CLEO PACIFIC RIM 2018

July 29 - August 3, 2018 | Hong Kong Convention and Exhibition Centre | HONG KONG

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CLEO PACIFIC RIM 2018

Conference Schedule

	Sunday 29 July	Monday 30 July	Tuesday 31 July	Wednesday 1 August	Thursday 2 August	Friday 3 August	Venue
Registration	14:00-17:00[1]	08:00-18:00[2]	08:00-18:00[2]	08:00-18:00[2]	08:00-18:00[2]	08:00-12:00[2]	1. Room AG206, The Hong Kong Polytechnic University 2. Room S221 Foyer, HKCEC
Lab Tours	14:00-17:00					14:00-17:00	The Hong Kong Polytechnic University
Workshops		08:30-12:30 14:00-18:00					Room S222-S228, HKCEC
Welcome Reception		18:30-20:00					DiVino Patio, Shop 11, 1/F, Causeway Centre, No. 28 Harbour Road, Wanchai
Opening and Plenary Session			08:30-12:30				Convention Hall, HKCEC
Technical Sessions			14:00-18:00[3,4]	08:30-18:00[3,4]	08:30-18:00[3,4]	08:30-12:00[3]	3. Room S223-S228, HKCEC 4. Room S423-S428, HKCEC
Poster Session				14:00-15:30			Room S421, HKCEC
Conference Reception and Banquet				18:00-22:00			Convention Hall, HKCEC
Post-deadline Papers					18:30-20:30		Room S421, HKCEC

Note:

All time reflect Hong Kong time. Please check with conference organizer during conference for schedule Changes and updates.

Pacific Rim Conference on Lasers and Electro-Optics (CLEO-PR) 2018

29 July–3 August, 2018

Hong Kong Convention and Exhibition Centre, Hong Kong

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Welcome to Hong Kong and to the Pacific Rim Conference on Lasers and Electro-Optics (CLEO-PR) 2018

Welcome to Hong Kong and to the Pacific Rim Conference on Lasers and Electro-Optics 2018.

It is our great pleasure to invite you to participate in the Pacific Rim Conference on Lasers and Electro-Optics (CLEO-PR) 2018 and share the latest discoveries and news in photonics science, technology and innovations from leading companies, universities and research laboratories throughout the world. CLEO-PR is now one of the largest conferences in the Asia-Pacific region on photonics and relevant technologies.

The CLEO-PR technical conference features a full suite of plenary, invited, and contributed talks given by international academic and industrial researchers who are leaders in their respective fields. The conference this year will feature the following topics: Solid State, Fiber, and Other Laser Sources; Ultrafast and Nonlinear Phenomena; Infrared and Terahertz Technologies and Applications; High Power, High Energy Lasers; Laser Processing and Innovative Applications; Optical Metrology; Quantum Optics, Atomic Physics and Quantum Information; Micro and Nanophotonics; Optical communication systems and networks; Optical Fiber and Waveguide Technologies; Semiconductor and Integrated Optical Devices; Silicon Photonics; Optical Signal Processing; Advanced 2D Materials for Photonics; Biophotonics and Applications; Plasmonics and Metamaterials; Optical Sensors and Systems; Imaging, Display and Storage Technologies; and Microwave Photonics.

With a conference program of broad scope and of the highest technical quality, CLEO-PR provides an ideal venue to keep up with new research directions and an opportunity to meet and interact with the researchers who are leading these advances. We have 792 papers scheduled, including 152 invited and 20 tutorial presentations made by many of the world's most prominent researchers from academia and industry. We thank all the contributors and authors for making CLEO-PR a truly unique, outstanding global event.

Our conference highlight is the Plenary Session scheduled on the morning of Tuesday, July 31. We will have four outstanding, distinguished speakers: Professor Kerry J. Vahala from California Institute of Technology, USA will present on High-Q Physics on-a-Chip for Integrated Optical Time Standards and Frequency Synthesizers; Professor Qihuang Gong from Peking University, China will give a talk on Light Manipulating and Detecting at Micro/Nano-Scale; Professor Bahram Jalali from University of California, Los Angeles, USA will present on Time Stretch and its Applications in Nonlinear Dynamics, Biomedicine, and Computational Imaging; Professor Susumu Noda from Kyoto University, Japan will discuss High-Power and High-Beam Quality Photonic-Crystal Lasers.

In addition to the regular technical sessions, twelve workshops will also be held on Monday, July 30. These workshops will be held free of charge to conference registrants. We would like to thank the workshop organizers and speakers for the excellent program.

Best Student Paper Awards sponsored by OSA will be given to students who are first authors and presenters of exceptional contributed talks. The selection will be made by the subcommittees during the conference. Awards will be presented during the Banquet on Wednesday, August 1. The poster-only session will also be held on 14:00 –15:30, Wednesday, August 1. This is a good chance for you to meet with the authors and discuss technical issues in-depth. Best poster awards sponsored by OSA and selected by conference delegates will be given as well.

In addition to the technical program, we have prepared a rich social program to facilitate meeting and networking with colleagues from all over the world. A conference reception will be held in the evening of Monday, July 30. In the evening of Wednesday, August 1, we will hold a Banquet for conference registrants in the Hong Kong Convention and Exhibition Centre. It is an enormous task to organize a conference and it is impossible to succeed without the dedicated efforts of many supporters and volunteers. We are indebted to the entire Technical Program Committee led by Hwa-Yaw Tam, Changyuan Yu and Feng Li from The Hong Kong Polytechnic University, and the Subcommittee co-chairs who have worked persistently throughout the whole year to invite speakers, solicit and review papers, organize the technical sessions which results in the excellent technical program. We also thank the local organizing committee led by Chao Lu and Alan Pak Tao Lau from The Hong Kong Polytechnic University, and the staffs and volunteers of the professional societies (especially OSA) organizing and sponsoring the event.

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Meng Zhang, Beihang Univ., China
Jungwon Kim, Korea Advanced Inst. of Science and Technology (KAIST), South Korea
William Renninger, Univ. of Rochester, USA

C2. Ultrafast and Nonlinear Phenomena
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Jinhui Yuan, Beijing Univ. of Posts and Telecommunications, China (co-chair)
Roberto Morandotti, INRS, Canada (co-chair)
Frederique Vanholsbeeck, Univ. of Auckland, New Zealand
Zhigang Chen, San Francisco State Univ., USA
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Mercedeh Khajavikhan, CREOL, Univ. of Central Florida, USA
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Sergei K. Turitsyn, Aston Univ., UK
Shixiang Xu, Shenzhen Univ., China
Peijun Yao, Univ. of Science and Technology of China, China

C3. Infrared and Terahertz Technologies and Applications
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Mo Li, Univ. of Minnesota, USA (co-chair)
Stuart Jackson, Macquarie Univ., Australia (co-chair)
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Matteo Clerici, Univ. of Glasgow, UK
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Juejun Hu, MIT, USA
Joey Talgahder, Univ. of Minnesota, USA
Xianshu Luo, Inst. of Microelectronics, Singapore
Yu Luo, Nanyang Technological Univ., Singapore
Bin Zhang, Sun Yat-sen Univ., China

C4. High Power, High Energy Lasers
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Xia Yu, SIMTech, Singapore (co-chair)
Zhan Sui, Shanghai Inst. of Laser Plasma, CAEP, China (co-chair)
Wanguo Zheng, Laser Fusion Research Center China Academy of Engineering Physics, China
Yuxin Leng, State Key Laboratory of High Field Laser Physics in SIOM, China
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Wenn Jing Lai, Tamasek Laboratory, Singapore
Rich Mildren, Macquarie Univ., Australia
Mark Dubinskiy, U.S. Army Research Laboratory, USA
Pu Wang, Beijing Univ. of Technology, China
Shibin Jiang, AdValue Photonics Inc., USA

C5. Laser Processing and Innovative Applications
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Hongyu Zheng, SIMTech A*STAR, Singapore (co-chair)
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Baohua Jia, Swinburne Univ. of Technology, Australia
Kan Wu, Shanghai Jiaotong Univ., China
Jiajing Tu, Univ. of Science and Technology Beijing, China

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Xiaoguang Zhang, Beijing Univ. of Posts and Telecommunications, China (co-chair)
Chao Wang, Univ. of Kent, UK (co-chair)
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Zheng Zheng, Beihang Univ., China
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Richard Leach, Univ. of Nottingham, UK
Hongxia Zhang, Tianjin Univ., China
Jinlong Yu, Tianjin Univ., China
Adonis Bogris, Technological Educational Inst. of Athens, Greece

C7. Quantum Optics, Atomic Physics and Quantum Information

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Alberto Bramati, Laboratoire Kastler Brossel, France

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C13. Optical Signal Processing

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C14. Advanced 2D Materials for Photonics

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C16. Plasmonics and Metamaterials

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C17. Optical Sensors and Systems

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C18. Imaging, Display and Storage Technologies

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C19. Microwave Photonics

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General Information

Conference Venue: Hong Kong Convention and Exhibition Centre (HKCEC), Hong Kong
Address: No. 1 Expo Drive, Wanchai, Hong Kong

The conference will take place in the HKCEC which is a major landmark located in the heart of Hong Kong on Victoria Harbour. Its vast curtain of glass and 40,000 square-meter aluminum roof is sculpted to echo a seabird soaring in flight. The HKCEC has been awarded 'Best Convention and Exhibition Centre in Asia' 13 times by the industry-leading CEI Asia magazine.

Accessibility

The HKCEC is easily accessible from MTR (metro system in Hong Kong) Wanchai Station, or Wanchai Ferry Pier. It is about a 10-minute walk from the MTR station or ferry pier.

From Hong Kong International Airport to HKCEC

By Bus: Take bus at Airport Ground Transport Center by

(1) A12 --> [Immigration Tower] (Stop No. 7) --- walk ~10 mins --> HKCEC (~80 mins, HK$45);

(2) A11 --> [Fleming Road, Hennessy Road] (Stop No. 10) --- walk ~15 mins --> HKCEC (~90 mins, HK$40);

By MTR: By Airport Express line from Airport station to Hong Kong station and switch at Central station to Wanchai station (~40 mins, HK$115)

By Taxi: (~45 mins, ~40 km via Western Harbour Tunnel, ~HK$360 including WHT Toll)

From Lo Wu/Fu Tian Port of Shenzhen to HKCEC

By MTR: East Rail Line from Lo Wu/Lok Ma Chau to Kowloon Tong, change to Kwun Tong Line (Direction: Whampoa), then change to Tsuen Wan Line (Direction: Central) at Mong Kok, then change to Island Line (Direction: Chai Wan) at Admiralty to Wan Chai. (~70 mins, HK$51).

The HKCEC is directly connected to two world class hotels: The Grand Hyatt Hong Kong and the Renaissance Harbour View Hotel.

Registration

Registration Hours and Location:

14:00–17:00	Sunday, 29 July	Room AG206, The Hong Kong Polytechnic Univ.
08:00–18:00	Monday - Friday, 30 July - 3 August	S221 Foyer, HKCEC

Speaker Preparation

All oral presenters should check in at the preview room or corresponding session room at least thirty minutes prior to their scheduled talk to upload and check their presentation. **No shows of the oral presentation will be reported to Conference management and these papers will not be published.**

Poster Session

Time: 14:00–15:30, Wednesday August 1
Venue: S421, HKCEC

Over 150 posters will be displayed during CLEO-PR 2018. The poster session is designed to provide an opportunity for selected papers to be presented in greater visual detail and facilitate vivid discussions with attendees. Authors are expected to remain in the vicinity of the bulletin board for the duration of the poster session to answer questions .

Poster Preparation

Authors should prepare their poster before the poster session starts. The poster must not exceed the boundaries of the display board and **A0** size is recommended. **Authors are required to be standing by their poster** for the duration of poster session to answer questions and further discuss their work with attendees. **No shows will be reported to Conference management and these papers will not be published.**

Poster Board Size – 2.0m (Height) X 0.95m (Width) Set-up Time – 10:00 on Wednesday, 1 August

Tear-down Time – 16:00 on Wednesday, 1 August

Exhibition

The CLEO PR Exhibition is open to all attendees. Location: *S221, HKCEC*

Exhibition Hours:

08:30–18:00	31 July – 2 August

Conference Materials

CLEO PR 2018 Technical Digest will be provided in a USB drive and not available in print form. The CLEO PR 2018 Technical Digest material is composed of the 2-page summaries of invited and accepted contributed papers. The Technical Digest material is included with a technical conference registration and can be found in your registration bag.

The Digest will be available on OSA Publishing's Digital Library (https://www.osapublishing.org/) and IEEE Xplore Digital Library (http://www.ieee.org/web/publications/xplore/) after the conference. IEEE Xplore Digital Library and OSA Publishing's Digital Library are archived and indexed by INSPEC and EI Compendex, where it will be available to the international research community.

Social Activities

Welcome Reception

The CLEO Pacific Rim 2018 welcome reception will be held on 30 July, 2018.

Location: *Divino Patio, Shop 11, 1/F, Causeway Centre, No. 28 Harbour Road, Wanchai*

Time: 18:30–20:00, Monday, 30 July, 2018

Conference Reception and Banquet

The CLEO Pacific Rim 2018 Banquet will be held in the Convention Hall of the Hong Kong Convention and Exhibition Centre on Wednesday August 1. The Best Paper Awards, OSA Best Student Paper Awards and Best Poster Awards will be presented at the banquet.

Location: *Convention Hall, HKCEC*

Time: 18:00–22:00, Wednesday, 1 August, 2018

Visit Program

Visit program will be organized to the Photonics Research Centre, The Hong Kong Polytechnic Univ. on both 29 July and 3 August, 2018

Gathering point: *AG206, The Hong Kong Polytechnic Univ., Hung Hom, Kowloon*

Time: 14:00–17:00, Sunday, 29 July, 2018

Gathering point: *CD634, The Hong Kong Polytechnic Univ., Hung Hom, Kowloon*

Time: 14:00–17:00, Friday, 3 August, 2018

Conference Highlights

Plenary Session

Time: 8:30–12:30, Tuesday, 31 July
Venue: Convention Hall, HKCEC

Topic: High-Q Physics on-a-Chip for Integrated Optical Time Standards and Frequency Synthesizers

08:55–09:40

Professor Kerry J. Vahala
California Inst. of Technology, USA

Biography:
Professor Kerry J. Vahala is the Jenkins Professor and Professor of Applied Physics at Caltech. He has pioneered the study of nonlinear optics in high-Q optical micro resonators. In the course of this work, his research group has invented optical resonators that hold the record for highest optical Q on a semiconductor chip. They have applied these devices to study a wide range of nonlinear phenomena including the first demonstration of parametric oscillation and cascaded four-wave mixing in a micro cavity - the central regeneration mechanisms for frequency micro combs. His research has also led to the demonstration of dynamic backaction, a long-anticipated interaction of mechanics and optics mediated by radiation pressure that is responsible for opto-mechanical cooling and recent realizations of mechanical amplification by stimulated phonon emission. Professor Vahala was involved in the early effort to develop quantum-well lasers for optical communications and received the IEEE Sarnoff Award for his research on quantum-well laser dynamics. He has also received an Alexander von Humboldt Award for his work on ultra-high-Q optical microcavities, a NASA achievement award for application of frequency combs to exoplanet detection and is a fellow of the IEEE, the IEEE Photonics Society and the Optical Society of America.

Abstract:
Communication systems leverage the respective strengths of optics and electronics to convey high-bandwidth signals over great distances. These systems were enabled by a revolution in low-optical-loss dielectric fiber, complex integrated circuits as well as devices that link together the optical and electrical worlds. Today, another revolution is leveraging the advantages of optics and electronics in new ways. At its center is the laser frequency comb which provides a coherent link between these two worlds. Significantly, because the link is also bidirectional, performance attributes previously unique to electronics and optics can be shared. The end result has been transformative for time keeping, frequency metrology, precision spectroscopy, microwave-generation, ranging and other technologies. Even more recently, low-optical-loss dielectrics, now in the form of high-Q optical resonators, are enabling the miniaturization of frequency combs. These new `microcombs' can be integrated with electronics and other optical components to potentially create systems on-a-chip. I will briefly overview the history and elements of frequency combs as well as the physics of the new microcombs. Application of the microcombs for spectroscopy and LIDAR will be discussed. Finally, efforts underway to develop integrated optical clocks and integrated optical frequency synthesizers using the microcomb element are described.

Topic: Light Manipulating and Detecting at Micro/Nano-Scale

09:40–10:25

Professor Qihuang Gong
Peking Univ., China

Biography:
Professor Qihuang Gong is the Academician of Chinese Academy of Science and member of the world academy of sciences. He is the Founding Director of the Inst. of Modern Optics, Peking Univ.. He also serves as the Vice President of Peking Univ.. In addition, Prof. Gong serves as Director of Academic committee of the State Key Laboratory for Artificial Microstructure and Mesoscopic Physics. His current research interests are in ultrafast optics and spectroscopy, nonlinear optics, and mesoscopic optical devices for applications in optical information processing and communication. Prof. Gong has received numerous awards, including The State Natural Science Award (2nd -Class), the Beijing City Science and Technology Award (1st -Class), the Science and Technology Award (1st-Class) of Ministry of Education. He serves as the President of the Chinese Optical Society, Vice President of the Chinese Physical Society. He is the Standing Committee member of China Association for Science and Technology. Prof. Gong is the vice chair for ICO (International Commission for Optics) and vice chair for IUPAP C17.

Abstract:
Micro/nano scaile light manipulating can be realized by using nano/mico photonic structures. Using photonic crystal made of the composite materials with large and fast third-order optical nonlinearity, ultrafast and low threshold all-optical switching was demonstrated. Based on tunable Fano resonance or PIT of metallic nanostructures, ultrafast modulations on light transmission were also demonstrated. Moreover, highly sensitive optical sensor were experimentally demonstrated using microcavity and SPP devices.

Topic: Time Stretch and its Applications in Nonlinear Dynamics, Biomedicine, and Computational Imaging

11:00–11:45

Professor Bahram Jalali
Univ. of California, Los Angeles, USA

Biography:
Bahram Jalali is the Director of the Photonics Laboratory, the Northrop-Grumman Endowed Chair and Professor of Electrical and Computer Engineering at UCLA with joint appointments in Biomedical Engineering, California NanoSystems Inst. (CNSI) and Department of Surgery at the UCLA School of Medicine. He received his Ph.D. in Applied Physics from Columbia Univ. in 1989 and was with the Physics Research Division of Bell Laboratories in Murray Hill, New Jersey until 1992 before joining UCLA. He is a Fellow of IEEE, the Optical Society of America (OSA), the American Physical Society (APS), American Inst. for Medical and Biological Engineering (AIMBE), and SPIE.

He is the recipient of the R.W. Wood Prize from OSA, Aaron Kressel Award from IEEE, and IET Achievement Medal, and the Pioneer in Technology Award from the Society of Brain Mapping & Therapeutics. He was the Founder and CEO of Cognet Microsystems, a company acquired by Intel in 2001. He was elected into the Scientific American Top 50 and MIT Technology Review Magazine Top 10 in 2005.

Abstract:
Measurements of non-repetitive and rare signals that occur on short timescales requires fast real-time measurements that exceed the speed, precision, and record length of digitizers. Time-stretch is an optical hardware accelerator that overcomes the speed limitations of photodetectors and electronic digitizers and enables ultrafast single-shot spectroscopy, imaging and other measurements at refresh rates reaching billions of frames per second with continuous recording spanning trillions of consecutive frames. The technology has opened a new frontier in measurement science and has led to discovery of several new scientific phenomena in nonlinear optics, laser dynamics and diagnostics of relativistic electron beams. It has also created a new class of instruments that have been integrated with artificial intelligence for sensing and biomedical diagnostics. We review the fundamental principles and applications of time stretch including a spin-off technology known as the phase stretch transform, a new computational imaging algorithm that is emerging as the best edge and texture feature extractor for digital images.

Topic: High-Power and High-Beam Quality Photonic-Crystal Lasers

11:45–12:30

Professor Susumu Noda
Kyoto Univ., Japan

Biograph:
Susumu Noda received B.S., M.S., and Ph.D. degrees from Kyoto Univ., Kyoto, Japan, in 1982, 1984, and 1991, respectively, all in electronics. In 2006, he received an honorary degree from Gent Univ., Gent, Belgium. Currently he is a full Professor with the Department of Electronic Science and Engineering and a director of Photonics and Electronics Science and Engineering Center (PESEC), Kyoto Univ.. His research interest covers physics and applications of photonic nanostructures based on photonic crystals. He received various awards, including the IBM Science Award (2000), the Japan Society of Applied Physics Achievement Award on Quantum Electronics (2005), Optical Society of America Joseph Fraunhofer Award/Robert M. Burley Prize (2006), 1st the Japan Society of Applied Physics Fellow (2007), The Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology (2009), the IEEE Nanotechnology Pioneer Award (2009), The Reo-Esaki Award (2009), Medal with Purple Ribbon (2014), and the Japan Society of Applied Physics Outstanding Achievement Award (2015).

Abstract:
Achieving high-power and high-beam-quality (namely, high-brightness) semiconductor lasers is important for various applications including direct-laser processing and light detection and ranging (LiDAR) for next-generation smart production and mobility. Although semiconductor lasers with various kinds of resonators have been developed, the usefulness of these lasers has been limited by their low brightness, which is more than one order of magnitude smaller than those of existing gas and fiber/disk lasers. The key challenge in realizing high brightness is to increase the output power while maintaining a good beam quality indicated by a low M^2 value. Here, we describe photonic crystal lasers have a potential to enable such a high-brightness operation. Very recently, 10W output power with M^2~2 has been successuffly achieved. We believe that these photonic-crystal lasers will allow compact, affordable semiconductor lasers to rival large-scale gas and fiber/disk ones in the future.

OSA Best Student Paper Awards

CLEO-PR 2018 is pleased to announce that this year's Best Student Paper Awards will be sponsored by OSA. There will be 5 recipients.

To be eligible for the award, a student must be the first author of the paper and declare his/her student candidature during online submission; and the student must give the presentation at the conference by himself/herself. The selection will be made by the subcommittees during the conference. The prize will be awarded at the conference banquet at Wednesday August 1.

Best Paper Awards

The selection will be made by the TPC chairs and sub-com- mittee chairs during the conference. The awards will be granted at the conference banquet in the evening of Wednesday August 1.

YSL Photonics Best Poster Awards

CLEO-PR 2018 is pleased to announce that the best poster awards will be sponsored by YSL Photonics. The selection will be based on the voting of conference delegates. The prize will be awarded at the Conference Banquet at Wednesday August 1.

YSL 安扬激光 Photonics

Workshops

Workshop 1: Artificial Intelligence in Photonics

Time: 08:30–12:35, 30 July
Venue: Room S223, HKCEC

Organizers:

Bahram Jalali
The University of California, Los Angeles

Lei Zhang
The Hong Kong Polytechnic University

Invited Speakers:

08:30–08:55 **Aydogan Ozcan**, *University of California, Los Angeles, USA*
Topic: Machine Learning Enabled Computational Imaging and Sensing for Point-of-Care Medicine and Global Health

08:55–09:20 **Andrew Laine**, *Columbia University, USA*
Topic: Quantitative imaging in classification of lung disease

09:20–09:45 **Lei Zhang**, *The Hong Kong Polytechnic University, Hong Kong SAR*
Topic: Super-Resolution of Nano-scale Particles with A Single Frame Wide-Field Microscopy

09:45–10:10 **Robert Huber**, *Universität zu Lübeck / Institut für Biomedizinische Optik, Germany*
Topic: Towards artificial intelligence for bionic imaging in advanced endo-microscopy

10:30–10:55 **David Brady**, *Duke University, USA*
Topic: Compressive Sampling and Artificial Neural Networks for Array Cameras

10:55–11:20 **YongKeun Park**, *Korea Advanced Institute of Science and Technology, South Korea*
Topic: Rapid and label-free detection of anthrax spores using quantitative phase imaging and deep learning

11:20–11:45 **Alan Pak Tao Lau**, *The Hong Kong Polytechnic University, Hong Kong SAR, China*
Topic: Machine Learning Techniques for Optical Communications and Networks

11:45–12:10 **Muneeb Khalid**, *Alazar Technologies Inc., Canada*
Topic: Data acquisition and direct graphic memory access for high throughput GPU-based processing

12:10–12:35 **Sifeng He**, *University of California, Los Angeles, USA*
Topic: Computationally-efficient and Hallucination-free Medical Image Super Resolution

Workshop 2: Optical Microscopy and Super-Resolution Imaging

Time: 08:30–12:15, 30 July
Venue: Room S224, HKCEC

Organizers:

Xu Liu
Zhejiang University

Renjie Zhou
The Chinese University of Hong Kong

Invited Speakers:

08:30–08:55 **Peter So**, *Massachusetts Institute of Technology, USA*
Topic: High Throughput, High Content Neurobiological Imaging

08:55–09:20 **Guoan Zheng**, *University of Connecticut, USA*
Topic: Fourier Ptychographic Imaging and a Machine-learning Approach

09:20–09:45 **Yongkeun Park**, *Korea Advanced Institute of Science and Technology, South Korea*
Topic: Holotomography for Non-invasive Label-free 3D Imaging of Live Cells and Tissues

09:45–10:10 **Gabriel Popescu**, *University of Illinois at Urbana-Champaign, USA*
Topic: Quantitative Histopathology of Stained Tissues using Color Spatial Light Interference (cSLIM)

10:30-10:55 **Zhuyuan Wang**, *Southeast University, China*
Topic: Single Molecule Localization Imaging and SERS Detection of Exosomes for Cancer Diagnosis

10:55–11:20 **Kimani Toussaint**, *University of Illinois at Urbana-Champaign, USA*
Topic: Polarimetric-Based Quantitative Second-Harmonic Generation Microscopy

11:20–11:45 **Cuifang Kuang**, *Zhejiang University, China*
Topic: Super-resolution Volume Imaging based on Multi-angle TIRF Microscopy

11:45–12:15 **Panel discussion**

Workshop 3: Advanced Laser Micro-Nanofabrication for Photonics

Time: 14:00–18:00, 30 July
Venue: Room S222, HKCEC

Organizers:

Hong-Bo Sun
Tsinghua University

Saulius Juodkazis
Swinburne University of Technology

A. Ping Zhang
The Hong Kong Polytechnic University

Invited Speakers:

14:00–14:25 **Andrei Rode**, *Australian National University, Australia*
Topic: Material modification at Megabar pressures with ultrashort microjoule pulses

14:25–14:50 **Kwang-Sup Lee**, *Hannam University, South Korea*
Topic: Diverse applications of 3D nano/micro-structures fabricated by two-photon photolithography

14:50–15:15 **Feng Chen**, *Shandong University, China*
Topic: Femtosecond laser writing of nonlinear optical waveguides

15:15–15:40 **Yoshiaki Nishijima**, *Yokohama National University, Japan*
Topic: Sub-micron plasmonic metasurfaces for mid infrared sensing application

16:00–16:25 **David Moss**, *Swinburne University of Technology, Australia*
Topic: Microcombs for photonic microwave and RF devices

16:25–16:50 **Vygantas Mizeikis**, *Shizuoka University, Japan*
Topic: Fabrication of optical field concentrator structures using direct laser write technique

16:50–17:15 **Qi-Dai Chen**, *Jilin University, China*
Topic: Micro-optics elements fabricated by femtosecond laser direct writing

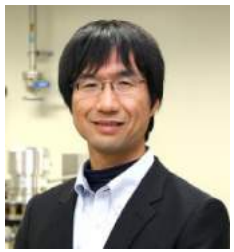
17:15–17:40 **F. Ömer Ilday**, *Bilkent University, Turkey*
Topic: Ultrafast laser-controlled, nonlinear feedback-driven self-organization of nanostructures

17:40–18:00 **Panel discussion**

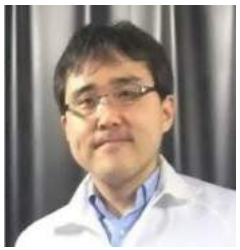
Workshop 4: Advanced THz Devices and Systems

Time: 08:30–12:30, 30 July
Venue: Room S225, HKCEC

Organizers:



Yukio Kawano
Tokyo Institute of Technology



Shinichi Watanabe
Keio University

Invited Speakers:

08:30–09:00 **Christoph Lange**, *University of Regensburg, Germany*
Topic: Nonlinear subcycle THz quantum dynamics of electronic charges and spins

09:00–09:30 **Hyunsoo Yang**, *National University of Singapore, Singapore*
Topic: Advancing terahertz technology using spintronics

09:30–10:00 **Manfred Helm**, *Helmholtz-Zentrum Dresden-Rossendorf, Germany*
Topic: THz relaxation dynamics and nonlinear optics in graphene

10:30–11:00 **Jérôme Faist,** *ETH Zurich, Switzerland*
Topic: Terahertz Quantum Cascade Lasers: single mode operation and frequency combs

11:00–11:30 **Takayuki Watanabe**, *Tohoku University, Japan*
Topic: Broadband terahertz light emission and lasing operation in current-injection distributed-feedback dual-gate graphene-channel field-effect transistor

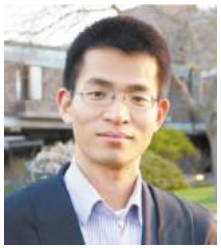
11:30–12:00 **Ya Zhang**, *The University of Tokyo, Japan*
Topic: Novel thermomechanical terahertz detection by using fundamental and coupled modes in doubly clamped MEMS beam resonators

12:00–12:30 **Panel discussion**

Workshop 5: Photonic Quantum Computing

Time: 08:30–12:30, 30 July
Venue: Room S226, HKCEC

Organizers:



Chao-Yang Lu
University of Science and Technology of China

Sven Hoefling
University of Wurzburg

Invited Speakers:

08:30–08:55 **Satoshi Iwamoto,** *The University of Tokyo, Japan*
Topic: Advances in quantum dot cavity quantum electrodynamics using photonic crystal nanocavities

08:55–09:20 **Niels Gregersen,** *Technical University of Denmark, Denmark*
Topic: Designing single-photon sources: towards unity

09:20–09:45 **Fabio Sciarrino,** *Sapienza Università di Roma, Italy*
Topic: Machine learning for processing and certification of photonic quantum information

09:45–10:10 **Anthony Laing,** *University of Bristol, UK*
Topic: Photonic simulations of molecular quantum dynamics

10:30–10:55 **Leonardo Midolo**, *University of Copenhagen, Denmark*
Topic: Quantum photonic circuits with semiconductor quantum dots

10:55–11:20 **Wenfu Zhang**, *Xi'an Institute of Optics and Precision Mechanics, CAS, China*
Topic: Silicon-based high-index-contrast waveguides for nonlinear optics and quantum photonics

11:20–11:45 **Daniel Riedel**, *University of Basel, Switzerland*
Topic: Deterministic enhancement of coherent photon generation from a nitrogen-vacancy centre in ultrapure diamond

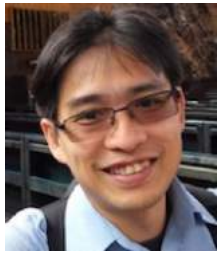
11:45–12:10 **John O'Hara**, *University of Sheffield, UK*
Topic: High Purcell factor generation of indistinguishable on-chip single photons

12:10–12:30 **Yuanzhao Yao**, *National Institute for Materials Science, Japan*
Topic: Excitonic aharonov-bohm effect in ring-shaped semiconductor nanostructures

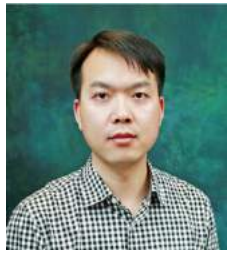
Workshop 6: Topology and Novel Symmetry in Optics

Time: 08:30–12:15, 30 July
Venue: Room S227, HKCEC

Organizers:



Jensen T. H. Li
The Hong Kong University of Science and Technology



Dangyuan Lei
The Hong Kong Polytechnic University

Invited Speakers:

08:30–08:55 **Nicholas X. Fang**, *Massachusetts Institute of Technology, USA*
Topic: Collective Behaviors of 2D Plasmon-Polaritons: From Topological States to Emission Engineering

08:55–09:20 **Yidong Chong**, *Nanyang Technological University, Singapore*
Topic: Magneto-optical Dirac cones

09:20–09:45 **Namkyoo Park**, *Seoul National University, Korea*
Topic: Symmetries in Optical Hamiltonians for Isospectrality

09:45–10:10 **Jianwen Dong**, *Sun Yat-Sen University, China*
Topic: All-dielectric valley photonic crystals: Paving the way to topological nanophotonics

10:30–10:55 **Baile Zhang**, *Nanyang Technological University, Singapore*
Topic: Spin-valley locking and topological phase transition in photonic crystals

10:55–11:20 **Qinghai Song**, *Harbin Institute of Technology, China*
Topic: Microlasers around exceptional points and their applications

11:20–11:45 **Haitao Jiang**, *Tongji University, China*
Topic: Experimental demonstration of the robust edge states in a split-ring-resonator chain

11:45–12:15 **Panel discussion**

Workshop 7: Optical Resonators: Fundamentals and Applications

Time: 14:00–17:45, 30 July
Venue: Room S223, HKCEC

Organizers:

Lan Yang
Washington University in St. Louis

Sile Nic Chormaic
Okinawa Institute of Science and Technology Graduate

Invited Speakers:

14:00–14:25 **Kyungwon An**, *Seoul National University, South Korea*
Topic: Coherent thresholdless lasing by single-atom superradiance

14:25–14:50 **Tal Carmon**, *Technion – Israel Institute of Technology, Israel*
Topic: Flying nano-couplers make an irreversible index of refraction

14:50–15:15 **Chunhua Dong**, *University of Science and Technology of China, China*
Topic: Optomechanically induced non-reciprocity

15:15–15:40 **Pascal Del'Haye**, *National Physical Laboratory in Teddington, UK*
Topic: Spontaneous symmetry breaking and optically induced nonreciprocity of counter propagating light in microresonators

16:00–16:25 **Takasumi Tanabe**, *Keio University, Japan*
Topic: Brillouin lasing in a coupled toroid microcavities system

16:25–16:50 **Yun-Feng Xiao**, *Peking University, China*
Topic: Ultra-high-Q asymmetric microcavity optics and photonics

16:50–17:15 **Andrew Poon**, *The Hong Kong University of Science and Technology, Hong Kong SAR*
Topic: Integrated microdisk lasers and nonlinear light sources on a silicon chip

17:15–17:45 **Panel discussion**

Workshop 8: Microstructured Optical Fibers and Applications

Time: 14:00–18:00, 30 July
Venue: Room S224, HKCEC

Organizers:

Wei Jin
The Hong Kong Polytechnic University

Yingying Wang
Beijing University of Technology

Invited Speakers:

14:00–14:25 **Jonathan Knight**, *University of Bath, UK*
Topic: Hollow optical fibres: What do we add by taking away the core?

14:25–14:50 **Xin Jiang**, *Max Planck Institute for the Science of Light, Germany*
Topic: Soft-glass micro-/nano-structured fibres

14:50–15:15 **Wei Ding**, *Institute of Physics, CAS, China*
Topic: Confinement loss in hollow-core negative curvature fiber

15:15–15:40 **Tristan Kremp**, *OFS laboratory, USA*
Topic: Improved Design and Fabrication of Low Loss Single Mode Photonic Bandgap Hollow Core Fibers

16:00–16:25 **Markus Schmidt**, *Leibniz Institute of Photonic Technology, Germany*
Topic: Optofluidic microstructured fibers: a tool to detect freely diffusing nanoobjects

16:25–16:50 **John Travers**, *Heriot-watt university, UK*
Topic: Nonlinear optics in gas-filled microstructured fibres

16:50–17:15 **Tijmen G. Euser**, *University of Cambridge, UK*
Topic: Optofluidic hollow-core photonic crystal fiber

17:15–17:40 **Wei Jin**, *The Hong Kong Polytechnic University, Hong Kong SAR*
Topic: Photonic crystal fiber gas sensors

17:40–18:00 **Panel discussion**

Workshop 9: Tailored Complex Optical Fields: from Twisted Light to Structured Light

Time: 08:30–18:00, 30 July
Venue: Room S228, HKCEC

Organizers:

Jian Wang
Huazhong University of Science and Technology

Andrew Forbes
University of the Witwatersrand

Siddharth Ramachandran
Boston University

Invited Speakers:

08:30–09:00 **Federico Capasso**, *Harvard University, USA*
Topic: J-plates for spin to total angular momentum conversion and complex structured light generation

09:00–09:30 **Siddharth Ramachandran**, *Boston University, USA*
Topic: Opto-mechanical interactions with OAM states

09:30–10:00 **Andrew Forbes**, *University of the Witwatersrand, South Africa*
Topic: Ghost imaging with structured photons

10:30–11:00 **Cornelia Denz**, *University of Muenster, Germany*
Topic: Tailored vectorial light landscapes pioneer applications in nanophotonics and quantum optics

11:00–11:30 **Yangjian Cai**, *Soochow University, China*
Topic: Manipulating the spatial coherence of vortex beam and orbital angular moment measurement

11:30–12:00 **Takashige Omatsu**, *Chiba University, Japan*
Topic: Wavelength-versatile vortex parametric sources

12:00–12:30 **Mo Mojahedi**, *University of Toronto, Canada*
Topic: Longitudinally structured light and its applications

14:00–14:30 **Qiwen Zhan**, *University of Shanghai for Science and Technology, China; University of Dayton, USA*
Topic: Complex optical fields: recent advances and future perspectives

14:30–15:00 **Filippo Romanato**, *University of Padova, Italy*
Topic: iMux: integrated device for orbital angular momentum mode division multiplexing

15:00–15:30 **Bora Ung**, *Université du Québec, Canada*
Topic: Annular beams: their generation and transmission in optical fibers

16:00–16:30 **Xiaocong Yuan**, *Shenzhen University, China*
Topic: Singular optical beam multiplexing communication for next generation high performance computing

16:30–17:00 **Alan Willner**, *University of Southern California, USA*
Topic: Some practical issues with free-space OAM-based optical communications

17:00–17:30 **Jian Wang**, *Huazhong University of Science and Technology, China*
Topic: Structured light communications: advances and perspectives

17:30–18:00 **Panel discussion**

Workshop 10: Visible Light Communications

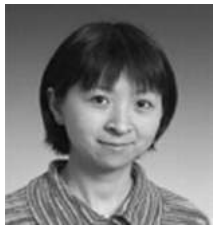
Time: 14:00–17:20, 30 July
Venue: Room S225, HKCEC

Organizers:

Nan Chi
Fudan University

Shinichiro Haruyama
Keio University

Boon Ooi
King Abdullah University of Science and Technology



Haiyan Ou
Technical University of Denmark

Steve Hranilovic
McMaster University

Tutorial Speaker:

14:00–14:45 **Boon S. Ooi**, *King Abdullah University of Science and Technology, Saudi Arabia*
Topic: Visible Light Communication: Devices and Systems

Invited Speakers:

14:45–15:15 **Takaya YAMAZATO**, *Nagoya University, Japan*
Topic: Overview of image-sensor communication

15:15–15:45 **Gong-Ru Lin**, *National Taiwan University, Taiwan, R.O.C.*
Topic: Visible Light Communication for White-Light and Underwater Applications

16:00–16:20 **Anthony E. Kelly**, *University of Glasgow, UK*
Topic: InGaN/GaN Laser Diodes for Visible Light Communications and Beyond

16:20–16:40 **Jaafar M. H. Elmirghani**, *University of Leeds, UK*
Topic: VLC Systems with CGHs

16:40–17:00 **Jin Xu**, *Zhejiang University, China*
Topic: Practical Considerations on Underwater Wireless Optical Communication

17:00–17:20 **Panel discussion**

Workshop 11: Advanced Laser Display

Time: 14:00–18:00, 30 July
Venue: Room S226, HKCEC

Organizers:

Lixin Xu
University of Science and Technology of China

Yong Bi
Technical Institute of Physics and Chemistry, CAS

Degang Zhao
Institute of Semiconductors, CAS

Invited Speakers:

14:00–14:30 **Yong Bi**, *Technical Institute of Physics and Chemistry, CAS, China*
Topic: High Efficiency and Compact Lasers Modules for Laser

14:30–15:00 **Degang Zhao**, *Institute of Semiconductors, CAS, China*
Topic: Performance improvement of GaN-based laser diodes by considering the residual carbon impurities and modulating the device structure

15:00–15:30 **Fushan Li**, *Fuzhou University, China*
Topic: Quantum dot light-emitting display technology

16:00–16:30 **Lixin Xu**, *University of Science and Technology of China, China*
Topic: Laser display: theory and technology

16:30–17:00 **Wenjiang Shen**, *Suzhou Institute of Nano-tech and Nano-bionics, CAS, China*
Topic: MEMS 2D scanning micromirror for Laser Display

17:00–17:30 **Zhaomin Tong**, *Shanxi University, China*
Topic: Methods for Laser Speckle Reduction in Projection Displays

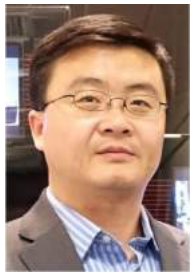
17:30–18:00 **Panel discussion**

Workshop 12: Solar Energy Materials and Devices

Time: 14:00–18:00, 30 July
Venue: Room S227, HKCEC

Organizers:

Feng Yan
The Hong Kong Polytechnic University



Gang Li
The Hong Kong Polytechnic University

Invited Speakers:

14:00–14:30 **Peng Wang**, *Zhejiang University, China*
Topic: Organic dye-sensitized solar cells

14:30–15:00 **Baoquan Sun**, *Soochow University, China*
Topic: Nanostructured silicon used for integrating energy harvesting device

15:00–15:30 **Tae-Dong Kim**, *Hannam University, Republic of Korea*
Topic: Enhanced photovoltaic performance of polymeric solar cells through side-chain engineering

16:00–16:30 **Jun Liu**, *Changchun Institute of Applied Chemistry, CAS, China*
Topic: n-Type polymer semiconductors containing boron-nitrogen coordination bond and their application in all polymer solar cells

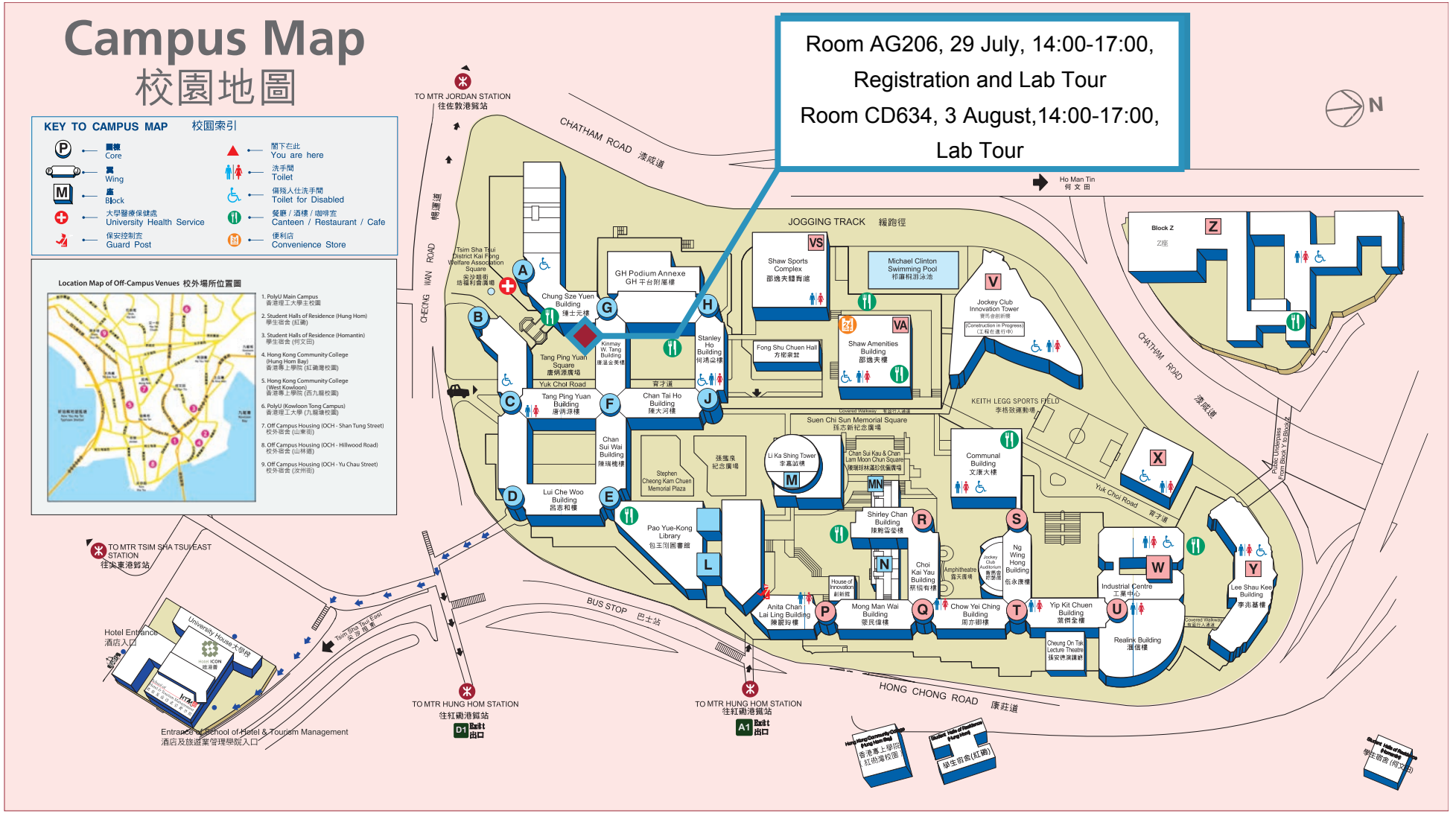
16:30–17:00 **Guojia Fang**, *Wuhan University, China*
Topic: Enhanced performance of perovskite solar cells with electron transport layer of SnO2 quantum dots

17:00–17:30 **Xuming Zhang**, *The Hong Kong Polytechnic University, Hong Kong SAR*
Topic: Microfluidics for photoenzymatic CO2 conversion using solar energy

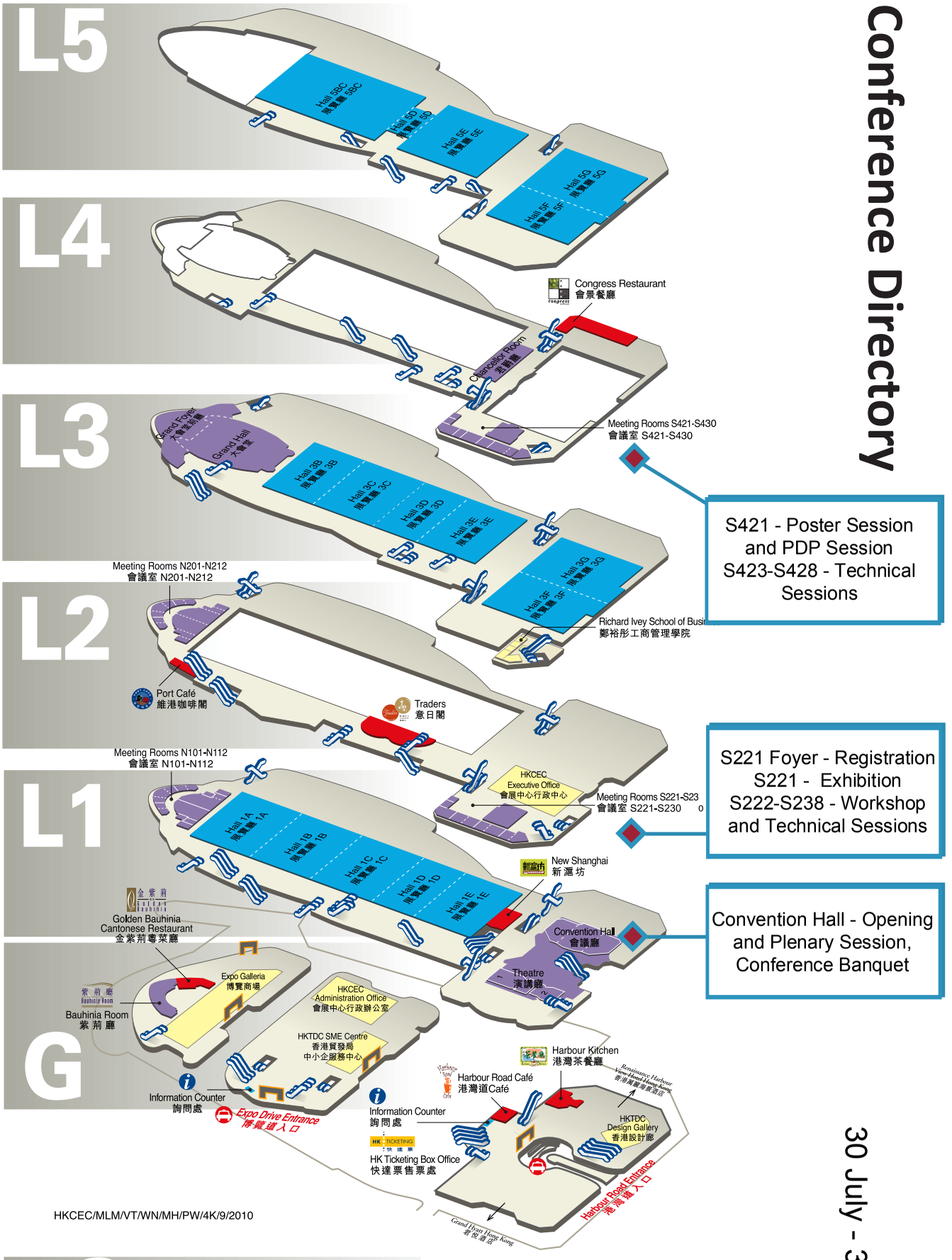
17:30–18:00 **Panel discussion**

Conference Directory

29 July and 3 August



Conference Directory



S421 - Poster Session and PDP Session
S423-S428 - Technical Sessions

S221 Foyer - Registration
S221 - Exhibition
S222-S238 - Workshop and Technical Sessions

Convention Hall - Opening and Plenary Session, Conference Banquet

HKCEC/MLM/VT/WN/MH/PW/4K/9/2010

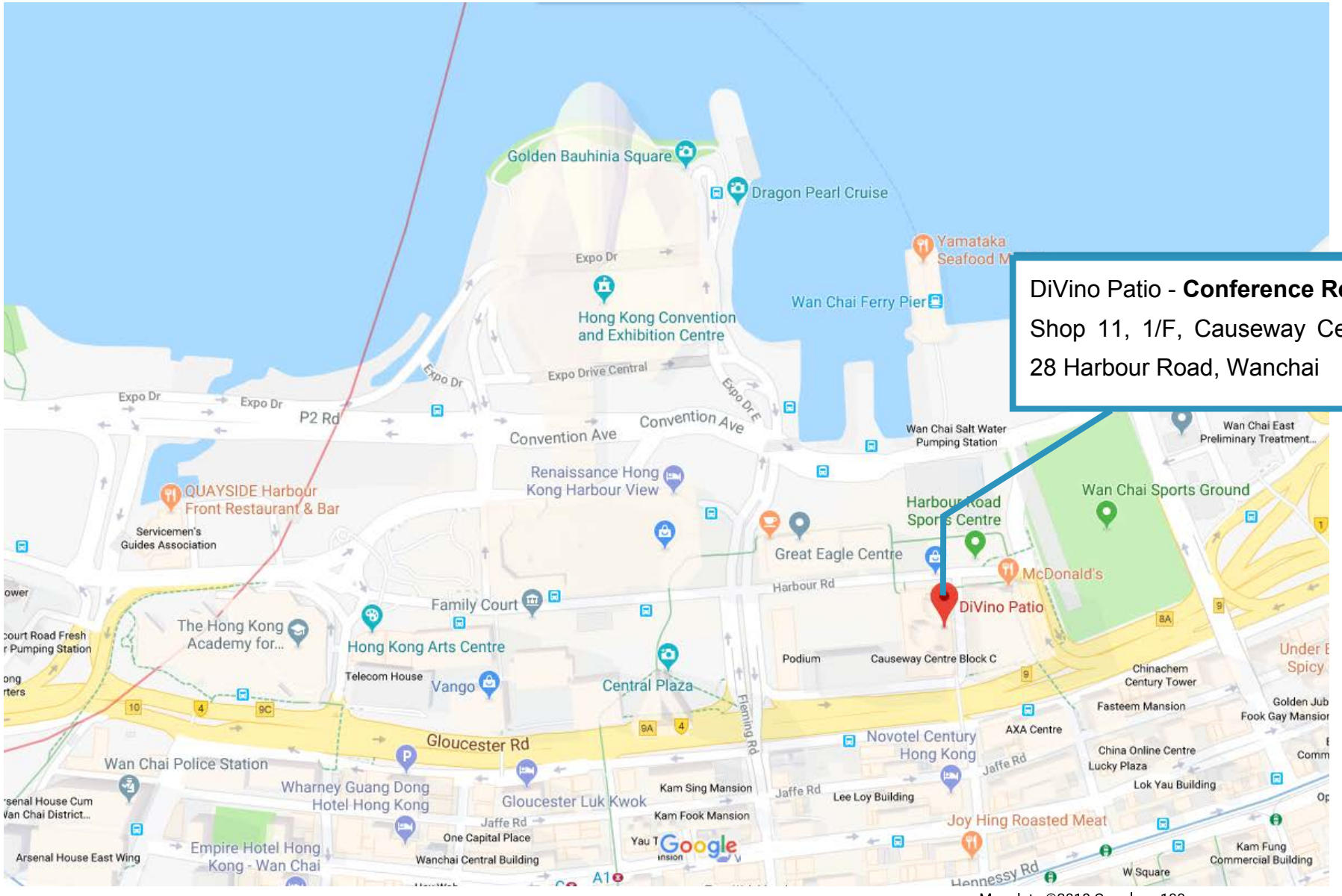
LG Expo Drive Hall, Car Parks & Loading Facilities
博覽道展廳、停車場及卸貨設施

