one can implement structures for studies of new regimes in quantum and nonlinear optics, and for new applications in communications, computing, and sensing.

FF5F • Hybrid Integration—Continued

FF5F.3 • 16:45

Demonstration of Self-Aligned Flip-Chip Photonic Assembly with 1.1dB Loss and >120nm Bandwidth, Tymon Barwicz[1], Yves Martin[1], Jae-Woong Nah[1], Swetha Kamlapurkar[1], Robert L. Bruce[1], Sebastian Engelmann[1], Yurii A. Vlasov[1]; [1]*IBM TJ Watson Research Center, USA*. We demonstrate direct flip-chip assembly of photonic dies with solder-induced self-alignment to sub-micron accuracy. We find a peak chip-to-chip transmission of -1.1 dB with 0.2 dB penalty over the 120 nm spectrum measured.

FF5F.4 • 17:00 Invited

III-V-on-silicon Photonic Integrated Circuits for Optical Communication and Sensing, Gunther Roelkens[1]; [1]*Universiteit Gent, Belgium*. The integration of III-V sources, high-speed germanium optical modulators and photodetectors on silicon waveguide circuits, and the co-integration with electronic integrated circuits will be discussed in this paper.

FF5G • Beams and Optical Coherence—Continued

FF5G.3 • 16:45

Beam shaping under extreme focusing conditions: Generalization of the Richards-Wolf formalism, Denis Panneton[1], Guillaume St-Onge[1], Michel Piché[1], Simon Thibault[1];[1]*Universite Laval, Canada*. We rigorously model nonparaxial focusing of electromagnetic beams by arbitrary axisymmetric surfaces such as spheres, ellipses and hyperbolae. We consider light's diffraction and polarization properties.

FF5G.4 • 17:00

Evolution of coherence singularities of beams associated with structurally stable Gaussian modes, Tatiana Alieva[1], Eugeny Abramochkin[2], Jose A. Rodrigo[1]; [1]*Universidad Complutense de Madrid, Spain;* [2]*Lebedev Physical Inst., Russian Federation*. The propagation of partially coherent Schell model beams associated with structurally stable Gaussian modes is studied using ambiguity function. This allows deriving a simple expression for the cross-correlation function in near and far field.

FF5G.5 • 17:15

Multiple Wavelength Concentric Vortex Optics: λ = 1064 nm and 2090 nm, Wenzhe Li[1], Yuan Li[1], Keith Miller[1], Eric G. Johnson[1]; [1]*Clemson Univ., USA*. Using a single concentric vortex optic to generate vortices with multiplexed 1064 nm and 2090 nm laser sources is studied and experimentally confirmed. The rotation of the resulting diffracted patterns is also explored.

FF5H • Exotic States and Applications II—Continued

FF5H.4 • 16:45

Dispersion Engineering in Whispering Gallery Mode Microbubble Resonators, Nicolas N. Riesen[1,2], Wen Qi Zhang[2], Tanya M. Monro[2,1]; [1]*Inst. for Photonics and Advanced Sensing (IPAS), Univ. of Adelaide, Australia;* [2]*Univ. of South Australia, Australia*. The opportunities for engineering dispersion in whispering gallery microbubbles are explored. Using certain materials it is shown that dispersion equalization can be realized at interesting wavelengths such as deep within the visible or mid-infrared.

FF5H.5 • 17:00

Vortex beam characterization in terms of Hypergeometric-Gaussian modes, Bereneice C. Sephton[1,2], Angela Dudley[1,2], Andrew Forbes[2]; [1]*CSIR National Laser Centre, South Africa;*[2]*Physics, Univ. of Witwatersrand, South Africa*. Q-plates are commonly used for uncomplicated generation of polarization controlled vortex beams. Here we show experimentally that the output is not a pure vortex but rather a Hypergeometric-Gaussian mode. Results are in good agreement with theory.

FF5H.6 • 17:15

A Simple Hubbard Model for the Excited States of π Conjugated -acene Molecules, Zaheen S. Sadeq[1], John E. Sipe[1]; [1]*Physics, Univ. of Toronto, Canada*. We investigate the excited states of tetracene, pentacene, and hexacene using a truncated Hubbard model; our technique yields reasonable energies and oscillator strengths. We show that the lowest doubly excited state acts like two triplets.

LF5I • Topological Photonics II—Continued

LF5I.3 • 17:00 Invited

New Ideas on Photonic Topological Insulators, Miguel Bandres[1], Gal Harari[1], Yaakov Lumer[1], Eran Lustig[1], Yonatan Plotnik[1], Moshe-Ishay Cohen[1], Rivka Bekenstein[1], Mordechai Segev[1]; [1]*Technion Israel Inst. of Technology, Israel*. Recent progress on photonic topological insulators will be presented, with new ideas ranging from topo lasers and photonic topological quasicrystals to curved-space topo photonics and effects of disorder on photonic topological phenomena.

FF5A • In-vivo Spectroscopy, Metabolism and Raman—Continued

FF5A.4 • 17:30
Identification of Single Human Immune Cells with Wavelength Modulation Raman Spectroscopy, Mingzhou Chen[1], Naomi McReynolds[1], E. C. Campbell[1], Michael Mazilu[1], Kishan Dholakia[1]; [1]*Univ. of St Andrews, UK*. We present a completely label-free optical method, wavelength modulation Raman spectroscopy (WMRS), for identifying closely related single human immune cells.

FF5A.5 • 17:45
Rapid detection of HIV1-p24 antigen in human blood plasma using Raman spectroscopy, Ben O. Otange[2], Ronald Rop[2], Julius O. Oyugi[3], Zephania Birech[1]; [1]*Department of Physics, Univ. of Nairobi, Kenya;* [2]*Department of Physics, Egerton Univ., Kenya;* [3]*Department of medical microbiology, Univ. of Nairobi, Kenya*. Raman spectroscopy together with principal component analysis (PCA) has been applied in detecting HIV1-p24 antigen in plasma. PCA distinguished Raman data of human blood Plasma contaminated with HIV1-p24 antigens from plasma without the antigen.

FF5B • Optical Manipulation, Processing and Applications—Continued

FF5B.7 • 17:30
Efficiency Enhancement in Organic Solar Cell using Dielectric Nanoparticles, Vidhi Mann[1], Vipul Rastogi[1]; [1]*Physics, IIT Roorkee, India*. We propose to incorporate the dielectric nanoparticles at anode to increase the efficiency of organic solar cells. 20% enhancement in efficiency could be achieved using the proposed organic solar cell structure.

FF5B.8 • 17:45
Raman spectroscopy of few-layer $MoSe_2$ in wide range of temperature, Malgorzata M. Zinkiewicz[1], Magdalena Grzeszczyk[1], Katarzyna Golasa[1], Karol Nogajewski[2], Adam Babinsk[1];[1]*Faculty of Physics, Univ. of Warsaw, Poland;* [2]*LNCMI, CNRS-UJF-UPS-INSA, France*. We focus on $MoSe_2$ micro-Raman analysis in wide range of temperature (4-300 K) for sample- thickness varying: 1 to 4 layers. Results are compared with previously studied excitation resonances at room temperature in this material.

FF5C • Quantum Electronics II—Continued

FF5C.7 • 17:30
Theory of Intense-Broadband-Pulse Storage and Retrieval, Rodrigo Gutiérrez-Cuevas[1], Joseph H. Eberly[1]; [1]*Univ. of Rochester, USA*. We study the storage and retrieval of intense-broadband pulses in hot atomic gases through analytical and numerical solutions. We show how the spin-wave can be manipulated and the storage of multiple pulses can be accommodated.

FF5C.8 • 17:45
Frequency Comb Generation at Near Visible Wavelengths in a Microbubble Resonator, Yong Yang[1], Xuefeng Jiang[2], Sho Kasumie[1], Guangming Zhao[2], Linhua Xu[2], Jonathan Ward[1], Lan Yang[2], Sile Nic Chormaic[1]; [1]*Okinawa Inst of Science & Technology, Japan;* [2]*Washington Univ. , USA*. We demonstrate frequency comb generation with 14 lines for visible wavelengths in a silica microbubble resonator, with a Q-factor of 10^7, via dispersion engineering. The visible wavelength comb has applications in metrology and bioimaging.

FF5D • Quantum Optical Measurement and Quantum Technologies II—Continued

FF5D.6 • 17:30
Ancilla–aided recovery of quantum super–sensitivity diminished by decoherence, Walker D. Larson[1], Bahaa E. Saleh[1]; [1]*UCF CREOL, USA*. The quantum super-sensitivity of phase esttimation in two-photon interferometery is diminished by decoherence. We show that this quantum advantage can be restored by employing an ancillary optical mode.

FF5D.7 • 17:45
Theoretical Intepretation of Light Storage by Coherent Population Oscillation, Pascal Neveu[1], Marie-Aude Maynard[1], Chitram Banerjee[1], Jasleen Lugani[1], Etienne Brion[1], Fabienne Goldfarb[1], Fabien Bretenaker[1]; [1]*Laboratoire Aimé Cotton, France*. We report a theoretical interpretation of an optical memory based on Coherent Population Oscillation (CPO). We introduce a new quantity superposition of light and matter that propagates with a controlled group velocity.

FF5E • Symposium on Integrated Quantum Photonics II—Continued

FF5F • Hybrid Integration—Continued

FF5F.5 • 17:30
InAs quantum dot mode-locked lasers on a Si substrate by Pd-GaAs wafer bonding, Zihao Wang[1], Stefan F. Preble[1], Michael Fanto[1,2], Jeffrey A. Steidle[1], Chi-Sen Lee[3], Wei Guo[3];[1]*Rochester Inst. of Technology, USA;* [2]*Air Force Research Laboratory, USA;* [3]*Univ. of Massachusetts- Lowell, USA.* Room temperature operation of passively mode locked InAs quantum dot lasers integrated on a Si substrate are demonstrated by using low-temperature palladium-GaAs wafer bonding.