HKCEC Elevation Plan 香港會議展覽中心立視圖

30 July - 3 August

Conference Directory

30 July



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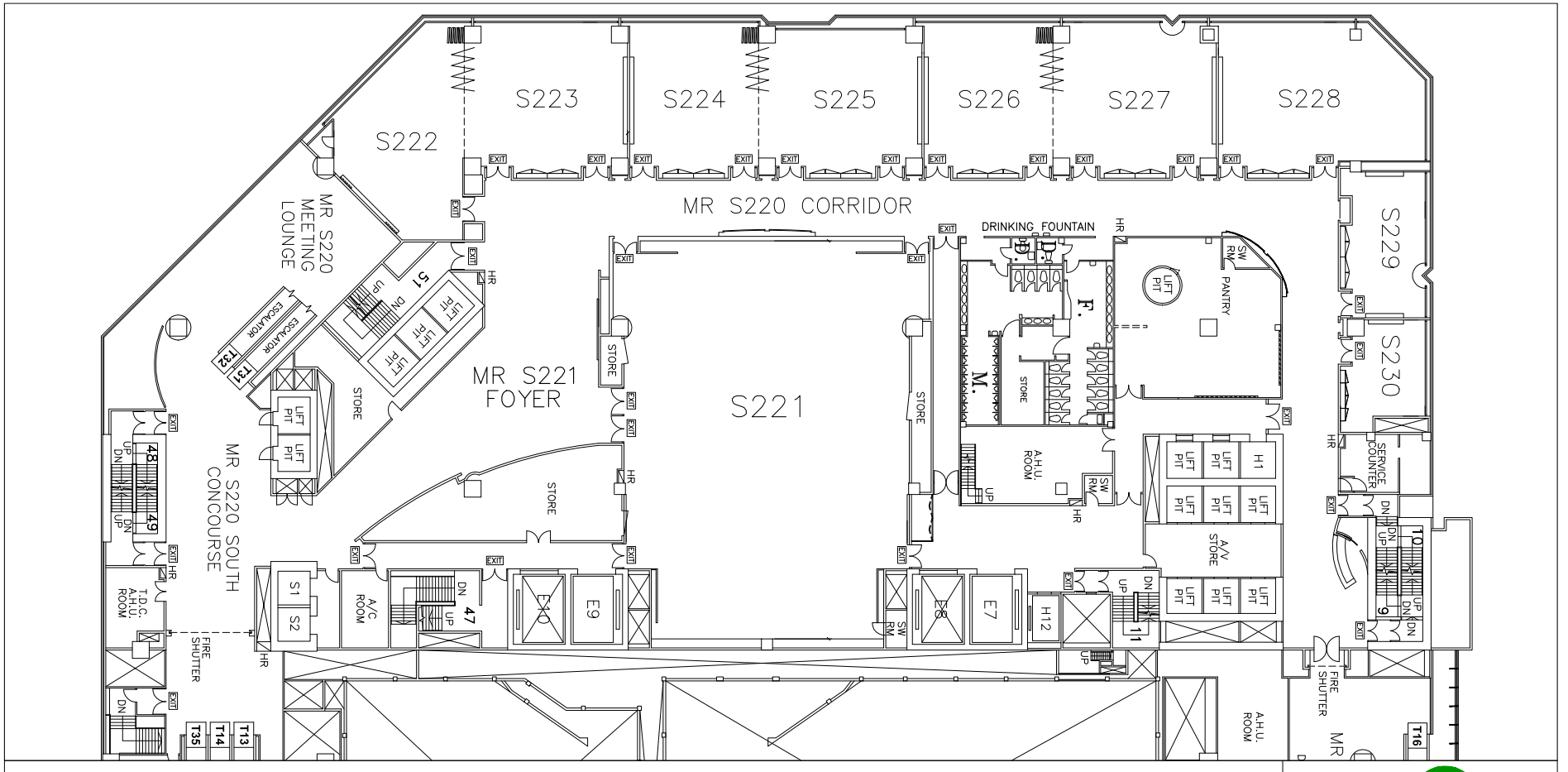
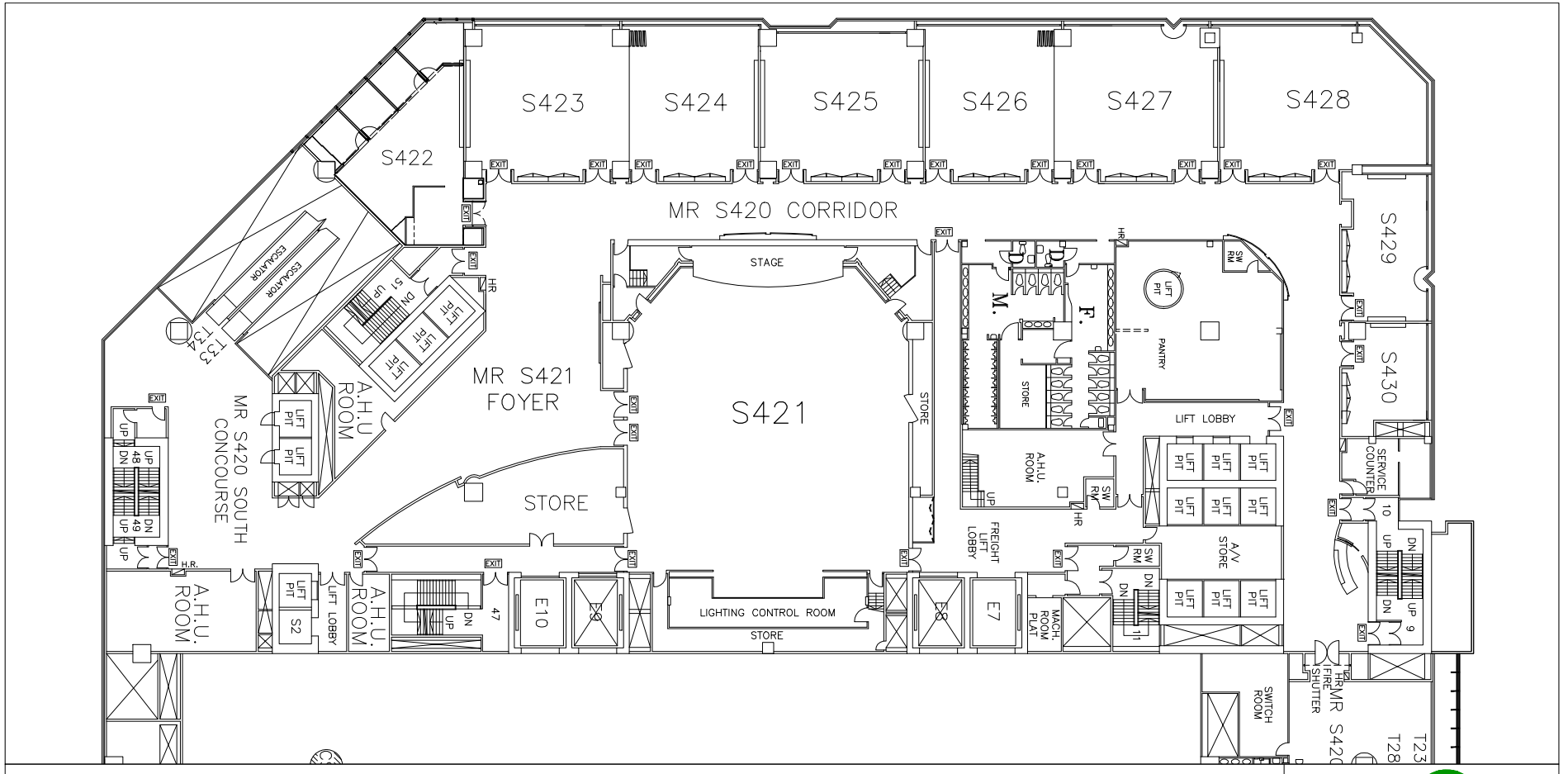
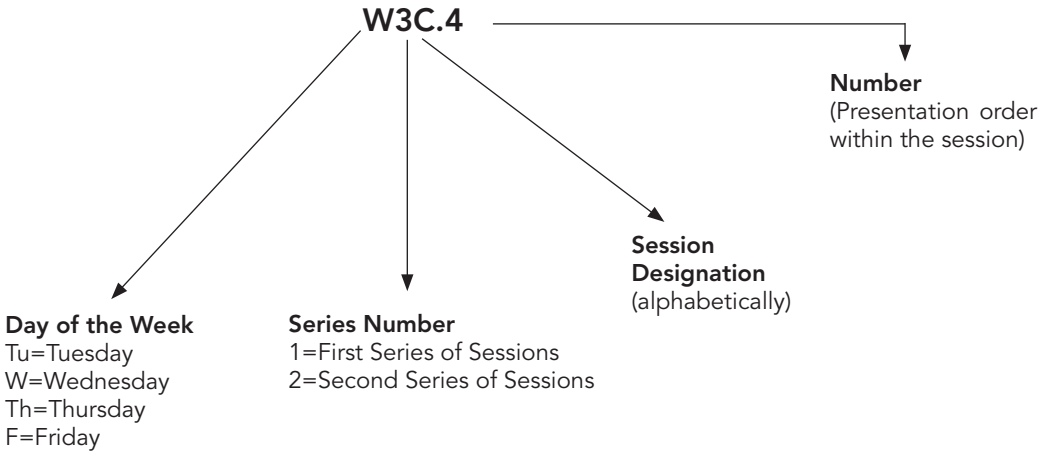


Conference Directory



Meeting Rooms S421-S430

Explanation of Session Codes



The first letter of the code designates the day of the week (Tu= Tuesday, W = Wednesday, Th =Thursday, F= Friday). The second element indicates the session series in that day (for instance, 1 would denote the first parallel sessions in that day). The third element 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 W3C.4 indicates that this paper is being presented on Wednesday (W) in the third series of sessions (3), and is the third parallel session (C) in that series and the fourth paper (4) presented in that session.

Invited papers are noted with Invited

Plenary papers are noted with Plenary

Tutorial papers are noted with Tutorial

Agenda of Sessions — Sunday, 29 July

14:00–18:00	**Registration,** *AG206 of The Hong Kong Polytechnic University*

Monday, 30 July

	Room S222	Room S223	Room S224	Room S225	Room S226	Room S227	Room S228
08:00–18:00	**Registration,** *S221 Foyer of HKCEC*						
08:30–10:00		**Workshop 1: Artificial Intelligence in Photonics Session I**	**Workshop 2: Optical Microscopy and Super-Resolution Imaging Session I**	**Workshop 4: Advanced THz Devices and Systems Session I**	**Workshop 5: Photonic Quantum Computing Session I**	**Workshop 6: Topology and Novel Symmetry in Optics Session I**	**Workshop 9: Tailored Complex Optical Fields: From Twisted Light to Structured Light Session I**
10:00–10:30	**Coffee Break**						
10:30–12:30		**Workshop 1: Artificial Intelligence in Photonics Session II**	**Workshop 2: Optical Microscopy and Super-Resolution Imaging Session II**	**Workshop 4: Advanced THz Devices and Systems Session II**	**Workshop 5: Photonic Quantum Computing Session II**	**Workshop 6: Topology and Novel Symmetry in Optics Session II**	**Workshop 9: Tailored Complex Optical Fields: From Twisted Light to Structured Light Session II**
12:30–14:00	**Lunch**						
14:00–15:30	**Workshop 3: Advanced Laser Micro-Nanofabrication for Photonics Session I**	**Workshop 7: Optical Resonators: Fundamentals and Applications Session I**	**Workshop 8: Microstructured Optical Fibers and Applications Session I**	**Workshop 10: Visible Light Communications Session I**	**Workshop 11: Advanced Laser Display Session I**	**Workshop 12: Solar Energy Materials and Devices Session I**	**Workshop 9: Tailored Complex Optical Fields: From Twisted Light to Structured Light Session III**
15:30–16:00	**Coffee Break**						
16:00–18:00	**Workshop 3: Advanced Laser Micro-Nanofabrication for Photonics Session II**	**Workshop 7: Optical Resonators: Fundamentals and Applications Session II**	**Workshop 8: Microstructured Optical Fibers and Applications Session II**	**Workshop 10: Visible Light Communications Session II**	**Workshop 11: Advanced Laser Display Session II**	**Workshop 12: Solar Energy Materials and Devices Session II**	**Workshop 9: Tailored Complex Optical Fields: From Twisted Lights to Structured Light Session IV**
18:30–20:00	**Welcome Reception,** *Divino Patio, Shop 11, 1/F, Causeway Centre, No. 28 Harbour Road, Wanchai*						

Agenda of Sessions — Tuesday, 31 July

	Room S223	Room S224	Room S225	Room S226	Room S227	Room S228	Room S423	Room S424	Room S425	Room S426	Room S427	Room S428
08:00–18:00	**Registration,** *S221 Foyer of HKCEC*											
08:30–12:30	**Tu1A • Plenary Session,** *Convention Hall, HKCEC*											
12:30–14:00	**Lunch**											
14:00–15:30	**Tu2A • Light Sources and Optical Fields**	**Tu2B • Mode-locked and Ultrafast Lasers**	**Tu2C • Infrared and Terahertz Metamaterials and Detectors**	**Tu2D • Time-frequency Signal Analysis and Processing**	**Tu2E • Special Fibers I**	**Tu2F • Novel Measurement Methods I**	**Tu2G • Quantum Optomechanics**	**Tu2H • Optical Filtering**	**Tu2I • High-Speed Optical Transmission**	**Tu2J • Advances in Plasmonics and Metamaterials**	**Tu2K • Biophotonics and Applications I**	**Tu2L • Fiber Devices & Sensing I**
15:30–16:00	**Coffee Break**											
16:00–18:00	**Tu3A • Ultrafast Fiber Laser Sources**	**Tu3B • Nonlinear Optical Sources**	**Tu3C • Infrared and Terahertz Microscopy and Nanoscopy and Their Applications**	**Tu3D • Nonlinear Wave Mixing and Applications**	**Tu3E • Waveguide Devices I**	**Tu3F • Novel Measurement Methods II**	**Tu3G • Atom-photon Interaction**	**Tu3H • Optical Microcavities**	**Tu3I • Fiber Technologies and Applications**	**Tu3J • Nonlinear Plasmonics and Metamaterials**	**Tu3K • Biophotonics and Applications II**	**Tu3L • Laser Applications and Technologies**

Agenda of Sessions — Wednesday, 1 August

	Room S223	Room S224	Room S225	Room S226	Room S227	Room S228	Room S423	Room S424	Room S425	Room S426	Room S427	Room S428
08:00–18:00	**Registration,** *S221 Foyer of HKCEC*											
08:30–10:00	**W1A • Power Scaling of Lasers**	**W1B • Nonlinear Optics in Microresonators**	**W1C • Infrared Fibers & Materials and Their Applications** (ends at 09:45)	**W1D • Machine Learning and Neural Networks in Photonics**	**W1E • Laser Additive Manufacturing**	**W1F • Silicon Hybrid Integration**	**W1G • High Power Fiber Laser**	**W1H • Optical Metasurfaces I**	**W1I • Advanced Signal Modulation**	**W1J • Integrated Sources I**	**W1K • Biophotonics and Applications III**	**W1L • Integrated Microwave Photonics I**
10:00–10:30	**Coffee Break**											
10:30–12:30	**W2A • Advanced Laser Sources I**	**W2B • Nonlinear Dynamics in Waveguides and Harmonic Generation**	**W2C • Infrared Ultrafast Subcycle Subwavelength Photonics**	**W2D • Optical Signal Processing Based on Integrated Devices**	**W2E • Ultra-fast Laser Machining and Processing**	**W2F • Optical Devices for Precision Measurements**	**W2G • Quantum Information Processing I**	**W2H • Optical Metasurfaces II**	**W2I • Fiber-Wireless Systems and PONs**	**W2J • Integrated Sources II**	**W2K • Biophotonics and Applications IV**	**W2L • Interferometers & Applications**
12:30–14:00	**Lunch**											
14:00–15:30	**W3A • Poster Session,** *S421, HKCEC*											
15:30–16:00	**Coffee Break** 16:00–18:00											
W4A •	**Advanced Light Sources II**	**W4B • Nonlinear Nanophotonics and Waveguides**	**W4C • Infrared and Terahertz Materials and Light Sources for High Performance Applications**	**W4D • Integrated Nanophotonic Devices**	**W4E • Fiber Devices I**	**W4F • Dual-comb Spectroscopy and its Applications**	**W4G • Holographic Technologies**	**W4H • Integrated Photonics**	**W4I • Optical Signal Characterization**	**W4J • Integrated Devices for Communications**	**W4K • Biophotonics and Applications V**	**W4L • Fiber Devices & Sensing II**
18:00–22:00	**Conference Reception and Banquet,** *Convention Hall, HKCEC*											

Agenda of Sessions — Thursday, 2 August

	Room S223	Room S224	Room S225	Room S226	Room S227	Room S228	Room S423	Room S424	Room S425	Room S426	Room S427	Room S428
08:00–18:00	**Registration,** *S221 Foyer of HKCEC*											
08:30–10:00	Th1A • Novel Laser Sources I	Th1B • Nonlinear Spectroscopy and Imaging	Th1C • Frequency Control and Measurement for Optical Metrology	Th1D • Quantum Information Processing II	Th1E • Fiber Devices II	Th1F • Metamaterials and Meta-devices	Th1G • 2D Nonlinear Materials	Th1H • Nanostructures for Optoelectronic Applications	Th1I • Probabilistic Signal Shaping	Th1J • Silicon Photonics Devices	Th1K • Display Technologies	Th1L • Waveguides and Sensors
10:00–10:30	Coffee Break											
10:30–12:30	Th2A • Novel Laser Sources II	Th2B • Solitons and Temporal Wave Guiding, and Frequency Comb	Th2C • Integrated Optical Devices for Switching Multiplexing and Signal Processing	Th2D • High Energy Laser	Th2E • Special Fibers II	Th2F • Plasmonics Metasurfaces (ends at 13:15)	Th2G • 2D Materials for Mode Locking and Nonlinear Photonics	Th2H • Light-matter Interactions in Micro/nano-structures	Th2I • Polarization Effects and Optical Networking	Th2J • Advanced Modulators	Th2K • Imaging Technologies	Th2L • Distributed Fiber Sensing
12:30–14:00	Lunch											
14:00–15:30	Th3A • Vectorial Light Sources	Th3B • High-field Technologies	Th3C • Germinum Modulators and Ge Photonics	Th3D • Power Scaling and Plasmonics	Th3E • Waveguide Devices II	Th3F • Integrated Microwave Photonics II	Th3G • Structured 2D Surfaces	Th3H • Entanglement and Squeezed States I	Th3I • Signal Processing for Optical Transmsison	Th3J • 2D and Metamaterial	Th3K • Microscopy	Th3L • Novel Fiber Structures
15:30–16:00	Coffee Break											
16:00–18:00	Th4A • Characteristics of shortpulse lasers	Th4B • Nonlinear Optical Technologies	Th4C • Novel Laser System and its Applications	Th4D • High Power CW Lasers and Coherent Combining	Th4E • Plasmon-enhanced Spectroscopies and Imaging	Th4F • Radio Over Fiber and Optical Wireless Communication	Th4G • 2D Photonics Devices	Th4H • Novel Photonic Structures	Th4I • Optical Access Technologies	Th4J • Entanglement and Squeezed States II	Th4K • Imaging and Applications	Th4L • Optical Fiber Gratings, Sensors & Technology
18:30–20:30	**Post Deadline Papers,** *S421, HKCEC*											

Agenda of Sessions — Friday, 3 August

	Room S223	Room S224	Room S225	Room S226	Room S227	Room S228
08:00–18:00	**Registration,** *S221 Foyer of HKCEC*					
08:30–10:00	**F1A • Mid infrared lightsource**	**F1B • Fiber Devices III**	**F1C • Emerging Technologies in Microwave Photonics**	**F1D • Entanglement and Squeezed States III**	**F1E • Optical Fiber Sensing & Microfluidics**	**F1F • Related Technologies and Applications for Imaging, Display and Storage**
10:00–10:30	**Coffee Break**					
10:30–12:30	**F2A • Laser Comb Technologies**	**F2B • Novel Plasmonics Nanostructures and Phenomena**	**F2C • Photonic Microwave Generation, Processing and Measurement**	**F2D • Optical Technologies for Communications**	**F2E • Laser Dynamics**	**F2F • Technologies and Approaches for Optical Transmission and Processing**
12:30–14:00	**Lunch**					
14:00	**Afternoon Tours**					

08:00–18:00 Registration, *S221 Foyer of HKCEC*

Convention Hall

08:30–12:30
Tu1A • Plenary Session and Welcome Remarks

Welcoming remarks by General Chair Professor Ping-kong Alexander Wai and OSA President Professor Ian Walmsley

Tu1A.1 • 08:55
High-Q Physics on-a-Chip for Integrated Optical Time Standards and Frequency Synthesizers, Kerry J. Vahala[1]; [1]*California Institute of Technology, USA.* Communication systems leverage the respective strengths of optics and electronics to convey high-bandwidth signals over great distances. These systems were enabled by a revolution in low-optical-loss dielectric fiber, complex integrated circuits as well as devices that link together the optical and electrical worlds. Today, another revolution is leveraging the advantages of optics and electronics in new ways. At its center is the laser frequency comb which provides a coherent link between these two worlds. Significantly, because the link is also bidirectional, performance attributes previously unique to electronics and optics can be shared. The end result has been transformative for time keeping, frequency metrology, precision spectroscopy, microwave-generation, ranging and other technologies. Even more recently, low-optical-loss dielectrics, now in the form of high-Q optical resonators, are enabling the miniaturization of frequency combs. These new `microcombs' can be integrated with electronics and other optical components to potentially create systems on-a-chip. I will briefly overview the history and elements of frequency combs as well as the physics of the new microcombs. Application of the microcombs for spectroscopy and LIDAR will be discussed. Finally, efforts underway to develop integrated optical clocks and integrated optical frequency synthesizers using the microcomb element are described.

Tu1A.2 • 09:40
Light Manipulating and Detecting at Micro/Nano-Scale, Qihuang Gong[1]; [1]*Peking University, China.* Micro/nano scaile light manipulating can be realized by using nano/mico photonic structures. Using photonic crystal made of the composite materials with large and fast third-order optical nonlinearity, ultrafast and low threshold all-optical switching was demonstrated.

Tu1A.3 • 11:00
Time Stretch and its Applications in Nonlinear Dynamics, Biomedicine, and Computational Imaging, Bahram Jalali[1]; [1]*University of California, Los Angeles, USA.* Measurements of non-repetitive and rare signals that occur on short timescales requires fast real-time measurements that exceed the speed, precision, and record length of digitizers. Time-stretch is an optical hardware accelerator that overcomes the speed limitations of photodetectors and electronic digitizers and enables ultrafast single-shot spectroscopy, imaging and other measurements at refresh rates reaching billions of frames per second with continuous recording spanning trillions of consecutive frames. The technology has opened a new frontier in measurement science and has led to discovery of several new scientific phenomena in nonlinear optics, laser dynamics and diagnostics of relativistic electron beams. It has also created a new class of instruments that have been integrated with artificial intelligence for sensing and biomedical diagnostics. We review the fundamental principles and applications of time stretch including a spin-off technology known as the phase stretch transform, a new computational imaging algorithm that is emerging as the best edge and texture feature extractor for digital images.

Tu1A.4 • 11:45
High-Power and High-Beam Quality Photonic-Crystal Lasers, Susumu Noda[1]; [1]*Kyoto University, Japan.* I would like to describe coherent lasing oscillation of photonic-crystal lasers with advanced double-hole structures over areas of 300 - 1000μm diameters and the formation of high-quality beams (M2 < 2) whose output power exceeds 10W at room temperature. These results promise to bring the benefits of semiconductor lasers to high-power applications including material processing and laser ranging (i.e., LiDAR et al).

12:30–14:00 Lunch

Room S223

14:00–15:30
Tu2A • Light Sources and Optical Fields
Presider: Andrey Komarov; Inst. of Automation and Electrometry, Russia

Tu2A.1 • 14:00 Tutorial
The Breakthroughs and Challenges in Mid-infrared Fibre Source Development, Stuart D. Jackson[1]; [1]*Macquarie Univ., Australia.* The development of mid-infrared fibre sources of light is reaching new levels of power, efficiency and wavelength coverage. In this tutorial I will briefly review the major achievements that have resulted in the record performance and I will outline the challenges and opportunities ahead.

Room S224

14:00–15:30
Tu2B • Mode-locked and Ultrafast Lasers
Presider: Frederique Vanholsbeeck; Univ. of Auckland, New Zealand

Tu2B.1 • 14:00 Invited
Polarization Dynamics in Ultrafast Thulium Fiber Lasers, Ahmet E. Akosman[1], Michelle Y. Sander[1]; [1]*Boston Univ., USA.* Polarization dynamics in soliton mode-locked femtosecond thulium fiber lasers are presented that can lead to pulse modulation. A dual output pulse train with orthogonally polarized interlaced pulses is discussed.

Room S225

14:00–15:30
Tu2C • Infrared and Terahertz Metamaterials and Detectors
Presider: Daniel Mittleman; Brown Univ., USA

Tu2C.1 • 14:00 Invited
Terahertz and Infrared Electromagnetic Metasurfaces, Willie J. Padilla[1]; [1]*Duke Univ., USA.* Abstract not available.

Room S226

14:00–15:30
Tu2D • Time-frequency Signal Analysis and Processing
Presider: Deepa Venkitesh; Indian Inst. of Technology, Madras, India

Tu2D.1 • 14:00
Compressing the dynamic range and statistics of optical signals, Yunshan Jiang[1], Bahram Jalali[1]; [1]*Univ. of California Los Angeles, China.* We describe a new concept in photonics in which the dynamic range and signal's statistical distribution is optically engineered. We discuss how it improves light detection and means to implement it.

Room S227

14:00–15:30
Tu2E • Special Fibers I
Presider: Kin Chiang; City Univ. of Hong Kong, Hong Kong

Tu2E.1 • 14:00 Tutorial
Recent Developments in Photonic Crystal Fibres, Philip S. Russell[1]; [1]*Max-Planck-Inst Physik des Lichts, Germany.* Recent PCF developments include optoacoustic high harmonic mode-locking of fibre lasers, twist-induced guidance in coreless PCF, "swimming" microparticle lasers in liquid-filled PCF and ultrashort wavelength-tunable DUV and VUV pulses from gas-filled hollow-core PCF.

Room S228

14:00–15:30
Tu2F • Novel Measurement Methods I
Presider: Zhichao Luo; South China Normal Univ., China

Tu2F.1 • 14:00 Invited
Extreme Imaging for Large-scale single-cell Analysis, Keisuke Goda[1], Cheng Lei[1]; [1]*Univ. of Tokyo, Japan.* I present an ultrafast molecular imaging technology combined with artificial intelligence on a microfluidic platform for large-scale single-cell analysis. It rapidly provides information-rich images of numerous single cells, enabling us to exploit cellular heterogeneity.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NOTES

Room S423	Room S424	Room S425	Room S426	Room S427	Room S428

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

14:00–15:30
Tu2G • Quantum Optomechanics
Presider: Guofeng Zhang; The Hong Kong Polytechnic Univ., Hong Kong

Tu2G.1 • 14:00 Tutorial
Quantum Optomechanics, Warwick P. Bowen[1]; [1]*Univ. of Queensland, Australia*. Quantum optomechanics is a rapidly growing field studying the quantum interaction of light with mechanical devices. This tutorial will review the field, as well as applications in precision sensing, quantum information science and fundamental physics.

14:00–15:30
Tu2H • Optical Filtering
Presider: Qijie Wang; Nanyang Technological Univ., Singapore

Tu2H.1 • 14:00 Invited
Silicon-based on-chip Hybrid (de)multiplexers, Daoxin Dai[1]; [1]*Zhejiang Univ., China*. Recent progress of silicon-based on-chip hybrid multiplexers is reviewed as a key element enabling more than one (de)multiplexing techniques simultaneously, including wavelength-division-multiplexing (WDM), polarization-division-multiplexing (PDM), and mode-division-multiplexing (MDM).

14:00–15:30
Tu2I • High-Speed Optical Transmission
Presider; Calvin Chun-Kit Chan; The Chinese University of Hong Kong, Hong Kong

Tu2I.1 • 14:00 Invited
Is Kramers-Kronig Receiver Suitable for Direct-detected Systems?, William Shieh[1], Qi Yang[2], Chuanbowen Sun[1], Di Che[1]; [1]*Electrical and Electronic Engineering Dept., The Univ. of Melbourne, Australia;* [2]*School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China*. We compare the performance of Kramers-Kronig (KK) receiver with conventional iterative cancellation (IC) receiver. We also show the impact of the receiver response imperfection on the 'quasi-coherent' receivers such as KK and IC receivers.

14:00–15:30
Tu2J • Advances in Plasmonics and Metamaterials
Presider: Dangyuan Lei; The Hong Kong Polytechnic Univ., Hong Kong

Tu2J.1 • 14:00 Tutorial
Ultrafast Control of Light Polarisation in Nonlinear Metamaterials, Anatoly Zayats[1]; [1]*King's College London, UK*. Plasmonic and dielectric metamaterials allow designing not only linear but also nonlinear optical response. We discuss applications of anisotropic metamaterials and metasurfaces in controlling polarisation state of transmitted and reflected light on ultrafast timescales.

14:00–15:30
Tu2K • Biophotonics and Applications I
Presider: L. Jay Guo; Univ. of Michigan, USA

Tu2K.1 • 14:00 Tutorial
Functional Imaging & Monitoring of Brain & Breast with Diffuse Light, Arjun G. Yodh[1]; [1]*Univ. of Pennsylvania, USA*. Diffuse optical spectroscopy and tomography of tissue is finding unique clinical niches. I will describe representative brain and breast functional imaging and monitoring results to illustrate the workings of these new tissue diagnostics.

14:00–15:30
Tu2L • Fiber Devices & Sensing I
Presider: Zhenzhou Cheng; The Univ. of Tokyo, Japan

Tu2L.1 • 14:00 Invited
Prospects in power scaling of fiber lasers and amplifiers, Andreas Tünnermann[1,2], Cesar Jauregui[2], Jens Limpert[2,1]; [1]*Fraunhofer IOF, Germany;* [2]*Inst. of Applied Physics, Friedrich-Schiller-Univ., Germany*. The state of the art of science and technology in fiber lasers and amplifiers is reviewed. Prospects for future power scaling using advanced fiber designs in combination with modern laser and amplifier architectures are discussed.

Room S223	Room S224	Room S225	Room S226	Room S227	Room S228

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Tu2A • Light Sources and Optical Fields—Continued

Tu2B • Mode-locked and Ultrafast Lasers—Continued

Tu2B.2 • 14:30
Passive mode-locking of a diode-pumped Nd laser based on cascaded second-order nonlinearity, How-Wei Liu[1], Shou-Tai Lin[1], Chun-Hui Huang[1]; [1]*Feng Chia Univ., Taiwan.* A diode-pumped mode-locking Nd:YVO4/YVO4 laser via positive cascaded second-order Kerr lens effects at 1064 nm was demonstrated. The measured average power, pulse repetition rate and pulse duration are 1.3 W, 186 MHz and 2.8 ps, respectively.

Tu2B.3 • 14:45
Asynchronous mode-locking and FM oscillation transition in a 10 GHz hybrid mode-locked fiber laser, Cheng-Jhih Luo[1], Yen-Chia Juan[1], Yinchieh Lai[1]; [1]*Dept. of Photonics, National Chiao Tung Univ., Taiwan.* By studying an asynchronously mode-locked (ASM) fiber laser, we experimentally find that the laser directly transits from the ASM state into the FM oscillation state when the modulation frequency detuning is increased beyond a threshold.

Tu2C • Infrared and Terahertz Metamaterials and Detectors—Continued

Tu2C.2 • 14:30 Invited
Metamaterials and Metallic Hole Arrays Coupled to Short Wave Infrared Intersubband Transitions in the GaN/AlN Based Quantum Cascade Structures, Gad Bahir[1]; [1]*Dept. of Electrical Engineering, Technion-Israel Inst. of Technology, Israel.* We present the design, realization and characterization of optical coupling between intersubband transitions within a GaN/AlN based quantum cascade detector structure and planar metamaterials nano-antennas or metal hole arrays (MHA) in the near-infrared spectral range.

Tu2D • Time-frequency Signal Analysis and Processing—Continued

Tu2D.2 • 14:15
Temporal differential manipulation of optical frequency chirp, Lei Zhang[1], Xin Dong[1], Liao Chen[1], Xi Zhou[1], Chi Zhang[1], Xinliang Zhang[1]; [1]*Wuhan National Lab for Optoelectronics,, China.* We propose and demonstrate the temporal differential manipulation of optical frequency chirp based on interference and cross-phase modulation. It realizes the dispersion order reduction, and enhances the flexibility of the dispersive time-stretch technique.

Tu2D.3 • 14:30
Temporal Shack-Hartman wavefront sensor for large temporal phase dynamics recovery, Chen Zheng[1], Liao Chen[1], Xi Zhou[1], Lei Zhang[1], Chi Zhang[1], Xinliang Zhang[1]; [1]*Wuhan National Lab for Optoelectronics,, China.* We propose and simulate a temporal Shack-Hartman wavefront sensor based on time-lenses array, which is capable of retrieving the temporal phase information with large dynamics. It is a complementary scheme for the coherent detection technique.

Tu2D.4 • 14:45
Real-time spectral analysis based on time-lens enhanced dispersive Fourier transform, Yuan Wei[1], Bowen Li[1], Pingping Feng[1], Kenneth Kin-Yip Wong[1]; [1]*Univ. of Hong Kong, Hong Kong.* Time-lens enhanced dispersive Fourier transform (TE-DFT) is demonstrated for real-time spectral analysis in the continuous-wave regime. Flexible frame rate, 0.03-nm resolution and -32.2-dBm detection sensitivity can be achieved across 36-nm range limited only by amplifier.

Tu2E • Special Fibers I—Continued

Tu2F • Novel Measurement Methods I—Continued

Tu2F.2 • 14:30
Direct spatially resolved snapshot polarimetric phase extraction by using an imaging PolarCam, Dahi Abdelsalam[1,2], Vamara Dembele[2], Inho Choi[2], Madhan P. Jayakumar[2], Sukhyun Choi[2], Junho Kim[2], Daesuk Kim[2]; [1]*National Inst. of Standards, Egypt;* [2]*Optical Engineering, Division of Mechanical System Engineering, Chonbuk National Univ., Korea.* We extract Stokes vectors and 3D phase of a transmissive anisotropic object by a novel polar interferometric system. PolarCam employing a micro polarizer array is used to capture four inline interferograms in single shot.

Tu2F.3 • 14:45
A frequency to voltage converter with ultra-low residual phase noise, Lulu Yan[1,2], Yanyan Zhang[1,2], Zhaoyang Tai[1,2], Pan Zhang[1], Ru Yuan[1], Shougang Zhang[1,2], Haifeng Jiang[1,2]; [1]*National Time Service Center, China;* [2]*School of Astronomy and Space Science, Univ. of Chinese Academy of Science, China.* We report on the process of residual noise suppression in a frequency to voltage converter based on a frequency difference multiplication method, for measuring frequency noise of ultra-stable laser. The double sideband frequency noise is lower than -40 dB Hz^2/Hz in a bandwidth from 3 Hz to 100 kHz.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Tu2G • Quantum Optomechanics—Continued

Tu2H • Optical Filtering—Continued

Tu2H.2 • 14:30
High-Extinction-Ratio Optical Filters Based on High-Order Silicon Microring Resonators, Renyou Ge[1], Xinlun Cai[1]; [1]*Sun Yat-sen Univ., China.* We designed and fabricated coupled-resonator optical waveguide filters on silicon platform with insertion loss ~ 1.5 dB, and obtained extinction ratio of > 70 dB for 7th filters by thermally tuning resonances of each ring.

Tu2H.3 • 14:45
Multi-wavelength tunable filter based on chirped phase-shift grating on Lithium Niobate, Yuan Yao[1], Ailing Zhang[1], Zhengrong Tong[1]; [1]*Tianjin Univ. of Technology, China.* Multi-wavelength tunable filter based on chirped phase-shift grating on Lithium Niobate (LN) is proposed. The wavelengths of the filter are linearly tuned and the number of wavelength is determined by the number of electrode pairs.

Tu2I • High-Speed Optical Transmission—Continued

Tu2I.2 • 14:30
On the Hardware Complexity of Kramers-Kronig Receiver, Tianwai Bo[1], Rui Deng[2], Jing He[2], Hoon Kim[1]; [1]*School of Electrical Engineering, Korea Advanced Inst. of Science and Technology (KAIST), Korea;* [2]*College of Computer Science and Electronic Engineering, Hunan Univ., China.* The analysis on the hardware complexity of Kramers-Kronig (KK) receiver shows that, compared with the conventional KK receiver, the recently proposed receiver without digital upsampling saves the number of adders, multipliers, and memory by 80%.

Tu2I.3 • 14:45
Comparison for 100 Gb/s PDM-DD Short Reach Optical Communication System Transmission Performance with PAM4, CAP16 and DMT, Jiahao Huo[1,2], Xian Zhou[1,2], Kangping Zhong[3], Jiajing Tu[1,2], Wei Huangfu[1], Jinhui Yuan[2], Keping Long[1], Changyuan Yu[2], Alan Lau[4], Chao Lu[2]; [1]*Beijing Engineering and Technology Research Center for Convergence Networks and Ubiquitous Services, Univ. of Science and Technology Beijing, China;* [2]*Dept. of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong;* [3]*Macom Technology Solutions, China;* [4]*Dept. of Electrical Engineering, The Hong Kong Polytechnic Univ., Hong Kong.* A promising way to significantly meet the demands of short reach systems is polarization division multiplexing with direct detection (PDM-DD). In this paper, we compare three advanced modulation formats performance on PDM-DD system.

Tu2J • Advances in Plasmonics and Metamaterials—Continued

Tu2K • Biophotonics and Applications I—Continued

Tu2L • Fiber Devices & Sensing I—Continued

Tu2L.2 • 14:30
Enhanced Sensitivity of Hetero-core Structure SPR Temperature Sensor Based on Local Microstructures, Wenjie Zhu[1], Qing Huang[1], Yong Wang[1], Elfed Lewis[2], Minghong Yang[1]; [1]*National Engineering Laboratory for Fiber Optics Sensing Technology, Wuhan Univ. of Technology, China;* [2]*Optical Fibre Sensors Research Centre, Univ. of Limerick, Ireland.* Femtosecond laser micromachining system was used to manufacture microstructures on hetero-core structure SPR sensor to enhance the temperature sensitivity of the conventional one. The temperature sensitivity of the proposed sensor has increased 30.2%.

Tu2L.3 • 14:45
Fiber optic plasmonic sensor utilizing carbon nanotubes based surface imprinted matrix for the sensing of dopamine, Anisha Pathak[1], Banshi D. Gupta[1]; [1]*IIT Delhi, India.* A fiber optic dopamine sensor is realized utilizing surface imprinted carbon nanotube platform and surface plasmon resonance technique. The sensor possesses dynamic range of 0-150 μM and detection limit of 2.1 μM.

Room S223	Room S224	Room S225	Room S226	Room S227	Room S228

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Tu2A • Light Sources and Optical Fields—Continued

Tu2A.2 • 15:00 Invited

Complex Optical Fields: Fundamentals and Applications, Qiwen Zhan[1,2]; [1]*Univ. of Dayton, USA;* [2]*Univ. of Shanghai for Science and Technology, China*. Complex optical fields with spatially structured field distributions within the cross section have drawn significant attention recently. This paper intends to review the latest developments and applications of this emerging field of optics.

Tu2B • Mode-locked and Ultrafast Lasers—Continued

Tu2B.4 • 15:00

All-optical multi-parameter regulations for ultrafast fiber laser, Yu Long Cao[1,2], Lei Gao[1,2], Tao Zhu[1,2], Yujia Li[1,2]; [1]*Chongqing Univ., China;* [2]*Key Laboratory of Optoelectronic Technology & Systems, China*. We employ all-optical devices with precise controllable spectra bandwidths and wavelengths into an ultrafast fiber laser cavity, durations and wavelengths of pulses can be all-optically tuned with sensitivities of 470 fs/mW and 2.9 pm/mW, separately.

Tu2B.5 • 15:15

78-fs Pulses from a SWCNTs Mode-Locked Tm:CLNGG Disordered Garnet Crystal Laser, Yicheng Wang[1], Zhongben Pan[1,2], Yongguang Zhao[1,3], Ji Bae[4], Sun Choi[4], Fabian Rotermund[4], Josep Serres[5], Xavier Mateos[5], Haohai Yu[6], Huaijin Zhang[6], Mark Mero[1], Uwe Griebner[1], Valentin Petrov[1]; [1]*Max Born Inst., Germany;* [2]*Inst. of Chemical Materials, China;* [3]*Jiangsu Normal Univ., China;* [4]*KAIST, Korea;* [5]*Universitat Rovira i Virgili , Spain;* [6]*Shandong Univ., China*. We report on a Tm:CLNGG laser passively mode-locked by single-walled carbon nanotubes (SWCNTs) at 2017 nm, generating 78-fs pulses with an average output power of 54 mW at a repetition rate of 86 MHz.

Tu2C • Infrared and Terahertz Metamaterials and Detectors—Continued

Tu2C.3 • 15:00

All-Dielectric Terahertz Half-Wave Plate with Antireflection Layer, Jianchen Zi[1], Quan Xu[1], Qiu Wang[1], Chunxiu Tian[2], Yanfeng Li[1], Xixiang Zhang[2], Jiaguang Han[1], Weili Zhang[1,3]; [1]*Tianjin Univ., China;* [2]*King Abdullah Univ. of Science and Technology, Saudi Arabia;* [3]*Oklahoma State Univ., USA*. We present an all-dielectric terahertz half-wave plate with an antireflection layer. The device is made of pure silicon, and can realize cross polarization conversion with almost 100% conversion rate and 90% of transmission at the operating frequency.

Tu2C.4 • 15:15

Frequency Comb Generation in Terahertz Quantum Cascade Lasers, Hua Li[1], Chang Wang[1], Wenjian Wan[1], Ziping Li[1], Zhiyong Tan[1], Juncheng Cao[1]; [1]*Shanghai Inst. of Microsystem and In, China*. We report the fast detection of terahertz light generated from an electrically-pump terahertz quantum cascade laser lasing at 4.2 THz by terahertz quantum well photodetector. It is demonstrated that the terahertz quantum well photodetector can extract the terahertz light modulated with frequency as high as 6.2 GHz.

Tu2D • Time-frequency Signal Analysis and Processing—Continued

Tu2D.5 • 15:00

Ultrafast optical tomography using Raman-assisted temporal magnification, Sheng Wang[1,2], Lingxiao Yang[1], Chi Zhang[2], Bowen Li[1], Kenneth Kin-Yip Wong[1]; [1]*Dept. of Electrical and Electronic Engineering, The Univ. of Hong Kong, Hong Kong;* [2]*Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, China*. The sensitivity of temporal magnified tomography is further enhanced using Raman-assisted temporal magnification. Tomographic imaging of a cm-thick phantom has been demonstrated at 78-dB sensitivity and 86.7-μm resolution with an A-scan rate of 44 MHz.

Tu2D.6 • 15:15

Realtime Comb-Assisted Discrete Fourier Transform Processor, Huan Hu[1], Vahid Ataie[1], Yauheni Myslivets[1], Stojan Radic[1]; [1]*UCSD, USA*. For the first time we present an optical comb-assisted 60-point DFT engine operating in real-time at 12×10^7 coefficients per second. The engine is used to demodulate an 8-PPM signal using its DFT coefficients.

Tu2E • Special Fibers I—Continued

Tu2E.2 • 15:00

Low loss large bandwidth seven-cell hollow core photonic bandgap fiber at 1 μm spectral range, Xin Zhang[1], Shoufei Gao[1], Yingying Wang[1], Pu Wang[1]; [1]*Inst. of Laser Engineering, Beijing Univ. of Technology, China*. We report a seven-cell hollow-core photonic bandgap fiber with loss of 26.7 dB/km at 1090 nm and bandwidth over 255 nm, ideal for creating all-fiber device for strong light-matter interaction type of applications.

Tu2E.3 • 15:15

Hollow Core Fibers for Optical pumped Fiber Gas Laser, Changming Xia[1], Zicheng Sheng[1], Haixia Fan[1], Jiantao Liu[1], Zhiyun Hou[1], Guiyao Zhou[1]; [1]*South China Normal Univ., China*. We report optical properties and fabrication of hollow core fibers in our lab for optical pumped fiber gas laser. A width transmission window in near infrared spectral region is obtained in octagram hollow core fiber.

Tu2F • Novel Measurement Methods I—Continued

Tu2F.4 • 15:00

Improvement of Frequency Accuracy of Spatially-resolved Spectroscopy / Tomographic Spectroscopy, Shohei Gunji[1], Tatsutoshi Shioda[1]; [1]*Saitama Univ., Japan*. Novel calibration method for tomographic spectroscopy with high-depth resolution is proposed. Measured depth resolution has been achieved to 1.1 μm, and the frequency accuracy was improved from 10.6 THz to 0.8 THz by calibration.

Tu2F.5 • 15:15

High-speed Optical Frequency Comb Analyzer with Single-detection Technique for Ultrafast Waveform Measurement, Leona Yuda[1], Tatsutoshi Shioda[1]; [1]*Saitama Univ., Japan*. Ultrafast-phase spectrum analyzer for 25 GHz × 45 lines frequency comb has been developed with novel optical delay-circuit system and single detector. It can be applied to single-shot optical waveform measurement system with femto-second time-resolution.

15:30–16:00 Coffee Break

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Tu2G • Quantum Optomechanics—Continued

Tu2G.2 • 15:00
Cavity Enhanced Raman Heterodyne Spectroscopy in Er:YSO for Microwave to Optical Signal Conversion, Xavier Fernandez-Gonzalvo[1], Sebastian P. Horvath[1], Yu-Hui Chen[1], Jevon J. Longdell[1]; *[1]Univ. of Otago, New Zealand.* The quantum efficiency of the microwave to optical frequency conversion process at the heart of Raman heterodyne spectroscopy was improved by four orders of magnitude by resonant enhancement of the pump and signal optical fields.

Tu2G.3 • 15:15
Cavity-free scheme for conditional π phase shift between two traveling single photons, Keyu Xia[1,2], Mattias Johnsson[2], Peter L. Knight[3], Jason Twamley[2]; *[1]Nanjing Univ., China; [2]Macquarie Univ., Australia; [3]Imperial College, UK.* Using four-wave mixing in a 1D medium, we present a scheme without using cavities for achieving a conditional π phase shift between two traveling single photons. Our proposal provides a way for cavity-free quantum information processing.

Tu2H • Optical Filtering—Continued

Tu2H.4 • 15:00
Temperature and optical feedback sensitivity of the relative intensity noise of epitaxial quantum dot lasers on Ge, Yue-Guang Zhou[1], Chun-Fang Cao[2], Jin-Yi Yan[2], Qian Gong[2], Cheng Wang[1]; *[1]ShanghaiTech Univ., China; [2]Shanghai Inst. of Microsystem and Information Technology, China.* This work demonstrates that the relative intensity noise of Ge-based epitaxial InAs quantum dot lasers are weakly sensitive to the temperature, while it is more sensitive to the optical feedback at higher bias currents.

Tu2H.5 • 15:15
Design of GaInAs/InP membrane p-i-n photodiode with back-end distributed-Bragg-reflector(DBR), Xu Zheng[1], Zhichen Gu[1], Tomohiro Amemiya[1], Nobuhiko Nishiyama[1], Shigehisa Arai[1]; *[1]Tokyo Inst. of Technology, Japan.* A GaInAs/InP membrane p-i-n photodiode integrated with a back end DBR was investigated under the back reflection of -30dB. As the result, it was found that the 3dB bandwidth of 17 GHz can be obtained with the device length of 12 μm. These are approximately 3 times faster and 1/3 times smaller than those of a similar PD without the back end DBR.

Tu2I • High-Speed Optical Transmission—Continued

Tu2I.4 • 15:00
100Gb/s/λ Optical Fiber Transmission Based on High Speed DAC in SiGe Technology, Weizhong Li[2,1], Lei Zhou[3], Ming Luo[1], Daojun Xue[1], Xiang Li[1]; *[1]State Key Laboratory of Optical Communication Technologies and Networks, Wuhan Research Inst. of Posts & Telecommunications, China; [2]Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, China; [3]Inst. of Microelectronics of Chinese Academy of Science, China.* This paper presents multi-level pulse amplitude modulation (PAM) optical fiber transmission based on 32-GS/s 6-bit digital to analog convertor fabricated by 0.18um SiGe technology. The 32GBd PAM-4/8/16 signals are successfully transmitted over 2-km fiber.

Tu2I.5 • 15:15
Longest-ever unrepeatered transmission over 713.2km of 2.5 Gb/s with a span loss in excess of 111dB, Jian Xu[1], Jiekui Yu[1], Qianggao Hu[1], Hongyan Zhou[3,4], Ming Li[1], Liyan Huang[1], Fusheng Zheng[2], Weihua Li[2], Li Deng[2], Lei Zhang[3], Honghai Wang[3], Jie Luo[3], Tao Zeng[5], Lingheng Meng[5]; *[1]Accelink Technologies Co. Ltd, China; [2]State Grid Information and Telecommunication Branch, China; [3]State Key Laboratory of Optical Fiber and Cable Manufacture Technology, China; [4]Yangtze Optical Fiber and Cable Company, China; [5]State Key Laboratory of Optical Communication Technologies and Networks, China.* Longest-ever unrepeatered transmission over 713.2km for 2.5G and 665.7km for 10G is achieved by employing 2.5G PM-BPSK,10G PM-QPSK, optimized ROPAs structure and ultra low loss & large effective area fiber link.

Tu2J • Advances in Plasmonics and Metamaterials—Continued

Tu2J.2 • 15:00
Plasmonic Computing of Spatial Differentiation, Tengfeng Zhu[1], Yihan Zhou[1], Yijie Lou[1], Hui Ye[2], Min Qiu[2], Shanhui Fan[3], Zhichao Ruan[1,2]; *[1]Dept. of Physics, Zhejiang Univ., China; [2]College of Optical Engineering, State Key Laboratory of Modern Optical Instrumentation, Zhejiang Univ., China; [3]Dept. of Electrical Engineering, Ginzton Laboratory, Stanford Univ., USA.* We show that the interference effects associated with surface plasmon excitations at a metal-dielectric interface can perform spatial differentiation. Utilizing it, we experimentally demonstrate edge detection of images without any Fourier lens. This work points to a simple yet powerful mechanism for optical analog computing at the nanoscale.

Tu2J.3 • 15:15
Strong Emission Enhancement in All-Dielectric High-Q Fano Metasurface, Xingzhi Qiu[1], Shuai Yuan[1], Jinsong Xia[1]; *[1]Huazhong Univ of Science and Technology, China.* A high-Q Fano metasurface by breaking structural symmetry is proposed and over three orders emission enhancement of embedded Ge quantum dots is experimentally demonstrated in the metasurface. The lineshape of photoluminescence is typically Fano-like, the origin of Fano resonance and strong emission enhancement are analyzed in detail.

Tu2K • Biophotonics and Applications I—Continued

Tu2K.2 • 15:00 Invited
Optical Micro Imaging Technologies for Biomedicine, Xingde Li[1]; *[1]Biomedical Engineering, Johns Hopkins Univ., USA.* We present recent developments of (1) a super-achromatic monolithic OCT microprobe for intraluminal imaging of tissue microanatomies and (2) a scanning fiber-optic nonlinear endomicroscope for in-vivo imaging of tissue histology. Representative applications will also be discussed.

Tu2L • Fiber Devices & Sensing I—Continued

Tu2L.4 • 15:00
Refractive index measurement based on disturbance to RF conversion function in a fiber OFC cavity, Ryo Oe[1,2], Kosuke Nagai[1], Takeo Minamikawa[1,2], Shuji Taue[3], Hideki Fukano[3], Yoshiaki Nakajima[4,2], Kaoru Minoshima[4,2], Takeshi Yasui[1,2]; *[1]Tokushima Univ., Japan; [2]JST, ERATO MINOSHIMA IOS, Japan; [3]Okayama Univ., Japan; [4]Univ. Electro-Commun, Japan.* We demonstrate refractive index (RI) measurement of water/ethanol mixture based on disturbance to RF conversion in fiber comb cavity including multi-mode interference fiber sensor. We attached RI resolution of 4.3×10^{-6} and RI accuracy of 5.4×10^{-5}

Tu2L.5 • 15:15
Static and dynamic strain sensing over 3.5 kHz with fiber-based optical frequency comb cavity, Takeo Minamikawa[1,2], Takashi Masuoka[1,2], Takashi Ogura[1], Kyuki Shibuya[1,2], Yoshiaki Nakajima[3,2], Yoshihisa Yamaoka[4], Kaoru Minoshima[3,2], Takeshi Yasui[1,2]; *[1]Tokushima Univ., Japan; [2]ERATO Intelligent Optical Synthesizer Project, Japan; [3]The Univ. of Electro-Communications, Japan; [4]Saga Univ., Japan.* We proposed a novel static and dynamic strain sensor employing an optical-frequency- comb. We realized strain sensing from 8.7 nε to 500 με over the strain frequencies of 3.5 kHz.

15:30–16:00 Coffee Break

Room S223	Room S224	Room S225	Room S226	Room S227	Room S228

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

16:00–18:00
Tu3A • Ultrafast Fiber Laser Sources
Presider: Chengbo Mou; Shanghai Univ., China

Tu3A.1 • 16:00 Invited

High Energy Ultrafast Fiber Lasers Based on Coherent Pulse Stacking Amplification, Almantas Galvanauskas[1]; [1]*Univ. of Michigan, USA.* Coherent pulse stacking amplification extends ultrashort pulse energies from a fiber amplifier by approximately two orders of magnitude compared to CPA, and can lead to compact coherently-combined laser systems with TW-peak and kW-average powers.

Tu3A.2 • 16:30

Development of a Spaceborne Fiber-based Laser MOPA Transmitter, Anthony W. Yu[1], Mark A. Stephen[1], Jeffrey R. Chen[1], Kenji Numata[1], Stewart T. Wu[1], Brayler Gonzalez[1], Lawrence I. Han[1], Molly E. Fahey[1], Michael R. Rodriguez[2], Graham R. Allan[2], James B. Abshire[1], Jeffrey W. Nicholson[3], Anand Hariharan[3], William A. Mamakos[4], Brian R. Bean[5]; [1]*NASA Goddard Space Flight Center, USA;* [2]*Science Systems and Applications, Inc., USA;* [3]*OFS Fitel LLC, USA;* [4]*Design Interface Inc, USA;* [5]*Sobosoft LLC, USA.* NASA is developing a lidar instrument to measure the atmospheric carbon dioxide (CO_2) column concentrations from space. We will discuss the development effort of a space-qualified fiber-based master oscillator power amplifier laser for this instrument.

16:00–18:00
Tu3B • Nonlinear Optical Sources
Presider: Michelle Sander; Boston Univ., USA

Tu3B.1 • 16:00 Tutorial

Building Quantum Machines Out of Light, Ian Walmsley[1]; [1]*Univ. of Oxford, UK.* Light has the remarkable capacity to reveal quantum features under ambient conditions, making exploration of the quantum world feasible in the laboratory and field. Further, the availability of high-quality integrated optical components makes it possible to conceive of large-scale quantum states by bringing together many different quantum light sources and manipulating them in a coherent manner and detecting them efficiently. By this route, we can envisage a scalable photonic quantum network that will facilitate the preparation of distributed quantum correlations among many light beams. This will enable a new regime of state complexity to be accessed - one for which it is impossible using classical computers to determine the structure and dynamics of the system. This is a new regime not only for scientific discovery, but also practical purpose: the same complexity of big quantum systems may be harnessed to perform tasks that are impossible using known future information processing technologies. For instance, ideal universal quantum computers may be exponentially more efficiently than classical machines for certain classes of problems, and communications may be completely secure. Photonic quantum machines will open new frontiers in quantum science and technology.

16:00–18:00
Tu3C • Infrared and Terahertz Microscopy and Nanoscopy and Their Applications
Presider: Willie Padilla; Duke Univ., USA

Tu3C.1 • 16:00 Invited

Advances in Ultrafast Terahertz Scanning Tunneling Microscopy, Frank A. Hegmann[1]; [1]*Univ. of Alberta, Canada.* Terahertz scanning tunneling microscopy (THz-STM) is able to probe ultrafast dynamics on the surface of materials with simultaneous sub-nanometer spatial resolution. How THz-STM works, recent progress in THz-STM, and future directions will be discussed.

Tu3C.2 • 16:30 Invited

Laser Terahertz Emission Nanoscopy, Angela Pizzuto[1], Pernille Klarskov[3,2], Daniel M. Mittleman[3]; [1]*Dept. of Physics, Brown Univ., USA;* [2]*DTU Fotonik - Dept. of Photonics Engineering, Technical Univ. of Denmark, Denmark;* [3]*Dept. of Electrical and Computer, Brown Univ., USA.* We demonstrate depletion of terahertz emission from semiconductors by applying a DC bias between a substrate and an AFM probe operating in tapping mode. The depletion is strongly dependent on the probe tapping amplitude.

16:00–18:00
Tu3D • Nonlinear Wave Mixing and Applications
Presider: Chester C.T. Shu; The Chinese Univ. of Hong Kong, Hong Kong

Tu3D.1 • 16:00 Tutorial

Advances in Core Technologies and Wave-Mixing Techniques for Optical Signal Processing, Alan E. Willner[1]; [1]*Univ. of Southern California, USA.* This tutorial will highlight challenges in achieving efficient, flexible, and reconfigurable optical networks. Various optical approaches that enable key functions will be discussed, including: dynamic bandwidth allocation, increasing spectral efficiency, format conversion, and phase-sensitive operations.

16:00–17:45
Tu3E • Waveguide Devices I
Presider: Paulo Dainese; Universidade Estadual de Campinas, USA

Tu3E.1 • 16:00 Invited

On-chip Brillouin filtering of RF and Optical Signals, Benjamin J. Eggleton[1]; [1]*Univ. of Sydney, Australia.* In this talk I review signal processing based on the nonlinear optical process known as stimulated Brillouin scattering (SBS) for high-performance analog signal filtering for RF communications and in coherent optical communication systems for carrier amplification.

Tu3E.2 • 16:30 Invited

Mid-Infrared Waveguides and Applications, Xin Gai[1]; [1]*City Univ. of Hong Kong, Hong Kong.* Mid-infrared spectroscopy attracts growing interests because of its coverage over the characteristic spectral absorption features for many molecules. This paper reviews our study in mid-infrared including material characterization, waveguide fabrication and supercontinuum for spectroscopic applications.

16:00–18:00
Tu3F • Novel Measurement Methods II
Presider: Zheng Zheng; Beihang Univ., China

Tu3F.1 • 16:00 Invited

Infrared On-Chip Photonics: Towards Precision Biodiagnostics, Boris Mizaikoff[1]; [1]*Ulm Univ., Germany.* State-of-the-art sensing platforms ideally benefit from miniaturized and integrated optical technologies providing direct access to molecule-specific information. With in-situ sensing strategies point-of-care diagnostics in medicine becoming more prevalent, in particular if labeled constituents are not required.

Tu3F.2 • 16:30

Study on remote gas sensing by photoacoustic wave detected with an optical probe, Daichi Fujii[1], Kazuhide Sato[1], Kazuyoku Tei[1], Shigeru Yamaguchi[1]; [1]*Tokai Univ., Japan.* We report the results of remote gas detection using an optical wave microphone(OWM). It enables photoacoustic signal remotely without installing conventional microphone where acoustic wave stands. We successfully demonstrated C_2H_2 detection with OWM.

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These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

16:00–18:00
Tu3G • Atom-photon Interaction
Presider: Arno Rauschenbeutel; Humboldt-Universitat zu Berlin, Germany

Tu3G.1 • 16:00 Invited
Multi-photon Quantum Boson-sampling Machines, Chaoyang Lu[1]; [1]*Univ of Science and Technology of China, China*. We develop single-photon sources that simultaneously combines high purity, efficiency, and indistinguishability. We demonstrate entanglement among ten single photons. We construct high-performance multi-photon boson sampling machines to race against classical computers.

Tu3G.2 • 16:30 Invited
Atom-photon Interaction in the Strong Focusing Regime, Christian Kurtsiefer[1]; [1]*Dept. of Physics / Centre for Quantum Technologies, National Univ. of Singapore, Singapore*. Abstract not available.

16:00–18:00
Tu3H • Optical Microcavities
Presider: Andrew Poon; Hong Kong Univ of Science & Technology, Hong Kong

Tu3H.1 • 16:00 Tutorial
Sensing the Nanoscale Dynamics of Proteins with Optoplasmonic Microcavities, Frank Vollmer[1]; [1]*Univ. of Exeter, UK*. My laboratory is developing a new class of nanophotonic architectures by combining optically resonant dielectric microcavities with plasmonically resonant metal nanostructures to enable detection at the nanoscale with extraordinary sensitivity.

16:00–18:00
Tu3I • Fiber Technologies and Applications
Presider: Calvin CK Chan, The Chinese Univ. of Hong Kong, Hong Kong

Tu3I.1 • 16:00 Tutorial
Hollow Core Fibers: Technology and Emerging Applications, David J. Richardson[1]; [1]*Univ. of Southampton, UK*. We describe the unique properties and latest advances in the design and fabrication of hollow core optical fibers. We then review use of the technology in important application areas including power delivery, sensing and communications.

16:00–18:00
Tu3J • Nonlinear Plasmonics and Metamaterials
Presider: Ho Wai Lee; Baylor Univ., USA

Tu3J.1 • 16:00 Invited
Gap-enhanced Raman Tags for Superstable and High-speed Imaging, Jian Ye[1]; [1]*School of Biomedical Engineering, Shanghai Jiao Tong Univ., China*. Gap-enhanced Raman tags (GERTs) are favorable for off-resonance near-infrared laser excitation with reduced photothermal effect, leading to super-photostable and high-speed cell and tumor imaging. GERTs have demonstrated for intraoperative imaging of the sentinel lymph nodes and elimination of microscopic and residual tumors.

Tu3J.2 • 16:30
Selective nano-CARS microscopy with dual-wavelength nanofocused ultrafast plasmon pulses, Keita Tomita[1], Fumihiko Kannari[1]; [1]*Keio Univ., Japan*. We demonstrate selective CARS measurements of a monolayer graphene and multi-walled carbon nanotubes (MWCNT) at the D-, G-, and 2D-bands with nanofocused SPP pulses at 800 and 440 nm using an aluminum tapered tip.

16:00–18:00
Tu3K • Biophotonics and Applications II
Presider: Tuan Guo; Jinan Univ., China

Tu3K.1 • 16:00 Invited
Ultrasound Detection and Imaging Using Microring Resonators and Laser Generated Focused Ultrasound, L. Jay Guo[1]; [1]*Univ. of Michigan, USA*. Optical detection of ultrasound is based on the interaction of strain field and optical field in an optical resonator for sensitive detection. Special optical transmitters generate and focus ultrasound, targeting high-amplitude focused ultrasound for imaging and therapeutic applications.

Tu3K.2 • 16:30 Invited
High Spatial Resolution Fiber Optic Sensors and Their Impact in Biomedical Measurements and Diagnostic, Daniele Tosi[1,2], Sanzhar Korganbayev[1,2], Carlo Molardi[1], Emiliano Schena[3], Guido Perrone[4], Agostino Iadicicco[5], Campopiano Stefania[5], Salvador Sales[6]; [1]*Nazarbayev Univ., Kazakhstan;* [2]*Laboratory of Biosensors and Bioinstruments, National Laboratory Astana, Kazakhstan;* [3]*Universita' Campus Bio-Medico di Roma, Italy;* [4]*Politecnico di Torino, Italy;* [5]*Parthenope Univ., Italy;* [6]*Universidad Politecnica de Valencia, Spain*. This work presents the recent developments on fiber optic sensing technologies having narrow spatial resolution, 0.1 mm to 10 mm. Sensors are finding emerging application in real-time monitoring of therapies and diagnostic.

16:00–18:00
Tu3L • Laser Applications and Technologies
Presider: Bo Dong; Chinese Academy of Sciences, China

Tu3L.1 • 16:00
Superfluorescent Fiber Source with Ultra-low Thermal Coefficiency Operating in the Conventional Band, Hsiang Wang[1], Yeng-Hong Lu[1], Tsung-Yu Lu[1], Ren-Young Liu[2], Shien-Kuei Liaw[1]; [1]*Taiwan Tech, Taiwan;* [2]*National Space Organization (NSPO), Taiwan*. An Erbium-doped fiber-based, optical DPB pumping broadband superfluorescent fiber source is proposed and demonstrated. By using temperature compensation, the mean wavelength stability of SFS is as small as 0.67 ppm/°C over the temperature range of -26 to 65°C. The output power, 3 dB bandwidth are 9 dBm and 16.5 nm, respectively.

Tu3L.2 • 16:15
Through-Focus Scanning Optical Fluorescence Microscopy for Marine Phytoplankton Count, Jun Ho Lee[1]; [1]*Kongju National Univ., Korea*. We propose the use of through-focus scanning fluorescence microscopy for marine phytoplankton count. We built a prototype and it was demonstrated to count the phytoplankton within 1cc seawater with 10 μm resolution in one second.

Tu3L.3 • 16:30
Nanosecond and Femtosecond Laser Induced Breakdown Spectroscopic Studies of Coal and Ash, Hemalaxmi R.[1], Aparna N[1], N J. Vasa[1], S Seshadri[2]; [1]*Engineering Design, Indian Inst. of technology madras, India;* [2]*Applied Mechanics, Indian Inst. of technology madras, India*. Nanosecond and femtosecond laser Induced Breakdown Spectroscopy (ns- and fs-LIBS) were used for elemental analysis of Indian coal and ash. Emissions from C, Na, K, Al, Fe, Ca and molecular CN were identified and analyzed.

Room S223	Room S224	Room S225	Room S226	Room S227	Room S228

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Tu3A • Ultrafast Fiber Laser Sources—Continued

Tu3A.3 • 16:45
Broadband coherence of bidirectional mode-locked Er-fiber laser with two saturable absorber mirrors, Yoshiaki Nakajima[1,2], Yuya Hata[2], Kaoru Minoshima[1,2]; [1]*Univ. of Electro-Communications, Japan;* [2]*JST ERATO MINOSHIMA IOS Project, Japan.* We evaluate broadband coherence of bidirectional mode-locked Er-fiber-laser with two saturable absorber mirrors. Signal-to-noise ratio of 35-dB at 100-kHz resolution bandwidth in beat notes between narrow linewidth single frequency laser and the output is obtained.

Tu3A.4 • 17:00
High average and peak power laser based on Yb:YAG amplifiers of advanced geometries for OPCPA pumping, Ivan Kuznetsov[1], Ivan Mukhin[1], Evgeny Perevezentsev[1], Mikhail Volkov[1], Oleg Palashov[1]; [1]*Inst. of Applied Physics of the RAS, Russia.* High-power picosecond laser for OPCPA pumping is under development. It is composed of ytterbium fiber oscillator, Yb:YAG thin-rod preamplifiers and Yb:YAG thin-disk amplifier. 120W average power, 10mJ pulse energy with diffraction-limited beam quality is achieved.

Tu3A.5 • 17:15
Picosecond Yb-doped Alumino-phosphosilicate Fiber MOPA with >35kW Peak Power, Arindam Halder[1], Di Lin[1], Andrey Umnikov[1], N. J. Rámirez-Martínez[1], Martin Miguel[1], Pranabesh Barua[1], Shaiful Alam[1], Jayanta K. Sahu[1]; [1]*Univ. of Southampton, UK.* We report a ps-MOPA using an efficient ytterbium-doped Al-P-SiO_2 fiber fabricated by MCVD solution-doping process, generating 35kW peak-power pulses at 1035nm with repetition-rate 1.47MHz and average power 9.1W. The optical conversion efficiency was 76%.

Tu3B • Nonlinear Optical Sources—Continued

Tu3B.2 • 17:00
100-as-level synchronized two-color source based on SPM-enabled spectral selection, Yi Hua[1], Gengji Zhou[1], Wei Liu[1], Ming Xin[1], Franz X. Kärtner[1], Guoqing Chang[1]; [1]*DESY, Germany.* We demonstrate that SPM-enabled spectral selection (SESS) pulses exhibit 100-as-level relative timing jitter with respect to excitation pulses, which is 10 times lower than the Raman soliton pulses derived from the same source laser.

Tu3B.3 • 17:15
Efficient Visible Femtosecond Supercontinuum from an Air-Suspended-Core Microstructured Optical Fiber, Feng Han[1], Jindan Shi[1], Chengli Wei[2], Jonathan Hu[2], Xian Feng[3]; [1]*Jiangsu Normal Univ., China;* [2]*Baylor Univ., USA;* [3]*Beijing Univ. of Technology, China.* We report efficient visible supercontinuum (SC) generated from an air-suspended-core microstructured optical fiber. The conversion efficiency of pump-to-SC was measured to be 25.4%, while the fraction of the visible SC was as high as 67.3%.

Tu3C • Infrared and Terahertz Microscopy and Nanoscopy and Their Applications—Continued

Tu3C.3 • 17:00
Immune assay using a micro-flow channels detected by a terahertz chemical microscopy, Tatsuki Kamiya[1], Masahiro Iida[1], Kenji Sakai[1], Toshihiko Kiwa[1], Keiji Tsukada[1]; [1]*Graduate school of natural science and technology, Okayama Univ., Japan.* We have developed a terahertz chemical microscopy (TCM) to visualize various types of chemical reactions. Here, a micro-flow channels were fabricated on a sensing plate, and measured time evolution of immune reactions using the TCM.

Tu3C.4 • 17:15
Determination of plant water status using THz radiation, Ran Li[1], Yaojie Lu[2], Andrew J. Lee[1]; [1]*Macquarie Univ., Australia;* [2]*Hawksbury Inst. for the Environment, Western Sydney Univ., Australia.* We report the application of THz radiation, generated from a solid-state THz laser source, to the detection of water content within plant leaves, and the determination of plant health status.

Tu3D • Nonlinear Wave Mixing and Applications—Continued

Tu3D.2 • 17:00 Invited
Ultra-fast and Ultra-broadband Nonlinear Optical Signal Processing, Leif K. Oxenlowe[1]; [1]*DTU Fotonik, Denmark.* Nonlinear optical effects are useful to control and manipulate large numbers of parallel optical data signals, enabling flexible networks with high spectral and energy efficiency. This talk will describe recent advances in optical signal processing.

Tu3E • Waveguide Devices I—Continued

Tu3E.3 • 17:00
Electro-optic Modulators Further than 100 Gbps, Feng Qiu[1], Shiyoshi Yokoyama[1]; [1]*Kyushu Univ., Japan.* The continuing explosive growth of the Internet and digital storage technology is creating a growing need for high performance electro-optic modulators. Through designing optical waveguides and developing organic materials, we have realized high-performance EO modulators for future optical communication systems.

Tu3E.4 • 17:15
All-optical control of propagation loss with a graphene-embedded polymer waveguide, Zeshan Chang[1], Kin S. Chiang[1]; [1]*City Univ. of Hong Kong, Hong Kong.* We demonstrate, theoretically and experimentally, all-optical control of propagation loss with a graphene-embedded polymer waveguide. Using a 10-mm long waveguide, we achieve 4.6-dB loss modulation for 1550-nm light with 12.4-dBm co-propagating 980-nm pump light.

Tu3F • Novel Measurement Methods II—Continued

Tu3F.3 • 16:45
Phonon Confinement by the Force of Light, Xin He[1], Christopher Baker[1], Yauhen Sachkou[1], Andreas Sawadsky[1], Stefan Forstner[1], Yasmine Sfendla[1], Warwick P. Bowen[1]; [1]*Univ. of Queensland, Australia.* Using superfluid optomechanical system, here we show both that radiation pressure can greatly deform superfluid film, and that this generates new sound modes within the film locally, that are confined by the optical mode and interact strongly with it. This demonstrates a new form of dynamical backaction between light and mechanics.

Tu3F.4 • 17:00
A Large Helium-Neon Ring Laser Gyroscope Operating at 543 nm, Caroline Anyi[1], Jon-Paul Wells[1], Robert Thirkettle[1], Robert Hurst[1], Karl U. Schreiber[2]; [1]*School of Physical and Chemical Sciences, Univ. of Canterbury, New Zealand;* [2]*Technical Univ. of Munich, Germany.* We report on the operation of a helium-neon based large ring laser gyroscope on the shortest wavelength neon laser transition at 543.5 nm. The 6.4 metre perimeter gyroscope unlocked on the bias provided by Earth rotation alone; exhibiting a Sagnac frequency near 133 Hz.

Tu3F.5 • 17:15
Theory of Inelastic Optical Wave Mixing Magnetometry, Lu Deng[1], Chengjie Zhu[2], Edward W. Hagley[1]; [1]*National Inst of Standards & Technology, USA;* [2]*MOE Key Lab of Advanced Micro-Structured Materials, Tongji Univ., China.* We show the presence of an energy-symmetry-based nonlinear propagation blockade on magneto-optical rotation in the widely used single-beam three-state scheme and an inelastic wavemixing scheme that removes this detrimental blockade.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Tu3G • Atom-photon Interaction—Continued

Tu3G.3 • 17:00
Deterministic Creation and Spins in Quantum Emitters in Atomically Thin Semiconductors, Alejandro Montblanch[1], Dhiren Kara[1], Carmen Palacios-Berraquero[1], Matteo Barbone[1], Pawel Latawiec[2], Marko Loncar[2], Andrea Ferrari[1], Mete Atatüre[1]; [1]*Univ. of Cambridge, UK;* [2]*Harvard Univ., USA.* We report the deterministic generation of novel single-photon emitters (SPEs) in monolayers of transition metal dichalcogenides (TMDs) by using patterned substrates, and current efforts to generate charged TMD-SPEs through electrical gating to act as qubits.

Tu3G.4 • 17:15
Synthetic spin-orbit coupling for ultracold fermions in optical lattices, Bo Song[1], Chengdong He[1], Zejian Ren[1], Elnur Hajiyev[1], Qianhang Cai[1], Gyu-Boong Jo[1]; [1]*The Hong Kong Univ. of Science and Technology, Hong Kong.* We experimentally implement synthetic spin-orbit coupling in optical lattices with ultracold ^{173}Yb fermions. We engineer band topology in one- and two-dimensional lattices and investigate topological states such as symmetry-protected topological phases in this spin-orbit-coupled system.

Tu3H • Optical Microcavities—Continued

Tu3H.2 • 17:00
Exceptional Points in a Specialty Microcavity: Interplay between State-Conversion and Cavity Control Parameters, Arnab Laha[1], Abhijit Biswas[2], Sayan Bhattacherjee[1], R. K. Varshney[1], Somnath Ghosh[1]; [1]*Indian Inst. of Technology, India;* [2]*Inst. of Radio Physics and Electronics, India.* Exploiting scattering-matrix in a gain-loss assisted optical-microcavity, interplay between asymmetric-state-conversion and cavity-control parameters around exceptional points is analyzed; where occupying a least area by coupled states during switching, maximum conversion-efficiency with minimal asymmetry is achieved.

Tu3H.3 • 17:15
Raman Lasing in a silica microdisk resonator, Xinyu Cheng[1], Jiaxin Gu[1], Longfu Xiao[1], Guanyu Li[1], Xiaoshun Jiang[1], Min Xiao[1]; [1]*Nanjing Univ., China.* We have demonstrated a chip-based Raman laser by using a silica microdisk resonator with an intrinsic optical Q-factor of 1.5×10^7. The achieved lasing threshold is as low as 3.9 mw with a conversion efficiency of 7.5%.

Tu3I • Fiber Technologies and Applications—Continued

Tu3I.2 • 17:00
High order cylindrical vector beams transmission in air-core photonic crystal fiber, Juncheng Fang[1]; [1]*Shenzhen Univ., China.* We propose and demonstrate high order cylindrical vector beams transmission in air-core photonics crystal fiber. According to the numerical simulation and experiment, the mode purities of CVBs are measured as high as 67%.

Tu3I.3 • 17:15 Invited
Huge Capacity SDM Transmission and Multi-granular Optical Switching Network Technologies, Naoya Wada[1], Benjamin Puttnam[1], José M. Mendinueta[1], Hideaki Furukawa[1]; [1]*NICT, Japan.* We describe Pb/s space-division-multiplexed transmission technologies to satisfy the ever-increasing traffic demand. We also present optical integrated network technologies capable of providing multi-granular switching capacity to allow data service diversification.

Tu3J • Nonlinear Plasmonics and Metamaterials—Continued

Tu3J.3 • 16:45
Plasmonic waveguides for nano-lasing and four-wave mixing, C. Martijn de Sterke[1], Guangyuan Li[1], Stefano Palomba[1]; [1]*Univ. of Sydney, Australia.* We present a systematic procedure for designing plasmonic waveguides for nano-lasing and for nonlinear optics. We identify superior device designs in which an increased overlap of the field with the gain compensates for higher losses.

Tu3J.4 • 17:00
Boosted Kerr Nonlinearity in Nanoscale Slot Waveguides with Hyperbolic Claddings, Guangyuan Li[1,2]; [1]*Shenzhen Inst.s of Advanced Technology, Chinese Academy of Sciences, China;* [2]*Biomedical Engineering Laboratory for Photoelectric Sensing Technology, China.* We show that nanoscale slot waveguides cladded by hyperbolic metamaterials can have higher Kerr nonlinear effects for shorter device lengths compared with the conventional metal-slot waveguides.

Tu3J.5 • 17:15
Brightening of Dark Excitons in Monolayer WS_2 Sandwiched in a Metal-film-coupled Nanocavity, Jin Liu[1], Tsz Wing Lo[1], Meng Qiu[1], Chi-hang Lam[1], Dang Yuan Lei[1]; [1]*Applied Physics, Hong Kong Polytechic Univ., Hong Kong.* We provide a simple method to observe the effects of dark excitons from room temperature in monolayer WS_2 by using a metal-film-coupled nanocavity.

Tu3K • Biophotonics and Applications II—Continued

Tu3K.3 • 17:00
Machine Learning Enabled Computational Imaging and Sensing for Point-of-Care Medicine and Global Health, Aydogan Ozcan[1]; [1]*Univ. of California Los Angeles, USA.* We provide an overview of our recent work on the use of machine learning, including e.g., deep neural networks, in advancing computational imaging and sensing systems, targeting various global health and point-of-care medicine related applications.

Tu3K.4 • 17:15
Wide-view Bessel light-sheet fluorescence microscopy for high-resolution, isotropic neuron imaging, Chunyu Fang[1], Xuechun Wang[1], Yusha Li[2], Tingting Chu[1], Lanxin Zhu[1], Dan Zhu[2], Peng Fei[1,3]; [1]*School of Optical and Electronic Information, Huazhong Univ. of Sci and Tech, China;* [2]*Britton Chance Center for Biomedical Photonics Wuhan National Laboratory for Optoelectronics Huazhong Univ. of Science and Technology, China;* [3]*Shenzhen Huazhong Univ. of Science and Technology Research Inst., China.* We develop a wide-view Bessel light-sheet fluorescence microscopy with 2 μm optical sectioning over 3 mm field of view. It achieves high-resolution, isotropic imaging of large-scale neural structures in mouse brain.

Tu3L • Laser Applications and Technologies—Continued

Tu3L.4 • 16:45
Supercontinuum Laser Based Photoacoustic Approach for Acetylene Gas Sensing, Ramya Selvaraj[1], N J. Vasa[1], Shiva N. S N[1]; [1]*Indian Inst. of Technology, Madras, India.* A broadband photoacoustic gas sensor with solid etalon using supercontinuum laser for acetylene monitoring was characterized. The acetylene concentration was determined to be 330 pptv at a data acquisition time of 10 ms

Tu3L.5 • 17:00
Optical monitoring of nitrous acid (HONO) in ambient air using a continuous-wave quantum cascade laser, Xiaojuan Cui[1], Fengzhong Dong[1], Runqing Yu[1], Zhirong Zhang[1], Hua Xia[1], Pengshuai Sun[1], Luo Han[1], Weidong Chen[2]; [1]*Anhui Inst. of Optics & Fine Mechani, China;* [2]*Université du Littoral Côte d'Opale, France.* An optical instrument based on a quantum cascade laser operating at 8 μm for measurement of atmospheric gaseous HONO was developed. Typical photochemical reactions of HONO have been observed on sunny and snowy days.

Tu3L.6 • 17:15
Linearly Optical Frequency Chirped DFB Laser with Pre-distorted Modulation Waveform for High Resolution FMCW Ranging System, Koichi Iiyama[1], Misaki Isoda[1], Atsushi Nakamoto[1]; [1]*Kanazawa Univ., Japan.* Optical frequency chirp of a DFB laser is linearized by modifying the modulation waveform using an interference signal of an interferometer, and high spatial resolution FMCW ranging system was realized.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Tu3A • Ultrafast Fiber Laser Sources—Continued

Tu3A.6 • 17:30
Hybrid fiber MOPA-bulk amplifier system, Kota Masuda[1], Daichi Fujii[1], Yuki -. Kato[1], Shota Mizuno[1], Yukiko Harada[1], Ayumu Maruyama[1], koji isaku[1], Kazuyoku Tei[1], Shigeru Yamaguchi[1]; [1]*Tokai Univ., Japan.* We report on a hybrid fiber MOPA + solid-state amplifier. The maximum average power from a solid-state amplifier was 10.9 W, and the maximum peak power was 1.0 MW with the spectral width of 0.07 nm.

Tu3A.7 • 17:45
Passively mode-locked Erbium-doped fiber laser using PbS quantum dots deposited on microfiber, Liyuan Liu[1], Xiaolan Sun[1], Wei Zhao[1], Chuanhang Zou[1], Qianqian Huang[1], Chengbo Mou[1], Tingyun Wang[1]; [1]*Key Laboratory of Specialty Fiber Optics and Optical Access Networks, Shanghai Univ., China.* PbS quantum dots (QDs) deposited on microfiber as a new type of saturable absorber is demonstrated in an erbium doped fiber laser. Successfully mode locked pulses with 51.56 dB signal to noise ratio was achieved.

Tu3B • Nonlinear Optical Sources—Continued

Tu3B.4 • 17:30
Hollow-core fiber based mid-IR gas Raman laser with high peak power, Shoufei Gao[1], Ling Cao[1], Zhigang Peng[1], Xiaocong Wang[1], Yingying Wang[1], Pu Wang[1]; [1]*Beijing Univ. of Technology, China.* We report a 2.8 μm gas Raman laser in a methane-filled hollow-core negative-curvature fiber with average power of 113 mW, pulse energy of 113 μJ and estimated peak power of 9.5 MW.

Tu3B.5 • 17:45
Two-color-field Driven Hollow-core Fiber Compressor with Robust Inline Scheme, Yudong Yang[1,2], Liwei Song[1,3], Fabian Scheiba[2,1], Giulio Maria Rossi[2,1], Roland E. Mainz[1], Shaobo Fang[1], Giovannni Cirmi[1,2], Oliver D. Mücke[1,2], Franz Kaertner[1,2]; [1]*Deutsches Elektronen-Synchrotron DESY, Germany;* [2]*The Hamburg Centre for Ultrafast Imaging CUI, Univ. of Hamburg, Germany;* [3]*State Key Laboratory of High Field Laser Physics, Shanghai Inst. of Optics and Fine Mechanics, China.* We present a new scheme of two-color-field driven hollow-core-fiber compression, whose ~1mJ output covers 300 nm to 950 nm supporting sub-cycle pulses of ~2.1 fs duration. The spectral phase is characterized with two-dimensional spectral shearing interferometry.

Tu3C • Infrared and Terahertz Microscopy and Nanoscopy and Their Applications—Continued

Tu3C.5 • 17:30
Evaluation of penetration of cosmetic liquid with Terahertz time-of-flight method, Taiga Morimoto[1], Taihei Kuroda[1], Kenji Sakai[1], Toshihiko Kiwa[1], Keiji Tsukada[1]; [1]*Okayama Univ., Japan.* A terahertz time-of-flight method has been developed to evaluate penetration of cosmetic liquid. By using a face mask as the reservoir of the cosmetic liquid, the evaluation from the horny layers could be realized.

Tu3C.6 • 17:45
Development of in situ methods for battery using a THz chemical microscope, Kentaro Fujiwara[1], Yuki Akiwa[1], Kenji Sakai[1], Toshihiko Kiwa[1], Keiji Tsukada[1]; [1]*Okayama Univ. graduate school, Japan.* It is important to measure the special deviation of electrochemical reactions on electrodes to improve the performance of batteries. Here, electrochemical measurement using THz chemical microscope with a sealed container was applied for measurements.

Tu3D • Nonlinear Wave Mixing and Applications—Continued

Tu3D.3 • 17:30
Pump correlation requirements for four wave mixing-based phase quantization schemes, Aneesh Sobhanan[1], Arjun N. Iyer[1], Aravind P. Anthur[2], Liam P. Barry[2], Deepa Venkitesh[1]; [1]*Indian Inst. of Technology, Madras, India;* [2]*School of Electronic Engineering, Dublin City Univ., Ireland.* We demonstrate the experimental results of phase noise measurements on the coherent addition of signal and conjugate in a four wave mixing-based two-level phase quantizer and illustrate the requirement of the anti-correlation between the pumps.

Tu3D.4 • 17:45
Polarization Insensitive Phase Conjugation Using Single-pump Four Wave Mixing in SOA, Aneesh Sobhanan[1], Lakshmi Narayanan Venkatasubramani[1], R David Koilpillai[1], Deepa Venkitesh[1]; [1]*Indian Inst. of Technology, Madras, India.* We experimentally demonstrate the generation of polarization insensitive phase conjugate of PM-QPSK signal in both input and output ports of SOA using partially degenerate four wave mixing with pump power of only 4 dBm.

Tu3E • Waveguide Devices I—Continued

Tu3E.5 • 17:30
Broadband filtering of the fundamental mode of a few-mode waveguide with a phase-shifted long-period grating, Quandong Huang[1], Wen Wang[2], Wei Jin[1], Kin S. Chiang[1]; [1]*City Univ. of Hong Kong, Hong Kong;* [2]*Univ. of Electronic Science and Technology of China, China.* We design and fabricate a phase-shifted long-period grating in a few-mode waveguide to filter out the fundamental mode. Our experimental device shows a mode extinction ratio larger than 8 dB from 1520 to 1610 nm.

Tu3F • Novel Measurement Methods II—Continued

Tu3F.6 • 17:30
Optical interferometry with transmitted Haidinger fringes through a plane parallel plate, Choonghwan Lee[1], Ju Eun Park[1], Heejoo Choi[1], Jiung Kim[1], Myoungsik Cha[1], Jonghan Jin[2]; [1]*Pusan National Univ., Korea;* [2]*Korea Research Inst. of Standards and Science, Korea.* Hadinger fringes can be observed when a quasi-monochromatic extended source is viewed through a plane parallel plate. We present two applications of Haidinger fringes; measurements of the thickness profiles of glass plates and laser wavelengths.

Tu3F.7 • 17:45
Infrared metrology with visible photons, Leonid A. Krivitsky[1], Anna Paterova[1,2], Hongzhi Yang[1], Chengwu An[1], Dmitry Kalashnikov[1]; [1]*Data Storage Inst., Singapore;* [2]*Nanyang technological Univ., Singapore.* We realize an infrared (IR) metrology technique, which uses only components for the visible range. It relies on nonlinear interference of correlated photons. We show its applications to IR spectroscopy, optical coherence tomography and imaging.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Tu3G • Atom-photon Interaction—Continued

Tu3G.5 • 17:30
Ultrathin Optical Fibers for Probing and Manipulating Neutral Atoms, Thomas Nieddu[1], Krishnapriya S. Rajasree[1], Ratnesh K. Gupta[1], Anjana Krishnadas[1], Tridib Ray[1], Jinjin Du[1], Wenfang Li[1], Sile Nic Chormaic[1]; [1]*Okinawa Inst of Science & Technology, Japan*. We present recent work on the integration of ultrathin optical fibers into a cold ^{87}Rb system, for exploring multiphoton processes and the generation of Rydberg atoms near a dielectric surface.

Tu3G.6 • 17:45
Accurate Determination of the Landé g-Factors for $5s^2\ ^1S_0$ and $5s5p\ ^3P_0$ States of the ^{87}Sr Atom, Benquan Lu[1,2], Yebing Wang[1,2], Qinfang Xu[1], Mojuan Yin[1], Hong Chang[1,2]; [1]*National Time Service Center, China;* [2]*Univ. of Chinese Academy of Sciences, China*. In the ultra-cold ^{87}Sr atomic system, the Zeeman shift of the clock transition was measured with the $\sigma^{\pm}$-polarized interrogation to accurately determine the g-factors of the $5s^2\ ^1S_0$ and $5s5p\ ^3P_0$ states.

Tu3H • Optical Microcavities—Continued

Tu3H.4 • 17:30
Kerr Comb Generation under Weak Dispersion Regime in High-Q Silica Microtoroids, Shun Fujii[1], Ryo Suzuki[1], Minori Hasegawa[1], Takasumi Tanabe[1]; [1]*Keio Univ., Japan*. We experimentally and numerically investigated Kerr comb generation under a weak dispersion regime in high-Q factor silica microtoroids. Higher-order dispersion dominates the Kerr comb at near zero dispersion wavelengths and potentially provides broadband frequency conversion.

Tu3H.5 • 17:45
Tunable Spatiotemporal Soliton Generation in Serially Coupled Dual Micro-Ring Resonators, Lingsong Hong[1], Shaohao Wang[1], Yazhen Zhang[1], Sai Tak Chu[2], Ping Kong A. Wai[3]; [1]*Fuzhou Univ., China;* [2]*City Univ. of Hong Kong, Hong Kong;* [3]*The Hong Kong Polytechnic Univ., Hong Kong*. We present an inter-ring detuning control scheme to generate spatiotemporal soliton in symmetric serially coupled dual micro-ring resonators. By using our proposed model, we numerical demonstrate tunable different orders solitons generation form identical initial state.

Tu3I • Fiber Technologies and Applications—Continued

Tu3I.4 • 17:45
Photodarkening of ytterbium-doped large-mode-area photonic crystal fiber, Yun Chen[1], Guiyao Zhou[1], Yang Xiao[1], Teng wang[1], Haixia Fan[1], Xian Wang[1], Jiantao Liu[1], Luyao Zhu[1], Mengmeng Zhu[1], Zhiyun Hou[1]; [1]*School of Information and Optoelectronics Science and Engineering, South China Normal Univ., China*. We investigate the temporal evolution of photodarkening effect in ytterbium-doped large-mode-area photonic crystal fiber and discuss its mechanism. The results show the great influence of photodarkening on lasing properties.

Tu3J • Nonlinear Plasmonics and Metamaterials—Continued

Tu3J.6 • 17:30 Invited
Quantum Entanglement of Surface Plasmons, Xifeng Ren[1], Yong-Jing Cai[1], Ming Li[1], Yang Chen[1], Guang-Can Guo[1]; [1]*Key laboratory of quantum information, China*. Here we introduce our recent works on quantum plasmonics: plasmon on-chip quantum interference, generation and propagation of plasmon entanglement and two-plasmon N00N state in a nanoscale waveguide. Our works can bridge nanophotonics and quantum optics.

Tu3K • Biophotonics and Applications II—Continued

Tu3K.5 • 17:30
Integration of photonic crystal and magnetic bead aggregation technique for fluorescence enhancement, Yang Chen[1], Ying-Bin Wang[1], Lin-Yun Su[1], Ching-Shu Fu[1], Cheng-Yeh Huang[1], Cheng-Sheng Huang[1], Wensyang Hsu[1]; [1]*National Chiao Tung Univ., Taiwan*. We combine photonic crystal and magnetic beads aggregation enhanced fluorescence for extremely sensitive detection of biomolecules in bead-based assay format. The limit of detection for Interleukin 1β can achieve 100 ag/ml.

Tu3K.6 • 17:45
3D super resolution microscopy in Multicellular tissues, Rong Chen[1], Yuxuan Zhao[1], Yarong Wang[1], Peng Fei[1,2]; [1]*Huazhong Univ. of Sci and Tech, China;* [2]*Shenzhen Huazhong Univ. of Science and Technology Research Inst., China*. We combined Bessel light sheet microscopy with Bayesian analysis of bleaching and blinking(3B) method to achieve multicellular volumetric imaging. This technology offers low-background, 3D super resolution imaging in thick scattering tissues and organisms.

Tu3L • Laser Applications and Technologies—Continued

Tu3L.7 • 17:30
Non-uniform Optical Phased Array Optimized with Genetic Algorithm, TianHua Lin[1,3], Tao Chu[2]; [1]*Inst. of Semiconductors, China;* [2] *Zhejiang Univ., China;* [3]*Univ. of Chinese Academy of Sciences, China*. An optical phased array with 32 Gaussian beam emitters was optimized with genetic algorithm. The side mode suppression deteriorates with the decrease of the beam waist radius and the increase of the steering angle.

Tu3L.8 • 17:45
Laser Architectures for Space-Based Sodium Resonance Fluorescence Lidar, Anthony W. Yu[1], Steven X. Li[1], Michael A. Krainak[1], Yingxing Bai[1], Oleg Konoplev[2], Molly E. Fahey[1], Kenji Numata[1], Diego Janches[1]; [1]*NASA Goddard Space Flight Center, USA;* [2]*SSAI, USA*. NASA GSFC is developing a space-based sodium resonance fluorescence lidar for the International Space Station (ISS). We discuss the technology, prototypes, risks and trades for two laser architectures - Raman laser and sum frequency generation.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

08:00–18:00 Registration, *S221 Foyer of HKCEC*

08:30–10:00
W1A • Power Scaling of Lasers
Presider: Anting Wang; Univ. of Sci & Tech of China, China

W1A.1 • 08:30 Invited

Coherent Beam Combining of Fiber Lasers, Arno Klenke[1,2], Michael Müller[1], Henning Stark[1], Andreas Tünnermann[1,3], Jens Limpert[1,2]; [1]*Friedrich-Schiller-Univ. Jena, Germany;* [2]*Helmholtz-Inst. Jena, Germany;* [3]*Fraunhofer Inst. of Applied Optics and Precision Engineering, Germany.* Coherent beam combination has been established as a performance scaling concept for laser systems to overcome limitations of a single emitter. Today, the most powerful femtosecond fiber lasers employ his technique.

W1A.2 • 09:00

Reinforcement Learning for Coherent Beam Combining, Henrik Tuennermann[1], Akira Shriakawa[1]; [1]*Univ. of Electro-Communications, Japan.* Reinforcement learning has been shown to be capable of solving complex tasks. Here we show potential advantages and disadvantages in the context of phase control for coherent beam combining.

08:30–10:00
W1B • Nonlinear Optics in Microresonators
Presider: Kuijuan Jin; Chinese Academy of Sciences, China

W1B.1 • 08:30 Tutorial

Whispering-gallery-mode Resonators and Their Applications for Nonlinear Optics, Lan Yang[1]; [1]*Washington Univ. in St Louis, USA.* I will discuss the fundamental physics, such as parity-time symmetry and exceptional points, in whispering-gallery-mode resonators, which can be used to achieve a new generation of nonlinear optical systems enabling unconventional control of light flow.

08:30–10:00
W1C • Infrared Fibers & Materials and Their Applications
Presider: Cheng Wang; Harvard Univ., USA

W1C.1 • 08:30 Invited

Thulium fiber lasers – the Modulation Instability and future high power scaling, Martin Richardson[1,2], Alex Sincore[1], Don Jin Shin[1], Justin Cook[1], Joshua Bradfiord[1], Nathan Bodnar[1]; [1]*Univ. of Central Florida, CREOL, USA;* [2]*School of Electrical & Electronic Engineering, Nanyang Technology Univ., Singapore.* A new examination of Tm fiber laser concepts and the interplay of non-linear thermal and optical effects, open promising avenues of investigation that should lead to effective power scaling of mid-IR sources in the future.

W1C.2 • 09:00 Invited

Nano-structured Optical Metasurfaces and Multi-material Fibers for IR Applications, Fabien Sorin[1], Tapajyoti Das Gupta[1], Wei Yan[1], Louis Martin-Monier[1], Tung Nguyen-Dang[1], Alexis G. Page[1], Yunpeng Qu[1]; [1]*Inst. of Materials, Ecole Polytechnqiue Fédérale de Lausanne (EPFL), Switzerland.* We will show how controlling the fluid dynamics of glasses and polymers can result in the scalable fabrication of optical metasurfaces and multimaterial fibers. Some applications in the IR region will also be discussed

08:30–10:00
W1D • Machine Learning and Neural Networks in Photonics
Presider: Lilin Yi; Shanghai Jiao Tong Univ., China

W1D.1 • 08:30 Invited

Coherent Ising Machine - Optical Neural Network operating at the Quantum Limit -, Yoshihisa Yamamoto[2,1]; [1]*Stanford Univ., USA;* [2]*Japan Science and Technology Agency, Japan.* We will present the basic concept, operational principle and experimental performance of a novel computing machine with the network of degenerate optical parametric oscillators. The developed machine has 2048 qubits with all-to-all connections.

W1D.2 • 09:00

Bit-Error Rate Performance on Depth of Learning in BPSK Label Processing Using Complex-Valued Neural Network, Kazumasa Ishihara[1], Hiroki Nakagawa[1], Hiroki Kishikawa[1], Nobuo Goto[1]; [1]*Tokushima Univ., Japan.* Bit-error rate performance of the BPSK-label processing optical neural network is numerically evaluated. As a result, the noise tolerance for the incident labels is improved by reducing the learning depth for weights.

08:30–10:00
W1E • Laser Additive Manufacturing
Presider: Wei Xiong; Wuhan National Lab for Optoelectronics, China

W1E.1 • 08:30 Invited

Fabrication of Metal Matrix Composites by Laser Additive Manufacturing, Zhuo Li[1], Dong Liu[1], Xiangjun Tian[1], Huaming Wang[1]; [1]*Beihang Univ., China.* Varieties of metal matrix composites were prepared by laser additive manufacturing. The stable and high energy density heat source provided by laser is suitable for the manufacture of intractable, refractory metal or metal matrix composite components.

W1E.2 • 09:00

Laser writing of nanostructures deep inside Gallium Arsenide (GaAs), Onur Tokel[1], Ahmet Turnali[1], Petro Deminskyi[1], Serim Ilday[1], F. Ömer Ilday[1]; [1]*Bilkent Universitesi, Turkey.* Recently, we have showed a direct laser writing method that enables the first subsurface modifications and functional devices created deep inside silicon. Here, we extend the technique demonstrating the first controlled subsurface nanostructures in GaAs.

08:30–10:00
W1F • Silicon Hybrid Integration
Presider: Hon Tsang; The Chinese Univ. of Hong Kong, Hong Kong

W1F.1 • 08:30

Hot-wire CVD a-Si:H for low loss silicon photonic waveguides, Swe Z. Oo[1,2], Antulio Tarazona[1], Rafidah Petra[2], Ali Khokhar[1], Graham Reed[1], Anna C. Peacock[1], Harold M. Chong[2]; [1]*Optoelectronics Research Centre, Univ. of Southampton, UK;* [2]*School of Electronics and Computer Science, Univ. of Southampton, UK.* We demonstrate low temperature hot-wire chemical vapor deposition of low loss a-Si:H wire waveguides. We achieved propagation loss of 0.65 dB/cm at TE polarized 1.55 μm wavelength for waveguides deposited at 230 °C.

W1F.2 • 08:45 Invited

O-band InAs Quantum Dot Light Sources Monolithically Grown on Si, Shu Pan[1], Mengya Liao[1], Zizhuo Liu[1], Ying Lu[1], Victoria Cao[1], Mingchu Tang[1], Jae-Seong Park[1], Jiang Wu[1], Siming Chen[1], Alwyn Seeds[1], Huiyun Liu[1]; [1]*Univ. College London, UK.* We discuss our recent progress made in the direct growth of 1.3 μm InAs/GaAs quantum dot (QD) light-emitting sources on Si substrates for Si photonics.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

08:00–18:00 Registration, *S221 Foyer of HKCEC*

08:30–10:00
W1G • High Power Fiber Laser
Presider: Pu Zhou; National Univ. of Defense Tech., China

W1G.1 • 08:30 Tutorial
High Power Fiber Lasers, Johan Nilsson[1]; [1]*Univ. of Southampton, UK.* Abstract not available.

08:30–10:00
W1H • Optical Metasurfaces I
Presider: Xiangping Li; Jinan Univ., China

W1H.1 • 08:30 Tutorial
A revolution towards multitasking metasurfaces, Erez Hasman[1], Elhanan Maguid[1], Bo Wang[1], Michael Yannai[1], Arkady Faerman[1], Vladimir Kleiner[1]; [1]*Technion-Israel Inst. of Technology, Israel.* The shared-aperture concept and the geometric phase phenomenon were incorporated within a metasurface to obtained photonic spin-control multifunctional devices. The shared-aperture metasurface platform opens a pathway to novel types of nanophotonic functionality.

08:30–10:00
W1I • Advanced Signal Modulation
Presider: Xian Zhou; Univ. of Science and Technology Beijing, China

W1I.1 • 08:30 Invited
High-speed Faster Than Nyquist Optical Transmission, Fan Zhang[1], Yixiao Zhu[1], Pengfei Wang[1], Chuanchuan Yang[1]; [1]*Peking Univ., China.* Faster-than-Nyquist (FTN) signaling is discussed both theoretically and experimentally. Several schemes of FTN signal generation and reception are compared with emphasize on high-speed transmission with 16-QAM format.

W1I.2 • 09:00
Simple Propagation Model for Nonlinear Fourier Transform (NFT) based Transmission, Wenqi Zhang[1], Tony Gui[2], Chao Lu[2], Tanya Monro[1], Alan Lau[2], Shahraam Afshar V[1], Terence Chan[1]; [1]*Univ. of South Australia, Australia;* [2]*The Hong Kong Polytechnic Univ., Hong Kong.* NFT-based approach for fibre optic transmission was recently proposed, aiming at achieving rate beyond the linear capacity limit. This paper simplifies the signal propagation model and characterises the effects of noises in NFT transmissions.

08:30–10:00
W1J • Integrated Sources I
Presider: T. Wang; Univ. of Sheffield, UK

W1J.1 • 08:30 Invited
Circular-side Polygonal Microcavity Semiconductor Lasers, Yong-Zhen Huang[1,2]; [1]*Inst. of Semiconductors, Chinese Academy of Sciences, China;* [2]*Univ. of Chinese Academy of Sciences, China.* Stable dual-mode lasing deformed square microcavity lasers and single mode deformed hexagonal microlasers are reported, where flat-sides are replaced by circular sides for enhancing mode Q factors due to the reduction of vertex radiation loss.