FF5F.6 • 17:45
Efficient extraction of zero-phonon-line photons from single nitrogen vacancy centers in an integrated GaP-on-diamond platform, Emma Schmidgall[1], Michael Gould[1], Shabnam Dadgostar[2], Fariba Hatami[2], Kai-Mei Fu[1]; [1]*Univ. of Washington, USA;* [2]*Humboldt Univ. Berlin, Germany.* We demonstrate coupling of single NV center zero phonon emission to integrated GaP-on-diamond waveguides, with estimated total quantum efficiency values above 10% due to Purcell enhancement and efficient coupling between the cavities and waveguides.

FF5F.7 • 18:00
Graphene-based electrostatic control of InAs quantum dots, Laura Kinnischtzke[1,2], Kenneth M. Goodfellow[3,2], Chitraleema Chakraborty[4], Yi-Ming Lai[1], Antonio Badolato[1], Stefan Fält[5], Werner Wegscheider[5], A. Nick Vamivakas[3,2]; [1]*Department of Physics and Astronomy, Univ. of Rochester, USA;* [2]*Center for Coherence and Quantum Optics, Univ. of Rochester, USA;* [3]*Inst. of Optics, Univ. of Rochester, USA;* [4]*Materials Science, Univ. of Rochester, USA;* [5]*Solid State Physics Laboratory, ETH Zurich, Switzerland.* We characterize voltage-dependent photoluminescence from single InAs quantum dots gated by graphene. Our device also exhibits a higher photon count rate than devices using thin-metallic films due to graphene's low absorption.

FF5G • Beams and Optical Coherence—Continued

FF5G.6 • 17:30
Tunable Bessel Beam in 2D PPLT Crystal, Dongmei Liu[1]; [1]*Nanjing Univ., USA.* We demonstrate the generation of a tunable diffraction-free Bessel beam from a 2D periodically-poled $LiTaO_3$ crystal. Our observation not only enriches the diffraction-free optics, but also has potential applications for photolithography and imaging.

FF5G.7 • 17:45
All-Optical Image Recognition Using Metamaterials, Maria Papaioannou[1], Eric Plum[1], Edward T F Rogers[1], João Valente[1], Nikolay I. Zheludev[1,2]; [1]*Univ. of Southampton, UK;* [2]*Nanyang Technological Univ., Singapore.* Coherent interaction of waves on a thin absorbing film allows performance of ultrafast, low energy logical functions with two-dimensional images, adaptive filtering and pattern recognition that we demonstrate with a plasmonic metamaterial absorber.

FF5H • Exotic States and Applications II—Continued

FF5H.7 • 17:30
Bimodal Phase-Matching in Nonlinear Plasmonics, Alessandro Salandrino[1,2], Kevin P. O'Brien[2], Taiki Hatakeyama[2], Yuan Wang[2], Xiang Zhang[2]; [1]*Univ. of Kansas, USA;*[2]*Univ. of California, Berkeley, USA.* Bimodal phase-matching exploits the interplay between nonlinear scattering modes and waveguide modes to provide perfect phase-matching of second harmonic generation in hybrid photonic-plasmonic waveguides.

FF5H.8 • 17:45
Experimental Generation of Attenuation-resistant Frozen Waves Inside an Absorbing Medium, Ahmed Dorrah[1], Michel Zamboni-Rached[2], Mo Mojahedi[1]; [1]*Univ. of Toronto, Canada;* [2]*Electrical Engineering, State Univ. of Campinas , Brazil.* We generate non-diffracting beams, known as Frozen Waves (FWs), which consist of co-propagating Bessel beams and can maintain a desired longitudinal intensity profile in absorbing fluids. FWs can be utilized in optical trapping and micromanipulation.

LF5I • Topological Photonics II—Continued

LF5I.4 • 17:30 Invited
Robust Transport of Time-Bin Entangled Photons in a 2D Topological System, Sunil Mittal[1], Venkata Vikram Orre[1], Mohammad Hafezi[1]; [1]*JQI/IREAP/Department of Electrical and Computer Engineering, Univ. of Maryland, College Park, USA.* We study transport of entangled photons in a topological system of coupled-ring resonators and show that the edge states could enable robust on-chip quantum communication channels. We report on the experimental progress towards this demonstration.

FiO/LS Sessions, Symposia and Invited/Tutorial Speakers by Topic

FiO 1 Optical Design and Instrumentation

Technical Sessions

Tutorial Speaker

Invited Speakers

FiO 2 Optical Sciences

Technical Sessions

Tutorial Speakers

Invited Speakers

FiO 3 Optics in Biology and Medicine

Technical Sessions

Invited Speakers

FiO 4 Fiber Optics and Optical Communications

Technical Sessions

Tutorial Speakers

Invited Speakers

FiO 5 Integrated Photonics

Technical Sessions

Invited Speakers

FiO 6 Quantum Electronics

Technical Sessions

FiO 7 Vision & Color

Laser Science Categories

Technical Sessions

Invited Speakers

Symposia

Technical Sessions

Tutorial Speakers

Invited Speakers

Key to Authors and Presiders

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