W1J.2 • 09:00
Multi-channel interference widely tunable semiconductor laser with a compact and efficient shallow-deep transition, Quanan Chen[1], Chun Jiang[1], Xiang Ma[1], Qiaoyin Lu[1], Weihua Guo[1]; [1]*Huazhong Univ. of S&T, China.* Multi-channel interference laser with a compact and efficient shallow-deep transition was fabricated, achieving around 22 mA threshold currents, > 40 nm tuning range covering C band, > 40 dB SMSRs.

08:30–10:00
W1K • Biophotonics and Applications III
Presider: Peng Xi; Peking Univ., China

W1K.1 • 08:30 Invited
LED-based spectrophotometry, Marco Marsan[1], Massimiliano Lucidi[1], Gabriella Cincotti[1]; [1]*Univ. Roma Tre, Italy.* We demonstrate that accurate spectrophotometric measurements can be achieved using low-cost LED-based devices, using a geometrical-optics approach and real-time image processing.

W1K.2 • 09:00 Invited
Objective Assessment of Surgical Skill with fNIRS, Xavier Intes[1], Arun Nemani[1], Suvranu De[1]; [1]*Rensselaer Polytechnic Inst., USA.* We present an advanced optical neuroimaging methodology that can objectively and successfully classify subjects with different expertise levels associated with surgical within the framework of the Fundamentals of Laparoscopic Surgery program.

08:30–10:00
W1L • Integrated Microwave Photonics I
Presider: Ming Li; Inst. of Semiconductor, CAS, China

W1L.1 • 08:30 Tutorial
Integrated Photonic Circuits for Microwave Photonics, Jianping Yao[1]; [1]*Univ. of Ottawa, Canada.* Photonic integrated circuits for microwave photonic signal generation and processing based on three materials systems are reviewed. The challenges and impact of new advances for short and long term applications in communications and information processing are discussed.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W1A • Power Scaling of Lasers—Continued

W1A.3 • 09:15
High power single-frequency VECSEL platform for AMO physics, Jussi-Pekka Penttinen[1,2], Shaun C. Burd[3], Sanna Ranta[1], David T. Allcock[3], Mika Mäki[1], Emmi Kantola[1], Dietrich Leibfried[3], Mircea Guina[1,2]; [1]*Optoelectronics Research Centre, Tampere Univ. of Technology, Finland;* [2]*Vexlum Ltd, Finland;* [3]*Time and Frequency Division, Ion Storage Group, National Inst. of Standards and Technology, USA.* We report high power single-frequency vertical external-cavity surface-emitting lasers (VECSELs) for applications in atomic, molecular and optical (AMO) physics. The laser platform is wavelength versatile, delivering watt-level output between 920 nm to 1260 nm in single-mode.

W1A.4 • 09:30
2.5 kW narrow linewidth fiber amplifier with white noise signal phase modulated seed, Chu Q. Chu[1,2], Yi Shi[1], Jing Wen[1], Lie Ouyang[1], Lei Zhao[2], Jianjun Wang[1], Honghuan Lin[1], Feng Jing[1]; [1]*China Academy of Engineering Physics, China;* [2]*Engineering Physics, Tsinghua Univ., China.* The fiber laser system with white noise signal phase modulated seed is optimized. Based on the theoretical results, a fiber laser with 54 GHz linewidth, 2.5 kW output power and near-diffraction-limited beam quality is obtained.

W1A.5 • 09:45
Power scaling, passive Q-switching and intracavity frequency doubling of blue-diode-pumped Pr^{3+}:YLF laser, Shogo Fujita[1], Hiroki Tanaka[1], Fumihiko Kannari[1]; [1]*Keio Univ., Japan.* We demonstrate a blue-diode-pumped Pr^{3+}:YLF laser. The output power of 6.7 W is obtained at 640 nm. The laser is extended to passive Q-switching and its intracavity second harmonic generation with a Co^{2+}:$MgAl_2O_4$ saturable absorber.

W1B • Nonlinear Optics in Microresonators—Continued

W1B.2 • 09:30
Inter-mode breather solitons in optical microresonators, Hairun Guo[1], Erwan Lucas[1], Martin H. Pfeiffer[1], Maxim Karpov[1], Tobias J. Kippenberg[1]; [1]*École polytechnique fédérale de Lausanne, Switzerland.* We demonstrate a novel type of breather solitons triggered by avoided mode crossings that are ubiquitous phenomena in multi-mode optical microresonators, which was termed as intermode breather soliton.

W1B.3 • 09:45
Soliton trapping in a Kerr microresonator with orthogonally polarized dual-pumping, Ryo Suzuki[1], Shun Fujii[1], Atsuhiro Hori[1], Takasumi Tanabe[1]; [1]*Keio Univ., Japan.* We study soliton trapping between orthogonally polarized solitons inside a microresonator by using dimensionless coupled LLEs. We reveal the trapping conditions, which depend on the FSR difference, second order dispersion, and input field.

W1C • Infrared Fibers & Materials and Their Applications—Continued

W1C.3 • 09:30
Low EML, large effective area, and high power fraction performance in THz propagation with porous core PCF, Li Xia[1], Udaya S. Rahubadde[1], Nishan Wu[1]; [1]*School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China.* We designed a porous core PCF with tetrahedral hole for THz with specific model property and improved essential performance parameters. The fiber is feasible to build with aid of prevailing state of the art fabrication.

W1C.4 • 09:45
Withdrawn.

W1D • Machine Learning and Neural Networks in Photonics—Continued

W1D.3 • 09:15
Prediction Performance of Reservoir Computing Using a Semiconductor Laser with Double Optical Feedback, Guang-Qiong Xia[1], Yu-Shuang Hou[1], Zheng-Mao Wu[1]; [1]*Southwest Univ., China.* A reservoir computing system is proposed, and its prediction performance is investigated numerically. The results indicate that, through optimizing parameters, predication with Gb/s rate and normalized mean square error below 3% can be realized.

W1D.4 • 09:30 Invited
Reinforcement Learning in a Large Scale Photonic Network, Sheler Maktoobi[2], Louis Andreoli[2], Laurent Larger[2], Maxime Jacquot[2], Daniel Brunner[1]; [1]*CNRS - FEMTO-ST, France;* [2]*FEMTO-ST, Univ. Bourgogne Franche-Comté, France.* We experimentally create a neural network, implementing 2025 connections in parallel. We numerically validate the scheme for at least 34000 photonic neurons. We demonstrate photonic efficiently converging reinforcement learning, prediction a chaotic signal with.

W1E • Laser Additive Manufacturing—Continued

W1E.3 • 09:15 Invited
Chemical Advances for 3D Laser Nano-Printing, Christopher Barner-Kowollik[1,2]; [1]*School of Chemistry, Queensland Univ. of Technology, Australia;* [2]*Inst. for Polymer Chemistry, Karlsruhe Inst. of Technology, Germany.* The lecture will highlight the most recent chemical advances in 3D laser lithography including aspects of super resolution lithography, substractive lithography and multi-material printing.

W1E.4 • 09:45
Performance improvement and add-on functionalities to conventional lateral-flow devices using a laser direct-write patterning technique, Collin L. Sones[1], Peijun He[1], Ioannis N. Katis[1], Robert W. Eason[1]; [1]*Optoelectronic Research Center, UK.* We report the use of a laser direct-write technique for modification of a conventional lateral-flow device that not only enables enhanced sensitivity and limit of detection, but also allows multiplexing detection within a single device.

W1F • Silicon Hybrid Integration—Continued

W1F.3 • 09:15
C/L-band InAs QDs on CMOS compatible Ge and on-axis Si (001) platform, Ting Wang[1], Jianjun Zhang[1]; [1]*Inst. of Physics, CAS, China.* In recent years, the growing demand for silicon based light sources has boosted the research field of III-V/IV hybrid lasers. Here, the C/L-band light emission (1.53 μm-1.63 μm) of InAs/$In_{0.25}Ga_{0.75}As$ quantum dots (QDs) epitaxially grown on CMOS-compatible Ge and U-shape Si (001) substrates by solid-source molecular beam epitaxy (MBE) are reported.

W1F.4 • 09:30 Invited
3D Hybrid Integration for Silicon Photonics, Jonathan Klamkin[1], Bowen Song[1]; [1]*Electrical and Computer Engineering Department, Univ. of California Santa Barbara, USA.* 3D hybrid integration for silicon photonics is based on flip-chip bonding and vertical coupling. The benefits of this approach will be discussed in comparison to other laser integration approaches.

10:00–10:30 Coffee Break

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W1G • High Power Fiber Laser—Continued

W1G.2 • 09:30
Generation of Megawatt Peak-power Femtosecond Pulses from an Excessive-Normal-Dispersion Fiber Laser, Wu Liu[1], Jintao Fan[1], Ruoyu Liao[1], Jiahua Cui[1], Chen Xie[1], Chingyue Wang[1], Ming-lie Hu[1]; [1]*Tianjin Univ., China.* We demonstrate a passively mode-locked fiber laser with excessive normal dispersion (ENDi) yielding 230 nJ pulses with 69 fs dechirped duration. Numerical simulation indicates the energy scalability to over 1 μJ is possible.

W1G.3 • 09:45
Compact, 200 MW Peak Power, 1 μm Source With All-fiber Front-End, Yizhou Liu[2,1], Peter Krogen[3], Damian Schimpf[2,4], Guoqing Chang[2,1], Phillip Keathley[3], Franz X. Kärtner[3]; [1]*Hamburg Univ., Germany;* [2]*DESY, Germany;* [3]*MIT, USA;* [4]*Hamburg Center for Ultrafast Imaging, Germany.* We report on a 1.035-μm, all-fiber, femtosecond chirped pulse amplifier with 55 uJ pulse energy, 1 MHz repetition rate, producing 800 ps chirped pulses. The output is compressed to 245 fs, 1.3x its transform limit.

W1H • Optical Metasurfaces I—Continued

W1H.2 • 09:30 Invited
Flat optis with metasurfaces, Federico Capasso[1], Yao-Wei Huang[1,2], Noah A. Rubin[1], Antonio Ambrosio[3], Robert C. Devlin[4], Cheng-Wei Qiu[2]; [1]*Harvard John A. Paulson School of Engineering and Applied Sciences, Harvard Univ., USA;* [2]*Dept. of Electrical and Computer Engineering, National Univ. of Singapore, Singapore;*[3]*Center for Nanoscale Systems, Harvard Univ., USA;* [4]*Metalenz Inc., USA.* Q-plates based on liquid crystals have been widely used in quantum optics and novel communication schemes. Here a far more general spin to orbital angular momentum scheme is demonstrated based on a novel optical elements (J-plates) not limited to conjugate converted states, which are used to generate new complex structured light. By cascading J plates we show additional light manipulation functionalities.

W1I • Advanced Signal Modulation—Continued

W1I.3 • 09:15
Real-Time Single Threshold PAM-4 Demodulation Scheme, Hanlin Feng[1]; [1]*Shanghai Jiao Tong Univ., China.* Complex three threshold decision circuit used to be a standard decoder for PAM-4 signal. We have experimentally demonstrated a novel single threshold demodulation scheme to real-time decode PAM-4 signal.

W1I.4 • 09:30
Employment of Multi-layer Neural Network for Channel Equalization in 4x50-Gb/s PAM4 Signal Transmission over 80-km SSMF, Xiaoxiao Dai[1], Xiang Li[1], Ming Luo[1]; [1]*State Key Laboratory of Optical Communication Technologies and Networks, China.* A four-layer artificial neural network is designed for non-linearity compensation under two different system configurations. It achieved 4x50-Gb/s PAM-4 IM/DD transmission for 80-km fiber with 4dB power sensitivity improvement over conventional algorithms.

W1I.5 • 09:45
The Influence of Laser Linewidth on Optical SSB Nyquist PAM-4 and Direct-detection Transmission Systems, Jing Zhang[1], Mingyue Zhu[1], Xingwen Yi[1], Kun Qiu[1]; [1]*Univ of Electronic Science & Tech China, China.* We study the influence of the laser linewidth on an optical SSB PAM-4 and direct-detection transmission systems at C-band by simulation and experiment. The 56-Gb/s PAM-4 signal successfully transmits over 800-km SSMF under 7% HD-FEC with 50-kHz laser linewidth

W1J • Integrated Sources I—Continued

W1J.3 • 09:15
Monolithic Integrated High-frequency, High-brightness Perovskite Quantum Dots Multicolor Photonic Sources Coupled with Hyperbolic Metamaterials, Feiliang Chen[1], Qian Li[1], Mo Li[1], Hui Zhang[1], Feng Huang[1], Shuxiao Li[1], Jian Zhang[1]; [1]*Microsystem & Terahertz Research Center, China.* The fluorescence intensity and spontaneous emission rate of perovskite quantum dots with different emission wavelength are enhanced by monolithic hyperbolic metamaterials, which provides a powerful way for monolithic integrated high-frequency, high-brightness perovskite multi-color photonic sources

W1J.4 • 09:30
Full C+L-Band, Mode-hop-free Wavelength Tunable Laser Diode with a Linewidth of 8 kHz and a RIN of -130 dB/Hz, Keisuke Kasai[1], Masataka Nakazawa[1], Yasunori Tomomatsu[2], Takashi Endo[2]; [1]*Tohoku Univ., Japan;* [2]*Koshin Kogaku Co., Ltd, Japan.* We demonstrate a wavelength tunable laser diode with a linewidth of less than 8 kHz and a RIN below -130 dB/Hz. The oscillation wavelength can be tuned over the full C+L-band (90-nm) without mode hopping.

W1J.5 • 09:45
Tunable Single-Mode Half-Wave Coupled Laser Using Two Back-to-Back Corner-Connected TIR Reflectors, Jia Guo[1], Xiaolu Liao[1], Jian-Jun He[1]; [1]*College of Optical Science and Engineering, Zhejiang Univ., China.* We report the design concept and experimental results of a tunable half-wave coupled-cavity laser using two back-to-back corner-connected total internal reflection reflectors. A wide tuning range of 26.4nm is achieved with 40dB SMSR.

W1K • Biophotonics and Applications III—Continued

W1K.3 • 09:30
Isotropic super-resolution imaging of thick samples with multi-view sub-voxel-resolved light-sheet microscopy, Junyu Ping[1], Fang Zhao[1], Sa Liu[1], Yusha Li[2], Dan Zhu[2], Peng Fei[1,3]; [1]*School of Optical and Electronic Information Huazhong Univ. of Science and Technology, China;* [2]*Britton Chance Center for Biomedical Photonics Wuhan National Laboratory for Optoelectronics Huazhong Univ. of Science and Technology, China;* [3]*Shenzhen Huazhong Univ. of Science and Technology Research Inst., China.* We present a multi-view super-resolved light-sheet fluorescence microscopy to enable high-throughput 3-D reconstruction of thick-and-scattering samples, with deteriorated signals recovered and isotropic super-resolution achieved.

W1K.4 • 09:45
A multiscale optical coherence tomography for skin imaging in vivo, Xiaojun Yu[1], Chi Hu[1], Qianshan Ding[2], Ganggang Mu[3], Yunchao Deng[3], Honggang Yu[3], Linbo Liu[2]; [1]*Northwestern Polytechnical Univ., China;* [2]*School of Electrical and Electronic Engineering, Nanyang Technological Univ., Singapore;* [3]*Dept. of Gastroenterology, Remin Hospital of Wuhan Univ., Wuhan,, China.* We report a multiscale optical coherence tomography (OCT) system that is capable of providing three-dimensional (3D) human skin imaging *in vivo* both cellular-level resolution mode and large area scanning mode.

W1L • Integrated Microwave Photonics I—Continued

W1L.2 • 09:30 Invited
Monolithic and Heterogeneous Microwave/Millimeter-wave Photonic Integrated Circuits, Guillermo Carpintero[1], Robinson Guzmán[1], Mu-Chieh Lo[1], Muhsin Ali[1], Alberto Zarzuelo Garcia[1], Luis Enrique García-Muñoz[1], Daniel Segovia[1], David De Felipe[2], Norbert Keil[2]; [1]*Universidad Carlos III de Madrid, Spain;* [2]*Photonics Components Dept., Fraunhofer Heinrich Hertz Inst., Germany.* Among the photonic techniques to generate RF signals, optical heterodyning ispreferred for wide frequency tuning. It combines two single wavelength laser sources, which behave as uncorrelated sources, afecting the sability of the generated signal. Two integration approaches are investigated, monolithic InP and heterogeneous In/Polymer.

10:00–10:30 Coffee Break

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

10:30–12:30
W2A • Advanced Laser Sources I
Presider: Sze Set; Univ. of Tokyo, Japan

W2A.1 • 10:30 Invited
High-Energy VUV Generation in Gas-Filled Hollow Capillary Fibers, John C. Travers[1], Teodora Grigorova[1], Federico Belli[1]; [1]*Heriot-Watt Univ., UK.* We show that soliton dynamics scale to millijoule energies in simple hollow capillary fibers. We numerically model sub-femtosecond pulse self-compression, and experimentally demonstrate high-brightness multiple-μJ-scale ultraviolet (115-330 nm) pulse generation.

W2A.2 • 11:00
Multiple Wavelength Mode-Locked Laser with Control of Temperature Gradient for Sixth Harmonic Generation, Aleksej Rodin[1,2], Andrejus Michailovas[1,2]; [1]*Center for Physical Sciences and Technology, Lithuania;* [2]*Ekspla Ltd, Lithuania.* Fundamental 1342 nm radiation of mode-locked Nd:Vanadate laser was converted to 224 nm wavelength with an average power of ~ 1 W by control of temperature gradient applied to BBO crystal. The laser also provides 1342 nm, 671 nm and 447 nm output with an average power of 10 W, 6 W and 4 W at 300 kHz.

10:30–12:30
W2B • Nonlinear Dynamics in Waveguides and Harmonic Generation
Presider: Lan Yang; Washington Univ. in St Louis, USA

W2B.1 • 10:30 Invited
Evolution of Structural Distortion in BiFeO3 Thin Films and the phase transition in BaTiO3 Probed by Second-harmonic Generation, Kuijuan Jin[1]; [1]*Chinese Academy of Sciences, China.* We report an initial state determined phase transition in barium titanate and the phase transition in BaTiO3 by applying second harmonic generation technology and piezoresponse force microscopy.

W2B.2 • 11:00
Light Emission Redistribution Owing to Nonlinearity in ITO/$LiNbO_3$, Jingwen Zhang[1], Dewang Huo[1], Chao Wang[1], Hua Zhao[1]; [1]*Harbin Inst. of Technology, China.* UV and short wave visible emission enhancement was observed from indium-tin-oxide coated y-cut Fe:$LiNbO_3$, suggesting nonlinearity plays a role due to interface plasmon polaritons were excited in electrostatic modified nanometric layer of free electron gas.

10:30–12:30
W2C • Infrared Ultrafast Subcycle Subwavelength Photonics
Presider: Martin Richardson; Univ. of Central Florida, CREOL, USA

W2C.1 • 10:30 Tutorial
Subcycle Quantum Physics, Alfred Leitenstorfer[1]; [1]*Univ. of Konstanz, Germany.* Operating out of a time-domain perspective provides new insights into the quantum physics of light and matter. Important ingredients include access to extreme nonequilibrium states and a lack of energy conservation on subcycle timescales.

10:30–12:30
W2D • Optical Signal Processing Based on Integrated Devices
Presider: Jian Wang; Huazhong Univ of Science and Technology, China

W2D.1 • 10:30 Invited
Optical Signal Processing in Silicon-Based Integrated Devices, Cosimo Lacava[1], Thalia Dominguez Bucio[1], Ali Khokhar[1], Francesca Parmigiani[1], Frederic Gardes[1], David J. Richardson[1], Marc Sorel[2], Periklis Petropoulos[1]; [1]*Univ. of Southampton, UK;* [2]*Univ. of Glasgow, UK.* We discuss the latest progress on the development of all-optical signal processing devices in Si-based platform. We discuss the realization of intra and inter-modal wavelength-converters by using our internally developed si-rich-silicon nitride platform.

W2D.2 • 11:00 Invited
An ISI-aware Design Process for SiP Modulators, Leslie Rusch[1], Hassan Sepehrian[1], Jiachuan Lin[1], Wei Shi[1]; [1]*Universite Laval, Canada.* Maximizing the bit rate of optical components implies operation in a bandwidth limited regime where communications are vulnerable to intersymbol interference. We provide guidelines for the design of modulators to mitigate this impairment.

10:30–12:30
W2E • Ultra-fast Laser Machining and Processing
Presider: Christopher Barner-Kowollik; Queensland Univ. of Technology, Australia

W2E.1 • 10:30 Invited
Femtosecond Laser LIPSS of Copper: Modeling and Experimental Comparison, Chung-Wei Cheng[1], Chin-Lun Chang[1], Jinn-Kuen Chen[2]; [1]*National Chiao Tung Univ., Taiwan;* [2]*Univ. of Missouri, USA.* The numerical values of FLPISS on copper obtained through our proposed method were in fairly good agreement with the experimental data from different femtosecond laser pulses, e.g. 1030 nm and 515 nm.

W2E.2 • 11:00 Invited
Picosecond laser filamentation in sapphire for precision machining, Lingfei Ji[1]; [1]*Beijing Univ. of Technology, China.* Picosecond laser filamentation in sapphire for precision machining were studied. The unique ability to create targeted filament traces in the material with high refractive index and provide fine cut structures based on the nonlinear effect was presented.

10:30–12:30
W2F • Optical Devices for Precision Measurements
Presider: Kenneth Kin-Yip Wong; Univ. of Hong Kong, Hong Kong

W2F.1 • 10:30 Invited
Microresonator Soliton Frequency Combs, Tobias J. Kippenberg[1], Hairun Guo[1], Martin H. Pfeiffer[1], John Jost[1], Erwan Lucas[1], Maxim Karpov[1], Junqiu Liu[1], Miles Anderson[1], Arslan Raja[1], Bahareh Ghadiani[1], Anton Lukashchuk[1], Wenle Weng[1], Romain Bouchand[1], Jia-Jung Ho[1], Michael Geiselmann[1]; [1]*IPHYS, Ecole Polytechnique Federale de Lausanne, Switzerland.* Microresonator frequency combs provide access to compact, photonic-integrated optical comb with large mode spacing operating in a soliton regime. We will discuss the physics of such solitons and their applications in telecommunication and distance measurements.

W2F.2 • 11:00
High-Resolution Spectroscopy using A Tunable Dissipative Kerr Soliton Microcomb, Yong Geng[1], Heng Zhou[1], Baojian Wu[1], Kun Qiu[1]; [1]*Univ of Electronic Science & Tech China, China.* We demonstrate interval-free frequency comb spectroscopy using a tunable dissipative Kerr soliton microcomb, and 5 MHz spectral resolution is achieved—the highest ever reported for Kerr comb based spectroscopy measurements.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

10:30–12:30
W2G • Quantum Information Processing I
Presider: Shengwang Du; Hong Kong Univ of Science & Technology, Hong Kong

W2G.1 • 10:30 Invited
Seeing a Single Atom Where It Is Not, Gabriel Araneda[3], Stefan Walser[1], Yves Colombe[3], Daniel Higginbottom[3,4], Jürgen Volz[1], Rainer Blatt[3], Arno Rauschenbeutel[1,2]; [1]*Atominstitut, TU Wien, Austria;* [2]*Institut für Physik, Humboldt-Universität zu Berlin, Germany;* [3]*Institut für Experimentalphysik, Universität Innsbruck, Austria;* [4]*Centre for Quantum Computation and Communication Technology, The Australian National Univ., Australia*. We demonstrate that spin-orbit coupling of light can lead to fundamental wavelength-scale errors in optical precision localization of sub-wavelength scale emitters using far-field optical imaging techniques. The effect occurs even for perfect, aberration-free imaging.

W2G.2 • 11:00
Generation, storage and processing of photons in a multimode quantum memory, Michal Parniak[1], Mateusz Mazelanik[1], Adam Leszczynski[1], Michal Dabrowski[1], Michal Lipka[1], Wojciech Wasilewski[1]; [1]*Univ. of Warsaw, Poland*. A quantum memory based on a cold atomic ensemble is demonstrated to process collective excitations in thousands of modes. Efficient photon coupling together with versatile manipulation techniques pave the way towards a universal photonic switch.

10:30–12:30
W2H • Optical Metasurfaces II
Presider: Xiangping Li; Jinan Univ., China

W2H.1 • 10:30 Invited
New Nano-photonics Based on vdW Materials, Antonio Ambrosio[1], Michele Tamagnone[2], Kundan Chaudhary[2], Luis A. Jauregui[3], Philip Kim[3], William Wilson[1], Federico Capasso[2]; [1]*Center for Nanoscale Systems, Harvard Univ., USA;* [2]*Harvard John A. Paulson School of Engineering and Applied Sciences, USA;* [3]*Dept. of Physics, Harvard Univ., USA*. We study ultra-confined polaritonic modes supported by thin micro- and nano-devices made of hexagonal boron nitride flakes. We image these modes using new optical scanning probes microscopy techniques. These results open new avenues for nano-photonics as a way to achieve extreme light confinement at the nanoscale.

W2H.2 • 11:00 Invited
Tailored Structural Disorder in Optical Metasurfaces, Dennis Arslan[1], Stefan Fasold[1], Aso Rahimzadegan[2], Trideep Kawde[1], Sebastian Linss[1], Najmeh Abbasirad[1], Matthias Falkner[1], Manuel Decker[1,3], Carsten Rockstuhl[2,4], Thomas Pertsch[1], Isabelle Staude[1]; [1]*Insitute of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany;* [2]*Inst. of Theoretical Solid State Physics, Karlsruhe Inst. of Technology, Germany;* [3]*Nonlinear Physics Centre, The Australian National Univ., Australia;* [4]*Inst. of Nanotechnology, Karlsruhe Inst. of Technology, Germany*. We experimentally realize various optical metasurfaces with tailored rotational and positional disorder, and demonstrate their ability to support pure circular dichroism and to tune the intensity of the transmitted light almost independently from its phase.

10:30–12:30
W2I • Fiber-Wireless Systems and PONs
Presider: Tianwai Bo; KAIST, Korea

W2I.1 • 10:30 Invited
Low-latency Optical Networks for 5G Wireless, Xiang J. Liu[1], Ning Deng[2]; [1]*Futurewei Technologies, Inc., USA;* [2]*Huawei Technologies, China*. We review recent advances in the evolution of optical networks to better address the demands of 5G wireless systems by providing high-bandwidth and low-latency connectivity. Particularly, the evolution of optical cross connect and optical transport network will be discussed.

W2I.2 • 11:00 Invited
Demonstration of Real-time 100Gb/s Multi-lane-based PON System with Low Latency DBA, Kwang Ok Kim[1], KyeongHwan Doo[1], HanHyub Lee[1], SeungHwan Kim[1], Hwan Seok Chung[1]; [1]*Electronics & Telecomm Res. Inst, Korea*. We report multilane-based real-time 100G-PON with dynamic channel bonding and low-latency DBA. Packet throughput of 80-Gb/s in downstream and 32-Gb/s in upstream with multi-speed ONUs on the distance 20-km and a 1:16 splitter are also demonstrated.

10:30–12:30
W2J • Integrated Sources II
Presider: Yong-Zhen Huang; Chinese Academy of Sciences, China

W2J.1 • 10:30 Invited
Electrically Injected Hybrid III-Nitride/Organic White LEDs with Non-radiative Energy Transfer, T Wang[1]; [1]*Univ. of Sheffield, UK*. An electrically injected hybrid organic/inorganic III-nitride white LEDs with a micro-hole array structure has been reported. The novel hybrid LED geometry enables the nonradiative energy transfer process with high efficiency while retaining excellent electrical characteristics.

W2J.2 • 11:00
Widely tunable high power sampled-grating MOPA system emitting around 970 nm, Mahmoud Tawfieq[1], Hans Wenzel[1], Olaf Brox[1], Pietro Della Casa[1], Andrea Knigge[1], Markus Weyers[1], Bernd Sumpf[1], Günther Tränkle[1]; [1]*Ferdinand-Braun Inst., Germany*. A high power widely tunable master oscillator power amplifier (MOPA) laser system will be presented, emitting between 962.0 nm - 985.5 nm, with an output power in the watt range.

10:30–12:30
W2K • Biophotonics and Applications IV
Presider: Chao Zhou; Lehigh Univ., USA

W2K.1 • 10:30 Invited
In vivo and Label-free Detection of Circulating Melanoma Cells by Photoacoustic Flow Cytometry, Xunbin Wei[1], Bobo Gu[1]; [1]*Shanghai JiaoTong Univ., China*. A new in vivo photoacoustic flow cytometry was proposed and demonstrated for in vivo, label-free, non-invasive and real-time detection of circulating melanoma cells with high absorption coefficient of near-infrared light in the tumor-bearing mouse model.

W2K.2 • 11:00 Invited
Jones Matrix Tomography - Principle, Implementation, and Application, Yoshiaki Yasuno[1]; [1]*Univ. of Tsukuba, Japan*. This presentation describes basic principle and applications of Jones matrix optical coherence tomography (JM-OCT), which simultaneously visualizes scattering, polarization, and flow property of living tissue.

10:30–12:30
W2L • Interferometers & Applications
Presider: Yunqi Liu; Shanghai Univ., China

W2L.1 • 10:30 Invited
Dual Cladding Modes Fiber Interferometer and its Application in Fiber Sensor, Bo Dong[1]; [1]*Xi'an Inst. of Optics and Precision Mechanics, CAS, China*. Dual cladding modes fiber interferometer is based on the interferences between the core mode and two cladding modes. Here its principle and application for dual parameters measurement are presented.

W2L.2 • 11:00 Invited
Investigation on Temperature Sensitivities of Microfiber Mach-Zehnder Interferometers, Young-Geun Han[1]; [1]*Hanyang Univ., Korea*. Abstract not available.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W2A • Advanced Laser Sources I—Continued

W2A.3 • 11:15
Passively mode-locked erbium-doped fiber laser with PbS colloidal quantum dots as saturable absorber, Wei Zhao[1], Xiaolan Sun[1], Bin Zhou[1], Qianqian Huang[1], Chuanhang Zou[1], Tianxing Wang[1], Chengbo Mou[1], Tingyun Wang[1], Alan Kost[2]; [1]*Key Laboratory of Specialty Fiber Optics and Optical Access Networks, Shanghai Univ., China;* [2]*Optical Sciences Center, Univ. of Arizona, USA.* We have demonstrated a passively mode-locked erbium-doped fiber laser using colloidal PbS quantum dots (QDs) thin film as saturable absorbers (SAs). As the pump power up to 34.1 mW, we can observe the mode-locked pulse with the duration of 2.86 ns.

W2A.4 • 11:30
870fs, 448kHz pulses from an all-PM Yb-doped fiber laser with a nonlinear amplifying loop mirror, Guanyu Liu[1], Aimin Wang[1], Zhigang Zhang[1]; [1]*Peking Univ., China.* We demonstrate a mode locked long all-polarization maintaining fiber laser with a nonlinear amplifying loop mirror. 870 fs pulse is obtained at the repetition rate of 448 kHz.

W2A.5 • 11:45
LD pumped Nd:$GdNbO_4$ crystal laser operating at 926 nm, Jing Gao[1,2], Changlei Li[2,1], Wenming Yao[1,2]; [1]*Chinese Academy of Sciences, China;* [2]*Univ. of Science & Technology of China, China.* We present a 926 nm laser based on quasi-three-level transition of a novel Nd:$GdNbO_4$ crystal. The slope efficiency with respect to absorbed pump power is estimated to be 47.7%.

W2B • Nonlinear Dynamics in Waveguides and Harmonic Generation—Continued

W2B.3 • 11:15
Quasi-phase-matching sinusoidally-tapered waveguides for third-order parametric interactions, Mohammed F. Saleh[1]; [1]*Heriot Watt Univ., UK.* I show how periodically-tapered waveguides can be employed as efficient quasi-phase-matching schemes for four-wave mixing parametric processes in third-order nonlinear materials. Enhancing third-harmonic generation in sinusoidally-tapered fibres has been thoroughly investigated, as an example.

W2B.4 • 11:30
Efficient four-wave mixing using CMOS-compatible ultra-silicon-rich nitride photonic crystal waveguides, Ezgi Sahin[1,2], Kelvin J. Ooi[1], Ju Won Choi[1], Doris K. T. Ng[3], C. E. Png[2], Dawn T. Tan[1]; [1]*Singapore Univ. of Technology and Design, Singapore;* [2]*Dept. of Electronics and Photonics, Inst. of High Performance Computing, Agency for Science, Technology and Research (A*STAR), Singapore;* [3]*Data Storage Inst., Agency for Science, Technology and Research, Singapore.* Continuous wave four-wave mixing (FWM) in ultra-silicon-rich nitride photonic crystal waveguides (PhCWs) is demonstrated using low coupled pump powers. A conversion efficiency of -37 dB was observed using a 776 μm long PhCW.

W2B.5 • 11:45
Enhanced Third Harmonic Generation in A Silicon Photonic Crystal Slab, Guoxun Ban[1], Chaobiao Zhou[1], Shiyu Li[1], Yi Wang[1]; [1]*Wuhan National Laboratory for Optoeletronics, Huazhong Univ. of Science and Technology, China.* Applying the Fano resonance in a Si photonic crystal slab, enhanced third harmonic generation (THG) has been experimentally demonstrated and the conversion efficiency is about 160 times larger than that of bulk silicon.

W2C • Infrared Ultrafast Subcycle Subwavelength Photonics—Continued

W2C.2 • 11:30 Invited
Terahertz Generation and Acceleration, Franz X. Kärtner[1]; [1]*Deutsches Elektronen-Synchrotron, Germany.* Recent theoretical and experimental results on laser based high-energy single-cycle and multi-cycle Terahertz generation and its use for electron acceleration are discussed.

W2D • Optical Signal Processing Based on Integrated Devices—Continued

W2D.3 • 11:30 Invited
Hybrid Photonics using Foundry-Fabricated Silicon and Thin-Film Lithium Niobate, Shayan Mookherjea[1]; [1]*Univ. of California San Diego, USA.* Thin-film lithium niobate (LN) is integrated with a silicon photonics pilot-line foundry platform, using large-area oxide bonding, and without etching or sawing LN. A Mach-Zehnder electrooptic modulator with >100 GHz 3-dB electrical bandwidth is shown.

W2E • Ultra-fast Laser Machining and Processing—Continued

W2E.3 • 11:30 Invited
Ultrafast Laser Induced Assembly of One-dimensional Nanomaterials, Wei Xiong[1], Y. Liu[2], J. Long[1], C.C.F. Lu[1], Huan Liu[1]; [1]Wuhan National Laboratory for Optoelectronics, *Huazhong Univ of Science and Technology, China;* [2] Dept. of Electrical and Computer Engineering, Univ. of Nebraska-Lincoln, USA. Ultrafast laser induced assembly of one-dimensional metallic and semiconducting nanomaterials with high spatial resolution will be introduced. The user-defined nanomaterial assembly technique brings multiple benefits to the 3D micro/nanofabrication and functional device fabrication.

W2F • Optical Devices for Precision Measurements—Continued

W2F.3 • 11:15
A High-Speed-Controllable Fiber Comb Using a Compact Optical-Bench System, Yu Asahina[1,2], Yuko Yamada[1,2], Yusuke Hisai[1,2], Kazumichi Yoshii[1,2], Feng-Lei Hong[1,2]; [1]*Yokohama National Univ., Japan;* [2]*JST, ERATO, MINOSHIMA Intelligent Optical Synthesizer Project, Japan.* We developed a mode-locked Er fiber laser containing a small optical bench. The electro-optic modulator on the bench is used to control the repetition frequency at a high speed together with a piezoelectric transducer.

W2F.4 • 11:30 Invited
Integrated Modelocked Comb Lasers for Spectroscopy, Bart Kuyken[1]; [1]*Ghent Univ., INTEC, Belgium.* Abstract not available.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W2G • Quantum Information Processing I—Continued

W2G.3 • 11:15
Two-Step Frequency Conversion for Connecting Distant Quantum Memories, Tamura Shuhei[1], Kohei Ikeda[1], Kotaro Okamura[2], Kazumichi Yoshii[1], Feng-Lei Hong[1], Tomoyuki Horikiri[1], Hideo Kosaka[1]; [1]*Yokohama National Univ., Japan;* [2]*Kanagawa Univ., Japan*. We demonstrate a two-step frequency conversion process (from 637.2 nm to the telecommunication wavelength and back). Signal-to-noise ratio is estimated to be sufficient for connecting nitrogen-vacancy centers in diamond based quantum repeater.

W2G.4 • 11:30
Direct quantum process tomography via sequential weak measurements, Yosep Kim[1], Yong-Su Kim[2], Sang-Yun Lee[2], Sang-Wook Han[2], Sung Moon[2], Yoon-Ho Kim[1], Young-Wook Cho[2]; [1]*POSTECH, Korea;* [2]*KIST, Korea*. We demonstrate measurement of the sequential weak value of two incompatible observables by making use of two-photon quantum interference. We also demonstrate direct quantum process tomography of a qubit channel using the sequential weak value.

W2G.5 • 11:45
Demonstration of controlled-phase gate for time-bin qubits, Hsin Pin Lo[1], Takuya Ikuta[1], Nobuyuki Matsuda[1], Toshimori Honjo[1], Hiroki Takesue[1]; [1]*NTT Basic Research Laboratories, Japan*. We demonstrate a controlled-phase (C-Phase) gate for the time-bin qubits using a 2x2 optical switch as a time-dependent beam splitter. We confirmed that independent time-bin qubits were entangled through the C-Phase gate.

W2H • Optical Metasurfaces II—Continued

W2H.3 • 11:30 Invited
Meta-device for Photonics in Demand, Din Ping P. Tsai[1]; [1]*Academia Sinica, Taiwan*. Metasurfaces composed of artificial nano-structures attract huge interests due to their ability on controlling the electromagnetic phase and amplitude at subwavelength scale. Several metasurface based novel components for photonic applications are included in this talk.

W2I • Fiber-Wireless Systems and PONs—Continued

W2I.3 • 11:30
A Bidirectional Fiber-FSO/Wireless Convergence, Yong-Nian Chen[1], You-Ruei Wu[1], Zhen-Han Wang[1], Chung-Wei Su[1], Chung-Yi Li[1], Hai-Han Lu[1]; [1]*National Taipei Univ. of Technology, Taiwan*. A bidirectional fiber-FSO/wireless convergence is proposed and demonstrated. One optical sideband (y-polarization) is transmitted to effectively reduce fiber dispersion due to a span of 40-km SMF and distortion due to the beating among multiple sidebands.

W2I.4 • 11:45
Hybrid Optical Wired/Coherent-Wireless OFDM Access Networks with Baseband Signal Modulation and Envelop-Detection Down-Conversion, Chao-Wei Chen[1], Wen-Huang Chen[1], Hao-Hsiang Chang[1]; [1]*National Chiao Tung Univ., Taiwan*. We propose hybrid optical wired/wireless access networks integrating fixed/mobile system. Tradeoff between strong carrier of EML modulation and nonlinearity is investigated. Hybrid access is achieved by employing commercial EML, envelop-detection down-conversion, and Volterra compensation.

W2J • Integrated Sources II—Continued

W2J.3 • 11:15
Optic Field Manipulation by Generation of Cylindrically Polarized Beams with Silicon Metasurface, Huiwen Luo[1], Liang Wang[1], Tianyang Zang[1], Yong Wang[1], Yonghua Lu[1], Pei Wang[1]; [1]*Univ. of Sci and Tech of China, China*. We demonstrated that amplitude ratio of anisotropic transmittance is very important to determine how much input optical field remains in the generated vector optical field after metasurface.

W2J.4 • 11:30
An Integrated Composite Cavity Laser Switchable Between Single and Multi-Mode Operations, Mu-Chieh Lo[1], Robinson Guzmán[1], Guillermo Carpintero[1]; [1]*Universidad Carlos III de Madrid, Spain*. An InP coupled cavity laser developed in a generic foundry is presented. Two active/passive ring cavities with different lengths constitute the Vernier-assisted versatile architecture. Single wavelength with >30 nm tunability and >30 dB extinction ratio and multimode operations with >300 GHz spacing are obtained.

W2J.5 • 11:45
Evolution of Junction Temperature and Heating Effects in UV AlGaN Nanowires LEDs, Davide Priante[1], Rami Elafandy[1], Aditya Prabaswara[1], Bilal Janjua[1], Chao Zhao[1], Malleswararao Tangi[1], Mohd Sharizal Alias[1], Yazeed Alaskar[2], Abdulrahman Albadri[2], Ahmed Alyamani[2], Tien Khee Ng[1], Boon Ooi[1]; [1]*King Abdullah Univ of Sci & Technology, Saudi Arabia;* [2]*King Abdulaziz City for Science and Technology , Saudi Arabia*. We show reduced junction temperature and heat dissipation in AlGaN nanowires LEDs on a metal substrate compared to devices on a silicon substrate by employing the forward-voltage and peak-shift methods.

W2K • Biophotonics and Applications IV—Continued

W2K.3 • 11:30
High Speed Optical Frequency Sweeper using Super Continuum Pulses and Optical Filters, Yuzo Yoshikuni[1], Hikari Shirasaki[1], Keiji Kuroda[1]; [1]*Kitasato Univ., Japan*. A novel high speed optical sweeper is proposed and fabricated using super continuum optical pulses and time of flight technique. Combination of optical filters and optical delay lines successfully generate the frequency sweep light from a single pseudo-white light pulse.

W2K.4 • 11:45
Ultrasound-Tagged Chemiluminescence Tomography in Turbid Media, Masaki Kobayashi[1], Torai Iwasa[1]; [1]*Tohoku Inst. of Technology, Japan*. Ultrasound assisted hybrid technique for optical imaging being available for biomedical tomography is proposed. We have developed a tomographic imaging system, based on the effect of ultrasonic enhancement of chemiluminescence, and demonstrated the tomographic imaging of a CL probe in dense light-scattering media with mm resolution.

W2L • Interferometers & Applications—Continued

W2L.3 • 11:30
Spaceborne Laser Transmitter for the Laser Interferometer Space Antenna (LISA) Mission, Anthony W. Yu[1], Kenji Numata[1], Hua Jiao[1], Scott A. Merritt[1], Frankie Micalizzi[1], Molly E. Fahey[1], Jordan B. Camp[1], Michael A. Krainak[1]; [1]*NASA Goddard Space Flight Center, USA*. NASA is developing a highly stable, robust and reliable master oscillator power amplifier laser transmitter. We will discuss our technology development and progress on a spaceborne laser transmitter for the LISA mission.

W2L.4 • 11:45
Broadband Spectral Chirped Fabry-Perot Interferometer Based on Tapered Microfiber Bragg Grating, Yuan Cao[1], Zhong Lu[1], Peng Xiao[1], Xudong Wang[1], Yang Ran[1], Xinhuan Feng[1], Bai-Ou Guan[1]; [1]*Inst. of Photonics Technology, Jinan Univ., China*. A compact Fabry-Perot (F-P) interferometer with chirped spectral characteristics based on microfiber Bragg grating is theoretically discussed and experimentally implemented. The interferometer has flat reflective and its bandwidth is 20 nm.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W2A • Advanced Laser Sources I—Continued

W2A.6 • 12:00
Different Lasing Modes from H+-Implantation-Defined Coherently Coupled VCSEL Arrays, Guanzhong Pan[1], Chen Xu[1], Yiyang Xie[1], Yibo Dong[1], Hongda Chen[2]; [1]*Beijing Univ. of Technology, China;* [2]*Inst. of Semiconductor, Chinese Academy of Sciences, China.* Different lasing modes including in-phase modes, out-of-phase modes and special mixture modes are obtained from H+-implantation-defined coherently coupled VCSEL arrays by engineering the interelement spacings between elements. The simulated far-field patterns match the experiments well.

W2A.7 • 12:15
A Tunable Single-longitudinal-mode Fiber Laser based on erbium-doped, peanut-shape fiber structure interferometer, Minling Du[1], Hongdan Wan[1], Jie Wang[1], Zuxing Zhang[1]; [1]*Nanjing Univ. of Posts&telecomm, China.* We propose a fiber laser using erbium-doped fiber peanut-shape structure interferometer as the mode-selector for achieving single-longitudinal-mode and wavelength-tunable operation. The fiber laser has a 3 dB bandwidth of about 0.015 nm

W2B • Nonlinear Dynamics in Waveguides and Harmonic Generation—Continued

W2B.6 • 12:00
Enhanced third harmonic generation in organic multilayers, Myoungsik Cha[1], Jiung Kim[1], Pavan Kumar[1], Heejoo Choi[2], Kyungjo Kim[2], Nasser Peyghambarian[2]; [1]*Pusan National Univ., Korea;* [2]*Univ. of Arizona, USA.* We demonstrate quasi-phase-matched third harmonic generation in organic multilayer films. The phase shift between the fundamental and the generated third harmonic light was compensated by alternatingly coated layers of a passive UV curable polymer material.

W2B.7 • 12:15
Phase control of high-order harmonics (HHG) in noble gas mixture by phase matching and interference effects, Lifeng Wang[1], Weiming Zhu[1], Qiandong Ran[1], Hao Li[1], Ying Zhang[1]; [1]*SIMTech, Singapore.* We experimentally observe strong modulation of HHG spectrum in gas mixture. Calculation results show phase of harmonics are contributed by phase-matching and interference effects, resulting in strong spectrum modulation and may benefit tunable XUV generation.

W2C • Infrared Ultrafast Subcycle Subwavelength Photonics—Continued

W2C.3 • 12:00
Terahertz Generation in PPLN by Pulse Recycling with Quartz Out-coupler, Lu Wang[1,2], Arya Fallahi[1], Koustuban Ravi[1,3], Franz Kaertner[1]; [1]*CFEL - DESY, Germany;* [2]*Hamburg Univ., Germany;* [3]*Research Laboratory of Electronics and the Dept. of Electrical Engineering and Computer Science, Massachusetts Inst. of Technology (MIT),, USA.* Multi-cycle terahertz generation using two consecutive PPLN crystals with designed quartz coupler is proposed. Our simulation suggests that pump pulse recycling with dispersion compensation can lead to higher terahertz conversion efficiency.

W2C.4 • 12:15
Direct Measurement of the Phase Coherence of Comb Sources, Luigi Consolino[1], Saverio Bartalini[1,2], Francesco Cappelli[1], Giulio Campo[1], Iacopo Galli[1,2], Davide Mazzotti[1,2], Pablo Cancio[1,2], Giacomo Scalari[3], Jerome Faist[3], Paolo De Natale[1,2]; [1]*CNR - INO, Italy;* [2]*ppqSense Srl, Italy;* [3]*ETH, Switzerland.* We report on a novel and general method capable of measuring the coherence and the time evolution of the phases of laser comb modes. Applications to Near-IR, Mid-IR and Far-IR (THz) comb sources are presented.

W2D • Optical Signal Processing Based on Integrated Devices—Continued

W2D.4 • 12:00
Four channel 48Gbps Multicasting in a Coupled Si Ring Resonator with Tunable Channel Spacing, Awanish Pandey[1], Shankar K. Selvaraja[1]; [1]*Indian Inst. of Science, India.* Wavelength multicasting in a quadruple resonance-split coupled cavity system is proposed and experimentally demonstrated. Bit error free performance at 12Gbps/channel is reported with aggregate data rata of 48Gbps with tunable channel spacing of 100GHz.

W2D.5 • 12:15
Tunable and Selective Wavelength Converter for 40Gbit/s Signals Employing Cascaded Second-Order Nonlinearity in Quasi-Phase Matched Lithium Niobate, Yutaka Fukuchi[1]; [1]*Dept. of Electrical Engineering, Tokyo Univ. of Science, Japan.* We report a tunable and selective wavelength converter using a 5cm-long quasi-phase-matched lithium niobate waveguide. The conversion efficiency is –10dB. The device is attractive for channel-by-channel wavelength conversion in 100GHz-spaced 40Gbit/s dense wavelength-division multiplexed systems.

W2E • Ultra-fast Laser Machining and Processing—Continued

W2E.4 • 12:00
This paper has been withdrawn.

W2E.5 • 12:15
Fabrication of Carbide Nanoparticles by Femtosecond Laser Ablation of Silicon and Molybdenum in Hexane, Shusaku Terakawa[1], Toru Asaka[1], Fumihiro Itoigawa[1], XI YU[1], Masaaki Sudo[2], Shingo Ono[1]; [1]*Nagoya Inst. of Technology, Japan;* [2]*IMRA America Inc., Japan.* Carbide nanoparticles are used in various applications. However, conventional fabrication methods are tend to be complicated and several steps are needed until fabrication. In this work, we report a simple method to fabricate carbide nanoparticles by femtosecond laser ablation in hexane.

W2F • Optical Devices for Precision Measurements—Continued

W2F.5 • 12:00
Simple method to lock an optical frequency comb to an ultra-stable laser without an RF signal generator, Kenya Hitomi[1], Atsushi Ishizawa[2], Kenichi Hitachi[2], Tadashi Nishikawa[1], Hideki Gotoh[2], Tetsuomi Sogawa[2], Kazutaka Hara[1]; [1]*Tokyo Denki Univ. , Japan;* [2]*NTT Basic Research Laboratories, Japan.* We achieved a simple method for stabilizing an optical frequency comb (OFC). The OFC with our method is very stable and its stability does not depend on the stability of RF signal generators.

W2F.6 • 12:15
Sub-Hz Spectral Purity Transfer at the 10-18 level based on optical frequency comb, Pu Zou[1], Michele Giunta[1,2], Wolfgang Hänsel[1], Matthias Lezius[1], Marc Fischer[1], Ronald Holzwarth[1,2]; [1]*Menlo Systems GmbH, Germany;* [2]*Max Planck Inst. of Quantum Optics, Germany.* We report on a Er:fiber-based optical frequency comb transferring the stability of ultra-stable lasers from 194THz to 429THz. Sub-Hz level transfer to a fiber-delivered 698.44nm output port for future Strontium QPN-limited lattice clocks is demonstrated.

12:30–14:00 Lunch

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W2G • Quantum Information Processing I—Continued

W2G.6 • 12:00
Experimental demonstration of superconducting nanowire single-photon detectors integrated with current reservoirs, Yuhao Cheng[1], Xiaoming Chi[1], Chao Gu[1], Kai Zou[1], Julien Zichi[2], Shufan Chen[1], Haiyi Liu[1], Val Zwiller[2], Xiaolong Hu[1]; [1]*Tianjin Univ., China;* [2]*Royal Inst. of Technology (KTH), Sweden*. We experimentally demonstrate the superconducting nanowire single-photon detectors integrated with current reservoirs that function as low-noise pre-amplifiers to increase the signal-to-noise ratio of detectors' outputs.

W2G.7 • 12:15
All optical actively tunable quantum signal de-multiplexer based on sum frequency generation, Zhi-Yuan Zhou[1], Yin-Hai Li[1], BaoSen Shi[1]; [1]*Univ. of Science and Technology of China, China*. An actively tunable quantum signal de-multiplexer for multi-channel energy-time entangled state based on sum frequency generation is reported. Such device can de-multiplex any signal frequency and preserves entanglement after up-conversion.

W2H • Optical Metasurfaces II—Continued

W2H.4 • 12:00
Displacement-targeted metasurfaces for dispersionless and full phase and polarization control, Zi-Lan Deng[1], Junhong Deng[2], Guixin Li[2], Xiangping Li[1]; [1]*Jinan Univ., China;* [2]*Southern Univ. of Science and Technology, China*. we propose a novel metasurface designs by exploiting displacements instead of the size and shape between adjacent meta-atoms, leading to dispersionless and full phase and polarization control of arbitrary wavefronts.

W2H.5 • 12:15
Laser printing aluminium plasmonic metasurface hologram, Yinan Zhang[1], Liu Shi[1], shouyi Xie[2], Yudong Lu[1], Dejiao Hu[1], Zilan Deng[1], Xiangping Li[1]; [1]*Jinan Univ., China;* [2]*The Univ. of New South Wales, Australia*. We demonstrate a laser-printed metasurface hologram through the photothermal reshaping of the aluminium nanorods. Size reshaping and consequent phase modulation can be precisely controlled by the pulsed laser induced transient heat effect.

W2I • Fiber-Wireless Systems and PONs—Continued

W2I.5 • 12:00
A Cost-effective and Imbalance-insensitive 112G bit/s PM-16QAM Coherent PON Downstream Scheme, Huan Chen[1], Tao Yang[1], Xue Chen[1], Xiao Luo[1]; [1]*Beijing Univ of Posts & Telecom, China*. We propose a cost-effective coherent PON downstream transmission scheme which not only shows high receiver sensitivity but also eliminates orthogonal imbalance inherently. Simulation and experimental results demonstrate its potentiality in next generation optical access network.

W2I.6 • 12:15
Orthogonal Matching Pursuit based Sparse Nonlinear Equalization for 40-Gb/s/wavelength Long-Reach PON, Junwei Zhang[1], Changjian Guo[2], Jie Liu[1], Xiong Wu[1], Alan Lau[3], Chao Lu[2], Siyuan Yu[1,4]; [1]*School of Electronics and Information Technology, Sun Yat-Sen Univ., China;* [2]*Dept. of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., China;* [3]*Dept. of Electrical Engineering, The Hong Kong Polytechnic Univ., China;* [4]*Merchant Venturers School of Engineering, Univ. of Bristol, UK*. We propose to use an orthogonal matching pursuit based sparse nonlinear equalization (OMP-SNE) for 40-Gbit/s OFDM-IM-DD long-reach PON over 60-km SSMF. Compared with conventional NE, the number of coefficients utilizing OMP-SNE is reduced by 63%.

W2J • Integrated Sources II—Continued

W2J.6 • 12:00
Novel Hybrid Micro Light-emitting Diodes with Increasing Color-Conversion Technical by Non-Radiative Energy Transfer, Sung-Wen Huang Chen[1], Zhen-You Liao[1], Yi-Yuan Chen[1], Tzu-Neng Lin[3], Po-Tsung Lee[1], An-Jye Tzou[1,2], Hao-Chung Kuo[1]; [1]*National Chiao Tung Univ., Taiwan;* [2]*National Nano Device Laboratories, Taiwan;* [3]*Chung Yuan Christian Univ., Taiwan*. Hybrid quantum dots m-LEDs promise a high color-conversion efficiency regarding the non-radiative energy transfer effect. The new approach enables a novel manufacturing method of the full-color m-display.

W2J.7 • 12:15
GaAs/AlGaAs tunable laser using Fabry-Perot filters based on half-wave coupled lossy deep etched trenches, Xin Chen[1], Jian-Jun He[1]; [1]*Centre for Integrated Optoelectronics, State Key Laboratory of Modern Optical Instrumentation, College of Optical Science and Engineering, Zhejiang Univ., China*. We present a GaAs/AlGaAs tunable laser based on three cascaded Fabry-Perot cavities coupled by two half-wave lossy deep etched trenches. The laser exhibits good performance in lasing threshold, side-mode suppression ratio and wavelength tuning range.

W2K • Biophotonics and Applications IV—Continued

W2K.5 • 12:00
Towards spatially more efficient wavefront optical focusing with a binary-amplitude modulator, Huanhao Li[1], Puxiang Lai[1], Zhipeng Yu[1], Tianting Zhong[1], Zihao Li[1]; [1]*The Hong Kong Polytechnic Univ., Hong Kong*. Optical wavefront shaping aims to focus light beyond the optical diffusion limit within scattering media. How to spatially enable better focusing, however, has been largely undefined. This study reports our latest effort in this regard.

W2K.6 • 12:15
OCT Endoscopic probe based on six circular arrayed two-axis MEMS, Site Luo[1], Dan Wang[1], Hao Liu[2], Guoxin Li[2], Hui Zhao[3], Huikai Xie[4,5], Qiao Chen[5], Yabing Liu[5], Li Huo[1]; [1]*Tsinghua Univ., China;* [2]*Dept. of General Surgery, Nanfang Hospital, Southern Medical Univ., China;* [3] *Foshan Optomedic Technologies Co., Ltd, China;* [4]*Univ. of Florida, USA;* [5]*Wuxi WiO Technologies Co. Ltd., China*. We present a novel circumferential scan endoscopic OCT probe by circular arrayed six MEMS mirrors and collimators with a diameter of 12 mm and a length of 25 mm.

W2L • Interferometers & Applications—Continued

W2L.5 • 12:00
Fiber optic non-wearable respiratory monitoring based on in-line modal interferometer, Ying Shen[1,3], Wei Xu[2], Na Zhang[2], Shanhong You[1], Changyuan Yu[3,4], Cheungchuen Yu[2]; [1]*Soochow Univ., China;* [2]*Anlight Optoelectronic Technology Inc, China;* [3]*National Univ. of Singapore (Suzhou) Research Inst., China;* [4]*Dept. of Electronic and Information Engineering, The Hong Kong PolytechnicUniv., China*. A real-time non-wearable respiratory monitoring system based on single-mode-fiber-multimode-fiber-single-mode-fiber (SMS) with core-offset splicing is demonstrated and experimentally validated. Both the inhalation and exhalation activities can be detected within a wide respiratory frequency range.

W2L.6 • 12:15
A Design of Double-ring Sensor Based on Heat-tuned Mach-Zehnder Interferometer, Qiongchan Shao[1]; [1]*Zhejiang Univ., China*. We utilize a heat-tuned Mach-Zehnder Interferometer Fourier transform spectrometer to retrieve the transmission spectrum of cascaded double-ring sensor. The sensor and spectrometer are integrated on one chip, providing a low-cost scheme for biochemical sensing.

12:30–14:00 Lunch

Room S421

14:00–15:30
W3A • Poster Session

W3A.1
Nonlinear Reflectance of Planar Plasmonic Nanostructure, Rui Xu[1], Zhonghui Nie[1], Shuchao Qin[1], Yao Li[1], Shining Zhu[2], Fengqiu Wang[1]; *[1]School of Electronic Science and Engineering, Nanjing Univ., China; [2]School of Physics, Nanjing Univ., China.* We reveal nonlinear reflectance of a planar plasmonic film with nanoaperture arrays. We further demonstrate that the nonlinear response of the plasmonic nanostructures can be effectively controlled by structural parameters.

W3A.2
Hybrid Quantum Dots /Photonic Crystal Color Tunable Light Emitting Diodes, Chirenjeevi Krishnan[1], Thomas Mercier[1], Zeeshan Ahmed[1], Kang-yuan Lee[2], Jhih-Kai Huang[2], Chung-Hsiang Lin[2], Martin Charlton[1]; *[1]Univ. of Southampton, UK; [2]Luxtaltek, Taiwan.* We demonstrate spectrally tunable hybrid photonic crystal Quantum Dots (QDs) LEDs. QDs are embedded into photonic crystals of GaN/InGaN LED for efficient color conversion. Color tunable LED has individually addressable LED module.

W3A.3
Optomechanical oscillation in the lithium niobate photonic crystal nanocavity, Haowei Jiang[1,2], Hanxiao Liang[2], Rui Luo[2], Xianfeng Chen[1], Yuping Chen[1], Qiang Lin[2]; *[1]Shanghai Jiao Tong Univ., China; [2]Univ. of Rochester, USA.* Nonlinear optomechanical oscillations are observed in the lithium niobate photonic crystal nanocavity. High harmonic oscillations up to 14th order are achieved, which may function as a mechanical frequency comb.

W3A.4
Strong MoS2 Photoluminescence on Graphene for Coupling with Silica Microcavity, Rammaru Ishida[1], Takasumi Tanabe[1]; *[1]Keio Univ., Japan.* We transferred monolayer MoS2 to various substrates and evaluated its optical property by photoluminescence intensity. The study revealed that a graphene substrate is adequate when using MoS2 as a cavity-QED material.

W3A.5
A single GaAs nanowire self-powered photodetector with Au-graphene Schottky electrodes, Yanbin Luo[1], Xin Yan[1], Xla Zhang[1], Yao Wu[1], Li Bang[1], QIchao Lu[1], Xiaomin Ren[1]; *[1]Beijing Univ. of Posts and Telecomm, China.* A single GaAs nanowire self-powered photodetector with Au/graphene Schottky electrodes is demonstrated. The device exhibits excellent photoelectric properties, showing a strong possibility for future integrated nano-optoelectronic systems.

W3A.6
Multipolar properties of guide resonances, Yi Xu[1], Yuan He[1], Tianhua Feng[1], Andrey E. Miroshnichenko[2]; *[1]Jinan Univ., China; [2]Univ. of New South Wales, Univ. of New South Wales, Australia.* We study the multipolar nature of guide resonance in photonic crystal waveguide which is consisted of periodic Mie type resonators. By reconstructed the guide resonance utilizing the induced multipole moments in one unit cell, we reveal the important roles of multipole modes play in the high-Q resonances.

W3A.7
Optically Pumped Lasing in Cesium Lead Bromide Perovskite Square-shaped Microplatelets, Zi-Wei Huang[1], Li-Jyuan Lin[1], Hsu-Cheng Hsu[1]; *[1]Dept. of Photonics, NCKU, Taiwan.* Single-crystalWe used CVD method to synthesize all-inorganic $CsPbBr_3$ microcrystal perovskite microplatelets were fabricated to realize lasing at room temperature.on mica substrate. Upon optical excitation, whispering-gallery-mode (WGM) lasing is was achieved at RT with low threshold (~2.8 mW) and high quality factor (~30001).

W3A.8
On chip quantum dot based phosphor for efficient and tunable color conversion, Thomas M. Mercier[1], Chirenjeevi Krishnan[1], Martin Charlton[1]; *[1]Univ. of Southampton, UK.* CdS_xSe_{1-x}/ZnS (core/shell) quantum dots were used in combination with band-pass filters to convert blue light emitted from InGaN/GaN LEDs to different wavelengths. We present results to show this approach is a promising way of achieving tunable color conversion.

W3A.9
Excitation Bessel beams designed for high resolution and wide-field live imaging, Jing Wen[1], Shiliang Liu[1], Binbin Yu[1], Dawei Zhang[1]; *[1]Engineering Research Center of Optical Instrument and System, Ministry of Education and Shanghai Key Lab of Modern Optical System, Univ. of Shanghai for Science and Technology, China.* We explore generating subwavelength non-diffracting Bessel beams with long focal depths by means of custom-designed metasurfaces. The excitation approach can achieve live imaging with a high axial resolution and an ultra-wide field of view.

W3A.10
Imaging Theory of Vectorial Optical Near Field Based on Reciprocity of Electromagnetism, Lin Sun[1], Benfeng Bai[1], Tong Cui[1], Jia Wang[1]; *[1]Dept. of Precision Instrument, Tsinghua Univ., China.* By using multipolar decomposition in the reciprocity of electromagnetism for near-field optics, a novel multipolar Hamiltonian model is developed to guide the design of functional nearfield probes and analyze the probe-field interaction.

W3A.11
Optical Power Amplification via TE Resonant Optical Tunneling in Asymmetric, Metal-Dielectric, Single Barrier Potential System, Yin-Jung Chang[1], Yu-Huan Chen[2]; *[1]National Central Univ., Taiwan; [2]Taiwan Semiconductor Manufacturing Company Limited, Taiwan.* We show that, when properly configured, it is possible to have field and power amplification via unbound-state-enabled TE resonant optical tunneling through a two-dimensional, asymmetric, single-barrier potential system with metal.

W3A.12
Single-mode VCSEL for Nearly 100-Gbit/s QAM-OFDM transmission over 100-m OM4 multi-mode fiber, Hsuan-Yun Kao[1], Cheng-Yi Huang[1], Chun-Yen Peng[1], Cheng-Ting Tsai[1], Huai-Yung Wang[1], Shan-Fong Leong[1], Hao-Chung Kuo[2], Chao-Hsin Wu[1], Gong-Ru . Lin[1]; *[1]National Taiwan Univ., Taiwan; [2]National Chiao Tung Univ., Taiwan.* A 850-nm single-mode VCSEL with 3-dB bandwidth of 22.1 GHz enables 16-QAM OFDM transmission at nearly 100 Gbit/s over 100-m-long OM4 MMF link is demonstrated over 100-m-long OM4 MMF with BER of 3.5×10^{-3}.

W3A.13
Direct Detection for Polarization Multiplexing 100-Gb/s Signal Based on 7-Core Fiber Transmission, Xu Zhang[1], Cai Li[2], Xiang Li[2], Ming Luo[2]; *[1]Wuhan National Laboratory for Optoelectronics, China; [2]Wuhan Research Inst. of Posts and Telecom, China.* We demonstrated a novel direct detection system for polarization multiplexing signal receiving based on 7-core fiber transmission. A 100-Gb/s signal transmit over 10-km with only 1.6 dB OSNR penalty compared with conventional coherent detection.

W3A.14
Simultaneous Measurement of Mode Dependent Loss and Differential Modal Group Delay in FMFs with OTDR, Feng Liu[1], Guijun Hu[1], Cuiguang Chen[1], Weicheng Chen[1], Congcong Song[1]; *[1]Jilin Univ., China.* A new method for measuring mode dependent loss and differential modal group delay in FMFs is proposed and experimentally demonstrated that uses OTDR technique. This technique allows simultaneous measurement of MDL and DMGD in a 9.8 km-long FMF.

W3A.15
Real-Time 4×28Gb/s Transmission Over 110-km SMF Based on Dispersion Compensation and Wavelength Selective Switch, Quan You[1,2], Xiang Li[2], Ming Luo[2], Liyan Huang[3]; *[1]Wuhan National Laboratory for Optoelectronics, China; [2]State Key Lab of optic communication, Wuhan research Inst. of post and telecommunication, China; [3]Accelink Technologies Company, Ltd., China.* We experimentally demonstrate real-time 4×28-Gb/s transmission over 110 km single mode fiber. Chromatic dispersion pre-compensation and post-compensation are achieved by dispersion compensation fiber and wavelength selective switch, which is also used for wavelength division multiplexing.

W3A.16
Analytical fiber transfer function with XPM-induced process in *N*-channel coherent WDM transmission systems, Wataru Imajuku[1], Kunihiko Mori[2], Mitsunori Fukutoku[2]; *[1]Kindai Univ., Japan; [2]NTT Network Innovation Labs., Japan.* This paper derives analytical fiber transfer function of XPM-induced optical noise in *N*-channel coherent WDM transmission systems by small signal approximation. The results provide analytical conditions to avoid the XPM-induced modulation instability for the first time.

W3A.17
XPM-induced phase noise mitigation by gain saturated parametric amplifiers, Wataru Imajuku[1], Kunihiko Mori[2], Mitsunori Fukutoku[2]; *[1]Kindai Univ., Japan; [2]NTT Network Innovation Labs., Japan.* This paper proposes the improvement of signal-to-noise ratio by gain saturated PPLN amplifiers in *n*-channel coherent WDM fiber transmission systems. For this purpose, we develop semi-analytical scheme to estimate the signal-to-noise ratio including the XPM-induced phase noise.

W3A.18
Nonlinear Spurs Caused by EDFA in Analog Photonic Links, Shanhong Guan[1], Yitang Dai[1], Qizhuang Cen[1], Feifei Yin[1], Kun Xu[1]; *[1]Beijing Univ. of Posts and Telecommunication, China. In analog photonic links, we find the nonlinearity caused by input power fluctuations in EDFA. We theoretically analyzed the characteristics of the nonlinear spur and experimentally demonstrated that these characteristics are consistent with the theory.*

W3A.19
Polarization tracking for Stokes-vector modulation formats using Kalman filter, Qian Xiang[1], Yanfu Yang[1], Juntao Cao[1], Qun Zhang[1], Yong Yao[1]; *[1]Harbin Inst. of Technology, China.* A novel polarization tracking algorithm based on Kalman filter for Stokes-vector modulation formats are proposed. Compared with reported algorithms, the proposed scheme with optimal *Q* value shows fast polarization tracking capability and quick convergence.

W3A.20
Robust Multiband Frequency-tuning Algorithm for Cascaded ROADM Filtering, Takahiro Kodama[1], Masanori Hanawa[1]; *[1]Yamanashi Univ., Japan.* Frequency tuning for digital multiband 400G transmission over ROADM system has been demonstrated. The long-term frequency tuning was evaluated through emulation model of laser frequency drift, and performance degradation can maintain less than 0.2 dB.

W3A.21
Accurate Channel Approximation Using Perspective Projection for a CamCom Link, Muhammad Asim Atta[1], Amine Bermak[1,2]; *[1]HKUST, Hong Kong; [2]College of Science and Engineering, Hamad Bin Khalifa Univ., Qatar.* This work presents channel approximation for a camera communication (CamCom) link using perspective projection model with complete intrinsic parameterization. The accuracy of the model is demonstrated by exploiting spatial separation characteristics of the output image.

W3A.22
Investigation of power allocation in ADO-OFDM based visible light communication system, Wei Liu[1], Haozhe Chen[1], Junjie Ding[1], Hao Wu[1], Mingrui Yang[1], Shihang Bian[1], Xiang Li[2], Wu Liu[2], Shanhong You[1], Honglong Cao[1], Minglai Zhou[1], Jianling Hu[1]; *[1]Soochow univerity, China; [2]State Key Laboratory of Optical Communication Technologies and Networks, China.* Asymmetrically clipped DC biased optical orthogonal frequency division multiplexing (AOD-OFDM) signals are experimentally transmitted in visible light communication system. We make an investigation of power allocation in ADO-OFDM and find the optimal power allocation ratio.

W3A.23
Compact Modeling of Laser Diode for Visible Laser Light Communication (VLLC) Systems, Can S. Wang[1], Bo Xu[1], Xianbo Li[1], Li Wang[1], Chik P. Yue[1]; *[1]Hong Kong Univ. of Sci & Tech, Hong Kong.* A compact behavior model of a commercial TO-56 package 520-nm laser diode is presented for VLLC systems. The model exhibits good agreement with the measurement results for both NRZ and PAM4 modulation.

W3A.24
Security-Enhanced Chaos Communication with Optical Spectrum Expansion, Ning Jiang[1], Chao Wang[1], Anke Zhao[1], Jing Zhang[1], Hui Wang[2], Kun Qiu[1]; *[1]Univ of Electronic Science & Tech China, China; [2]Westone Information Industry INC, 30th Inst. of CETC, China.* We propose a chaos communication scheme by transforming the modulated chaotic carrier as an uncorrelated wideband signal with an optical-spectrum-expansion module. It is demonstrated that the message-security is greatly enhanced with respect to conventional cases.

W3A.25
2 µm long period fiber grating fabricated by CO_2 laser, Le Liu[1], Meng Wang[1], Xiaoming Xi[1], Zefeng Wang[1]; *[1]National Univ of Defense Technology, China.* Using a CO_2 laser, 2 µm long period fiber gratings (LPFG) are fabricated here for the first time. The transmission spectrum changing with the period, effective index modulation and grating length is investigated.

W3A.26
Withdrawn.

W3A.27
All-Optical Clock Recovery from 10 Gbps NRZ OOK and BPSK Data through Injection-Locking of Fiber Laser, Manas Srivastava[1], Balaji Srinivasan[1], Deepa Venkitesh[1]; *[1]Indian Inst. of Technology, Madras, India.* We demonstrate all-optical clock recovery from 10 Gbps NRZ-OOK and NRZ-BPSK data through injection-locking of Erbium-doped fiber (EDF) laser after enhancement of clock tones using non-linearities in an SOA.

W3A.28
Adaptive fringe projection technique for phase error compensation, Han-Yen Tu[1], Ssu-Chia He[2]; *[1]Dept. of Electrical Engineering, Chinese Culture Univ., Taiwan; [2]Dept. of Electrical Engineering, Chinese Culture Univ., Taiwan.* The non-sinusoidal problems of fringe projection lead to phase errors for three-dimensional shape measurement. For reducing phase measurement errors effectively and without time-consuming photometric calibration, the adaptive fringe projection technique is proposed in this work.

W3A.29
A new Pattern Recognition System Using Photoanisotropic Phenomena in Polarization-Sensitive Materials, Barbara N. Kilosanidze[1], George Kakauridze[1], Irina Kobulashvili[1]; *[1]Georgian Technical Univ., Georgia.* Objects recognition method is suggested based on determining parameters of the integral ellipse in the Fraunhofer diffraction region by the photoanisotropic copy of the object image while it is illuminated with nonactinic circularly polarized light

W3A.30
Supercontinuum Generation in an All-Normal Dispersion Tellurite Photonic Crystal Fiber, Feng Xu[1], Chao Mei[1], Jinhui Yuan[1,3], Feng Li[3,2], Zhe Kang[3], Binbin Yan[1], Kuiru Wang[1], Xinzhu Sang[1], Xian Zhou[3], Kangping Zhong[3], Chongxiu Yu[1]; *[1]Beijing Univ of Posts & Telecom, China; [2]The Hong Kong Polytechnic Univ. Shenzhen Research Inst., China; [3]Photonics Research Centre, Dept. of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong.* We design a tellurite photonic crystal fiber with all-normal dispersion profile for generating supercontinuum (SC). The octave-spanning SC can be generated when the pump pulses with different widths, peak powers, and center wavelengths are used.

W3A.31
Chaotic pulse dynamics and synchronizations in Q-switched optical vortex pulses in an azimuthal symmetry breaking laser resonator, Jhih-He Tu[1], Shang-Lin Yang[1], Chung-Po Tang[1], YuanYao Lin[1]; *[1]National Sun Yat-Sen Univ., Taiwan.* Chaotic dynamics and chaotic pulse synchronization are observed in optical vortex generated from a passive Q-swtiched laser resonator with broken an azimuthal symmetry when it was pumped by diode laser without critical beam shaping.

W3A.32
Passive mode-locking of a fiber optical parametric oscillator with optical time-stretch, Josephine Yi Qiu[1], Xiaoming Wei[2], Shuxing Du[1], Kenneth Kin-Yip Wong[2], Kevin K. Tsia[2], Yiqing Xu[2,3]; *[1]Huzhou Univ., China; [2]Dept. of EEE, The Univ. of Hong Kong, China; [3]College of ISEE, Zhejiang Univ., China.* With the assistance of optical time-stretch using the lately developed free-space angular-chirp-enhanced delay cavity, we demonstrate the short pulse generation numerically by passively mode-locking a fiber optical parametric oscillator pumped by a quasi-CW pump.

W3A.33
Mid-Infrared Spectral Compression of Parabolic Pulses in a Chalcogenide Ridge Waveguide, Zeli Li[1], Jinhui Yuan[1,2], Feng Li[2,3], Zhe Kang[2], Banban Yan[1], Kuiru Wang[1], Xinzhu Sang[1], Chongxiu Yu[1]; *[1]Beijing Univ. of Posts and Telecommunications, China; [2]The Hong Kong Polytechnic Univ., China; [3]The Hong Kong Polytechnic Univ. Shenzhen Research Inst., China.* We design a dispersion-engineered chalcogenide (As_2S_3) ridge waveguide to achieve the mid-infrared spectral compression of chirped parabolic pulses. Simulation results show that the compression factor can be up to 27 in a 6.6-mm long waveguide

W3A.34
Period-timing Bifurcation of the Pulse Train in an Actively Q-switched Fiber Laser, Chuang Ma[1], Ju Wang[1], Tianyuan Xie[1], Yang Yu[1], Tianyu Li[1], Shuaishuai Wang[1], Jinlong Yu[1], Yang Jiang[2]; *[1]Tianjin Univ., China; [2]GuiYang Univ., China.* Period-doubling bifurcation, period-trebling bifurcation and period-quadrupling bifurcation of the pulse train in an actively Q-switched fiber laser is experimentally observed in this paper.

W3A.35
Mid-infrared self-similar picosecond pulse compression in a suspended inversely tapered silicon strip waveguide, Yujun Cheng[1], Chao Mei[1], Jinhui Yuan[1,2], Feng Li[2], Zhe Kang[2], Xianting Zhang[2], Yin Xu[2], Binbin Yan[1], Kuiru Wang[1], Xinzhu Sang[1], Xian Zhou[2], Chongxiu Yu[1], Ping Kong A. Wai[2]; *[1]Beijing Univ. of Posts and Telecommunications, China; [2]Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong.* We design a suspended inversely tapered silicon strip waveguide for high degree self-similar picosecond pulse compression. A 1.5-ps input pulse at wavelength 2250 nm is compressed to 46.73 fs in a 2.79-cm long waveguide taper.

W3A.36
Optical burst pulse generation from a gain-switched laser diode through CW laser light injection, Jui-Hung Hung[1], He-Jie Yan[1], Kazuo Sato[1], Hirohito Yamada[1], Lung-Han Peng[2], Hiroyuki Yokoyama[1]; *[1]Tohoku Univ., Japan; [2]National Univ. of Taiwan, Taiwan.* A novel method for producing optical burst pulses is demonstrated. Optical pulses having a several tens of picosecond duration, and a 100-200-ps period are generated from a gain-switched laser-diode under CW laser light injection.

W3A.37
Wavelength-Dependent Angular Distributions of Low-Energy Electrons in Mid-Infrared Strong Field Ionization, Zhiyang Lin[1]; *[1]Huaqiao Univ., China.* The experimentally observed pronounced mid-infrared wavelength-dependent angular distributions (ADs) of low-energy electrons is attributed to the non-adiabatic effect by restoring to an improved semi-classical model.

W3A.38
Polarization coherence deterioration of conventional soliton in amplification, Yujia Li[1], Lei Gao[1], Tao Zhu[1], Yulong Cao[1]; *[1]Chongqing Univ., China.* Nonlinear interactions during the amplification of conventional soliton are studied in terms of polarization change with statistical descriptions. Coherence degeneration of amplified lasers is manifested by an unordered polarization stability among different filtered wavelengths.

W3A.39
Ultrafast electron-phonon coupling and photo-induced strain in the morphotropic phase boundary of $Bi_xDy_{1-x}FeO_3$ films, Zeyu Zhang[1], Juan Du[1]; *[1]Shanghai Inst of Optics and Fine Mech, China.* Using ultrafast two-color pump-probe spectroscopy, the dysprosium doped-BiFeO3 films on SrTiO3 substrate have been investigated systematically. The doping induced structural transition and magnetic enhancement in BDFO is observed by ultrafast electron-phonon and spin-lattice interaction, respectively.

W3A.40
Inter-sublattice coupling dynamics in laser-induced ultrafast demagnetization processes of TbFeCo film, Zhifeng Chen[1], Xiaohui Fang[1], Chengyun Zhang[1], Rongbiao Deng[1], Bairu Xu[1]; *[1]Guangzhou Univ., China.* Laser-induced ultrafast demagnetization of TbFeCo film is studied by employing a dual-color TR-MOKE measurement. Inter-sublattice exchange coupling is found to have significant contribution to the Tb demagnetization in ps time scale. The dynamics is discussed.

W3A.41
Enhanced nonlinearity in a tapered PCF with a central void core, Haihu Yu[1], Jian Ma[1], X Jiang[1], Yu Zheng[1]; *[1]National Engineering Laboratory for Fiber Optic Sensing Technology, Wuhan Univ. of Technology, China.* We report the fabrication of a photonic crystal fiber with a central void, with enhanced nonlinearity via mode squeezing manipulation. Spectral broadening is observed by launching ultrafast pulses into an adiabatically tapered fiber piece.

W3A.42
Supercontinuum Generation in an Amorphous Silicon Strip-loaded Dielectric Waveguide, Yuhua Li[1], Jianguo Zhao[2], Roy Davidson[2], Brent E. Little[3,2], Sai Tak Chu[1]; *[1]Dept. of Physics, City Univ. of Hong Kong, China; [2]QXP Technology Inc., China; [3]State Key Laboratory of Transient Optics and Photonics, XIOPM, CAS, China.* We demonstrate supercontinuum (SC) generation at 1550 nm in a high-index doped glass waveguide strip-loaded with a thin a-Si layer. The strip added 0.1 dB/cm to the propagation loss but it enhanced the SC generation.

W3A.43
Polarization Sensitive Femtosecond Mid-Infrared Spectrometer Using Chirped-Pulse Upconversion, Ryosuke Nakamura[1], Yoshizumi Inagaki[1,2], Nobuhiro Umemura[3], Tomosumi Kamimura[2]; *[1]Osaka Univ., Japan; [2]Osaka Inst. of Technology, Japan; [3]Chitose Inst. of Science and Technology, Japan.* Polarization sensitive femtosecond mid-infrared spectrometer is developed based on chirped-pulse upconversion. A small signal from a Raman-active mode that couples to an infrared-active mode due to a slight decrease in the molecular symmetry is detected.

W3A.44
24 W Tm-doped silica-fiber laser at 2153 nm, Xiaoxi Jin[1], Xiong Wang[2], Jiaxin Song[1], Xiaolin Wang[1], Hu Xiao[1], Pu Zhou[1]; *[1]National Uni of Defense Technology, China; [2]China Satellite Maritime Tracking and Control Dept., China.* We demonstrated a 24 W Tm-doped fiber laser at 2153 nm. A 1942 nm Tm-doped fiber laser was employed as pump laser. The temperature and fiber length were optimized to improve laser performance.

W3A.45
The realization of a topological insulator saturable absorber-based mode-locked solid state laser, Jia C. Lan[1], Yi-Ran Wang[2], Chao-Kuei Lee[1], Wei-Heng Song[1]; *[1]Photonics, National Sun Yat-sen Univ., Taiwan; [2]State Key Laboratory of Crystal Materials, Inst. of Crystal Materials, China.* In this paper, by using the prepared topological insulator saturable absorber mirror, a GHz, mode-locked Nd:YVO_4 bulk laser is realized for the first time with the output power of 180mW and pulse duration of 8ps

W3A.46
Gain-Switched and Passively Mode-Locked Thulium Fiber Laser at 2 µm, Pawel Grzes[1], Maria Michalska[1], Jacek Swiderski[1]; *[1]Inst. of Optoelectronics, Military Univ. of Technology, Poland.* An all-fiber fast gain-switched and mode-locked (GS-ML) thulium-doped fiber laser (TDFL) is reported. The system delivers regular 2 µm mode-locked subpulses with duration <100 ps recorded within one gain-switched pulse envelope

W3A.47
Modeling of soft X-ray Ar^{+8}-laser excited by capillary Z-pinch versus experiments, Anatolij A. Shapolov[1], Matyas Kiss[1], Balazs Fekete[1], Sandor Szatmari[2], Sergei V. Kukhlevsky[1]; *[1]Inst. of Physics, Univ. of Pecs, Hungary; [2]Dept. of Experimental Physics, Univ. of Szeged, Hungary.* The atomic kinetic description of lasing in the capillary Ar^{+8}-laser is connected to the 0-D or 1-D magneto-hydrodynamics models of capillary discharge Z-pinch. The models are in a good agreement with our experimental results.

W3A.48
Generation and Propagation of Anomalous Bessel Vortex Beam, Jun Zeng[1], Yuanjie Yang[2], Chengliang Zhao[1], Yangjian Cai[1]; *[1]College of Physics,Soochow Univ., China; [2]School of Astronautics & Aeronautics,Univ. of Electronic Science and Technology of China, China.* we propose and experimentally study an anomalous Bessel vortex beam. Unlike the traditional Bessel beams, the anomalous Bessel vortex beam carries decreasing orbital angular momentum (OAM) along the propagation axis in free space.

Room S421

14:00–15:30
W3A • Poster Session

W3A.49
Dynamics of Dual Frequency Mode-Locked Fiber Lasers, Xianting Zhang[1,2], Feng Li[1,2], Jinhui Yuan[1], Zhe Kang[1], Ping Kong A. Wai[1,2]; [1]*The Hong Kong Polytechnic Univ., Hong Kong;* [2]*The Hong Kong Polytechnic Univ. Shenzhen Research Inst., Shenzhen, China.* The nonlinear dynamics of a dual-frequency mode-locked fiber laser was investigated theoretically. Cross phase modulation between the two frequency channels induces a new gain loss dynamics which leads to unequal energy pulses in two channels.

W3A.50
288 km-long 2nd-order Raman fiber laser with resolvable mode structure, Han Wu[1], Zinan Wang[1], Yunjiang Rao[1]; [1]*Univ of Electronic Science & Tech China, China.* A 288 km-long 2nd-order Raman fiber laser at 1550nm with mode separation of ~360 Hz is designed and experimentally demonstrated, which is the longest ever laser with resolvable mode structure, reported so far.

W3A.51
CW Tunable 3 μm Fiber Gas Laser Source, Zhiyue Zhou[1], Ni Tang[1], Zhixian Li[1], Wei Huang[1], Yulong Cui[1], Zefeng Wang[1]; [1]*National Univ of Defense Technology, China.* We demonstrate a tunable 3 μm fiber laser source using acetylene-filled hollow-core fibers pumped with a tunable, narrowband and diode-seeded fiber amplifier. The maximum laser power is 766 mW, and the power efficiency is ~13%.

W3A.52
Difference-frequency Generation at 9.2 & 4.6 μm in $LiGaS_2$ Pumped by a 20-picosecond Nd:YAG/$CaCO_3$ Raman Laser, Sergei Smetanin[2], Michal Jelinek[1], Aleksey Kurus[3], Lyudmila Isaenko[3,4], Vaclav Kubecek[1]; [1]*Czech Technical Univ. in Prague, Czechia;* [2]*A.M. Prokhorov General Physics Inst., Russian Academy of Sciences, Russia;* [3]*Siberian Branch Russian Academy of Sciences, Sobolev Inst. of Geology and Mineralogy, Russia;* [4]*Novosibirsk State Univ., Russia.* Single-pass frequency conversion of picosecond Nd:YAG/$CaCO_3$ Raman laser (1.064 / 1.203 & 1.384 μm) into the mid-infrared wavelengths of 9.2 and 4.6 μm by the difference-frequency generation in a $LiGaS_2$ crystal is presented.

W3A.53
Development of coherent pulse combining module, Jin Jang[1], Ki-Nam Joo[1]; [1]*Chosun Univ., Korea.* In this investigation, we propose the practical compact divided pulse amplification (DPA) system, which consists of the pulse divider and combiner in the time domain (T-DPA) and space domain (S-DPA) by a multi-path interferometric structure.

W3A.54
Extra-cavity Pumped Parametric Raman Crystalline Anti-Stokes Laser at 954 nm with Collinear Orthogonally Polarized Beam Interaction at Tangential Phase Matching, Michal Jelinek[1], Sergei Smetanin[2,3], Dmitriy Tereshchenko[3], Vaclav Kubecek[1]; [1]*Czech Technical Univ. in Prague, Czechia;* [2]*Prokhorov General Physics Inst., Russian Academy of Sciences, Russia;* [3]*National Univ. of Science and Technology MISiS, Russia.* Tangentially phase-matched parametric Raman $CaCO_3$ anti-Stokes laser at 954 nm with the extra-cavity 1064-nm 6-ns laser pumping was investigated. The highest optical-to-optical efficiency into the anti-Stokes of ~4 % and 0.3-mJ output energy was achieved.

W3A.55
Compact Fe:ZnSe and Fe:ZnMnSe tunable lasers at 80 K pump with Er:YAG, Richard Svejkar[1], Jan Šulc[1], Helena Jelínková[1], Maxim E. Doroshenko[2], Nazar O. Kovalenko[3], Andrey S. Gerasimenko[3]; [1]*Czech Technical Univ. in Prague, Czechia;* [2]*Laser Materials and Technology Research Center, AM Prokhorov General Physics Inst. of RAS , Russia;* [3]*Inst. for Single Crystals, National Academy of Sciences of Ukraine, Ukraine.* The influence of manganese concentration in compact Er:YAG pumped Fe:ZnMnSe tunable lasers at 80 K were investigated. Using a birefringent plate, the wavelength range of 3950 – 4830 nm (880 nm) was covered.

W3A.56
Fe:$Zn_{0.6}Mn_{0.4}Se$ Spectroscopic Properties and Laser Generation at 5.0 – 5.8 um in the Temperature Range of 78 – 300 K, Helena Jelínková[1], Maxim E. Doroshenko[2], Vjatcheslav Osiko[2], Michal Jelinek[1], Jan Šulc[1], David Vyhlidal[1], Nazar O. Kovalenko[3], A. Gerasimenko[3]; [1]*Czech Technical Univ. in Prague, Czechia;* [2]*A.M. Prokhorov General Physics Inst., Russian Academy of Sciences, Russia;* [3]*Inst. for Single Crystals, National Academy of Sciences of Ukraine, Ukraine.* Temperature-dependent spectroscopic and laser properties of novel Fe:ZnMnSe crystal with high manganese concentration of 0.4 were investigated. Laser central wavelength varied from 5.0 um at 78 K up to 5.8 um at 300 K without any intracavity wavelength-selective element.

W3A.57
A 698 nm Hertz-Linewidth ultrastable diode laser, Linbo Zhang[1,2], Long Chen[1,2], Guanjun Xu[1], Jun Liu[1], Tao Liu[1], Shougang Zhang[1]; [1]*National Time Service Centre, Chinese Academy of Sciences, China;* [2]*Univ. of Chinese Academy of Sciences, China.* Two external cavity diode lasers are frequency-stabilized to two ultrahigh finesse optical resonant cavities with PDH method. The linewidth of each ECDL is measured to be about 1Hz by their beating and the frequency stability below 2.6×10^{-15} between 1s to 100s averaging time.

W3A.58
Wavelength tunable bidirectional Q-switched fiber laser based on carbon nanotube saturable absorber, Chuanhang Zou[1], Qianqian Huang[1], Tianxing Wang[1], mohammed AlAraimi[2,3], Aleksey Rozhin[2,4], Chengbo Mou[1]; [1]*Key Laboratory of Specialty Fiber Optics and Optical Access Networks, Shanghai Univ., China;* [2]*Aston Inst. of Photonic Technologies, Aston Univ., UK;* [3]*Al Musanna College of Technology, Oman;* [4]*Nanoscience Research Group, Aston Univ., UK.* We demonstrate a wavelength tunable bidirectional Q-switched fiber laser based on carbon nanotube and a tunable bandpass filter with tuning range 51.43nm from 1515.43nm to 1566.86nm in clockwise and counter-clockwise direction for the first time.

W3A.59
Spectrally resolved shot-by-shot intensity noise characteristics of soliton spectrum broadening in normal dispersion single-mode fiber, Zijun Yao[1], Jie Chen[1], Ting Li[1], Yu Zhang[1], Xin Zhao[1], Zheng Zheng[1,2]; [1]*School of Electronic and Information Engineering, Beihang Univ., China;* [2]*Beijing Advanced Innovation Center for Big Date-based Precision Medicine, China.* Spectral intensity noise distribution of pulses after spectral broadening in single-mode fiber with normal dispersion is experimentally investigated, and vastly different noise magnitudes and some low-noise regions farther away from the pump wavelength are observed.

W3A.60
Generation of vector beams from wavelength-mismatched vortex plates, Teng-De Huang[1], Ting-Hua Lu[1]; [1]*Taiwan Normal Univ., Taiwan.* The vector beam can be generated from wavelength-mismatched vortex plates, and it was mapped onto a small portion of the Poincaré sphere. All experimental results are consistent with the theoretical results.

W3A.61
Determination of the dioptric power of a thin-disk laser based on the translation of the stability zone, Deng Cao[1], Guangzhi Zhu[1], Jiaqi Gu[1], Xiao Zhu[1], Wenguang Zhao[1], Hailin Wang[1]; [1]*Huazhong Univ. of Science and Technology, China.* The dioptric power of a thin-disk laser is determined by the method of equidistant translation of stability zone with constant shape. The experiments show that the method can determine the dioptric power effectively and precisely.

W3A.62
All polarization-maintaining ultra-broad and flat-topped spectrum Er-doped femtosecond fiber laser, Le Huang[1], Yu Chen[1], Shaozhen Liu[1], Jikun Yan[1], Xuanchao Qin[1], Tao Cao[1], Ziyue Guo[1], Kailin Hu[1], Jiahui Peng[1]; [1]*Huazhong Univ. of S&T, China.* An all polarization-maintaining (PM) Erdium-doped fiber laser that produces ultrabroad and flat-topped spectrum with 3dB bandwidth of more than 60 nm is demonstrated. Hybrid mode-locking is employed to enable self-started mode-locking and spectral shaping.

W3A.63
Efficient suppression of high-order Stokes wave in high power linearly polarized Raman fiber laser using a novel flexible filter, Jiaxin Song[1], Haiyang Xu[1], Xiaoxi Jin[1], Hanwei Zhang[1], Jiangming Xu[1], Pu Zhou[1]; [1]*National Univ of Defense Technology, China.* A novel all-fiber spectral-agile filter was designed and employed to suppress high order Stokes wave in high power linearly polarized Raman fiber laser. The maximum output power was increased by 24.2 %.

W3A.64
Transformation From Dissipative Solitons to Noise-Like Pulses in a Mode-Locked Yb-Doped Fiber Laser, Xingliang Li[1], Shumin Zhang[1], Mengmeng Han[1], Liangliang Chen[1], Zhenjun Yang[1]; [1]*Hebei Advanced Thin Films Laboratory, Hebei Normal Univ., China.* We have demonstrated clearly the direct transition from dissipative soliton to noise-like pulses only by increasing the pump power in a nonlinear polarization rotation mode-locked Yb-doped fiber laser.

W3A.65
Compact THz Spectrometer Based on Varying Illumination on a Rough Semiconductor Surface, Tao Yang[1], Jia-cheng Ge[2], Ho-pui Ho[3], Yong-yuan Zhu[4], Wei Huang[2]; [1]*Nanjing Univ of Posts & Telecomm, China;* [2]*Nanjing Univ. of Posts & Telecommunications, China;* [3] *The Chinese Univ. of Hong Kong, Hong Kong;* [4]*National Laboratory of Solid State Microstructures, Nanjing Univ., China.* The terahertz spectrometer consists of three components, which are used for dispersion, modulation and detection respectively. With a calibration measurement process, one can reconstruct the terahertz spectra by solving a system of simultaneous linear equations.

W3A.66
Terahertz Antireflective Structures Fabricated via Femtosecond Laser Ablation, Xi Yu[1], Mahiro Takeuchi[1], Masaaki Sudo[2], Shingo Ono[1], Jongsuck Bae[1]; [1]*Nagoya Inst. of Technology, Japan;* [2]*IMRA America, Inc., Japan.* Terahertz antireflective structures on Si substrates are fabricated by femtosecond laser processing. The structure is constituted by periodic grooves at micro order. Evaluation results of reflectance by THz-TDS show that the surface reflectance is almost decreased to 0 and antireflection band was widened by improving aspect ratio of grooves.

W3A.67
Terahertz Wave Amplification in Stacked Graphene Layers, Montasir Qasymeh[1]; [1]*Abu Dhabi Univ., United Arab Emirates.* We propose a novel technique for terahertz amplification in optically pumped stacked graphene layers. The terahertz amplification is achieved through a down conversion process, which is enabled by generating a backward terahertz wave.

W3A.68
Electric-Field Vector Imaging of Terhertz Surface Waves on an Indium tin Oxide Thin Film, Kenta Suzuki[1], Kenichi Oguchi[1], Makoto Okano[1], Shinichi Watanabe[1]; [1]*Keio Univ., Japan.* We present a novel method for imaging terahertz electric-field vector using a rotating polarizer technique. We investigate the polarization-dependent propagation of terahertz surface waves on an indium tin oxide metal film.

W3A.69
Explanation for the discontinuous tunability of $KTiPO_4$ terahertz parametric oscillator, Dong Wu[1], Xingyu Zhang[1], Zhenhua Cong[1], Zengguang Qin[1], Zhaojun Liu[1], Xiaohan Chen[1], Jie Zang[1], Feilong Gao[1], Yuan Li[1], Chenyang Jia[1], Yue Jiao[1], Weitao Wang[2], Shaojun Zhang[1]; [1]*Shandong Univ., China;* [2]*Laser Inst. of Shandong Academy of Sciences, China.* By using the polariton dispersion relation in $KTiPO_4$ crystal and the coupled wave equations for stimulated polariton scattering, a semiquantitative explanation for the discontinuous tunability of the KTiPO4 terahertz parametric oscillator is given.

W3A.70
Multi-Position UV-Monitoring Sensor Based on FBG Coated with Photo-Responsive Polymer Material, GyeongSeo Seo[1], Hee-Taek Cho[1], Ok-Rak Lim[1], Tae-Jung Ahn[1]; [1]*Chosun Univ., Korea.* We proposed an ultraviolet light sensor based on a fiber Bragg grating in combination with a photo-responsive polymer material. The sensor can be utilized to monitor UV lights in multiple positions.

W3A.71
Helical Long-period Grating Inscription in Graded-index Few-mode Fiber for Temperature Sensing, Zuyao Liu[1], Yunqi Liu[1], Chengbo Mou[1], Songnian Fu[2]; *[1]Shanghai Univ., China; [2]Huazhong Univ. of Science and Technology, China.* We experimentally demonstrate the fabrication of helical long-period grating (HLPG) in graded-index few-mode fiber by CO2 laser. The fabricated HLPG is found to be sensitive to temperature with a high sensitivity up to 244 pm/°C.

W3A.72
A Long-Distance Fiber-Optic Arc-Flash Sensing System, Pu Wei[1], Lu Deng[2], Hui Huang[3]; *[1]Nanjing Insititute of Technology, China; [2]Nari Group Corp., State Grid Electric Power Research Inst., China; [3]Global Energy Interconnection Research Inst., State Grid Corporation of China, China.* We propose and experimentally demonstrate a long-distance fiber-optic arc-flash sensing system. Using an optical energized VOA, the arc-flash signal can be transmitted by 4-km optical fiber, which meets the demand of the power industry.

W3A.73
Visualization of a periodic structure in arcjet plasma by laser absorption spectroscopy, Yoshiharu Yoshimura[1], Yutaro Sonoyama[1], Chihiro Suzuki[2], Leo Matsuoka[1]; *[1]Graduate school of engineering, Hiroshima-Univ., Japan; [2]National Inst. for Fusion Science, Japan.* We performed spatially-resolved laser absorption spectroscopy of argon arcjet plasma with characteristic optical emission structures. We observed a periodic change of temperatures corresponding to the emission intensities along the jet axis.

W3A.74
Remote and real-time low dose rate gamma radiation measurement using NaI(Tl) based fiber optic sensor, Qiang Guo[1], Chengbo Mou[1]; *[1]Shanghai Univ., China.* A low activity radiation fiber optic measurement system is investigated, NaI(Tl) scintillation crystal attached to a UV optical fiber act as the sensing probe. More than 200 counts can be obtained with the demonstrated sensor.

W3A.75
Laser tracking system for aquatic organisms, Yuki Kakushi[1], Yoshihiko Hibino[1], Cao Yang[1], Ryo Amano[1], Wataru Imajuku[2], Yasushi Mitsunaga[3], Shinsuke Torisawa[3], Yoshinobu Maeda[1]; *[1]Kindai Univ., Japan; [2]Kindai Univ., Japan; [3]Kindai Univ., Japan.* We released Chicken grunts (*Parapristipoma trilineatum*) equipped with capsule lens type retroreflective sheet at the experimental pond and estimated its position with Airborne Laser Bathymetry (ALB) from about 500 m above the sea.

W3A.76
A Fiber-Optic magnetometer Based on Graphene NEMS Using Superparamagnetic Nanoparticles, Zeng-Yong Liu[1], Shao-cheng Yan[1], Zhen-da Lu[1], Fei Xu[1]; *[1]Nanjing Univ., China.* We demonstrate a fiber-optic magnetometer using superparamagnetic nanoparticles based on a graphene NEMS. The resonant frequency of the graphene NEMS shifts with the magnetic field. The sensor shows a sensitivity as high as ~ 104.5 kHz/T.

W3A.77
Metal corrosion measurement method based on optical reflection spectrum analysis, HeeTaek Cho[1], Ok-Rak Lim[1], GyeongSeo Seo[1], KyuHyuk Lee[1], TaeJun Park[1], SooYeon Cho[1], HeeJin Jang[1], Tae-Jung Ahn[1]; *[1]Chosun Univ., Korea.* In this paper, we suggest a metal corrosion measurement method using optical reflection spectrum analysis. Herein, copper samples corroded at high temperatures, up to 900°C, were tested.

W3A.78
A sensor for saturated absorption spectroscopy measurement using a hollow waveguide, Dong T. Cai[1], Guangzhen Gao[1], Jow-Tsong Shy[2]; *[1]Jiangsu Normal Univ., China; [2]Dept. of Physics, National Tsing Hua Univ., Taiwan.* A sensor for saturated absorption spectroscopy is built using a hollow waveguide with diameter of 300 μm. The performance of the sensor is demonstrated by observing the saturated absorption spectroscopy of acetylene around 1536 nm.

W3A.79
Silicone Optical Technology: Quasi Spatial Filter and Its Application for Multichannel Absorption Analysis, Chacriya Malasuk[1], Keisuke Nakakubo[1], Shota Tsuru[1], Hiroaki Yoshioka[1], Kinichi Morita[1,2], Yuta Nakashima[3], Yuji Oki[1]; *[1]Dept. of I&E Visionaries, Kyushu Univ., Japan; [2]New Business Development Office, USHIO INC., Japan; [3]Advanced Science and Technology, Kumamoto Univ., Japan.* Quasi spatial filter was purposed based on silicone optical technology (SOT). A simple structure as coaxial combination of a transparent polydimethylsiloxane (PDMS) core and carbon/PDMS clad was developed and then applied for multichannel absorption analysis.

W3A.80
D-shaped Photonic Crystal Fiber Sensing Probe for Biological Applications, Aruna Gandhi M S[1]; *[1]Shenzhen Graduate School, Peking Univers, China.* Sensing performances of D-shaped photonic crystal fiber are investigated in this work. The highest sensitivity of 2000 nm/RIU in the refractive index ranges from 1.33 to 1.34 for the biological applications.

W3A.81
Evaporation rate sensor of liquids using a simple fiber optic configuration, Ok Rak Lim[1], HeeTaek Cho[1], GyeongSeo Seo[1], Min Ki Kwon[1], Tae-Jung Ahn[1]; *[1]Chosun Univ., Korea.* The volatilization or evaporation rates of liquids were measured herein using the interference between the end surface of an optical fiber and the surface of the liquid on the fiber. We also measured these rates for deionized water and 99% ethanol solution. Our technique has a low cost and simple configuration.

W3A.82
Using Tapered Silicon Fibers to Detect High Refraction Index Liquid, Guan Hung Chen[1], Lon Wang[1], Nien Tsu Huang[1]; *[1]National Taiwan Univ., Taiwan.* A tapered silicon fiber sensor embedded in a microfluidic channel is realized as an absorption sensor to detect liquid with high refractive index (RI), which is hardly obtainable by a traditional silica fiber.

W3A.83
A Surface Plasmon Resonance based Photonic Quasi-Crystal Fibre Biosensor with Fan-Shaped Analyte Channel for High Refractive Index Analytes, Suoda Chu[1], K. Nakkeeran[1], Abdosllam M. Abobaker[2], Sumeet S. Aphale[1], P. Ramesh Babu[3], K. Senthilnathan[3]; *[1]School of Engineering, Univ. of Aberdeen, UK; [2]Dept. of Communications Engineering, College of Electronic Technology, Bani Walid, Libya; [3]Dept. of Physics, School of Advanced Sciences, VIT Univ., India.* We propose a surface plasmon resonance biosensor using a photonic quasi-crystal fibre with a fan-shaped channel for liquids of high refractive index (from 1.46 to 1.52) and it exhibits a maximum sensitivity of 6100 nm/RIU.

W3A.84
Nanoscale self-mixing interferometer based on multiple reflection and spectrum analysis algorithm, Yanting Zhang[1], Rui Wang[1], Zheng Wei[1], Xiulin Wang[2], Wencai Huang[1]; *[1]Xiamen Univ., China; [2]Jimei Univ., China.* A high precision self-mixing interferometer was proposed by combining multiple reflection technique with spectrum analysis algorithm. The interferometer has the ability to measure nanoscale amplitude and the experiments show good agreement with the theory.

W3A.85
An oil-sealed thin-film silica microbubble based fiber-tip Fabry-Perot sensor for Enhancing temperature sensitivity, Guanjun Wang[2,1], Gao Wang[1]; *[1]North Univ. of China, China; [2]Collage of Information Science&Technology, Hainan Univ., China.* An improved pressure-assisted arc discharge technology was utilized to fabricate thin-film silica microbubble based fiber-tip temperature sensor. Then, it was coated with metal film before immersed with oil for ten times of sensitivity enhancement.

W3A.86
Phase detection autofocus pixels with plasmonic nanostructures, Seunghwan Choi[1], Yunkyung Kim[1]; *[1]Dept. of Electronic Engineering, dong-a Univ., Korea.* A phase detection autofocus pixel having the plasmonic nanostructures formed by the subwavelength metal-insulator-metal stack arrays is reported. Using its wavelength selectivity by the incident angles, the autofocus performance is confirmed by the optical simulation.

W3A.87
A reflective optical phased array design based on elements with limited phase tuning range, Bo Yang[1,2], MingHua Chen[1,2], Hongwei Chen[1,2], SiGang Yang[1,2]; *[1]Electronic Engineering, Tsinghua Univ., China; [2]National Research Center for Information Science and Technology, China.* A reflective optical phased array model based on elements with small phase tuning range (~2 rad) is proposed. A steering range of ±8.9° with 5μm element spacing is achieved.

W3A.88
Reflective Differential Interference Contrast Microscopy for Retinal Cell Layer Imaging, Subeen Park[1,2], Juyeong Oh[1], Yu J. Kim[3], Hyo-suk Kim[1], Chulki Kim[1], Hyung M. Kim[2], Kyoung M. Lee[4], Dae Y. Kim[5], Seok H. Kim[4], Jae Hun Kim[1]; *[1]Korea Inst. of Science & Technology, Korea; [2]Chemistry, Kookmin Univ., Korea; [3]Ophthalmology, Seoul National Univ. Hospital, Korea; [4]Ophthalmology, , Seoul Metropolitan Government Seoul National Univ. Boramae Medical Center, Korea; [5]Electrical Engineering, Inha Univ., Korea.* We observed retinal cell layers using a reflective differential interference contrast (DIC) microscopy. This technique allows non-stained, transparent retinal cells to be possibly imaged in a three-dimensional view.

W3A.89
A Method of One-Exposure Coherent Diffraction Imaging Through the Turbid Media, Wusheng Tang[1], Wenjun Yi[1], Meicheng Fu[1], Lei Wang[1], Qianwen Nie[1], Mengjun Zhu[1], Xiujian Li[1], Ping Wang[1]; *[1]National Univ of Defense Technolog, China.* We use simple optical setup and algorithm of coherent diffraction imaging to reconstruct the object completely hidden behind an opaque diffuser. A linear model is deduced and we get the experimental results consistent with it.

W3A.90
Single-shot coded aperture structured illumination digital holographic microscopy for resolution enhancement, Han-Yen Tu[2], Xin-JI Lai[1], Yu-Chih Lin[1], Chau-Jern Cheng[1]; *[1]National Taiwan Normal Univ., Taiwan; [2]Chinese Culture Univ., Taiwan.* This work proposes coded aperture structured illumination digital holographic microscopy for directional resolution enhancement. The Fresnel hologram at a single exposure with compressive sensing is applied to avoid temporal phase shifting process in structured illumination.

W3A.91
Joule level long pulse green laser and its application for the micro welding of copper and aluminum, Zhiqiang Fang[1], Baohua Zhu[1], Xiaoting Li[1], Jianqiang Liu[1], Jin Wang[2]; *[1]Institution of Laser Source for welding, Precision Welding Division, Han's Laser Technology Co. Ltd , China; [2]Precision Welding Division, Han's Laser Technology Co. Ltd , China.* To solve the poor weldability of copper and aluminum, Hans Laser has developed a joule level long pulse green laser with high frequency doubling efficiency. The process experiment results showed that a greatly improved weld quality and splatter free micro welding of the dissimilar metals has been achieved.

W3A.92
Fabrication and Evaluation of Ce^{3+} Ion Doped CaF_2 Thin Film Phosphor, Masato Hishiki[1]; *[1]Nagoya Inst. of Technology, Japan.* We fabricated Ce^{3+}:CaF_2 thin films with different doping concentration in anticipation of use as a phosphor. We calculated practical doping concentration from lattice distortion and evaluated the optimized doping concentration for high efficiency light emission.

W3A.93
Patterning Oxidation via Femtosecond Laser Irradiation on Copper Substrate, Xi Yu[1], Masaaki Sudo[2], Fumihiro Itoigawa[1], Shingo Ono[1]; *[1]Nagoya Inst. of Technology, Japan; [2]IMRA America, Inc., Japan.* Patterning oxidation was performed by irradiating femtosecond laser pulses to surface of oxygen-free copper substrate. Conglomerations less than 1 μm were observed on irradiated are by SEM. Expansion (about 400 nm) and discoloration were observed by CLSM. Results of EDX, Raman spectroscopy and XRD suggested that the irradiated area was Oxidized.

W3A.94
Direct-bonding TC4 and PA plastics by a nanosecond laser lap joining technology, Zhihao Fang[2], Longfei Chen[2], Yingchun Guan[1,3]; *[1]School of Mechanical Engineering and Automation, Beihang Univ., China; [2]School of Energy and Power Engineering, Beihang Univ., China; [3]National Engineering Laboratory of Additive Manufacturing for Large Metallic Components, Beihang Univ., China.* This study carried out the direct-bonding between titanium and polyamide using nanosecond laser, investigated the effect of the textured micro-groove depth on the strength of the joint and obtained the optimal joint strength.

W3A.95
Modification of SiC surface transport properties via excimer laser irradiation in various atmosphere conditions, Zhenyuan Lin[1], Lingfei Ji[1]; [1]*Beijing Univ. of Technology, China.* Excimer laser was employed for the surface modification of transport properties on n-type single-crystal 4H-SiC substrates. Corresponding electrical performance was measured and modified mechanism was analyzed.

W3A.96
Fabricating Fine Structures Induced by Femtosecond Laser on Molybdenum Surface, Masato Hishiki[1]; [1]*Nagoya Inst. of Technology, Japan.* We fabricated nanostructures on molybdenum with a femtosecond laser, and pores and spikes that are smaller than LIPSS were observed. Additionally, we controlled the wettability with micro and nanostructures as well as just nanostructures.

W3A.97
Research on the laser drilling property of glass fiber composite material by quasi-continuous-wave laser, Changyong Tian[1]; [1]*Key Laboratory of Functional Crystal and Laser Technology, Technical Inst. of Physics and Chemistry, Chinese Academic of Science, China.* The laser drilling property of glass fiber composites irradiated by quasi-continuous wave laser (QCW) is researched under different subsonic tangential airflow velocities, based on a combination of online experimental system and off-line measuring system.

W3A.98
All-solid Microstructured Fiber for Coherent Supercontinuum Pumped by Sub-picosecond Pulse, Meisong Liao[1]; [1]*Shanghai Inst of Optics and Fine Mech, China.* We proposed and fabricated an asterisk-shaped all-solid microstructured fiber, presenting a low, ultra-flat, and all-normal dispersions. An octave-spanning coherent SC pulse with a 0.5-ps pump pulse at 1.55 μm was numerically generated.

W3A.99
Quantum Noise Analysis of Gain Saturated Periodically Poled Lithium Niobate waveguides, Takuya Takemura[1], Shun Noguchi[1], Kunihiko Mori[2], Mitsunori Fukutoku[2], Wataru Imajuku[1]; [1]*Kindai Univ., Japan;* [2]*NTT Network Innovation Labs., Japan.* This paper analyses quantum noise in gain saturated Periodically Poled Lithium Niobate waveguides for optical repeater amplifier in fiber transmission systems. The feature of amplitude noise suppression can improve performance of signal-to-noise ratio in the systems.

W3A.100
Design of Logarithmic-Index Fiber for Orbital Angular Momentum (OAM) Transmission, Shuhui Li[1], Pei You[1], Zhe Xu[1], Ruixuan Zhao[1], Li Shen[1], Jian Wang[1]; [1]*Wuhan National Lab for Optoelectronics, China.* We propose and design a fiber with logarithmic-index profile for orbital angular momentum (OAM) transmission. The designed fiber shows favorable performance of low mode crosstalk and tensile invariance property of mode field diameter (MFD).

W3A.101
Dual-core Photonic Crystal Fiber Multi-mode Selective Coupler Supporting up to Seven High Modes, Qihang Hu[1], Li Gao[1], Mingying Lan[1], Shanyong Cai[1], Song Yu[1]; [1]*State Key Laboratory of Information Photonics and Optical Communications, China.* A multi-mode selective coupler based on asymmetric dual core photonic crystal fiber is proposed. Efficient mode conversion between LP_{01} and high order modes is achieved, more than previous report. Minimum bandwidth can reach 2 nm.

W3A.102
Fabrication of chirped and tilted fiber Bragg gratings on LMA-DC fiber by phase mask technique, Meng Wang[1], Yulong Cui[1], Le Liu[1], Zefeng Wang[1], Xiaojun Xu[1], Xijia Gu[2]; [1]*National Univ of Defense Technology, China;* [2]*Dept. of Electrical and Computer Engineering, Ryerson Univ., Canada.* The inscription of chirped and tilted fiber Bragg gratings (CTFBGs) is demonstrated in hydrogen-loaded large-mode-area double-cladding (LMA-DC) fiber by a linearly chirped phase mask.

W3A.103
Design of Broadband Plasmonic Polarization Beam Splitter, Lanting Ji[1], Yang Gao[1], Yan Xu[1], Xiaoqiang Sun[1], Xibin Wang[1], Fei Wang[1], Daming Zhang[1], Zhiyong Li[2]; [1]*Jilin Univ., China;* [2]*Inst. of Semiconductors, Chinese Academy of Sciences, China.* A polarization beam splitter based on vertical coupling between plasmonic mode and optical mode is theoretically designed. A bandwidth of 250 nm at an extinction ratio of over 10 dB can be realized.

W3A.104
Transformation of the fiber based $LP_{0,n}$ modes into free-space $LG_{0,p}$ beams, Nitin Bhatia[1,2], Shailendra Varshney[1]; [1]*Indian Inst. of Technology Kharagpur, India;* [2]*NIIT Univ., India.* We show that the beam waist of the LG modes should be less than the fiber core diameter for transforming the $LP_{0,n}$ modes into free-space beams. The choice of beam waist does not alter the free-space propagation of the beam, given that the LG mode set is complete.

W3A.105
Design of polarization-maintaining rectangular core fiber supporting eight modes, Zihao Wang[1], Li Gao[1], Mingying Lan[1], Shanyong Cai[1], Song Yu[1]; [1]*State Key Laboratory of Information Photonics and Optical Communications, China.* Polarization-maintaining rectangular core fiber is proposed. Eight modes are hold simultaneously under regular cladding, with extreme small dispersion over entire C and L bands. It's suitable for long-distance, high-capacity MIMO-free spatial division multiplexing.

W3A.106
Experimental Demonstration of Femtosecond-level Quantum Clock Synchronization, Quan Run ai[1,2], Ruifang Dong[1], Yiwei Zhai[1,2], Fei y. Hou[1,2], Tao Liu[1], Shougang Zhang[1]; [1]*Key Laboratory of Time and Frequency Primary Standards, National Time Service Center, CAS, China;* [2]*Univ. of Chinese Academy of Sciences, China.* Based on the second-order quantum interference between frequency entangled photons generated via parametric down conversion process, we have demonstrated a new experiment of synchronizing two clocks separated by 6-km fiber link. A synchronization accuracy of 13 ps has been achieved with a minimum timing stability of 60 fs.

W3A.107
Quantum secure ghost imaging, Xin Yao[1], Xu Liu[1], Wei Zhang[1], Yidong Huang[1]; [1]*Tsinghua Univ., China.* We propose and experimentally demonstrate a scheme of quantum secure ghost imaging. It realizes information transmission over optical fibers by temporal ghost imaging, and performs the security test by monitoring the entanglement in photon pairs.

W3A.108
Enhanced coincidence between two independent heralded single-photons using a fiber-optic single-photon buffer, Akiko Tada[1], Naoto Namekata[1], Shuichiro Inoue[1]; [1]*Nihon Univ., Japan.* We report on the all-fiber single-photon buffer for long-distance quantum communications. The coincidence between single photons generated by two independent heralded single-photon sources was successfully enhanced without degrading the polarization-entanglement.

W3A.109
Manipulating conditional photon statistics of lasers via second-order interference and post-selections, Kang-Hee Hong[1], Jisung Jung[2], Young-Wook Cho[2], Sang-Wook Han[2], Sung Moon[2], Kyunghwan Oh[3], Yong-Su Kim[2], Yoon-Ho Kim[1]; [1]*Pohang Univ of Sci & Tech (POSTECH), Korea;* [2]*Korea Inst. of science and technology, Korea;* [3]*physics, Yonsei Univ., Korea.* Here we report theoretical analysis on the limits of manipulating conditional photon statistics of lasers via interference and post-selections. We demonstrate explicitly that photon anti-bunching cannot be obtained in such a scheme.

W3A.110
Compression of chirped biphotons by Fresnel-inspired binary phase shaping, Baihong Li[1,2]; [1]*Xi'an Univ. of Science & Technology, China;* [2]*Key Laboratory of Time and Frequency Primary Standards, National Time Service Center, Chinese Academy of Sciences, China.* We theoretically show that chirped biphotons can be compressed to Fourier-transform limited by shaping its spectrum using Fresnel-inspired binary phase shaping. This provides a way for the generation of single-cycle biphotons.

W3A.111
Homodyne detection of 1.57-μm squeezed vacuum pulse with degenerate optical parametric oscillator pumped by a common 785-nm laser, Akihito Omi[1], Aruto Hosaka[1], Masaya Tomita[1], Shintaro Niimura[1], Fumihiko Kannari[1]; [1]*Keio Univ., Japan.* We generate 1.57-μm squeezed vacuum pulses by degenerate spontaneous parametric down conversion (DSPDC) and observe 3.5dB anti-squeezing and -0.48dB squeezing using local oscillator pulses generated from a degenerate synchronously pumped optical parametric oscillator.

W3A.112
Universal Model for Multi-mode NOON State Generation Using Fock State Filters, Lu Zhang[1], Kam Wai C. Chan[1]; [1]*Univ. of Oklahoma, USA.* We present a universal model for generating multi-mode NOON states using Fock state filters. The generation efficiencies for different input scenarios such as coherent states and squeezed vacuum states are calculated for comparisons.

W3A.113
Measuring the topological charge of light beams generated by four-wave mixing in Rb vapours, Jack Muir[1], Nafia Rahaman[1], Alexander Akulshin[1], Russell McLean[1]; [1]*Swinburne Univ. of Technology, Australia.* Collimated light generated via four wave mixing in atomic rubidium vapours excited by light carrying orbital angular momentum is analyzed, particularly the case of doughnut-shaped intensity profiles with zero topological charge.

W3A.114
Uncovering quantum interferences between photon numbers using the Fisher information of field quadrature estimates, Junyi Wu[1], Holger Hofmann[1]; [1]*Hiroshima Univ., Japan.* We show that the reduction of the Fisher information of field quadrature displacements of squeezed states in lossy channels reveals characteristic patterns relating to quantum interferences between different photon numbers.

W3A.115
Wideband MZI based Thermo-Optic Switch with Slab Integrated Microheater in SOI, Ramesh K[1], Bijoy K. Das[1]; [1]*IIT MADRAS, India.* Silicon waveguide slab integrated microheater is proposed in MZI configuration for efficient and broadband thermo-optic switch. Fabricated devices exhibit fast switching (~5 ms) and extinction of > 20-dB over a broad wavelength range (1520-1620 nm).

W3A.116
Robust Excitation of High-Q Nanocavities via a Super-Luminescent Diode, Risa Shiozaki[1], Kohei Ashida[1], Yasushi Takahashi[1]; [1]*Osaka Prefecture Univ., Japan.* We employ a superluminescent diode (SLD) as excitation light source for photonic crystal high-Q nanocavities. We demonstrate that the broad emission of the SLD enables robust and simultaneous excitation of eight high-Q L3-type nanocavities.

W3A.117
Successful fabrication of GaInAsP ridge waveguide laser diode using hydrophilic bonded InP/Si substrate, Hiromu Yada[1], Naoki Kamada[1], Yuya Onuki[1], Xu Han[1], Gandhi Kallarasan Periyanayagam[1], Kazuki Uchida[1], Hirokazu Sugiyama[1], Masaki Aikawa[1], Natsuki Hayasaka[1], Kazuhiko Shimomura[1]; [1]*Sophia Univ., Japan.* We have successfully fabricated 1.5 μm GaInAsP ridge waveguide laser diode on InP/Si substrate and obtained lasing emission. We have measured I-L-V characteristics and compared threshold current between InP/Si and InP substrate at several temperatures.

W3A.118
Robust TE0 + TE1 Waveguide Crossing, Pengfei Xu[1], Yanfeng Zhang[1], Yujie Chen[1], Siyuan Yu[1,2]; [1]*Sun Yat-sen Univ., China;* [2]*Univ. of Bristol, UK.* We proposed a silicon waveguide crossing device supporting both TE0 and TE1 modes, TE0 mode insertion loss about -1 ~ -1.2 dB and TE1 insertion loss about -0.5 ~ -1 dB, and the crosstalk is better than -30 dB.

W3A.119
Measurement of the Threshold of Stimulated Brillouin Scattering with Super-Gaussian-shaped Laser Pulses, Xuehua Zhu[1], Guanling Wang[1], Guangzhen Dai[1], Haojuan Hu[1]; [1]*Anhui Polytechnic Univ., China.* We present a novel method for measuring the threshold of stimulated Brillouin scattering (SBS) from the waveform of reflected light with large-aperture super-Gaussian-shaped laser pulses.

W3A.120
Suppression of SRS in a two-stage 1090 nm fiber amplifier using chirped and tilted fiber Bragg gratings, Meng Wang[1], Yulong Cui[1], Le Liu[1], Zefeng Wang[1], Xiaojun Xu[1], Xijia Gu[1]; [1]*National Univ of Defense Technology, China.* We report here the suppression of stimulated Raman scattering in a 1090 nm two-stage fiber laser amplifier using chirped and tilted fiber Bragg gratings (CTFBGs).

14:00–15:30
W3A • Poster Session

W3A.121
Modeling of TMI effect in high power multi-wavelength pumped Yb-doped fiber amplifier, Lingchao Kong[1], Jinyong Leng[1], Pu Zhou[1], Zongfu Jiang[1]; [1]*National Univ. of Defense Technology, China.* We demonstrate a model to simulate the TMI effect in multi-wavelength pumped YDFA. The maximum output power is increased about 20% by optimizing the power ratio between the 915 nm and 976 nm pump laser

W3A.122
Graphene-incorporated sol–gel glass for saturable absorption of fiber lasers, Yusheng Zhang[1], Xueming Liu[1]; [1]*Zhejiang Univ., China.* We successfully demonstrated all-fiber mode-locked laser with the graphene-incorporated sol-gel glass as the saturable absorber, and conventional soliton spectrum with Kelly sideband and spectral full width of 1.1 nm is obtained.

W3A.123
Experimental Study on the Mitigation of Photodarkening in Yb-doped Fibers by Li co-doping, Miao Li[1,2], Nan Zhao[2], Yehui Liu[2], Gui Chen[2], Jinyong Leng[1], Jinbao Chen[1], Jinyan Li[2]; [1]*National Univ. of Defense Technology, China;* [2]*Huazhong Univ. of Science and Technology, China.* We experimentally demonstrated that Li^+ ions doping into Yb-doped fiber is beneficial to mitigate the photodarkening-induced excess loss. The mechanism of alkali metal elements Li and Na co-doping to mitigate the PD effect is discussed.

W3A.124
High Power 1.5 μm Fiber Gas Raman Laser Source, Zhixian Li[1], Wei Huang[1], Yulong Cui[1], Zefeng Wang[1]; [1]*National Univ of Defense Technology, China.* We report here a high-power 1.5 μm gas Raman laser source using a methane-filled hollow-core fiber. The maximum average power is ~830 mW, which is about 20 times as much as the similar experiment reported.

W3A.125
A high-efficiency GaAs photodetector enhanced by a near-infrared dipole antenna, Yanni Tang[1]; [1]*Beijing Univ. of Posts and Telecomm, China.* We present a plasmon-enhanced PN photodetector structure based on a GaAs nanowire decorated with a half-wave Hertz dipole antenna. An enhancement by a factor of 100 in the responsivity due to the antenna resonance.

W3A.126
Mode Converters Based on LPFGs at 1 μm, Le Liu[1], Meng Wang[1], Xiaoming Xi[1], Zefeng Wang[1]; [1]*National Univ of Defense Technology, China.* Here we report a LP_{01}-LP_{11}mode converter based on long-period fiber grating (LPFG) in a conventional two-mode fiber (TMF) operating at 1μm. The mode converter was fabricated with point-by-point technique using a CO_2 laser.

W3A.127
First-principles investigation of semiconductor-like MXenes, Qiran Chen[1,2], Weijun Fan[1,2], Dao Hua Zhang[1,2], Haibin Su[3], Jisheng Pan[4]; [1]*School of EEE, Nanyang Technological Univ., Singapore;* [2]*OPTIMUS, Centre for OptoElectronics and Biophotonics, LUMINOUS! Centre of Excellence for Semiconductor Lighting and Displays, Nanyang Technological Univ., Singapore;* [3]*School of Materials Science & Engineering, Nanyang Technological Univ., Singapore;* [4] *Inst. of Materials Research and Engineering (IMRE), Agency for Science, Technology and Research (A*STAR), Singapore.* MXenes are a large family of two-dimensional material composed of transition metal carbides or nitrides. This article gives theoretical investigation of a type of MXene that behave like semiconductors.

W3A.128
Frequency Noise Reduction of Injection-Locked Quantum Cascade Lasers, Xing-Guang Wang[1], Bin-bin Zhao[1], Cheng Wang[1]; [1]*ShanghaiTech Univ., China.* This work theoretically shows that the optical injection significantly reduces the frequency noise of quantum cascade lasers in the low frequency range. Frequency detunings close to the positive locking boundary enhance the frequency noise peak.

W3A.129
Application of High-reflectivity Non-periodic Sub-wavelength Gratings with Small-angle Beam-steering Ability in Fabry-Perot Cavity, Shuai Zhang[1], Xiaofeng Duan[1], Gongqing Li[1], Kai Liu[1], Yongqing Huang[1], Xiaomin Ren[1]; [1]*Beijing Univ. of Posts and Telecomm, China.* An axisymmetric high-reflectivity non-periodic sub-wavelength gratings (SWGs) with small-angle beam-steering ability for reflected light is presented, and it brings a new characteristic of flexibly controlling the width of oscillation optical field for the improved Fabry-Perot (F-P) cavity which based on it.

W3A.130
Analysis of collagen fiber orientation using rapidly-polarization-modulated second-harmonic-generation microscopy, Takuya Sakaue[1], Eiji Hase[1,2], Takeo Minamikawa[1], Takeshi Yasui[1]; [1]*Tokushima Univ., Japan;* [2]*Japan Synchrotron Radiation Research Inst., Japan.* We constructed continuously-polarization-resolved SHG microscopy based on rapid polarization rotation every 15 degrees with electric-optic Pockells cell, and applied it for the quantitative analysis of collagen fiber orientation in biological tissues.

W3A.131
Imaging and Spectral Analysis of Ultra-weak Biophoton Emission and Delayed Luminescence from Human Skin, Torai Iwasa[1], Masaki Kobayashi[1]; [1]*Tohoku Inst. of Technology, Japan.* Biophoton is spontaneous ultra-weak photon emission (UPE) from living body. Delayed luminescence is also UPE from living body but emission after visible light exposure. Both are associated with oxidative stress of the body. We have developed highly sensitive imaging and spectroscopic system for UPE and characterized them for diagnostic application.

W3A.132
A Study on the Sensitivity and Specificity of Tactile Sensation Induced by Pulse Laser, Hyung-Sik Kim[1], Jihun Jo[1], Mi-Hyun Choi[1], Soon-Cheol Chung[1]; [1]*Biomedical Eng., Konkuk univ, Korea.* Pulse laser of two energies was presented on the finger and the perceptual characteristic of the human response from the laser-based tactile sensation was observed.

W3A.134
Spectral Interferometry based SPR Phase Response on the Non-resonant Wavelengths, Meng-Syuan Jian[1], Ding-Zhang Tsai[1], Shih-Hsiang Hsu[1]; [1]*Electronic and Computer Engineering, National Taiwan Univ. of Science and Technology, Taiwan.* A real-time, high sensitivity and label-free spectral interferometry-based surface plasma resonator biosensor is demonstrated. We prove that the Mycobacterium tuberculosis (MTB) DNA can be captured by the immobilized IS 6110 DNA probe successfully and the system sensitivity is showing -0.162 (rad/(μg/mL)) *from the non-resonant wavelengths.*

W3A.135
Dual low coherence scanning interferometer for rapidly measuring large step height and thickness, Jun Woo Jeon[1], Hyo Mi Park[1], Ki-Nam Joo[1]; [1]*Chosun Univ., Korea.* In this investigation, spectroscopic ellipsometry using a LCP (Liquid crystal polymer) type of depolarizer, named as spatially phase-retarded spectroscopic ellipsometry (SPARSE), is proposed to significantly raise the measurement speed compared to the typical spectroscopic ellipsometry.

W3A.136
Mode Density Multiplication of an Optical Frequency Comb by N^2 with Phase Modulation, Taro Hasegawa[1,2], Hiroyuki Sasada[1,2]; [1]*Keio Univ., Japan;* [2]*JST, ERATO, MINOSHIMA Intelligent Optical Synthesizer Project, Japan.* We introduce a simple scheme for mode density multiplication of an optical frequency comb by square of an arbitrary integer with phase modulation. The mode density of an Er fiber comb is multiplied by 4^2.

W3A.137
Piezoelectric Resonance Laser Calorimetry for Optical Absorptance Testing of Crystal Boules, Georgii A. Aloian[1], Nikita Kovalenko[1], Irina Shebarshina[1], Aleksey Konyashkin[2]; [1]*Moscow Inst. of Physics and Technolo, Russia;* [2]*Kotelnikov Inst. of Radio-engineering and Electronics of RAS, Russia.* Novel technique for measuring low optical absorption coefficients of massive crystal boules of arbitrary shape is proposed. The accuracy of the method was theoretically estimated.

W3A.138
A Simplified Distance Measurement Method Based on Optoelectronic Oscillator, Tianyuan Xie[1], Jinlong Yu[1], Ju Wang[1], Zixiong Wang[1], Chuang Ma[1], Yang Yu[1], Tianyu Li[1]; [1]*Tianjin Univ., China.* We propose a long-range, high-precision distance measurement system with low complexity and cost based on optoelectronic oscillator. The relative measurement accuracy of 1.667 km is 3×10^{-9}.

W3A.139
Real-time spectroscopic ellipsometer using a depolarizer, Jin Sub Kim[1], Dae Hee Kim[1], Ki-Nam Joo[1]; [1]*Chosun Univ., Korea.* In this investigation, spectroscopic ellipsometry using a LCP (Liquid crystal polymer) type of depolarizer, named as spatially phase-retarded spectroscopic ellipsometry (SPARSE), is proposed to significantly raise the measurement speed compared to the typical spectroscopic ellipsometry.

W3A.140
Development of a laser system for observation of light-induced drift of Cs atoms, Yuya Kusano[1], Noritaka Nishiya[1], Leo Matsuoka[1]; [1]*Graduate School of Engineering,, Hiroshima Univ., Japan.* A laser system with a widely-tunable stabilized frequency suitable for observation of the light-induced drift was developed. The reference signal was obtained by dichroic atomic vapor spectroscopy over the range of 2 GHz.

W3A.141
Plasmon-assisted Random Lasing in Perovskite Quantum Dots, Si Q. Li[1], Jijun He[1], Yunfeng Wang[1], Decheng Yang[1], Siu Fung Yu[1], Dang Yuan Lei[1]; [1]*The Hong Kong Polytechnic Univ., Hong Kong.* Here we report a plasmonic all-inorganic perovskite $CsPbBr_3$ quantum dots hybrid films for two photonics random laser. The gold nanorods with good optical confinement and strong plasmonic enhancement properties formed randomly closed-loop cavities for the green random laser which are applied for speckle-free imagine.

W3A.142
Thermal tuning of plasmon-bright-exciton coupling by redistribution of exciton density between bright and dark exciton, Tsz Wing Lo[1], Dang Yuan Lei[1]; [1]*The Hong Kong Polytechnic Univ., Hong Kong.* We discover plasmon-exciton coupling strength in MoS_2 system and WS_2 system opposite to each other under thermal tuning. The variation comes from energy difference on bright and dark exciton due to redistribution of oscillator strength.

W3A.143
Complex-amplitude modulation of linear polarization via metasurface, Jangwoon Sung[1], Gun-Yeal Lee[1], Chulsoo Choi[1], Byoungho Lee[1]; [1]*Seoul National Univ., Korea.* We present a novel complex amplitude modulation method for linear polarization from incident circular polarization. We achieved high efficiency up to 98 % with fulfilling continuous and independent modulation of amplitude and phase.

W3A.144
Observation of a plasmon induced magnetic resonance in a gold sphere dimer-on-film nanocavity, Yongjun Meng[1, 2], Qiang Zhang[1], Meng Qiu[1], Guang-Can Li[1], Chi Wah Leung[1], Xuewen Chen[2], Dang Yuan Lei[1]; [1]*Dept. of Applied Physics, Hong Kong Polytechic Univ., Hong Kong;* [2]*School of Physics, Huazhong Univ. of Science and Technology, China.* We experimentally and theoretically reveal that a gold nanosphere-dimer-on-film nanocavity supports a strong in-plane magnetic dipolar resonance in a deep sub-wavelength region, induced by a current loop in the nanometer thick dimer-film gap.

W3A.145
Plasmonic Au/TiO_2-dumbbell-on-film nanocavities for high-efficiency hot-carrier generation and extraction, Aixue Shang[1], Dang Yuan Lei[1]; [1]*The Hong Kong Polytechnic Univ., Hong Kong.* Au/TiO_2 dumbbell assembled on Au film optically establish plasmonic nanocavities, resulting in strong near-field enhancement and confinement and eventually contributing to the improved photocurrent, IPCE and decomposition rate.

W3A.146
Polarization conversion in toroidal metamaterial in optical spectral range, Sang-Eun Mun[1], Sun-Je Kim[1], Jongwoo Hong[1], Byoungho Lee[1]; [1]*Seoul National Univ., Korea.* We propose a novel scheme to realize broadband polarization conversion using anisotropic metamaterial based on the fourfold symmetry breaking. The coupling of plasmon resonances generates orthogonal polarization component. Magnetic and toroidal resonances lead to bandwidth expansion of polarization conversion in optical spectral range.

Room S421

14:00–15:30
W3A • Poster Session

W3A.147
Tunable hybrid plasmonic split-ring resonator refractive index sensor for high FOM applications, Kishore K R[1]; [1]*Electronics And Communication Engineering, NIT TRICHY, India.* We propose a hybrid plasmonic micro-ring resonator combining split-ring and photonic waveguide. The finite difference time domain analysis of the design exhibit strong field confinement and have a figure of merit of 216.67 /RIU which can be used for refractive index sensor application.

W3A.148
Coupling of a metasurface with two non-coplanar and inter-perpendicular graphene nanoribbon arrays, Feng Chao Ni[1], Ze T. Xie[1], Qi Chang Ma[1], Jin Tao[2], Jian Li[1], Hongyun Men[1], Xu Guang Huang[1]; [1]*South China Normal Univ., China;* [2]*Wuhan Research Inst. of Posts Telecommunications, State Key Laboratory of Optical Communication Technologies and Networks, China.* A graphene metasurface is proposed and investigated. Through the analysis of the light field, the formation mechanism of the spectral splitting is attributed to the coupling between localized and delocalized graphene surface plasmon polaritons.

W3A.149
Light-actuation of carbon nanotubes in liquids, Yujie Liu[1], Chunhui Zhu[1], Emmanuel Flahaut[2,3], Fengqiu Wang[1]; [1]*School of Electronic Science and Engineering, Nanjing Univ., China;* [2]*CNRS, Institut Carnot Cirimat, France;* [3]*Universite de Toulouse; UPS, INP, Institut Carnot Cirimat; 118, route de Narbonne, F-31062 Toulouse cedex 9, France.* We observed a novel phenomenon where single-wall carbon nanotube flocculations can be photo-actuated in liquids by either sunlight or laser irradiation. The light-actuation phenomenon is found highly repeatable.

W3A.150
Highly Efficient Multilayer Rhenium Disulfide-based Homo- and Hetero-junction Photovoltaic Devices, Kwan-Ho Kim[1], JeaWoo Shim[1], Jin-Hong Park[1]; [1]*Sungkyunkwan Univ., Korea.* We demonstrated the photovoltaic devices based on ReS_2 homo- and hetero-junctions. First, ReS_2 based homo-junction photovoltaic device showed PCE of 2.4%. Furthermore, ReS_2/WSe_2 heterojunction exhibited high PCE of 12%.

W3A.151
Two-dimensional ReS_2 nanosheets based saturable absorbers for passively mode-locked fiber lasers, Mengyu Zhang[1], Jinde Yin[1], Peiguang Yan[1]; [1]*College of Optoelectronic Engineering, Shenzhen Univ., China.* We prepared ReS_2 nanosheets by liquid-phase exfoliation and fabricated ReS_2 saturable absorbers with all-fiber integrated structure. Their nonlinear optical properties were investigated systematically. The results demonstrate that ReS_2 nanosheets own excellent nonlinear saturable absorption properties.

W3A.152
Polarization-independent and wide-incident-angle absorber with periodically patterned graphene-dielectric arrays, Gaige Zheng[1], Xiujuan Zou[1]; [1]*Nanjing Univ. of Information Sci. & Tech, China.* A graphene optical absorber with periodically patterned grating is demonstrated. The proposed absorber exhibits polarization-insensitive behavior and maintains the high absorption above 90% within a wide range of incident angle (more than 80°).

W3A.153
Wearable Full-duplex Digital Transceiver for Underwater Optical Wireless Communications, Zixian Wei[1], Xin Mu[1], Hongyan Fu[1]; [1]*Tsinghua-Berkeley Shenzhen Inst., China.* We demonstrate an UOWC system with up to 235 Mbps at BER of 1.0×10-3 over 11.5-meters in water, which is based on a compact full-duplex digital transceiver by integrating commercial available blue-LED and APD.

W3A.154
A Multichannel WDM-PON System with Port Agnostic Tunable SFP+ Transceiver Modules, Yang Liu[1], Da Li[1], Tiantian Zhang[1], Jian-Jun He[1]; [1]*Zhejiang Univ., China.* We demonstrate a WDM-PON system with port agnostic tunable SFP+ transceiver modules. With low-frequency envelope-modulated message channel, error-free data transmission is achieved at 8.5 Gbps with a sensitivity better than -19 dBm.

W3A.155
Visible Light Communication based on Orbital Angular Momentum Multiplexing, Youpeng Xie[1], Lei Ting[1], Zhang Shan[1], Xiaocong L. Yuan[1]; [1]*Shenzhen Univ., China.* We propose and demonstrate a visible light communication based on orbital angular momentum multiplexing. The coaxial two signal channels achieve the transmission of the audio and video, which improve the capacity of the system.

W3A.156
Visible Frequency Comb in a Silica Microbubble Resonator, Sho Kasumie[1], Jonathan Ward[1], Sile Nic Chormaic[1], Yong Yang[2]; [1]*OIST Graduate Univ., Japan;* [2]*Aston Inst. of Photonic Technologies, UK.* Kerr frequency comb generation in a microbubble resonator have its advantage in its manipulatability of the total dispersion of the cavity. Here we try to improve the comb so it include more comb lines and extend to shorter wavelength.

W3A.157
Photonic multiple microwave frequency measurement based on a swept frequency silicon microring resonator, Feng Zhou[1], Hao Chen[1], Xu Wang[1], Linjie Zhou[2], Jianji Dong[1], Xinliang Zhang[1]; [1]*Wuhan National Lab for Optoelectronics, China;* [2]*State Key Laboratory of Advanced Optical Communication Systems and Networks, Dept. of Electronic Engineering, Shanghai Jiao Tong Univ., China.* A photonic multiple microwave frequency measurement system is presented based on a swept frequency silicon microring resonator. The measurement bandwidth, accuracy and multi-frequency resolution are 25 GHz, ±510 MHz and 5 GHz, respectively.

W3A.158
A Tunable Narrowband Microwave Photonic Bandpass Filter with An Ultra-high-Q Silicon Microring Resonator, Huaqing Qiu[1], Feng Zhou[1], Yuhan Yao[1], Jianji Dong[1], Yuan Yu[1], Xi Xiao[2], Xinliang Zhang[1]; [1]*Wuhan National Lab for Optoelectronics, China;* [2]*State Key Laboratory of Optical Communication Technologies and Networks, Wuhan Research Inst. of Posts & Telecommunications, China.* A 170-MHz 3-dB bandwidth microwave photonic bandpass filter is achieved owing to utilize an ultra-high-Q as 1.14×10^6 of the silicon microring resonator. The central frequency could be tuned from 2.0 GHz to 18.4 GHz.

15:30–16:00 Coffee Break

NOTES

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

16:00–18:00
W4A • Advanced Light Sources II

Presider: Anting Wang; Univ. of Sci & Tech of China, China

W4A.1 • 16:00
Multi-GHz mode-locked Yb:YAG channel waveguide laser using SESAM and carbon nanotube saturable absorbers, Sun Young Choi[1], Thomas Calmano[2], Fabian Rotermund[1], Clara Saraceno[3], Christian Kränkel[4]; [1]*Dept. of Physics, KAIST, Korea;* [2]*Institut für Laser-Physik, Universität Hamburg, Germany;* [3]*Photonics and Ultrafast Laser Science, Ruhr-Universität Bochum, Germany;* [4]*Zentrum für Lasermaterialien, Leibniz-Institut für Kristallzüchtung, Germany.* We demonstrated GHz modelocking of femtosecond-laser inscribed Yb:YAG channel waveguide lasers using SESAM and single-walled carbon nanotube saturable absorber. Sub-2-ps pulses at multi-GHz repetition rates are generated from a dispersion-managed compact laser cavity with watt-level output powers.

W4A.2 • 16:15
Growth, Characterization and Laser Operation of Tm^{3+}, Na^{+} codoped CNGG (Tm:CNNGG) Disordered Garnet, Zhongben Pan[2,1], Hualei Yuan[2], Xiaojun Dai[2], Huaqiang Cai[2], Josep Serres[3], Xavier Mateos[3], Magdalena Aguilo[3], Francesc Diaz[3], Yicheng Wang[1], Yongguang Zhao[1,4], Pavel Loiko[5], Uwe Griebner[1], Valentin Petrov[1]; [1]*Max Born Inst., Germany;* [2]*Inst. of Chemical Materials, China;* [3]*Universitat Rovira i Virgili, Spain;* [4]*Jiangsu Normal Univ., China;* [5]*ITMO Univ., Russia.* A Tm,Na-codoped calcium niobium garnet (Tm:CNNGG) crystal was grown and its structure and spectroscopic properties characterized. A diode-pumped Tm:CNNGG laser generated 0.63 W with 24.2% slope efficiency. Tunability from 1885 to 2053 nm was achieved.

16:00–18:00
W4B • Nonlinear Nanophotonics and Waveguides

Presider: Cornelia Denz; Westfaelische Wilhelms Univ Munster, Germany

W4B.1 • 16:00 Invited
High Nonlinear Figure of Merit Nonlinear Optics Leveraging Ultra-Silicon-Rich Nitride Devices, Dawn T. Tan[1]; [1]*Singapore Univ. of Technology & Design, Singapore.* Nonlinear optics leveraging CMOS-compatible, ultra-silicon-rich nitride devices is presented. Films are engineered to possess high Kerr nonlinearity and negligible two-photon absorption at telecommunications wavelengths. We demonstrate high-gain optical parametric amplifiers, wavelength conversion, slow light and supercontinuum devices.

16:00–18:00
W4C • Infrared and Terahertz Materials and Light Sources for High Performance Applications

Presider: Fabien Sorin; Ecole Polytechnique Federale de Lausanne, Switzerland

W4C.1 • 16:00 Invited
Chalcogenide Planar Waveguides for Infrared Applications, Duk-Yong Choi[1,2]; [1]*Laser Physics Centre, Australian National Univ., Australia;* [2]*College of Information Science and Technology, Jinan Univ., China.* I review recent research activities of my group on chalcogenide planar waveguides for near- and mid-infrared applications. Also, new research directions including the hybrid integration of chalcogenides with silicon and silica platforms are covered.

16:00–18:00
W4D • Integrated Nanophotonic Devices

Presider: Xinlun Cai; Sun Yat-Sen Univ., China

W4D.1 • 16:00 Invited
Flat Subwavelength Grating Achromatic Lens over Whole Visible Bandwidths, Yasha Yi[1]; [1]*Univ. of Michigan, USA.* The achromatic micro grating lens covering the whole visible wavelength is demonstrated by utilizing relatively low index contrast gratings. Our works are promising for compact integrated nanophotonic devices on chip.

16:00–18:00
W4E • Fiber Devices I

Presider: John Canning; Univ. of Technology Sydney, Australia

W4E.1 • 16:00 Invited
Fiber Integrated Silicon Photonics, Anna C. Peacock[1]; [1]*Univ. of Southampton, UK.* This paper reviews the recent advancements in the fabrication and application of silicon core optical fibers. Particular focus is placed on novel materials and device designs for use in optical signal processing systems.

16:00–18:00
W4F • Dual-comb Spectroscopy and its Applications

Presider: Xiaoguang Zhang; Beijing Univ. of Posts and Telecom, China

W4F.1 • 16:00 Invited
Electro-Optic Dual Optical Frequency Combs Outside of the Metrology Lab: Opportunities in and Beyond Spectroscopy, Pedro Martin-Mateos[1], Pablo Acedo[1]; [1]*Universidad Carlos III de Madrid, Spain.* The rapid evolution of Electro Optic Dual Comb spectrometer design during the last years have opened new opportunities for such powerful optical technique beyond the research/metrology lab that are reviewed in this work.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

16:00–18:00
W4G • Holographic Technologies
Presider: Limin Xiao; Fudan Univ., China

W4G.1 • 16:00 Tutorial

Displaying Digital Holograms on Phase-only Devices, Peter Tsang[1]; [1]*City Univ. of Hong Kong, Hong Kong.* A number of methods for generating phase-only hologram (POH) are reviewed in this tutorial. These works share the common advantage that the POHs generated can be displayed directly on a single phase-only spatial light modulator.

16:00–18:00
W4H • Integrated Photonics
Presider: Andrew Poon; Hong Kong Univ of Science & Technology, Hong Kong

W4H.1 • 16:00 Invited

Quantum Communication using Integrated SIlicon Photonics, Shayan Mookherjea[1]; [1]*Univ. of California San Diego, USA.* Silicon microring resonators have made major recent improvements in high-quality entangled photon pair generation, with CAR > 19,000 and g2(0) < 0.006. They are now being used in prototypical quantum optical communication links.

16:00–18:00
W4I • Optical Signal Characterization
Presider: Leslie Rusch; Universite Laval, Canada

W4I.1 • 16:00 Invited

Image Processing Techniques for Signal Processing in Optical Communication Systems, Tianwai Bo[1], Calvin C. K. Chan[2], Hoon Kim[1]; [1]*School of Electrical Engineering, Korea Advanced Inst. of Science and Technology (KAIST), Korea;* [2]*Dept. of Information Engineering, The Chinese Univ. of Hong Kong, Hong Kong.* We review the image processing techniques for signal processing in optical communication systems. Their applications in optical performance monitoring and compensation of common phase error are discussed in terms of implementation complexity and system performance.

16:00–18:00
W4J • Integrated Devices for Communications
Presider: Duncan MacFarlane; Southern Methodist Univ., USA

W4J.1 • 16:00 Invited

Hybrid Photonic Integration and Plasmonic Devices - New Perspectives for High-Speed Communications and Signal Processing, Christian Koos[1], Sebastian Randel[1], Wolfgang Freude[1], Larry R. Dalton[2], Stefan Wolf[1], Clemens Kieninger[1], Yasar Kutuvantavida[1], Matthias Lauermann[1], Delwin Elder[2], Sascha Muehlbrandt[1], Heiner Zwickel[1], Argishti Melikyan[1], Tobias Harter[1], Sandeep Ummethala[1], Muhammad R. Billah[1], Matthias Blaicher[1], Philipp I. Dietrich[1], Tobias Hoose[1]; [1]*Karlsruhe Inst. of Technology (KIT), Germany;* [2]*Univ. of Washington, USA.* Hybrid photonic integration allows to combine the advantages of different material platforms while maintaining the scalability advantages of monolithically integrated systems. Here we give an overview on our research in the field of hybrid integration, combining multi-chip approaches on a package level with hybrid on-chip integration.

16:00–18:00
W4K • Biophotonics and Applications V
Presider: Daniele Tosi; Nazarbayev Univ., Kazakhstan

W4K.1 • 16:00 Invited

New Progress of Photoacoustic Imaging Technology in Biomedical Applications, Da Xing[1], Sihua Yang[1]; [1]*South China Normal Univ., China.* This report presented the new progresses in photoacoustic dermoscopy, all-optical photoacoustic microscopy, intravascular photoacoustic tomography, photoacoustic elasticity and viscosity imaging toward biomedical and clinical applications.

16:00–18:00
W4L • Fiber Devices & Sensing II
Presider: Zinan Wang; Univ. Electronic Sci. & Tech. of China, China

W4L.1 • 16:00 Invited

Specialty Few Mode Fiber and Its Application, Songnian Fu[1]; [1]*Huazhong Univ of Science & Technology, China.* We review the design, fabrication and characterization of several specialty few mode fibers (FMFs) including elliptical-core FMF(e-FMF), panda type FMF(P-FMF), and panda type e-FMF(PE-FMF). Those specialty FMFs and its corresponding applications have lots of potentials to be further exploited.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W4A • Advanced Light Sources II—Continued

W4A.3 • 16:30
High-power femtosecond pulse generation seeded by planar waveguide Yb:YAG ceramic laser, Daping Luo[1], Yang Liu[1], Chao Yang[1], Chao Wang[1], Wenchao Zhang[1], Wenxue Li[1]; *[1]East China Normal Univ., China.* We demonstrate high-power femtosecond pulse generations in chirped-pulse and self-similar amplifiers both seeded by a Yb:YAG ceramic laser. After amplification, the CPA can emit 100-W, 250-fs pulses while the SSA can output 60-W, 60-fs pulses.

W4A.4 • 16:45
Passively mode-locked Thulium-doped nanoengineered Yttrium-Alumina Silica fiber laser, Yin-Wen Lee[1], Jen-Yen Chuang[1], J. T. Lin[2], Y. W. Jhang[2], Shyamal Das[3], Anirban Dhar[3], M. C. Paul[3]; *[1]National Taipei Univ. of Technology, Taiwan; [2]Industrial Technology Research Inst., Taiwan; [3]CSIR-Central Glass and Ceramic Research Inst., India.* We have successfully developed a mode-locked fiber laser utilizing a nano-engineered Tm^{3+}-doped yttrium–alumina-silica (YAS) glass fiber. Such kind of new material fiber exhibits the better capability of cluster elimination than commercial Tm^{3+}-doped silica fibers.

W4B • Nonlinear Nanophotonics and Waveguides—Continued

W4B.2 • 16:30
Optical Pulse Generation Using Fast Graphene Saturable Absorbers on Silicon Waveguides, Guoqin Liu[1], Shaodong Hou[1], Hong Wang[1], Ning Yang[1], Chi Zhang[1], Nengli Dai[1], Yi Wang[1]; *[1]Wuhan National Laboratory for Optoelectronics, Huazhong Univ. Of Science And Technology, China.* The graphene/silicon hybrid waveguide is applied into a ring cavity laser system working as fast saturable absorber with a recovery time of ~48 ps. Q-switched mode-locking pulses are achieved with a threshold of 11 mW.

W4B.3 • 16:45
Sub-surface Layer of Silicon Singe Crystal Periodically Nanostructured by Near-infrared Femtosecond Laser Pulses, Iaroslav Gnilitskyi[1,2], Vitaly Gruzdev[3], Xiaoqing He[3], Olga Sergaeva[3], Pengfei Ji[4], Tommi White[3], Yuwen Zhang[3]; *[1]UNIMORE, Italy; [2]NoviNano Inc., Ukraine; [3]Univ. of Missouri, USA; [4]Southern Univ. of Science and Technology, China.* Structure of subsurface layer beneath silicon single-crystal surface periodically nanostructured by femtosecond laser suggests significant contribution of laser-driven defect generation to formation of periodic surface ripples by few laser pulses in a broad fluence range.

W4C • Infrared and Terahertz Materials and Light Sources for High Performance Applications—Continued

W4C.2 • 16:30 Invited
Lithium Niobate Nanophotonics for Ultra-fast Optoelectronics, Cheng Wang[1,2]; *[1]City Univ. of Hong Kong, Hong Kong; [2]Harvard Univ., USA.* We demonstrate a nanophotonic lithium niobate platform that simultaneously features sub-wavelength optical confinement, ultralow optical propagation loss and ultra-fast electro-optic control capability (> 100 GHz). These devices are promising for future chip-scale ultra-fast optoelectronic interface.

W4D • Integrated Nanophotonic Devices—Continued

W4D.2 • 16:30
Genetic-algorithm-optimized wideband on-chip polarization rotator with an ultrasmall footprint, Zejie Yu[1], Haoran Cui[1], Xiankai Sun[1]; *[1]The Chinese Univ. of Hong Kong, Hong Kong.* With a genetic algorithm, we designed an onchip TE0-TM0 polarization rotator with a footprint of 0.96μm×4.2μm and experimentally demonstrated its conversion loss of ~2.5dB and extinction ratio of ~10dB in the wavelength range of 1440–1580nm.

W4D.3 • 16:45
Nondetrimental Surface Modification of Ultrahigh-Q Photonic Crystal Silicon Nanocavities, Takahiro Ito[1], Kohei Ashida[1], Kei Kinoshita[2], Rai Moriya[2], Tomoki Machida[2,3], Kenichi Maeno[4], Tatsuro Endo[4], Koji Yamada[5], Makoto Okano[5], Yasushi Takahashi[1]; *[1]Dept. of Physics and Electronics, Osaka Prefecture Univ., Japan; [2]Inst. of Industrial Science, Univ. of Tokyo, Japan; [3]CREST, Japan Science and Technology Agency (JST), Japan; [4]Dept. of Applied Chemistry, Osaka Prefecture Univ., Japan; [5]National Inst. of Advanced Industrial Science and Technology, Japan.* We investigated the influence of surface preparation procedures on the resonance characteristics of silicon nanocavities. We demonstrate that ultrahigh-*Q* factors larger than one million can be maintained when applying preparation procedures that support attaching nanomaterials.

W4E • Fiber Devices I—Continued

W4E.2 • 16:30 Invited
Optical Nanofibers for Fiber-in-line Quantum Photonics, Kohzo Hakuta[1], Ramachandrarao Yalla[1], K. Muhammad Shafi[1]; *[1]Univ. of Electro-Communications, Japan.* Recent progress in quantum photonics with optical nanofibers (ONFs) is reported. Emphasis is on the photon channeling into the fiber guided modes for a hybrid system of an ONF cavity and a single quantum emitter.

W4F • Dual-comb Spectroscopy and its Applications—Continued

W4F.2 • 16:30
Real-time corrections of air refractive index fluctuation using two-color interferometry with optical frequency combs, Yoshihisa Ikisawa[1], Tomohiro Makino[1,2], Yoshiaki Nakajima[1,2], Guanhao Wu[3], Kaoru Minoshima[1,2]; *[1]The Univ. of Electro-Communications, Japan; [2]Japan Science and Technology Agency (JST), ERATO MINOSHIMA Intelligent Optical Synthesizer (IOS) Project, Japan; [3]Tsinghua Univ., China.* We developed a technique to correct large and fast variation of air refractive index using two-color interferometry with optical frequency combs. This technique will enhance the applicability of high-accuracy optical distance measurements under air turbulence.

W4F.3 • 16:45
Fourier transform spectroscopic optical microscopy using dual-comb spectroscopic technique, Takeo Minamikawa[1,2], Shota Nakano[1], Eiji Hase[3,1], Takahiko Mizuno[1,2], Hirotsugu Yamamoto[4,2], Takeshi Yasui[1,2]; *[1]Tokushima Univ., Japan; [2]JST-ERATO Minoshima Intelligent Optical Synthesizer Project, Japan; [3]Japan Synchrotron Radiation Research Inst. (JASRI), Japan; [4]Utsunomiya Univ., Japan.* We developed a Fourier transform spectroscopic optical microscope employing dual-comb spectroscopy. We realized the observation with two different contrasting mechanisms, i.e., amplitude and phase, with tightly focused light without mechanical step-scan in time domain.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W4G • Holographic Technologies—Continued

W4H • Integrated Photonics—Continued

W4H.2 • 16:30
An ultra-compact multimode waveguide crossing based on subwavelength asymmetric Y-junction, Weijie Chang[1], Luluzi Lu[1], Deming Liu[1], Minming Zhang[1]; [1]*Huazhong Univ. of Science and Technology, China.* An ultra-compact multimode waveguide crossing composed of a pair of asymmetric Y-junctions based on subwavelength structures is proposed and demonstrated with a footprint of 34 × 34 μm^2, low insertion loss < 1.5 dB.

W4H.3 • 16:45
Improved CMOS compatible photonic crystal demultiplexer, Shengji Jin[1], Yuta Ooka[1], Tomohiro Tetsumoto[1], Nurul A. Daud[1], Naotaka Kamioka[1], Taku Okamura[1], Takasumi Tanabe[1]; [1]*Keio Univ., Japan.* We optimized a compact photolithographically fabricated photonic crystal DeMUX and obtained flat and high transmittance between channels. A thermal analysis showed that a footprint of 110 μm^2/ch is possible with PhC technology.

W4I • Optical Signal Characterization—Continued

W4I.2 • 16:30
OSNR Monitoring and Modulation Format Recognition Based on Neural Networks and Normalized Autocorrelation Function, Zhuili Huang[1], Jifang Qiu[1], Honghang Zhou[1], Xue Ji[1], Jian Wu[1]; [1]*Beijing Univ. of Posts and Telecom., China.* We experimentally demonstrate the use of neural networks in combination with normalized autocorrelation function (NACF) of noisy signal for simultaneous optical signal to noise ratio (OSNR) monitoring and modulation format recognition (MFR).

W4I.3 • 16:45
Joint Modulation Format, Bit-Rate and OSNR Identification Using Cascaded Deep Neural Networks, Yuanxiang Chen[1], Yongtao Huang[1], Kaile Li[1], Yitong Li[1], Jianguo Yu[1]; [1]*Beijing Univ. of Posts and Telecommunications, China.* Cascaded deep neural networks model trained with signal amplitude histograms is developed for joint optical modulation format, bit-rate and OSNR identification. The averaged joint identification accuracy is 98.78% for four modulation formats.

W4J • Integrated Devices for Communications—Continued

W4J.2 • 16:30
O-L band bias-free high-speed UTC-PD for advanced optical fiber communications, Toshimasa Umezawa[1], Atsushi Kanno[1], Kouichi Akahane[1], Atsushi Matsumoto[1], Naokatsu Yamamoto[1]; [1]*National Inst of Information & Comm Tech, Japan.* We present an O-L band high-baud-rate UTC-PD excluding a bias circuit, which can be operated at zero bias. The 100 Gbaud (NRZ) good eye diagram performances were confirmed for 1320 nm and 1550 nm.

W4J.3 • 16:45
A Horn-Waveguide Asymmetric RSOA as Colorless Transmitter in WDM-PON with Reduced Crosstalk, Chengliang Zuo[1], Xun Li[2]; [1]*Huazhong Univ. of Science and Techn, China;* [2]*McMaster Univ., Canada.* A horn-waveguide reflective semiconductor optical amplifier was studied. Experimental results reveal that it can reduce downstream extinction ratio from 5 dB to 1.2 dB, and a 5 Gbps upstream signal was reloaded with clear eye-opening.

W4K • Biophotonics and Applications V—Continued

W4K.2 • 16:30 Invited
Super-resolution Dipole Orientation Microscopy, Peng Xi[1], Karl Zhanghao[1], Long Chen[2], Juntao Gao[2]; [1]*Dept. of Biomedical Engineering, Peking Univ., China;* [2]*Dept. of Automation, Tsinghua Univ., China.* With the modulation of fluorescent excitation polarization, here we report a novel super-resolution microscopy technique in which the orientation of the fluorophores can be mapped in addition to super-resolution imaging.

W4L • Fiber Devices & Sensing II—Continued

W4L.2 • 16:30 Invited
Multicore Optical Fiber Sensors, Rodrigo Amezcua Correa[1], E. Antonio-Lopez[1], O. Arrizabalaga[2], J. Zubia[2], A. Schülzgen[1], J. Villatoro[2,3]; [1]*Univ. of Central Florida, CREOL, USA;* [2]*Dept. of Communications Engineering, Escuela de Ingeniería de Bilbao, Univ. of the Basque Country (UPV/EHU), Spain;* [3]*IKERBASQUE—Basque Foundation for Science, Spain.* We review recent multicore optical fiber-based interferometric sensors for vibration, strain and temperature monitoring. Simple, highly sensitive sensors operating in reflection and transmission mode have been fabricated using short segments of strongly coupled core MCFs.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W4A • Advanced Light Sources II—Continued

W4A.5 • 17:00
1GHz harmonic mode-locked fiber laser by using carbon nanotubes film saturable absorber, Qianqian Huang[1], Chuanhang Zou[1], Tianxing Wang[1], Mohammed AlAraimi[2,3], Aleksey Rozhin[2,4], Chengbo Mou[1]; [1]*Key Laboratory of Specialty Fiber Optics and Optical Access Networks, Shanghai Univ., China;* [2]*Aston Inst. of Photonic Technologies, Aston Univ., UK;* [3]*Al Musanna College of Technology, Oman;* [4]*Nanoscience Research Group, Aston Univ., UK.* Passively harmonic mode locking in a fiber laser based on single wall carbon nanotubes polyvinyl alcohol film is experimentally implemented. 916MHz pulses at the 34th harmonic with 41dB super-mode suppression ratio can be generated.

W4A.6 • 17:15
LD pumped Q-switched Nd:YAG slab laser with stable output within temperature range of -30 - 50 degrees centigrade, Wei Xie[1,2], Xiao Chen[1,2], Xiuhua Ma[1], Xiaolei Zhu[1], Zhengyang Jiang[1,2], Junxuan Zhang[1], Shiguang Li[1], Weibiao Chen[1]; [1]*Shanghai Inst. of Optics and Fine Mechanics, Chinese Academy of Sciences, China;* [2]*Universtiy of Chinese Academy of Science, China.* A temperature insensitive all solid state laser functioning from -30 to 50 degrees centigrade without cooling facility is realized. Maximum output pulse energy about 95mJ is obtained over above temperature range.

W4B • Nonlinear Nanophotonics and Waveguides—Continued

W4B.4 • 17:00
320Gbps physical random bit generation from chaotic optoelectronic oscillator with silicon modulator, Wenjing Tian[1,2], Lei Zhang[1,2], Jianfeng Ding[1], Xin Fu[1], Lin Yang[1,2]; [1]*State Key Laboratory on Integrated Optoelectronics, Inst. of Semiconductors, Chinese Academy of Sciences, China;* [2]*College of Materials Science and Opto-Electronic Technology, Univ. of Chinese Academy of Sciences, China.* We demonstrate a physical random bit generation scheme based on a chaotic optoelectronic oscillator with silicon Mach-Zehnder modulator. The randomness of the 320Gbps sequence after two self-delay XOR operations is verified with NIST statistical tests.

W4B.5 • 17:15
Characterization of Acoustic Phonons in InGaAsP MQW by Asynchronous Optical Sampling, Kenichi Hitachi[1], Mayu Someya[1,2], Atsushi Ishizawa[1], Tadashi Nishikawa[2], Hideki Gotoh[1]; [1]*NTT Basic Research Laboratories, Japan;* [2]*Tokyo Denki Univ., Japan.* We measured transient reflectivity in an InGaAsP multi-quantum well by asynchronous optical sampling with an Er-doped fiber laser. The oscillation in longitudinal acoustic phonons induced by resonant Raman scattering lasts more than 1 ns.

W4C • Infrared and Terahertz Materials and Light Sources for High Performance Applications—Continued

W4C.3 • 17:00
Terahertz Signal Generation Based on a Dual-Mode 1.5 μm DFB Semiconductor Laser, Song Tang[1], Bin Hou[1], Song Liang[2], Dejun Chen[3], Lianping Hou[1], John Marsh[1]; [1]*School of Engineering, Univ. of Glasgow, UK;* [2]*School of Optoelectronic Information, Univ. of Electronic Science and Technology of China, China;* [3]*Inst. of Semiconductors, Chinese Academy of Sciences, China.* A novel dual-mode DFB semiconductor diode laser has been demonstrated. Using photomixing techniques, a terahertz signal at ~560 GHz has been generated. The THz signal shows power fluctuations related to mode competition in the laser.

W4C.4 • 17:15
Generation of THz Radiation by Sampled Grating DBR Mode Locked Laser Diodes, Lianping Hou[1], Bin Hou[1], Song Liang[3], Dejun Chen[2], John Marsh[1]; [1]*Univ. of Glasgow, UK;* [2]*Univ. of Electronic Science and Technology of China, China;* [3]*Inst. of Semiconductors, Chinese Academy of Sciences, China.* 640 GHz THz signals were generated based on 1.55 μm operating wavelength sampled grating distributed-Bragg-reflector mode locked laser diodes and photomixing techniques which will pave a way to provide compact low-cost, robust THz sources.

W4D • Integrated Nanophotonic Devices—Continued

W4D.4 • 17:00
Experimental demonstration of single Fabry-Perot resonator based optical add-drop filters in silicon, Qingzhong Huang[1], Qiang Liu[1], Jinsong Xia[1]; [1]*Huazhong Univ. of Sci. and Tech., China.* We have demonstrated highly efficient add-drop filters based on a single travelling-wave like Fabry-Perot resonator in silicon. A dropping efficiency of 68% is realized, and only 8% of light is left at the through port.

W4D.5 • 17:15
High Quality Factor Deuterated Silicon Nitride (SiN:D) Microring Resonators, Zeru Wu[1], Zengkai Shao[1], Zihan Xu[1], Yanfeng Zhang[1], Lin Liu[1], Chunchuan Yang[1], Yujie Chen[1], Siyuan Yu[1,2]; [1]*Sun Yat-sen Univ., China;* [2]*Univ. of Bristol, UK.* We demonstrate low-loss deuterated SiN microring resonators fabricated by low-temperature plasma-deposition technique with a high intrinsic quality factor of up to 1.2 × 10^6 at 1547.6 nm, and >0.8 × 10^6 throughout 1500 – 1600 nm.

W4E • Fiber Devices I—Continued

W4E.3 • 17:00
Diameter Measurement of Optical Nanofibers by Using a Commercial and Standardized Ruled Grating, Ming Zhu[1], Yaoting Wang[1], Yizhi Sun[1], Wei Ding[1]; [1]*CAS Inst. of Physics, China.* A precise and *in-situ* measurement of diameter of optical nanofibers (ONFs) is presented. Mounting a commercial micron-scale-period ruled grating on ONF forms a high-order Bragg reflector, making possible convenient diagnosis of the ONF diameter.

W4E.4 • 17:15
Design of an Elliptical-Core Few-Mode Fiber for Mode-Independent Wavelength Conversion, Joseph C. Slim[1], Mathilde Gay[1], Christophe Peucheret[1]; [1]*Institut Foton, France.* An elliptical-core graded-index fiber that allows simultaneous intramodal wavelength conversion of mode-multiplexed signals is proposed. The fiber breaks the degeneracy between the LP_{11a} and LP_{11b} modes and prevents detrimental intermodal processes.

W4F • Dual-comb Spectroscopy and its Applications—Continued

W4F.4 • 17:00
Dual-comb spectroscopy using a hybrid mode-locked fiber laser, Ting Li[1], Xin Zhao[1], Zijun Yao[1], Yuehan Wu[1], Jie Chen[1], Zheng Zheng[1,2]; [1]*School of Electronic and Information Engineering, Beihang Univ., China;* [2]*Beijing Advanced Innovation Center for Big Date-based Precision Medicine, China.* Dual-comb absorption spectroscopy is realized by using a dispersion-managed, hybrid mode-locked fiber laser, which emits two pulse trains with different bandwidths due to hybrid pulse formation mechanizms.

W4F.5 • 17:15
Dual-comb based Angle Measurement Method Using a Grating and a Corner Cube Combined sensor, Siyu Zhou[1], Zebin Zhu[1], Shilin Xiong[1], Kai Ni[2], Qian Zhou[2], Guanhao Wu[1,2]; [1]*State Key Laboratory of Precision Measurement Technology and Instruments, Dept. of Precision Instrument, Tsinghua Univ., Beijing 100084, China , China;* [2]*Division of Advanced Manufacturing, Graduate School at Shenzhen, Tsinghua Univ., Shenzhen 518055, China, China.* We present an angle measurement method of dual-comb interferometry which uses a grating and a corner cube combined sensor. The precision is better than 10 arc-seconds within 3000 arc-seconds and 30 arc-seconds within 7800 arc-seconds.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W4G • Holographic Technologies—Continued

W4G.2 • 17:00 Invited

Polarization Holography and its Application to Optical Data Storage, Toyohiko Yatagai[1]; [1]*Utsunomiya Univ., Japan*. To increase data capacity for holographic mass-data storage, some techniques are presented, including dual-channel polarization logography and angular multiplication techniques. Theoretical and experimental results are described.

W4H • Integrated Photonics—Continued

W4H.4 • 17:00

Valley-controlled light flow in a photonic crystal waveguide, Xiaodong Chen[1], Fulong Shi[1], Weimin Deng[1], Jianwen Dong[1]; [1]*Sun Yat-Sen Univ., China*. With the valley degree of freedom, we demonstrate the unidirectional propagation of bulk states and topological transport of edge states in a photonic crystal waveguide.

W4H.5 • 17:15

Demonstration of CdTe microwires as mid-infrared optical waveguides, Chenguang Xin[1], Xin Guo[1], Limin Tong[1]; [1]*Zhejiang Univ., China*. CdTe microwires (MWs) with diameters of several micrometers were fabricated. Excellent MIR optical waveguiding properties were obtained experimentally with waveguiding losses of several dB/cm, which demonstrated these MWs as promising waveguides for MIR microphotonics.

W4I • Optical Signal Characterization—Continued

W4I.4 • 17:00

A Frequency-domain Kalman Scheme for Large PMD and Ultra-fast RSOP in PDM-QPSK System, Zibo Zheng[1], Nan Cui[1], Lixia Xi[1], Xiaoguang Zhang[1], Wenbo Zhang[1], Yuanyuan Fang[2], Liangchuan Li[2]; [1]*Beijing Univ of Posts & Telecom, China;* [2]*Network Research Dept., Huawei Technologies Co., Ltd., China*. With reasonable simplified polarization modelling for fiber channel, we propose a window-split frequency domain Kalman scheme to equalize the signal distortion induced by combined large DGD (more than 200ps) and fast RSOP (up to 2Mrad/s).

W4I.5 • 17:15

Time Domain Measurement of MPI caused by Double Rayleigh Scattering in Distributed Raman Amplifiers, Toshihiko Sugie[1], Hiroji Masuda[2], Kazuo Aida[3]; [1]*NTT Electronics Corporation, Japan;* [2]*Shimane Univ., Japan;* [3]*Ex-Professor of Shizuoka Unversity, Japan*. An MPI-based time-domain method for evaluating DRS in transmission fiber with distributed Raman amplifiers is proposed; it combines self-heterodyne detection and OSW. We characterize the MPI with/without distributed Raman amplifiers at 1.5μm.

W4J • Integrated Devices for Communications—Continued

W4J.4 • 17:00

Front-rear LI linearity correlation of uncooled (-40 to +90°C) InGaAlAs DML for robust tracking error in 10G-EPON ONU, Jack Jia-Sheng Huang[1,2]; [1]*Optoelectronics R&D, Source Photonics, USA;* [2]*Optoelectronics R&D, Source Photonics Taiwan, Taiwan*. Uncooled directly modulated lasers are key components for optical transmission in 10G-EPON. In this paper, we study the front to rear LI characteristics of DML and demonstrate robust tracking error performance over a wide temperature range (-40 to +90°C). Design factors for optimal uncooled tracking error are discussed.

W4J.5 • 17:15

16×16 AWG Router Based on Silicon Oxynitride Waveguide Platform, Shuxin Wang[1], Tingting Lang[2], Yue Wu[1], Jian-Jun He[1]; [1]*Zhejiang Univ., China;* [2]*China Jiliang Univ., China*. We experimentally demonstrate a 16×16, 200 GHz cyclic AWG router using silicon oxynitride waveguides. Insertion losses vary from -1.34 dB to -5.27 dB and crosstalks vary from -19 dB to -20.5 dB for all channels.

W4K • Biophotonics and Applications V—Continued

W4K.3 • 17:00

Live Visualization of Granule Release from Cells with Simultaneous Cellular Observation by Laser Speckle, Munenori Yamamura[1], Saki Tsukijima[1], Keisuke Ohta[2], Yasuyuki Hirakawa[1], Kei-ichiro Nakamura[2]; [1]*NIT, Kurume College, Japan;* [2]*School of Medicine, Kurume Univ., Japan*. Live monitoring of granule release from living cells was performed when the cells were observed by a laser speckle microscope estimating the LS fluctuation.

W4K.4 • 17:15

Label-free Diagnosis of Cervical Cancer based on Ultrahigh Resolution Optical Coherence Microscopy and Machine Learning, Xianxu Zeng[2], Xiaoan Zhang[2], Tao Xu[3], Canyu Li[2], Xiaofang Wang[2], Jason Jerwick[1], Yuan Ning[1], Yihong Wang[4], Linlin Zhang[2], Zhan Zhang[2], Yutao Ma[3], Chao Zhou[1]; [1]*Lehigh Univ., USA;* [2]*The Third Affiliated Hospital of Zhengzhou Univ., China;* [3]*Wuhan Univ., China;* [4]*Warren Alpert Medical School of Brown Univ., USA*. Current tools for cervical cancer screening cannot provide real-time results or localize suspicious regions. Label-free optical coherence microscopy combined with a machine learning algorithm shows great potential to provide real-time diagnosis of human cervical diseases.

W4L • Fiber Devices & Sensing II—Continued

W4L.3 • 17:00

Temperature Sensor by Using Highly Germanium-doped Fiber, Lifeng Bao[1,2], Xinyong Dong[1], Perry P. Shum[2], Changyu Shen[1]; [1]*China Jiliang Univ., China;* [2]*Nanyang Technological Univ., Singapore*. We demonstrate a temperature sensor by splicing a short highly germanium-doped fiber to a single mode fiber with a bowknot-type taper. The sensor possesses miniature size of 1.4 mm and high sensitivity of 100 pm/°C.

W4L.4 • 17:15

Ultrahigh sensitivity low-cost optical fiber temperature sensors, Yi Liu[1], Xin Cheng[1], Changyuan Yu[1], Hwa-yaw Tam[1]; [1]*The Hong Kong Polytechnic Univ., Hong Kong*. A high sensitivity, low-cost optical fiber temperature sensor is proposed. Its sensitivity and resolution are 11.66nm/°C and 8.3×10^{-5} °C over the interval of 28-41°C. It is larger 1000 times than that of FBG sensors.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W4A • Advanced Light Sources II—Continued

W4A.7 • 17:30
Simulation Model of Multiple Oxide-Aperture VCSEL, Shun-Chieh Hsu[1], Yu-Ming Huang[1], Yu-Yun Cho[1], Chun-Yen Peng[2], Chao-Hsin Wu[2], Gong-Ru Lin[2], Hao-Chung Kuo[1], Chien-Chung Lin[1]; [1]*National Chiao Tung Universuty, Taiwan;* [2]*National Taiwan Univ., Taiwan.* An oxide VCSEL model was built based on measured results. We then design a new multiple oxide-apertured VCSEL based on this model. The simulation result shows that the bandwidth can be improved and reaches 24GHz.

W4A.8 • 17:45
Anomalous Spectral Broadening in High Quality-Factor, 1-GHz Mode-locked Oscillator using Yb:CALGO crystal, Shota Kimura[1], Takuma Nakamura[1], Shuntaro Tani[1], Yohei Kobayashi[1]; [1]*The Inst. for Solid State Physics, The Univ. of Tokyo, Japan.* An Yb:CALGO Kerr-lens mode-locked oscillator at 1-GHz repetition rate was developed. We found an anomalous spectral broadening at a high pumping-power condition, which lead to a pulse duration of 22 fs.

W4B • Nonlinear Nanophotonics and Waveguides—Continued

W4B.6 • 17:30
Kilohertz PPLN Optical Parametric Oscillator with Intracavity Difference-Frequency Generation in OPGaAs, Andrey Boyko[1,2], Dmitry Kolker[2], Li Wang[1], Peter Schunemann[3], Nadezhda Kostyukova[2,4], Shekhar Guha[5], Vladimir Panyutin[1], Georgi Marchev[1], Andre Schirrmacher[6], Valentin Petrov[1]; [1]*Max Born Inst., Germany;* [2]*Novosibirsk State Univ., Russia;* [3]*BAE Systems, USA;* [4]*Special Technologies, Russia;* [5]*Air Force Research Laboratory, USA;* [6]*Canlas Laser Processing, Germany.* Intracavity difference-frequency generation (DFG) in orientation-patterned GaAs (OPGaAs) produces an average power of 24 mW at 6.74 μm using a Nd:YAG laser pumped Mg-doped periodically-poled $LiNbO_3$ (Mg:PPLN) nanosecond optical parametric oscillator (OPO) at 1.5 kHz.

W4B.7 • 17:45
Mid-infrared difference frequency generation of Er and Yb fiber lasers radiation in periodically poled crystals, Igor Larionov[1,2], Alexander Gulyashko[2], Valentin Tyrtyshnyy[2]; [1]*Dept. of Physical and Quantum Electronics, Moscow Inst. of Physics and Technology, Russia;* [2]*NTO «IRE-Polus», Russia.* The parametric generation of mid-infrared radiation in the periodically poled lithium niobate and lithium tantalate nonlinear-optical crystals was investigated. Up to 10 W of output radiation near 3 μm wavelength was obtained with 20% efficiency

W4C • Infrared and Terahertz Materials and Light Sources for High Performance Applications—Continued

W4C.5 • 17:30
Widely tunable (2-6THz) Terahertz vortex source, Katsuhiko Miyamoto[1,2], Kazuki Sano[1], Tomohito Yamaski[1], Takahiro Miyakawa[1], Takashige Omatsu[1,2]; [1]*Chiba Univ., Japan;* [2]*Molecular chirality research center, Chiba Univ., Japan.* We have developed a widely tunable terahertz (THz) vortex source with an average power of ~3 μW and a frequency tuning range of 2-6 THz. The handedness of the THz vortex output in this system is also controlled.

W4C.6 • 17:45
Enhancement of Nonlinearity by Terahertz Vortex Beam, Bong Joo Kang[1], Katsuhiko Miyamoto[2], Won Tae Kim[1], Kwang Jun Ahn[3], Takashige Omatsu[2], Fabian Rotermund[1]; [1]*KAIST, Korea;* [2]*Chiba Univ., Japan;* [3]*Ajou Univ., Korea.* High-power THz vortex beam was generated based on optical rectification in nonlinear crystal and mode conversion by employing spiral phase plate. Subsequent application of vortex beam for nonlinear spectroscopy in graphene shows enhanced nonlinear characteristics.

W4D • Integrated Nanophotonic Devices—Continued

W4D.6 • 17:30 Invited
Miniature Silicon Nanobeam Resonator Tuned by GST Phase Change Material, Linjie Zhou[1], Hanyu Zhang[1], Hao Hu[1], Liangjun Lu[1], Jianping Chen[1], Aziz, B. M. Rahman[2]; [1]*Shanghai Jiao Tong Univ., China;* [2]*City, Univ. of London, UK.* We report a silicon optical nanobeam resonator with central hole infiltrated with a thin layer of $Ge_2Sb_2Te_5$ (GST) material. The resonances can be tuned when the GST changes its phases between the amorphous and crystalline states.

W4E • Fiber Devices I—Continued

W4E.5 • 17:30
Optimization Design of Fiber Optical Parametric Amplifier with Multi-Stage High Nonlinear Fiber, Kai Wang[1], Rahat Ullah[4], Yiying Wang[2], Lei Shu[3], Jianzhao Yin[5]; [1]*State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ Posts & Telecommunications, China;* [2]*School of Information and Communication, Guilin Univ. of Electronic Technology, China;* [3]*School of Astronautics, Harbin Inst. of Technology, China;* [4]*Inst. of Optotelectronics, Nanjing Univ. of Information Science & Technology, China;* [5]*State Grid Rushan Power Supply Company, China.* We propose one optimization algorithm of longitudinal zero dispersion wavelength management. Optimized high nonlinear fiber enables a single pump fiber optical parametric amplifier with a gain of 20±1.6 dB over 35 nm bandwidth.

W4E.6 • 17:45
Resonant State Expansion in Fiber Geometries, Swaathi H. Upendar[1], Izzatjon Allayarov[1], Guangrui Li[2], Markus Schmidt[2,3], Thomas Weiss[1]; [1]*4th Physics Inst., Univ. of Stuttgart, Germany;* [2]*Leibniz Inst. of Photonic Technology e.V., Germany;* [3]*Otto Schott Inst. of Material Research, Friedrich Schiller Univ., Germany.* We extend the resonant state expansion to guiding geometries such as step-index and photonic crystal fibers. By correctly normalizing all modes, this approach allows for predicting the guiding properties in perturbed and disordered fibers.

W4F • Dual-comb Spectroscopy and its Applications—Continued

W4F.6 • 17:30
Frequency Domain 2D Incoherent Comb Interferometry for Single-shot Tomographic Imaging, Futoshi Kokubun[1], Tatsutoshi Shioda[1]; [1]*Saitama Univ., Japan.* Frequency-domain VIPA installed comb interferometry has been developed for 2D single-shot tomography. An etalon co-installed with VIPA to generate 2.2 THz incoherent comb brings multiple and periodic higher-order interference fringes, which expands the measurement range.

W4F.7 • 17:45
Spatially scanning dual-comb spectroscopy for precise measurement of refractive index and thickness profiles of solids, Yue Wang[1,2], Akifumi Asahara[1,2], Ken-ichi Kondo[1,2], Kaoru Minoshima[1,2]; [1]*Univ. of Electro-Communications, Japan;* [2]*Japan Science and Technology Agency (JST), ERATO MINOSHIMA Intelligent Optical Synthesizer (IOS) Project, Japan.* Raster-scanning dual-comb spectroscopy is used to simultaneously evaluate the refractive index and thickness profiles of solid samples. Refractive index and step structure profiles of glass plates are evaluated successfully with 10^{-4} uncertainty.

18:00–22:00 Conference Reception and Banquet, *Convention Hall*

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

W4G • Holographic Technologies—Continued

W4G.3 • 17:30
Incoherent Digital Holography Adaptive Imaging by phase Diversity, Yuhong Wan[1], hongqiang Zhou[1], Tianlong Man[1]; [1]*Beijing Univ. of Technology, China.* We developed an adaptive imaging technique by Fresnel incoherent digital holography combined with phase diversity (PD-FINCH). The experimental results demonstrated the improvement of reconstructed image quality after adaptive wavefront aberration compensation.

W4G.4 • 17:45
Applying the principle of orthogonality of high dimensional random vectors to obtain high-density, large-volume 3D holographic display, Ghaith Makey[1], Özgün Yavuz[1], Denizhan K. Kesim[1], Ahmet Turnali[1], Parviz Elahi[1], Johnny Toumi[2], Moustafa Sayem El-Daher[2], Serim Ilday[1], Onur Tokel[1], F. Ömer Ilday[1]; [1]*Bilkent Univ., Turkey;* [2]*Damascus Univ., Syrian Arab Republic.* The efforts toward truly 3D displays are far from exploiting the full potential of holography. Here, we apply the principle of orthogonality of high dimensional random vectors to obtain unprecedented dense, large volume holograms.

W4H • Integrated Photonics—Continued

W4H.6 • 17:30
Transient Analysis of Photonic-Crystal Surface-Emitting Lasers via Time-Dependent 3D Coupled-Wave Theory, Takuya Inoue[1], Ryohei Morita[1], Masahiro Yoshida[1], Menaka D. Zoysa[1], Yoshinori Tanaka[1], Susumu Noda[1]; [1]*Kyoto Univ., Japan.* We develop time-dependent three-dimensional coupled-wave theory for photonic-crystal surface-emitting lasers (PCSELs), which enables comprehensive analyses of lasing characteristics of high-power PCSELs under high current injection including relaxation oscillation, spatial hole-burning, and lasing spectra.

W4H.7 • 17:45
Resistive Switching and Electrochromic Characteristics of DNA Biopolymer Devices, Li Yang[1], Yu-Chueh Hung[1]; [1]*Inst. of Photonics Technologies, National Tsing Hua Univ., Taiwan.* We present both resistive switching and electrochromic characteristics of a transparent DNA biopolymer-based device. The device exhibits an on/off ratio of ~100 at 0.4V and more than 20% change in transmittance under applied voltages.

W4I • Optical Signal Characterization—Continued

W4I.6 • 17:30
Maximum-Likelihood Mth Power Carrier Phase Estimation for Coherent Optical Communication, Yan Li[1,2], Ming-Wei Wu[3], Xin-Wei Du[1], Gurusamy Mohan[1], Changyuan Yu[4], Pooi-Yuen Kam[1,2]; [1]*National Univ. of Singapore, Singapore;* [2]*National Univ. of Singapore (Suzhou) Research Inst., China;* [3]*School of Information and Electronic Engineering, Zhejiang Univ. of Science and Technology, China;* [4]*Dept. of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong.* We propose a maximum-likelihod (ML) Mth power carrier phase estimator which is optimized considering the amplitude of received signal. Significant improvement can be achieved compared to conventional Mth power which relies on intuitive nonlinear operations.

W4I.7 • 17:45
Novel FM-Noise Spectrum Measurement Based on Three-Wave Interference, Shuhei Yamaoka[1], Yojiro Mori[1], Hiroshi Hasegawa[1], Ken-ichi Sato[1]; [1]*Nagoya Univ., Japan.* This paper proposes a novel FM-noise spectrum measurement scheme for future ultra-dense digital coherent systems that is based on three-wave interference and DSP. The effectiveness of the proposed scheme is confirmed through simulations and experiments.

W4J • Integrated Devices for Communications—Continued

W4J.6 • 17:30
Integrated optoelectronic transceiving chips, Kai Liu[1], Yongqing Huang[1], Xiaofeng Duan[1], Qi Wang[1], Qi Wei[1], Xiaomin Ren[1], Shiwei Cai[1]; [1]*Beijing Univ. of Posts and Telecomm., China.* A pair of integrated optoelectronic chips is proposed for short WDM transceiver. One is emitting at 848.1nm and receiving at 805.3nm, while the other is emitting at 805.3nm and receiving at 848.1nm.

W4J.7 • 17:45
Proposal of Integrated-Optical Circuit for Recognition of 8PSK-Coded Label for Photonic Label Router, Nyam-Erdene Odbayar[1], Munkhbayar Adiya[1], Hiroki Kishikawa[1], Nobuo Goto[1]; [1]*Tokushima Univ., Japan.* Label recognition is a key function in photonic label routing. We propose an 8-ary PSK (8PSK) recognition circuit based on a basic waveguide-type circuit for recognition of optical label encoded in quadrature-PSK format.

W4K • Biophotonics and Applications V—Continued

W4K.5 • 17:30
Fiber-optic Activity Monitoring With Machine Learning, Qihang Zeng[1,2], Wei Xu[3], Changyuan Yu[2,4], Na Zhang[3], Cheungchuen Yu[3]; [1]*School of Electronic Engineering, Xidian Univ., China;* [2]*Centre of Advanced Microelectronic Devices, National Univ. of Singapore (Suzhou) Research Inst., China;* [3]*Anlight Optoelectronic Technology Inc., China;* [4]*Dept. of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong.* Unobtrusive activity monitoring based on fiber-optic Mach-Zehnder interferometer is proposed, employing deep bi-directional long short-term memory network, realizing three activities recognition with accuracy of 99.2% and resolution of 0.5s.

W4K.6 • 17:45
Autofluorescence Spectroscopy for Cell Monitoring, Derrick Yong[1], Ahmad Amirul Abdul Rahim[2], Jesslyn Ong[2], May Win Naing[2]; [1]*Precision Measurements Group, Singapore Inst. of Mfg Tech, Singapore;* [2]*Bio-Manufacturing Programme, Singapore Inst. of Mfg Tech, Singapore.* We used autofluorescence spectroscopy to determine the metabolic activity of cells. Results show noticeable differences in activity at different cell confluencies. The non-contact and non-destructive nature of the method makes it suitable for cell monitoring.

W4L • Fiber Devices & Sensing II—Continued

W4L.5 • 17:30
Application of Fibre-optical Mechanical & Thermal Multi-parameter Instrument in hydraulic structure, Chao Wang[1,2], Kun Liu[1,2], Junfeng Jiang[1,2], Shuang Wang[1,2], Xuezhi Zhang[1,2], Yuanyao Li[3], Xiaojun Fan[1,2], Xin Li[1,2], Rundong Wang[1,2], Mengdi Li[1,2], YI Huang[1,2], Yong Du[1,2], Tiegen Liu[1,2]; [1]*School of Precision Instrument and Opto-Electronics Engineering, Tianjin Univ., China;* [2]*Key Laboratory of Opto-electronics Information Technology (Tianjin Univ.), China;* [3]*Tianjin Inst. of Metrological Supervision Testing, China.* Fibre-optical Mechanical & Thermal Multi-parameter Instrument is based on the principle of discrete optical fiber sensing. In this research it is applied to monitor underflow of hydraulic structure model. The result indicates that the velocity and turbulent frequency can be detected by the instrument.

W4L.6 • 17:45
High-birefringence two-core fiber vector bending sensor, Chang-He Cheng[1], Zhengyong Liu[2], Chuang Wu[1], Li-Peng Sun[1], Jie Li[1], Bai-Ou Guan[1], hwa-yaw Tam[2]; [1]*Jinan Univ., China;* [2]*Hong Kong Polytechnic Unviersity, Hong Kong.* We propose and demonstrate a simple vector bending sensor based on polarization dependent supermodes interference in a high birefringence two-core photonic crystal fiber. The bending responses of both two polarizations depend on the bending direction.

18:00–22:00 Conference Reception and Banquet, *Convention Hall*

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

08:00–18:00 Registration, *S221 Foyer of HKCEC*

08:30–10:00
Th1A • Novel Laser Sources I
Presider: Zhichao Luo; South China Normal Univ., China

Th1A.1 • 08:30 Invited

Practical Tabletop-Scale Femtosecond X-Ray Laser Light Sources for Science and Technology, Henry C. Kapteyn[1,2], Margaret M. Murnane[2,1]; [1]*Kapteyn-Murnane Laboratories Inc., USA;* [2]*JILA and Dept. of Physics, Univ. of Colorado, USA.* Recent advances in ultrafast solid-state and fiber lasers make possible robust and practical tabletop-scale light sources in the vacuum-ultraviolet, extreme-ultraviolet, and soft x-ray spectral regions. These sources are being applied for a wide variety of applications.

08:30–10:00
Th1B • Nonlinear Spectroscopy and Imaging
Presider: Xinhuan Feng; Jinan Univ., China

Th1B.1 • 08:30 Invited

Nonlinear 3D Photonic Structures by Femtosecond Laser Lithography, Cornelia Denz[1], Joerg Imbrock[1], Mousa Ayoub[1], Haissam Hanafi[1]; [1]*Westfaelische Wilhelms Univ Munster, Germany.* We explore a novel ferroelectric domain engineering approach based on infrared femtosecond laser lithography and thermal control. Various nonlinear photonic structures are created without any external electric field in the volume of lithium niobate.

08:30–10:00
Th1C • Frequency Control and Measurement for Optical Metrology
Presider: Bowen Li; Univ. of Hong Kong, Hong Kong

Th1C.1 • 08:30 Invited

Self-action Mitigation for High Repetition Rate Ultrashort Pulses Using Fractional Temporal Self-imaging, Mohamed Seghilani[1], Reza Maram[1], Luis Romero Cortes[1], Jose . Azana[1]; [1]*INRS-Energie Materiaux et Telecom, Canada.* We review recent work on mitigation of nonlinear propagation impairments of optical pulses through reversible pulse division using fractional temporal self-imaging, overcoming limitations of previous methods for application at high repetition rates (> GHz).

08:30–10:00
Th1D • Quantum Information Processing II
Presider: Guofeng Zhang; The Hong Kong Polytechnic Univ., Hong Kong

Th1D.1 • 08:30 Invited

Time-domain Multiplexed Measurement-based Quantum Computing for Large-scale Optical Quantum Computing, Akira Furusawa[1]; [1]*Univ. of Tokyo, Japan.* I will explain the methodology of time-domain multiplexing measurement-based quantum computing. With this methodology the size of the quantum computer is independent of the number of qubits for quantum computing, which means it has real scalability.

08:30–10:00
Th1E • Fiber Devices II
Presider: Peter Dragic; Univ of Illinois at Urbana-Champaign, USA

Th1E.1 • 08:30 Invited

Fibers with Liquid Cores: A New Way to Control Supercontinuum Generation and Soliton Dynamics, Markus Schmidt[1], Kay Schaarschmidt[1], Ramona Scheibinger[1], Mario Chemnitz[1]; [1]*Leibniz Inst. of Photonic Technology, Germany.* Liquid core fibers offer unique features such as hybrid nonlinear responses, wide transmission windows and real-time tuning capabilities. Here I will report on hybrid temporal solitons, coherent supercontinuum generation and real-time dispersive wave tuning.

08:30–10:00
Th1F • Metamaterials and Meta-devices
Presider: Xifeng Ren; Key laboratory of quantum information, China

Th1F.1 • 08:30 Invited

Experimental Realization of Unidirectional Zero Reflection from Bianisotropic Microwave to Elastic Metamaterials, Jensen Li[1]; [1]*Dept. of Physics, Hong Kong Univ. of Science and Technology, Hong Kong.* We introduce the concept of passive Parity-time symmetry to bianisotropic metamaterials, which can possess exceptional points. We experimentally demonstrate the associated unidirectional zero reflection in both microwave and elastic metamaterials.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

08:00–18:00 Registration, *S221 Foyer of HKCEC*

08:30–10:00
Th1G • 2D Nonlinear Materials
Presider: Han Zhang, Shenzhen Univ., China

Th1G.1 • 08:30 Invited

2D Nonlinear Optical Mateirals, Jun Wang[1]; [1]*Shanghai Inst of Optics and Fine Mech, China.* The saturation of two-photon absorption (TPA) in four types of layered transition metal dichalcogenides (TMDCs) (MoS_2, WS_2, $MoSe_2$, WSe_2) was systemically studied both experimentally and theoretically.

08:30–10:00
Th1H • Nanostructures for Optoelectronic Applications
Presider: Xuming Zhang; The Hong Kong Polytechnic Univ., Hong Kong

Th1H.1 • 08:30

Tunable Amplified Spontaneous Emission and Lasing from All-inorganic Perovskite Nanocube, Zhengzheng Liu[1], Zhiping Hu[2], Tongchao Shi[1], Zeyu Zhang[1], Xin Xing[1], Xiaosheng Tang[2], Juan Du[1], Yuxin Leng[1]; [1]*Shanghai Inst of Optics and Fine Mech, China;* [2]*Chongqing Univ., China.* We report high-quality and low-threshold lasing, enhanced stability, and excellent wavelength tunability from a facile solution-processed sub-wavelength size of cesium lead halide perovskite CsPbX3 (X= I/Br/Cl) nanocubes under both one- and two-photon excitation

Th1H.2 • 08:45

High-Q Nanocavity-Based Raman Laser Fabricated on a (100) SOI Substrate with a 45-Degree-Rotated Top Silicon Layer, Yukiko Yamauchi[1], Makoto Okano[2], Susumu Noda[3], Yasushi Takahashi[1]; [1]*Osaka prefecture Univ., Japan;* [2]*National Inst. of Advanced Industrial Science and Technology , Japan;* [3]*Kyoto Univ., Japan.* We report a low-threshold Raman laser based on nanocavities fabricated on an improved (100) SOI substrate with a 45-degree-rotated top silicon layer. We consider that this SOI substrate enables mass production of silicon Raman lasers.

08:30–10:00
Th1I • Probabilistic Signal Shaping
Presider: Fan Zhang; Peking Univ. China

Th1I.1 • 08:30

Simultaneous RSOP and Carrier Phase Noise Equalization for Probabilistical Shaping QAM Signals Based on Extended Kalman Filter, Nannan Zhang[1], Qisong Shang[1], Zibo Zheng[1], Nan Cui[1], Wenbo Zhang[1], Hengying Xu[1], Xianfeng Tang[1], Lixia Xi[1], Xiaoguang . Zhang[1]; [1]*Beijing Univ of Posts & Telecom, China.* We propose a joint equalization method for ratation station of polarization (RSOP) and carrier phase noise (CPN) utilizing EKF for probabilistical shaping QAM(PS-QAM). The influences of RSOP and CPN are analyzed by numerical simulation.

Th1I.2 • 08:45

A Flexible Overhead Probabilistic Shaping Scheme for QC-LDPC Coded PM-64QAM Optical System, Shanyong Sun[1], LiQian Wang[1], Dongdong Wang[1], Xue Chen[1], Qijia Xu[1]; [1]*Beijing Univ. of Posts and Telecommunications, China.* We propose a flexible overhead probabilistic shaping QC-LDPC coded modulation scheme, which is easy to implement and it can all exceed the traditional QC-LDPC coded modulation scheme in the case of 16.7%, 8.3% and 5.5% overhead.

08:30–10:00
Th1J • Silicon Photonics Devices
Presider: Liang Wang; Univ. of Sci and Tech of China, China

Th1J.1 • 08:30 Tutorial

Monolithically Integrated 3D Silicon Photonics, Joyce K. Poon[1]; [1]*Electrical and Computer Engineering, Univ. of Toronto, Canada.* I will review multilayer silicon nitride-on-silicon (SiN-on-Si) photonic platforms that incorporate several SiN waveguide layers on top of an active Si waveguide layer. These 3D photonic platforms enable very large-scale photonic circuits.

08:30–10:00
Th1K • Display Technologies
Presider: Toyohiko Yatagai; Utsunomiya Univ., Japan

Th1K.1 • 08:30 Invited

Volumetric Bubble Display, Yoshio Hayasaki[1], Kota Kumagai[1]; [1]*Utsunomiya Univ., Japan.* Volumetric bubble display using high viscosity liquid is presented. The bubbles are produced by the holographic parallel femtosecond laser pulse excitations.

08:30–10:00
Th1L • Waveguides and Sensors
Presider: Songnian Fu; Huazhong Univ of Science & Technology, China

Th1L.1 • 08:30

Resonant tunneling diode photodetectors for mid-infrared gas-sensing based on GaSb substrate, Florian Rothmayr[1], Andreas Pfenning[2], Caroline Kistner[1], Johannes Koeth[1], Georg Knebl[2], Anne Schade[2], Sebastian Krueger[2], Lukas Worschech[2], Fabian Hartmann[2], Sven Höfling[2,3]; [1]*nanoplus Nanosystems and Technologies GmbH, Germany;* [2]*Physikalisches Institut and Röntgen Center for Complex Material Systems (RCCM), Universität Würzburg, Germany;* [3]*SUPA, School of Physics and Astronomy, Univ. of St. Andrews, UK.* We fabricated resonant tunneling diode photodetectors with a GaInAsSb absorption layer and a GaAsSb/AlAsSb double barrier. The detector cut-off wavelength is 3.5 µm and reaches a peak sensitivity of 0.85 A/W at 2004 nm.

Th1L.2 • 08:45

All-Optical Ammonia Gas Sensor Using Silicon Microring Resonator Covered with Graphene, Masayasu Sato[1], Hiroki Kishikawa[1], Nobuo Goto[1], Shin-ichiro Yanagiya[1], Shien-Kuei Liaw[2]; [1]*Tokushima Univ., Japan;* [2]*National Taiwan Univ. of Science and Technology, Taiwan.* All-optical gas sensor consisting of graphene covered silicon microring resonator is proposed. Ammonia gas increases the Fermi level of graphene. The gas concentration can be detected by the resonant-wavelength shift by microring resonator.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th1A • Novel Laser Sources I—Continued

Th1A.2 • 09:00
Miniaturized Mid-infrared All-fiber Laser at 2.9 μm, Weiwei Li[1], Tuanjie Du[1], Kaijie Wang[1], Hongjian Wang[1], Zhengqian Luo[1]; [1]*Xiamen Univ., China.* We report the first demonstration of a miniaturized mid-infrared all-fiber laser operating at 2.9 μm. The linear laser cavity consists of a 55 cm Ho^{3+}:ZBLAN fiber, a 1154 nm Raman fiber laser as pump source, and a fiber end-faced mirror. Stable lasing at 2865 nm was achieved with the maximum output power of 67 mW and a slope efficiency of ~48.9%.

Th1A.3 • 09:15
Harmonic mode-locking generation from a Cr:ZnSe laser synchronously pumped by a picosecond thulium doped fiber laser, Xiangbao Bu[1], Fangzhou Tan[1], Ying Liu[1], Shuxian Qi[1], Pu Wang[1]; [1]*Beijing Univ. of Technology, China.* We report 209 MHz harmonic mode-locking of a 2420 nm Cr:ZnSe laser synchronously pumped by a 1935 nm, 104.5 MHz, 112 ps thulium doped fiber laser. Self-starting behavior was investigated by a chopper wheel.

Th1B • Nonlinear Spectroscopy and Imaging—Continued

Th1B.2 • 09:00
Coherent Raman Microspectroscopy for Non-Contact and Non-Destructive Measurements of Carrier Concentrations in Wide-Bandgap Semiconductors, Yu Okano[1], Ken Goto[3,2], Akito Kuramata[3,2], Shigenobu Yamakoshi[3,2], Hisashi Murakami[5,4], Bo Monemar[4,6], Yuki Obara[1], Yoshinao Kumagai[5,6], Kazuhiko Misawa[1,4]; [1]*Applied Physics, Tokyo Univ. of Agriculture and Tech, Japan;* [2]*Tamura Corporation, Japan;* [3]*Novel Crystal Technology, Japan;* [4]*Inst. of Global Innovation Reserach, Tokyo Univ. of Agriculture and Technology, Japan;* [5]*Applied Chemistry, Tokyo Univ. of Agriculture and Technology,, Japan;* [6]*Physics,Chemistry and Biology (IFM), Linkoping Univ., Sweden.* We developed a coherent Raman microspectroscopy that realizes a three-dimensional visualization of the spatial distribution of optical phonon modes in wide-bandgap semiconductors. This microspectroscopy will be a powerful tool for measuring the carrier concentration in semiconductors.

Th1B.3 • 09:15
Single-shot Ultrafast Burst Imaging by Spectrally Sweeping Pulse Train with 100-ps Interval, Hirofumi Nemoto[1], Takakazu Suzuki[1], Yuki Yamaguchi[1], Fumihiko Kannari[1]; [1]*Keio Univ., Japan.* We generate a spectrally sweeping 100-ps-interval pulse train for ultrafast burst imaging. Adopting those pulses to sequentially timed all-optical mapping photography utilizing spectral filtering (SF-STAMP), we realize single-shot burst imaging with a sub-nanosecond time window.

Th1C • Frequency Control and Measurement for Optical Metrology—Continued

Th1C.2 • 09:00
Offset Frequency Measurement of a Broadband Optical Comb Generated in a Waveguide-Type Periodically Poled Lithium Niobate Crystal, Junia Nomura[1,2], Kaho Taguchi[1], Yusuke Hisai[1,2], Kazumichi Yoshii[1,2], Feng-Lei Hong[1,2]; [1]*Dept. of Physics, Yokohama National Univ., Japan;* [2]*JST, ERATO, MINOSHIMA Intelligent Optical Synthesizer Project, Japan.* We developed an ultra-broadband frequency comb in a WG-PPLN and measured the offset frequency of the comb by using an iodine-stabilized laser at 532 nm. The visible comb is generated through the $\chi^{(2)}$ process.

Th1C.3 • 09:15
Repetition rate multiplication of fiber-based frequency comb with high side-mode suppression ratio, Yoshiaki Nakajima[1,2], Akiko Nishiyama[1,2], Takuya Hariki[1,2], Kaoru Minoshima[1,2]; [1]*Univ. of Electro-Communications, Japan;* [2]*JST ERATO MINOSHIMA IOS Project, Japan.* All-fiber-based mode-filtering has been developed for repetition multiplication of fiber-based frequency comb with multiplication factor of 11. We achieved high side-mode suppression ratio of approximately 40 dB with 536.0-MHz repetition-rate fiber-based mode-filtered comb.

Th1D • Quantum Information Processing II—Continued

Th1D.2 • 09:00
Extending gradient echo memory using machine learning and single photons, Anthony C. Leung[1,2], Aaron Tranter[1,2], Karun Paul[1,2], Jesse Everett[1,2], Pierre Vernaz-Gris[1,2], Daniel Higginbottom[1,2], Geoff Campbell[1,2], Ping Koy Lam[1,2], Ben Buchler[1,2]; [1]*Centre for Quantum Computation and Communication Technology, Dept. of Quantum Science, The Australian National Univ., Australia;* [2]*Dept. of Quantum Science, The Australian National Univ., Australia.* Gradient echo memory is the most efficient quantum memory protocol to date. Recent additions of machine learning and compatible single photons can raise its performance and the possibility of using it as a quantum gate.

Th1D.3 • 09:15
Design of a Multistage Quantum Pulse Gate in the Frequency Domain, Shintaro Niimura[1], Aruto Hosaka[1], Masaya Tomita[1], Akihito Omi[1], Fumihiko Kannari[1]; [1]*Keio Univ., Japan.* We propose a multistage quantum pulse gate which efficiently mix multimode quantum states in the frequency domain. Furthermore we introduce a practicable quantum simulator for calculating Frank Condon factors.

Th1E • Fiber Devices II—Continued

Th1E.2 • 09:00
Converting between CVB and OAM beams, Hongwei Zhang[1], Yange Liu[1], Zhi Wang[1], Ya Han[1], Kang Yang[1]; [1]*Nankai Univ., China.* We have proposed a method to generate cylindrical vector beams (CVBs) based on a mode selective coupler (MSC) and convert it to orbital angular momentum (OAM) beams using a quarter-wave plate (QWP) at wavelength of 1550 nm.

Th1E.3 • 09:15
Ultra-broadband mode converter based on an apodized long-period grating in two-mode fiber, Yunhe Zhao[1], Yunqi Liu[1], Chen Jiang[1], Chengbo Mou[1], Tingyun Wang[1]; [1]*Shanghai Univ., China.* We demonstrate an ultra-broadband LP_{01}-LP_{11} mode converter based on an apodized long-period grating in two-mode fiber via CO_2-laser inscription. The proposed device provides mode conversion efficiency higher than 90% over a bandwidth of ~180 nm.

Th1F • Metamaterials and Meta-devices—Continued

Th1F.2 • 09:00
Tunable Hyperbolic Metamaterials for Novel Photonic Devices, Marcin R. Kieliszczyk[1], Bartosz Janaszek[1], Anna Tyszka-Zawadzka[1], Robert Mroczynski[1], Pawel Szczepanski[1,2]; [1]*Inst. of Microelectronics and Optoelectronics, Warsaw Univ. of Technology, Poland;* [2]*National Inst. of Telecommunications, Poland.* Hyperbolic metamaterials (HMMs) are proven suitable for tunable filters, controlled gain/absorption and mode propagation in waveguides, including mode coupling. We present opportunities which HMMs bring to the design of novel passive and active photonic devices.

Th1F.3 • 09:15
Control of mode propagation in tunable hyperbolic metamaterial waveguides, Bartosz Janaszek[1], Marcin R. Kieliszczyk[1], Anna Tyszka-Zawadzka[1], Pawel Szczepanski[1,2]; [1]*Inst. of Microelectronics and Optoelectronics, Warsaw Univ. of Technology, Poland;* [2]*National Inst. of Telecommunications, Poland.* We demonstrate waveguides based on hyperbolic metamaterials providing means for controlled propagation in near-infrared, including slow light effects and controlled mode propagation, including power flow direction.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th1G • 2D Nonlinear Materials—Continued

Th1G.2 • 09:00 Invited

2D carbon allotrope with incorporated Au-Ag nanoclusters – laser-induced synthesis and optical characterization, Alina A. Manshina[1], Yuriy Petrov[1], Iliya Kolesnikov[1], Nikolai Mitetelo[2], Tatiana Murzina[2], Muhammad Butt[3], Martin Neugebauer[3], Peter Banzer[3], Gerd Leuchs[3]; [1]*Saint Petersburg State Univ., Russia;* [2]*Moscow state Univ., Russia;* [3]*Max-Planck Inst. for the Science of Light, Germany.* We discuss the laser-induced fabrication and detailed structural and optical characterization of a novel carbon allotrope intercalated with bimetallic nanoclusters.

Th1H • Nanostructures for Optoelectronic Applications—Continued

Th1H.3 • 09:00

Controlling the lasing and hybrid plasmonic lasering actions based on lead halide perovskite nanosheets at the bottom, Qinghai Song[1]; [1]*Harbin Inst. of Technology, China.* We report here a simple approach to precisely control the lasing and hybrid plasmonic laser (spaser) actions based on MAPbX3 perovskite nanosheets by tailoring the substrate.

Th1H.4 • 09:15

Demonstration of Self-pulsating Photonic-Crystal Surface-Emitting Lasers, Ryohei Morita[1], Takuya Inoue[1], Menaka D. Zoysa[1], Kenji Ishizaki[1], Yoshinori Tanaka[1], Susumu Noda[1]; [1]*Kyoto Univ., Japan.* We demonstrate self-pulsation with a pulse width of 100 ps and a beam divergence angle of 0.35° in a photonic-crystal surface-emitting laser by introducing a saturable absorber section and employing a new double-hole photonic crystal.

Th1I • Probabilistic Signal Shaping—Continued

Th1I.3 • 09:00

On the optimum decision threshold for probabilistically shaped PAM constellation, Wenjing Zhang[2], Shaohua Hu[2], Xingwen Yi[1,2], Jing Zhang[2], Wenjng Zhou[2], Xiang Gao[2]; [1]*Sun Yat-sen Univ., China;* [2]*Univ. of Electronics and Technology of China, China.* We investigate and derive the optimum decision threshold for probabilistically shaped PAM constellation. Both in simulation and experiment, we verify our anaysis and show a lower BER performance compared with the conventional median threshold.

Th1I.4 • 09:15

Probabilistic Shaping QC-LDPC Coded Modulation Scheme for Optical Fiber Systems, Qijia Xu[1], LiQian Wang[1], Dongdong Wang[1], Xue Chen[1], shanyong sun[1]; [1]*Beijing Univ of Posts & Telecom, China.* We proposed a probabilistic shaping QC-LDPC coded modulation scheme, which can achieve 0.33dB OSNR improvement at the BER of 10^{-5} compared with the traditional QC-LDPC coded modulation scheme with the same total overhead.

Th1J • Silicon Photonics Devices—Continued

Th1K • Display Technologies—Continued

Th1K.2 • 09:00

Laser Splashed Three-dimensional Nanostructures for Crypto-Display, Dejiao Hu[1], Yudong Lu[1], Yaoyu Cao[1], Xiangping Li[1]; [1]*Jinan Univ., China.* We report a crypto-display metasurface fabricated by laser splashed 3D nanostructures. Splashing morphologies that scatter angle-sensitive colors are realized through irradiation of a single femtosecond pulse onto titanium film. Angularly-anisotropic color image encryption are demonstrated.

Th1K.3 • 09:15

Optical Crosstalk Reduction in Quantum-Dot-Based Full-Color micro-LED Display by Lithographic-Fabricated Photoresist Mold, Yung-Min Pai[1], chih-hao Lin[1], Huang-Yu Lin[1], Chun-Fu Lee[1], cheng-huan CHEN[1], Hao-Chung Kuo[1]; [1]*National Chiao Tung Univ., Taiwan.* The full-color emission RGB quantum dot (QD)-based micro-LED array with reduced optical crosstalk effect by photoresist mold .The crosstalk effect of the well-confined QDs in the window by the fluorescence microscope.

Th1L • Waveguides and Sensors—Continued

Th1L.3 • 09:00

Compact spectrometer based on a multimode silicon waveguide device, Yuhang Wan[1], Yitong Shi[1], Mengxuan Cheng[1], Yu Zhang[1], Zijun Yao[1], Zheng Zheng[1,2]; [1]*School of Electronic and Information Engineering, Beihang Univ., China;* [2]*Beijing Advanced Innovation Center for Big Date-based Precision Medicine, China.* A highly compact spectroscopic measurement schem is proposed based on a fabricated on-chip silicon device that consists of a multimode interference waveguide containing randomly distributed disturbances with an anomalous wavelength dependent spectral-to-spatial map.

Th1L.4 • 09:15

Temperature-insensitive Waveguide Sensor Based on Vernier-effect, Yang Zhang[1], Jun Zou[2], Jian-Jun He[1]; [1]*Zhejiang Univ., China;* [2]*Zhejiang Univ. of Technology, China.* We proposed a temperature-insensitive sensor using cascaded microring resonator and Mach-Zehnder Interferometer (MZI) filter. Temperature sensitivity of the sensor was less than 29 pm/K in a temperature range from 20 °C to 40 °C.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th1A • Novel Laser Sources I—Continued

Th1A.4 • 09:30
Wavelength tunable carbon nanotube mode-locked fiber laser based on an all-fiber birefringent filter, Bingbing Lu[1], Chuanhang Zou[1], Qianqian Huang[1], Zhijun Yan[2], mohammed AlAraimi[3,4], Aleksey Rozhin[3,5], Chengbo Mou[1]; [1]*Key Lab of Specialty Fiber Optics and Optical Access Networks, Shanghai Univ., China;* [2]*School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China;* [3]*Aston Inst. of Photonic Technologies, Aston Univ., UK;* [4]*Al Musanna College of Technology, Oman;* [5]*Nanoscience Research Group, Aston Univ., UK.* A wavelength tunable carbon nanotube mode-locked fiber laser based on an all-fiber birefringent filter consisting of 45°tiled fiber grating and polarization maintaining fiber is demonstrated with a tuning range of 30 nm.

Th1A.5 • 09:45
Fourier domain mode-locked lasers with an optical intensity modulator, Xiaolong Yuan[1], Feng Li[2,3], Qian Li[1], P K A Wai[2,3]; [1]*School of Electronic and Computer Engineering, Peking Univ., China;* [2]*The Hong Kong Polytechnic Univ. Shenzhen Research Inst., China;* [3]*Dept. of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong.* We propose and study an FDML laser with an intracavity intensity modulator. Numerical simulations show that the pulse quality can be significantly improved if a short pulse modulation is applied to the intracavity signal.

Th1B • Nonlinear Spectroscopy and Imaging—Continued

Th1B.4 • 09:30
Magnetic sub-Wavelength Imaging using High-Harmonic Radiation, Sergey Zayko[1], Ofer Kfir[1], Michael Heigl[2], Murat Sivis[1], Manfred Albrecht[2], Claus Ropers[1]; [1]*IV. Physical Inst. – Solids and Nanostructures, Univ. of Göttingen, Germany;* [2]*Inst. of Physics, Univ. of Augsburg, Germany.* We demonstrate nanoscale magnetic imaging with sub-20 nm spatial resolution using high-harmonic radiation. This first demonstration will allow for comprehensive studies of ultrafast spin dynamics with nanometer spatial and femtosecond temporal resolution using a lab-scale source.

Th1B.5 • 09:45
Ultrafast dynamics and coherent vibrations in zinc chlorin aggregates, Tongchao Shi[1], Juan Du[1], Zhengzheng Liu[1,2], Zeyu Zhang[1], Yuxin Leng[1,2], Tomohiro Makino[3], Hitoshi Tamiaki[4], Masaki Kobayashi[5]; [1]*Shanghai Inst of Optics and Fine Mech, China;* [2] *ShanghaiTech Univ., China;* [3] *Ryukoku Univ.,, Japan;* [4]*Ritsumeikan Univ., Japan;* [5]*The Univ. of Electro-Communications, Japan.* The ultrafast dynamics of zinc chlorin aggregates were studied by 7.1fs transient absorption spectroscopy. And interaction of the Frenkel exciton with the coherent molecular vibrations were obtained by 7.1fs real-time vibrational spectroscopy.

Th1C • Frequency Control and Measurement for Optical Metrology—Continued

Th1C.4 • 09:30
Frequency-Stabilized Pump Laser for Wavelength Conversion in Long-Distance Quantum Communication, Kohei Ikeda[1], Yusuke Hisai[1], Tomoyuki Horikiri[1], Kazumichi Yoshii[1], Hideo Kosaka[1], Feng-Lei Hong[1]; [1]*Yokohama National Univ., Japan.* We develop a compact frequency-stabilized laser at 1064 nm for wavelength conversion in long-distance quantum communication. Linewidth and frequency stability are demonstrated to be sufficient to connect nitrogen-vacancy centers in diamond in remote nodes.

Th1C.5 • 09:45
High-Resolution No-Scanning 3D Image Detection Using Sum-Frequency Generation of Chirped Optical Frequency Combs, Yurina Tanaka[1,2], Takashi Kato[1,2], Megumi Uchida[1,2], Akifumi Asahara[1,2], Kaoru Minoshima[1,2]; [1]*The Univ. of Electro-Communications, Japan;* [2]*Japan Science and Technology Agency (JST), ERATO MINOSHIMA Intelligent Optical Synthesizer (IOS) Project, Japan.* No-scanning 3D imaging with 3-μm depth accuracy was demonstrated with optical frequency combs using a 2D color-image detection method with a spectral filter pair. No significant image degradation due to nonlinear optical detection was observed.

Th1D • Quantum Information Processing II—Continued

Th1D.4 • 09:30
Witness assisted eigenspectra solver on a silicon quantum photonic simulator, Antonio Gentile[1], Raffaele Santagati[1], Jianwei Wang[1], Stefano Paesani[1], Nathan Wiebe[2], Jarrod McClean[3,7], Damien Bonneau[1], Joshua Silverstone[1], Sam Morley-Short[1], Peter Shadbolt[4], David Tew[1,6], Xiaoqi Zhou[5], Jeremy O'Brien[1], Mark Thompson[1]; [1]*Univ. of Bristol, UK;* [2]*Quantum Architectures and Computation Group, Microsoft Research, USA;* [3]*Quantum AI Lab, Google Inc., USA;* [4]*Imperial College London, UK;* [5]*State Key Laboratory of Optoelectronic Materials and Technologies and School of Physics, Sun Yat-sen Univ., China;* [6]*Max Planck Inst. for Solid State Research, Germany;* [7]*Lawrence Berkeley National Laboratory, USA.* We demonstrate a new protocol capable of finding ground and excited states of physical Hamiltonians via an eigenstate witness. The experimental test employs a silicon quantum photonic device, embedding arbitrary controlled unitary operations.

Th1D.5 • 09:45
Characterizing the Temporal Mode of Single-Photon State Generated from Cold Atoms, Zhenjie Gu[1], Ce Yang[1], Peng Chen[1], Jiefei Chen[1]; [1]*East China Normal Univ., China.* Single photons with pure temporal state are able to be generated and manipulated in cold atoms. We demonstrate the amplitude and phase of their temporal-mode function are both revealed in homodyne detection of photon currents.

Th1E • Fiber Devices II—Continued

Th1E.4 • 09:30
A High-Index Ring Core Layer for Highly Sensitive Micro Fiber Mach-Zehnder Temperature Sensors, Xuan Li[1], Yu-Jian Hu[2], Nan-Kuang Chen[3,4], Xiaoguang Zhang[1], Lixia Xi[1], Hu Zhang[1]; [1]*State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ. of Posts and Telecoms, China;* [2]*National United Univ., Taiwan;* [3]*Shandong Provincial Key Laboratory of Optical Communication Science and Technology, Liaocheng Univ., China;* [4]*School of Physics Sciences and Information Technology, Liaocheng Univ., China.* We demonstrate micro fiber Mach-Zehnder interferometric temperature sensors based on tapered ring core fiber with a thinned high-index ring structure to separate core and cladding modes to improve the temperature sensitivity up to 60 pm/°C.

Th1E.5 • 09:45
Volatile organic gas recognition with an in-line fiber Mach-Zehnder interferometer coated with ZIF-8, Wanying Zhang[1], JieYun Wu[1], Ting Hao[2], Yang Liu[1], Kaixin Chen[1], Kin S. Chiang[1,2]; [1]*Univ of Electronic Science and Technology of China, China;* [2]*Electronic Engineering, City Univ. of Hong Kong, Hong Kong.* We demonstrate an in-line fiber Mach-Zehnder interferometer coated with the metal-organic framework ZIF-8 for volatile organic gas recognition. The ZIF-8 coating can absorb different gases and cause significant shifts of the interference fringes of the MZI.

Th1F • Metamaterials and Meta-devices—Continued

Th1F.4 • 09:30 Invited
Tunable Conducting Oxide Epsilon-Near-Zero Meta-Devices, Aleksei Anopchenko[1], Long Tao[1], Sudip Gurung[1], Jingyi Yang[1], Subhajit Bej[1], Catherine Arndt[1], Ho Wai H. Lee[1,2]; [1]*Dept. of Physics, Baylor Univ., USA;* [2]*The Inst. for Quantum Science and Engineering, TexasA&M, USA.* This talk will review our recent development on an electrically tunable conducting oxide metasurface that can tune the optical phase and amplitude and a broadband, tunable, and ultrathin conducting oxide epsilon-near-zero perfect absorber.

10:00–10:30 Coffee Break

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th1G • 2D Nonlinear Materials—Continued

Th1G.3 • 09:30
Multi-Photon Absorption in Monolayer Transition-Metal Di-Chalcogenides and its Applications for Sub-band Multi-Photon Detection, Wei Ji[1,2]; [1]*National Univ. of Singapore, Singapore;* [2]*Shenzhen Univ., China.* Multi-photon absorption spectra in monolayer transition-metal di-chalcogenides have been calculated by quantum mechanical perturbation theories for the first time. Their applications have been demonstrated for sub-band multi-photon detections.

Th1G.4 • 09:45
Determination of the optical constants of atomically thin MoS_2 by spectroscopic ellipsometry, Michele Merano[1]; [1]*Universita degli Studi di Padova, Italy.* In literature, the optical constants of monolayer MoS_2 are extracted from experimental data modelling the crystal as a three dimensional slab. We use the surface current model, and compare the two procedures with surprising results.

Th1H • Nanostructures for Optoelectronic Applications—Continued

Th1H.5 • 09:30 Invited
Semiconductor Nanowires for Optoelectronics Applications, Chennupati Jagadish[1]; [1]*Australian National Univ., Australia.* In this talk, I will present our results on nanowire growth and characterization. I will discuss our work on Nanowire lasers, THz detectors, solar cells and engineered neuronal growth and their function.

Th1I • Probabilistic Signal Shaping—Continued

Th1I.5 • 09:30
Submarine Cable Ageing and Repair Management Using Adaptable Probabilistic Constellation Shaping, Omar Ait Sab[1], Philippe Plantady[1], Alain Calsat[1], Suwimol Dubost[1], Pascal Pecci[1], Vincent Letellier[1]; [1]*Alcatel Submarine Netwoks, France.* We experimentally demonstrate that an OSNR distortion of 5.5dB can be compensated for by using two PCS formats without any in-line gain flatness management over 7445km submarine transmission link at the expense of only 3% capacity loss.

Th1I.6 • 09:45
A Novel Scheme to Increase Receiver Sensitivity of PAM-4 Signal in Optical Amplified Network, Hanlin Feng[1]; [1]*Shanghai Jiao Tong Univ., China.* We propose and demonstrate a novel scheme to increase receiver sensitivity of PAM-4 signal in optical amplified network. Non-uniform PAM-4 signal is generated to suppress signal-spontaneous beating noise from optical amplifier and reduce power penalty.

Th1J • Silicon Photonics Devices—Continued

Th1J.2 • 09:30 Invited
Silicon-based III-V Quantum Dot Materials and Dsevices, Huiyun Liu[1]; [1]*Univ. College London, UK.* III-V Quantum-dot (QD) materials and lasers directly grown on Si platform are the most prospective candidate to realize on-chip optical sources for Si photonics. The recent progress made in this field are discussed.

Th1K • Display Technologies—Continued

Th1K.4 • 09:30
Dynamic 3D holographic display with enhanced viewing angle by using a nonperiodic pinhole array, Jongchan Park[1], KyeoReh Lee[1], YongKeun Park[1]; [1]*KAIST, Korea.* We demonstrate a flat-panel wavefront modulator for generating dynamic holographic images. A nonperiodic photon sieve is combined with a liquid crystal display panel to generate holographic images with a large area and wide viewing angle.

Th1K.5 • 09:45
Optical illusion by scattering light manipulated with a spatial light modulator, Hexiang He[2,1], Kam Sing Wong[1]; [1]*Hong Kong Univ of Science & Technology, Hong Kong;* [2]*Foshan Univ., China.* We introduce an optical illusion method by transforming the object light into a designed illusion image with a spatial light modulator and a scattering medium. Both theoretical and experimental results show the method to be robust and easy-to-use.

Th1L • Waveguides and Sensors—Continued

Th1L.5 • 09:30
Highly Sensitive Temperature Sensor based on a Long Period Waveguide Grating with Polymer Upper Cladding and Metal Under Cladding, Nabarun Saha[1], Arun Kumar[1]; [1]*Indian Inst. of Technology, Delhi, India.* We propose a temperature sensor based on a long period grating inscribed metal clad ridge waveguide with polymer upper cladding, which shows a very high sensitivity and does not require any polarization control.

Th1L.6 • 09:45
Nanoscale strain gauges composed of microdisk lasers embedded in a flexible substrate, TaoJie Zhou[2], Jie Zhou[1], Yuzhou Cui[2], Xiu Liu[2], Zhaoyu Zhang[2]; [1]*Peking Univ., Shenzhen Graduate School, School of Electronic and Computer Engineering, China;* [2]*School of Science and Engineering, The Chinese Univ. of Hong Kong, Shenzhen, China.* Compact visible microdisk lasers were fabricated and embedded in a deformable polydimethylsiloxane (PDMS) polymer substrate. A smooth wavelength tuning of 1.5 nm and 2.6 nm for microdisk lasers with the diameter of 1.2 μm and 1.5 μm are demonstrated under 36% strain, respectively.

10:00–10:30 Coffee Break

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

10:30–12:30
Th2A • Novel Laser Sources II
Presider: Meng Zhang; Beihang Univ., China

Th2A.1 • 10:30 Invited
New Schemes of Raman Fiber Lasers with Random Distributed Feedback, Sergey A. Babin[1]; [1]*Inst. of Automation and Electrometry, Russia.* We review recent results on cascaded Raman fiber lasers (RFLs) with broadband random distributed feedback (RDFB) enabling tuning in 1-2 micron range, and directly diode-pumped RFL with RDFB in multimode GRIN fiber at <1 micron.

Th2A.2 • 11:00
Switchable dual-mode pulsed fiber laser with few-mode fiber grating, Yu Cai[1], Zhiqiang Wang[1], Zuxing Zhang[1]; [1]*Nanjing Univ of Posts & Telecomm, China.* A switchable dual-mode pulsed fiber laser by using a two-mode fiber Bragg grating for mode discrimination and SESAM for mode-locking has been demonstrated. Stable pulsed operation on separate or simultaneous fundamental mode and intercoupling mode can be obtained, respectively.

10:30–12:30
Th2B • Solitons and Temporal Wave Guiding, and Frequency Comb
Presider: Stephane Coen; Univ. of Auckland, New Zealand

Th2B.1 • 10:30 Invited
Pulse-driven Microresonator Solitons, Ewelina Obrzud[1,2], Steve Lecomte[1], Tobias Herr[1]; [1]*Swiss Cent for Electronics and Microtech, Switzerland;* [2]*Observatoire de Genève, Université de Genève, Switzerland.* Nonlinear optical microresonator driven by picosecond laser pulses can generate temporal dissipative solitons. These femtosecond soliton pulses can be all-optically controlled and are generated at a fraction of the power required in continuous-wave driven systems.

Th2B.2 • 11:00
Soliton Bursts in Nonlinear Microcavity, Wenwen Cui[1], Heng Zhou[1], Yong Geng[1], Baojian Wu[1], Kun Qiu[1]; [1]*Univ of Electronic Science & Tech China, China.* We demonstrate new dissipative Kerr soliton formation route with red-detuned pump entrance and observe soliton bursts in microcavity. We show that ignition of soliton burst requires much less pump tuning than conventional blue-pump-entry soliton generation.

10:30–12:30
Th2C • Integrated Optical Devices for Switching Multiplexing and Signal Processing
Presider: Daoxin Dai; Zhejiang Univ., China

Th2C.1 • 10:30 Tutorial
Silicon Photonic Devices for Optical Signal Processing in Wavelength, Polarization and Mode Domains, Yikai Su[1]; [1]*Shanghai Jiao Tong Univ., China.* We review recent progress on silicon photonic devices for optical signal processing, including nanobeam devices for wavelength filtering and switching, directional couplers for polarization/mode processing, and subwavelength grating devices for multi-dimensional processing.

10:30–12:30
Th2D • High Energy Laser
Presider: Deepak Jain; DTU Fotonik, Denmark

Th2D.1 • 10:30 Invited
High Energy and Broad Bandwidth Ti:Sapphire Chirped Pulse Amplifier in 10 PW Laser, Xiaoyan Liang[1], Zebiao Gang[1], Lianghong Yu[1], Wenqi Li[1], Zhen Guo[1], Yanqi Liu[1], Cheng Wang[1], Shuai Li[1], Yuxin Leng[1], Ruxin Li[1], Zhizhan Xu[1]; [1]*Shanghai Inst of Optics & Fine Mechanics, China.* The amplified energy of 339 J from the SULF laser was achieved with 235 mm diameter Ti:sapphire in final amplifier. After compressor, the measured pulse duration of 21.0 fs supported the peak power of 10.3PW.

Th2D.2 • 11:00 Invited
Recent Performance of the Fusion Laser Facility SG-III, Qihua Zhu[1]; [1]*China Academy Of Engineering Physics (CAEP), China.* Abstract not available.

10:30–12:30
Th2E • Special Fibers II
Presider: Markus Schmidt; Leibniz Inst. of Photonic Technology, Germany

Th2E.1 • 10:30 Invited
World-Beating Performance from Hollow Core Fibers, Jonathan C. Knight[1], Fei Yu[1,2]; [1]*Univ. of Bath, UK;* [2]*Shanghai Inst. of Optics and Fine Mechanics, China.* Hollow core optical fibers have the potential to outperform conventional optical fibers in numerous ways. We report on ultra-low loss fibers for the mid-infrared and the ultraviolet, the absence of solarization, mid-IR gas lasers and prospects for the lowest optical fiber loss ever.

Th2E.2 • 11:00 Invited
Tailored Glasses Optimized for Optical Fiber-Based Photonic Applications, Peter D. Dragic[1], Maxime Cavillon[2], Matthew Tuggle[2], Nanjie Yu[1], Courtney Kucera[2], Joshua Parsons[2], Thomas Hawkins[2], John Ballato[2]; [1]*Univ of Illinois at Urbana-Champaign, USA;* [2]*Clemson Univ., USA.* Silica glass, arguably the most ubiquitous of all optical materials, is a pillar of modern fiber optics. However, careful compositional tuning can render fibers with far more remarkable properties for a wide range of applications.

10:30–13:30
Th2F • Plasmonics Metasurfaces
Presider: Jensen Li, Hong Kong Univ. of Science & Tech, Hong Kong

Th2F.1 • 10:30 Invited
Sieving Photons for Wavefront Manipulation, Jinghua Teng[1]; [1]*A*STAR, Singapore.* This talk will introduce our work on using photon sieves to manipulate optical wavefront for high tolerance hologram generation, orbital angular momentum control and sub-diffraction limit focusing.

Th2F.2 • 11:00
Using Metasurfaces to Control Random Light Emission, Zhengtong Liu[1], Egor Khaidarov[2,3], Ramón Paniagua-Domínguez[2], Song Sun[1,4], Ping Bai[1], Ching Eng Png[1], Hilmi Volkan Demir[3], Arseniy I. Kuznetsov[2]; [1]*Inst. of High Performance Computing, Singapore;* [2]*Data Storage Inst., Singapore;* [3]*Nanyang Technological Univ., Singapore;* [4]*Microsystem & Terahertz Research Center, China Academy of Engineering Physics, China.* Metasurfaces have been designed for plane waves or point emitters with precise positions, but generally fail to control emission from random light emitters such as LEDs. We demonstrate a method that resolves this problem.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

10:30–12:15
Th2G • 2D Materials for Mode Locking and Nonlinear Photonics
Presider: Han Zhang; Shenzhen Univ., China

Th2G.1 • 10:30 Invited
2D Materials for Mode-locking of Bulk 2 Micron Lasers: Alternatives to SESAMs, Yicheng Wang[1], Zhongben Pan[1], Yongguang Zhao[1,2], Weidong Chen[1], Mark Mero[1], Fabian Rotermund[3], Pavel Loiko[4], Xavier Mateos[5], Xiaodong Xu[2], Jun Xu[6], Haohai Yu[7], Huaijin Zhang[7], Uwe Griebner[1], Valentin Petrov[1]; [1]*Max Born Inst., Germany;* [2]*Jiangsu Normal Univ., China;* [3]*KAIST, Korea;* [4]*ITMO Univ., Russia;* [5]*URV, Spain;* [6]*Tongji Univ., China;* [7]*Shandong Univ., China*. We review the recent progress in passively mode-locked Tm- and Ho-lasers operating near 2 µm, comparing saturable absorbers based on carbon nanostructures (SWCNTs and graphene) with SESAMs, employed in lasers based on different active media.

Th2G.2 • 11:00 Invited
Mid-infrared Ultrafast Lasers Based on Two-dimension Materials, Guoqiang Xie[1], Zhipeng Qin[1]; [1]*Shanghai Jiao Tong Univ. , China*. In this talk, mid-infrared ultrafast lasers from 2 µm to 3.5 µm based on two-dimension materials will be introduced. The two-dimension materials provide opportunity for generating ultrashort pulses in long mid-infrared wavelength.

10:30–12:30
Th2H • Light-matter Interactions in Micro/nano-structures
Presider: Xuming Zhang; The Hong Kong Polytechnic Univ., Hong Kong

Th2H.1 • 10:30 Invited
Light-Matter Interactions Within Extreme Dimensions: Strategies to Surpassing Conventional Nanophotonics, Qiaoqiang Gan[1]; [1]*State Univ. of New York at Buffalo, USA*. We will present an overview of new strategies to boost the light-matter interaction within extremely small dimensions.

Th2H.2 • 11:00
Ultrahigh-Efficiency Nonlinear Mechanical Intermodal Coupling in High-Q Square Nano-membrane, Da In Song[1], Dae Seok Han[1], Myeongsoo Kang[1]; [1]*Dept. of Physics, KAIST, Korea*. We experimentally demonstrate optomechanically driven nonlinear mechanical intermodal coupling by using high-Q square nano-membranes. Pumping via radiation forces as low as 34 pN, we achieve ultrahigh-efficiency coupling of the first-order mode into the higher-order ones.

10:30–12:30
Th2I • Polarization Effects and Optical Networking
Presider: Changjian Guo; The Hong Kong Polytechnic Univ., Hong Kong

Th2I.1 • 10:30
A Low-Complexity and Fast Adaptive Stokes-Space-Based Polarization Demultiplexing Technique for Optical Fiber Transmissions with Low Polarization Mode Dispersion, Xiong Wu[1], Jie Liu[1], Junwei Zhang[1], Siyuan Yu[1,2]; [1]*Sun Yat-Sen Univ., China;* [2]*Univ. of Bristol, UK*. We propose a low-complexity fast adaptive polarization demultiplexing technique in Stokes-Space for optical fiber transmissions with low polarization mode dispersion. Experimental results of a polarization-multiplexed QPSK system confirm the feasibility of the proposed technique.

Th2I.2 • 10:45
2-Parameter-SOP and 3-Parameter-RSOP Fiber Channel: Trouble and Solution for Polarization Demultiplexing using Stokes Space, Nan Cui[1], ZiBo Zheng[1], Wenbo Zhang[1], Lixia Xi[1], Xianfeng Tang[1], Xiaoguang . Zhang[1]; [1]*Beijing Univ. of Posts and Telecomm, China*. We present a 3-parameter representation for RSOP model, and based on it propose a PolDemux method using extended Kalman filter. The method is independent on RSOP models, and performs well in time-varying RSOP scenarios.

Th2I.3 • 11:00
Performance improvement on polarization state and phase tracking based on pilot-aided adaptive Kalman filter, Qian Xiang[1], Juntao Cao[1], Yanfu Yang[1], Qun Zhang[1], Yong Yao[1]; [1]*Dept. of Electronic Information Engineering,, Harbin Inst. of Technology (Shenzhen),, China*. A novel polarization and phase tracking scheme based on adaptive Kalman filter is proposed. Compared with extended Kalman filter, the proposed scheme shows fast polarization tracking capability, high linewidth tolerance and quick convergence speed.

10:30–12:30
Th2J • Advanced Modulators
Presider: Christian Koos; Karlsruhe Inst. of Technology KIT, Germany

Th2J.1 • 10:30 Invited
Advanced Architectures for QAM Modulators, Unaiza Tariq[1], Duncan L. MacFarlane[1]; [1]*Electrical Engineering, Southern Methodist Univ., USA*. Deviations to the input parameters of QAM can cause errors in the output, causing the output to deviate from its ideal position on the constellation diagram. This paper suggests adding feedback to the modulator branches to reduce the error in the output signal.

Th2J.2 • 11:00 Invited
III-V/Si Integration Platform for Laser Diodes and Mach-Zehnder Modulators, Tatsurou Hiraki[1], Takuma Aihara[1], Koichi Hasebe[1], Koji Takeda[1], Takuro Fujii[1], Takaaki Kakitsuka[1], Tai Tsuchizawa[1], Hiroshi Fukuda[1], Shinji Matsuo[1]; [1]*NTT Device Technology Labs, Japan*. We demonstrate membrane III-V/Si integrated devices. An InGaAsP/Si metal-oxide-semiconductor capacitor Mach-Zehnder modulator shows small VπL (0.09 Vcm), and a laser diode coupled to a 0.2-µm-thick Si waveguide shows a fiber coupled power of 4.6 mW.

10:30–12:30
Th2K • Imaging Technologies
Presider: Jung-Hoon Park; Ulsan National Inst of Science & Tech, Korea

Th2K.1 • 10:30 Invited
Micro Fourier Transform Profilometry (µFTP): 3D imaging at 10,000 fps, Chao Zuo[1]; [1]*Nanjing Univ of Science and Technology, China*. We present a new 3D dynamic imaging technique, Micro Fourier Transform Profilometry (µFTP), which can capture 3D surfaces of transient, time evolving events at up to 10,000 fps. We demonstrate µFTP's broad utility by imaging several transient scenes, for example, balloon's explosion triggered by a flying dart.

Th2K.2 • 11:00 Invited
Ultrahigh-Speed Optical Coherence Tomography and its Applications, Chao Zhou[1]; [1]*Lehigh Univ., USA*. Optical coherence tomography (OCT) enables 3D imaging of biological tissue with micron-scale resolutions in vivo. Recent technical advances to achieve ultrahigh-speed OCT and its novel applications will be discussed.

10:30–12:30
Th2L • Distributed Fiber Sensing
Presider: Xuping Zhang; Nanjing Univ., China

Th2L.1 • 10:30 Invited
A Review on Advances in Fiber-optic Distributed Acoustic Sensors (DAS), Zuyuan He[1], Qingwen Liu[1], Xinyu Fan[1], Dian Chen[1], Shuai Wang[1], Guangyao Yang[1]; [1]*Shanghai Jiao Tong Univ., China*. Latest advances in fiber-optic distributed acoustic sensors (DAS) are reviewed. Field demonstrations of DAS based on φ-OTDR with fading-suppression are shown, and newly developed DAS based on time-gated digital optical frequency domain reflectometry introduced.

Th2L.2 • 11:00 Invited
Phase-Sensitive OTDR Based on Coherent Detection, Zinan Wang[1], Ji Xiong[1], Yun Fu[1], Yunjiang Rao[1]; [1]*Univ. Electronic Sci. & Tech. of China, China*. Phase-sensitive optical time domain reflectometry (Φ-OTDR) as a versatile tool for distributed sensing has drawn great attention in both academic and industrial sectors. Recent progress at UESTC in Φ-OTDR is presented with emphasis on coherent detection scheme, and future prospects are discussed.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th2A • Novel Laser Sources II—Continued

Th2A.3 • 11:15
Sub-70fs generation from passively mode locked Erbium doped fiber laser using 45° tilted fiber grating, Tianxing Wang[1], Zhijun Yan[2], Qianqian Huang[1], Chuanhang Zou[1], Chengbo Mou[1], Kaiming Zhou[3], Lin Zhang[3]; [1]*Key Laboratory of Specialty Fiber Optics and Optical Access Networks, Shanghai Univ., China;* [2]*School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China;* [3]*Aston Inst. of Photonic Technologies, Aston Univ., UK.* We have demonstrated an all-fiber Erbium doped ultrafast laser by inserting a 45° tilted fiber grating. After optimizing the balance between intra-cavity nonlinearity and dispersion, an ultrashort pulse with sub-70 fs pulse duration can be achieved.

Th2A.4 • 11:30
Elegant modes of confocal laser resonators with OAM and its intracavity self-healing properties, Alfonso I. Jaimes-Nájera[1], Songjie Luo[2], Jixiong Pu[2], Sabino Chávez-Cerda[1]; [1]*INAOE, Mexico;* [2]*Fujian Provincial Key Laboratory of Light Propagation and Transformation, College of Information Science and Engineering, Huaqiao Univ., China.* Elegant beams were introduced as a variant to standard Gaussian beams that are not eigenmodes of confocal cavities. We remove this asymmetry by superposing a finite number of elegant Laguerre-Gauss beams, rendering a new family of single pass cavity eigenmodes.

Th2B • Solitons and Temporal Wave Guiding, and Frequency Comb—Continued

Th2B.3 • 11:15
Strong resonant radiation limits Kerr cavity soliton existence in longitudinally modulated resonators, Alexander U. Nielsen[1], Bruno Garbin[1], Stephane Coen[1], Stuart G. Murdoch[1], Miro J. Erkintalo[1]; [1]*The Dodd-Walls Centre for Photonic and and Quantum Technologies, Dept. of Physics, The Univ. of Auckland, New Zealand.* We have experimentally and numerically studied the effects of dispersion management on temporal Kerr cavity solitons. We find that the solitons can parametrically excite strong resonant sidebands that affect their range of existence.

Th2B.4 • 11:30
Fiber-Optic Solitons with Gain and Loss, Alexander Hause[1], Christoph Mahnke[1], Fedor Mitschke[1]; [1]*Univ. of Rostock, Germany.* Propagation of solitons in fibers with gain or loss beyond the perturbative regime is considered. Analytical results, corroborated with soliton eigenvalues from numerical studies, predict generation and decay of solitons, and the energy budget.

Th2C • Integrated Optical Devices for Switching Multiplexing and Signal Processing—Continued

Th2C.2 • 11:30
Integrated Multi-Functional Photonic Filters Based on Mode-Split Cascaded Sagnac Loop Reflectors, Jiayang Wu[1], Tania Moein[1], Xingyuan Xu[1], David Moss[1]; [1]*Swinburne Univ. of Technology, Australia.* We propose and demonstrate integrated multi-functional photonic filters implemented by mode-split cascaded Sagnac loop reflectors (SLRs). A wide range of filter shapes for diverse applications are experimentally achieved and show good agreement with theory.

Th2D • High Energy Laser—Continued

Th2D.3 • 11:30
1 TW-Class OPCPA Pumped with Fiber Laser Seeded Two-Cascaded Yb:YAG Rod Amplifier-Compressor, Aleksej Rodin[1,2], Paulius Mackonis[1]; [1]*Center for Physical Sciences and Technology, Lithuania;* [2]*Ekspla Ltd, Lithuania.* Fiber laser seeded two-stage double-pass chirped pulse amplifier-compressor based on Yb:YAG rods with scalable output energy from 20 mJ to 60 mJ at a repetition rate of 100 Hz, a pulsewidth of 1.2 ps and excellent beam quality is used to pump 1 TW-class OPCPA

Th2E • Special Fibers II—Continued

Th2E.3 • 11:30
Optimized design of 125-μm 6-core fiber with large effective area for wideband optical transmission, Shoulin Jiang[1,2], Lin Ma[2], Martin Miguel[1], Zuyuan He[2], Jayanta K. Sahu[1]; [1]*Optoelectronics Research Centre, Univ. of Southampton, UK;* [2]*Shanghai Jiao Tong Univ., China.* We propose an optimized design of heterogeneous trench-assisted 125-μm 6-core fiber with Aeff about 90 μm^2, λ_{cc} about 1300 nm, and XT<-30 dB/100 km for wideband transmission. Relative core multiplicity factor of 6.75 was achieved.

Th2F • Plasmonics Metasurfaces—Continued

Th2F.3 • 11:15
Optical Superchirality in a Perfect Lattice of Three-dimensional Nano-holes with High Q-factor and large area, Meng Qiu[4], Yidong Hou[2], Ho M. Leung[1], Che T. Chan[1], Jinglei Du[2], Wei Jin[4], Dang Yuan Lei[3]; [1]*Dept. of Physics, The Hong Kong Univ. of Science and Technology, Hong Kong;* [2]*College of Physical Science and Technology, Sichuan Univ., China;* [3]*Dept. of Applied Physics, The Hong Kong Polytechnic Univ., Hong Kong;* [4]*Dept. of Electrical Engineering, The Hong Kong Polytechnic Univ., Hong Kong.* We demonstrate a lattice of 3D chiral plasmonic nano-holes, with strong relative optical circular dichroism ~0.5, high Q-factor up to 45, and a perfect lattice of 1cm^2 This CD enhancement is due to the interaction between the chiral response of the chiral holes and the scattering modes of the lattice.

Th2F.4 • 11:30
The radiation-reaction force in two-dimensional atomic crystals and metasurfaces, Michele Merano[1]; [1]*Universita degli Studi di Padova, Italy.* Retardation effects are very relevant in the expression of local electromagnetic fields in two-dimensional systems. How do we go from the microscopic description to the macroscopic one? The radiative-reaction electric field connects micro to macro.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th2G • 2D Materials for Mode Locking and Nonlinear Photonics—Continued

Th2G.3 • 11:30 Invited

On-chip Chalcogenide-glass Nonlinear Photonics Using 2D-Material Mode-locked Fiber Lasers, Zhengqian Luo[1]; [1]*Xiamen Univ., China.* In this talk, we will present our recent research progress on on-chip CHGs-based nonlinear photonic devices using 2D-material mode-locked fiber lasers, mainly including 1) supercontinuum source integrated on-chip spectroscopic sensor, 2) on-chip optical frequency combs based on cascaded four-wave mixing, and 3) on-chip Raman soliton generation.

Th2H • Light-matter Interactions in Micro/nano-structures—Continued

Th2H.3 • 11:15

Resonant Third Harmonic Generation Microscopy of amorphous-silicon sub-wavelength nanostructures, Jayanta Deka[1], Keshav Kumar Jha[1], Sruti Menon[1], Lal Krishna[1], Varun Raghunathan[1]; [1]*Indian Inst. of Science, India.* We demonstrate multispectral third harmonic generation microscopy of amorphous silicon two-dimensional nanostructure arrays. Sub-wavelength structures designed with resonance at the fundamental wavelength result in enhancement of third-harmonic by a factor of ~ 370.

Th2H.4 • 11:30

Plasmonic-Dielectric Mushroom Nanoantenna for Fluorescence Enhancement, Song Sun[1,4], Ru Li[1,4], Mo Li[1,4], Qingguo Du[2,5], Ping Bai[3]; [1]*CAEP Microsystem and Terahertz Center, China;* [2]*School of Information Engineering, Wuhan Univ. of Technology, China;* [3]*Electronics and Photonics, A*STAR Inst. of High Performance Computing, Singapore;* [4]*CAEP Insititute of Electronic Engineering, China;* [5]*Key Laboratory of Fiber Optic Sensing Technology and Information Processing, Wuhan Univ. of Technology, China.* A plasmonic-dielectric mushroom nanoantenna is proposed to achieve an enhancement-factor (far-field intensity) twice (20-times) as high as that from a pure metallic antenna by matching the Stokes-shift of the emitter, accompanied with an improved directivity.

Th2I • Polarization Effects and Optical Networking—Continued

Th2I.4 • 11:15

Three-dimensional Stokes-vector based Polarization Recovery for Polarization Diversity Coherent Optical Detection, Soo-Min Kang[1], Dong-Yoon Han[1], Kyoung-Hak Mun[1], Sang-kook Han[1]; [1]*Yonsei Univ., Korea.* State of polarization variation of ONUs is critical in CO-OFDMA-PON uplink detection due to different fiber-birefringence and polarization-sensitive components. Stokes-Vector of pilot-tone based polarization recovery is proposed and its performance is verified experimentally.

Th2I.5 • 11:30

Dynamic Virtual Network Embedding with Distance Adaptive RSA over SDM-Based Elastic Optical Networks, Lijie Cheng[1], Xiaosong Yu[1], Zhu Liu[2], Xiao Liao[2], Ping Jia[3], Wei Li[3], Wenjing Li[2], Ruijie Zhu[4], Yajie Li[1], Yongli Zhao[1], Jie Zhang[1]; [1]*Beijing Univ. of Posts and Telecommunications, China;* [2]*State Grid Information & Telecommunication Group CO., LTD, China;* [3]*State Grid Jiangsu Electric Power Company Information & Telecommunication Branch, China;* [4]*Zhengzhou Univeristy, China.* A virtual network embedding strategy is proposed with distance-adaptive RSA over space-division-multiplexing based elastic optical networks. It not only improves network flexibility and spectrum utilization but also reduces the failure rate of virtual network embedding.

Th2J • Advanced Modulators—Continued

Th2J.3 • 11:30

Intensity and Phase Modulators at 1.55 μm with InAs/InGaAs Quantum Dots Epitaxially Grown on Silicon, Prashanth Bhasker[1], Justin Norman[1], John Bowers[1], Nadir Dagli[1]; [1]*Univ. of California Santa Barbara, USA.* InAs quantum dot core electro-optic modulators are fabricated on (100) silicon substrates opening up large-scale III-V photonic integration. Mach-Zehnder modulator with 8 mm long electrode has 2.2V Vpi and less than 3 dB/cm propagation loss.

Th2K • Imaging Technologies—Continued

Th2K.3 • 11:30 Invited

Time-stretch Imaging and Beyond, Cheng Lei[1], Yasuyuki Ozeki[1], Keisuke Goda[1]; [1]*Univ. of Tokyo, Japan.* Optofluidic time-stretch imaging has been widely studied and applied for its capability to acquire high-quality images at high speed. Here, we present recent advances and trends in its applications to biomedical research and treatment.

Th2L • Distributed Fiber Sensing—Continued

Th2L.3 • 11:30

Improvement of Brillouin Frequency Shift Estimation Accuracy in BOTDR Using Cross Correlation with Reference Spectrum Tracking, Wei Yang[1,2], Yuanhong Yang[3]; [1]*China Academy of Electronics and Information Technology, China;* [2]*CETC Research Center for Development and Strategy, China;* [3]*School of Instrumentation Science and Opto-electronics Engineering, Beihang Univ., China.* We propose an approach using cross correlation with reference spectrum tracking to improve Brillouin frequency shift estimation accuracy in BOTDR by studying the influence factor on cross-correlated spectrum symmetry. Simulations and experiments verify its advantage.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th2A • Novel Laser Sources II—Continued

Th2A.5 • 11:45
Generation and manipulation of polarization dependent sidebands in a fiber parametric oscillator, Kangwen Yang[1], Peng Zhao[1], Pengbo Ye[1], Qiang Hao[1], Kun Huang[1], Heping Zeng[1]; [1]*Univ of Shanghai Science & Technology, China.* A tunable fiber optical parametric oscillator was demonstrated to generate and control of scalar and cross-phase modulation instabilities at 779-793 nm and 864-978 nm respectively, which could be used in coherent anti-Stokes Raman spectroscopy.

Th2A.6 • 12:00
A compact and robust polarization-maintain fiber laser with a locked repetition rate, Zhiwei Zhu[1], Zejiang Deng[1], Chao Wang[1], Chenglin Gu[1], Yang Liu[1], Daping Luo[1], Wenxue Li[1]; [1]*East China Normal Univ., China.* A compact and robust mode-locked fiber laser with a locked repetition rate is demonstrated in a polarization-maintain fiber ring cavity. The repetition rate is locked at 108 MHz and the standard deviation of the controlled signal is 0.997 mHz in a 10-hours test.

Th2A.7 • 12:15
Designs of Nanostructured Materials made by Glancing Angle Deposition for Improved Spectral Brightness of Solid-State Lasers, Koffi Amouzou[1], Jean-Francois Bisson[1], Gabriel Gallant[1], Kris Bulmer[1], Georges Bader[1]; [1]*Universite de Moncton, Canada.* We present two types of nanostructured laser mirrors designed for suppressing spatial hole burning. They were made with GLancing Angle Physical vapor deposition. First, helically-nanostructured materials. Second, thick anisotropic coatings behaving as halfwave plates.

Th2B • Solitons and Temporal Wave Guiding, and Frequency Comb—Continued

Th2B.5 • 11:45
Dispersion and nonlinearity jointly engineered silicon waveguide taper for self-similar parabolic pulse propagation, Chao Mei[1,2], Feng Li[2], Jinhui Yuan[1,2], Zhe Kang[2], Xianting Zhang[2], Yin Xu[2], Binbin Yan[1], xinzhu sang[1], Kuiru Wang[1], Chongxiu Yu[1], Ping Kong A. Wai[2]; [1]*Beijing Univ of Posts & Telecom, China;* [2]*The Hong Kong Polytechnic Univ., Hong Kong.* We analytically investigate the condition of passive self-similar propagation for parabolic pulse. Based on the derived condition, a dispersion and nonlinearity jointly engineered silicon waveguide taper for the parabolic similariton propagation is designed and analyzed.

Th2B.6 • 12:00
Mid-infrared Optical Frequency Comb via Coherent Supercontinuum Processes in Nano-photonic Waveguides, Hairun Guo[1], Wenle Weng[1], Martin H. Pfeiffer[1], Tobias J. Kippenberg[1]; [1]*École polytechnique fédérale de Lausanne, Switzerland.* We demonstrated mid-infrared optical frequency comb generation via coherent supercontinuum generation process, in a large-cross-section silicon nitride nano-photonic waveguide. We experimentally assessed the coherence of the mid-infrared dispersive wave that serves as the frequency comb.

Th2B.7 • 12:15
Investigation of semiconductor optical amplifier gain recovery through dual-comb asynchronous optical sampling, Ningning Yang[1], Liao Chen[1], Haidong Zhou[1], Xi Zhou[1], Xin Dong[1], Chi Zhang[1], Xinliang Zhang[1]; [1]*Wuhan National Lab for Optoelectronics,, China.* We perform a novel pump-probe scheme based on dual-comb asynchronous optical sampling (ASOPS) with 10.86-ns observation range, 2-ps temporal resolution and 1-kHz frame rate, and investigate the semiconductor optical amplifier (SOA) gain recovery process.

Th2C • Integrated Optical Devices for Switching Multiplexing and Signal Processing—Continued

Th2C.3 • 11:45
A Silicon Photonic Optical Add-Drop Multiplexer based on Mode-Selective Device and Bragg Grating, Zifei Wang[1], Bruno Taglietti[1], Ming Ma[1], Lawrence R. Chen[1]; [1]*McGill Univ., Canada.* We demonstrate a compact add-drop multiplexer using Bragg grating in a mode-selective device for the silicon-on-insulator (SOI) platform. The proposed design has crosstalk lower than -42 dB within the 3 dB bandwidth of 1.6 nm.

Th2C.4 • 12:00 Invited
Silicon Integrated Devices for On-chip Mode Multiplexing, Yaocheng Shi[1], Hongnan Xu[1]; [1]*Zhejiang Univ., China.* On-chip multi-mode communication has attracted much attention for its potential to greatly expand the bandwidth of data transmission. In this paper, we will introduce some silicon integrated devices for on-chip mode multiplxing, including the multiplexers, multimode crossing and the multimode bending.

Th2D • High Energy Laser—Continued

Th2D.4 • 11:45
Impact of disk laser geometry on excess nonlinear heat release, Mikhail R. Volkov[1], Ivan Kuznetsov[1], Ivan Mukhin[1]; [1]*Inst. of Applied Physics of the RAS, Russia.* Disk active elements of various doping and geometry are investigated for heat sources and lasing. Yb:YAG of 10% doping has strong overheating under high excitation level. The phenomenon is most severe for thin disk, while composite disk shows much less overheating. The latter case shows less lasing efficiency but better small-signal gain.

Th2D.5 • 12:00
Mode Instability in Yb:YAG Crystalline Fiber Amplifiers, Shicheng Zhu[1,2], Jinyan Li[2], Xiuquan Ma[1]; [1]*School of Mechanical Science and Engineering, Huazhong Univ. of Science and Technology, China;* [2]*Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, China.* Mode instability (MI) in Yb:YAG crystal fiber amplifiers is investigated through full numerical simulations. The MI threshold in a 50/250 Yb:YAG crystalline fiber is found to be greater than 10kW.

Th2E • Special Fibers II—Continued

Th2E.4 • 11:45
High resolution imaging microstructured optical fibres, Stephen C. Warren-Smith[1], Alastair Dowler[1], Hoa Huynh[1], Heike Ebendorff-Heidepriem[1]; [1]*Univ. of Adelaide, Australia.* We show that an imaging fibre with a pixel pitch of 2 μm is theoretically achievable using silica-based microstructured fibres. Preliminary fabrication results are presented using extrusion of glass through 3D printed titanium dies.

Th2E.5 • 12:00
Single-polarization single-mode double-layer hollow-core antiresonant fiber, Shibo Yan[1], Shuqin Lou[1], Xin Wang[1], Zhen Xing[1]; [1]*Beijing Jiaotong Univ., China.* A single-polarization single-mode double-layer hollow-core antiresonant fiber with two single-polarization regions (1545-1552 and 1591-1596 nm) is proposed. The polarization extinction ratio is 14155 awhile the loss of x-polarized is 0.036 dB/m at 1550 nm.

Th2F • Plasmonics Metasurfaces—Continued

Th2F.5 • 11:45 Invited
High-efficiency, Multifunctional and Tunable Metasurfaces, Lei Zhou[1]; [1]*Fudan Univ., China.* Metasurfaces, ultrathin metamaterials composed by array of planar "meta-atoms" with pre-designed electromagnetic (EM) properties, have attracted extensive attention recently. In this talk, I will summarize our recent efforts in this field, focusing on the tunability, efficiency, and multifunctionality issues of them.

Th2F.6 • 12:15 Tutorial
Soft Metamaterials: Self-Gauged Assembly, Non-Equilibrium Matters, and 3D Super-Resolution Imaging; Xiang Zhang[1]; [1]*Univ. of Hong Kong, Hong Kong.* We explore "soft metamaterials" with building blocks that have a strong propensity for self-assembly/re-assembly. In this regards, the structure units can be artificially evolving during the formation of soft metamaterials. Particularly, we explore the self-feedback mechanism between structures and properties for self-selective assembly of complex metamaterial nanoarchitectures with tailored symmetries. We expand structural design using soft metamaterial approach to achieve isotropic negative index metamaterials and Brownian optical imaging. We also explore approach for realizing bandgap materials that reside far from equilibrium and emerge enslaved to an external drive. Experimental results are providing supports as well as new insights into such new type of soft metamaterials that facilitate self-responsive material applications.

12:30–14:00 Lunch

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th2G • 2D Materials for Mode Locking and Nonlinear Photonics—Continued

Th2G.4 • 12:00
Enhanced third-order optical nonlinearity of flexibly synthesized h-BN film via localized laser oxidation, Ren Jun[1,2], Xiaorui Zheng[2], Weiwei Lei[3], Dan Liu[3], Pu Wang[1], Baohua Jia[2]; [1]*Beijing Univ. of Technology, China;* [2]*Swinburne Univ. of Technology, Australia;* [3]*Deakin Univ., Australia*. Hexagonal boron nitride film was achieved using ball-milled exfoliation and functionalization method for high concentration solution. Enhanced third-order nonlinearity was investigated during interaction with high intensity laser source owing to the formation of oxidization group.

Th2H • Light-matter Interactions in Micro/nano-structures—Continued

Th2H.5 • 11:45
Enhancing the Stability and Emission of $CsPbBr_3$ Quantum Dots by Embedding in Silica Spheres, Zhengzheng Liu[1], Zhiping Hu[2], Xiaosheng Tang[2], Juan Du[1], Yuxin Leng[1]; [1]*Shanghai Inst of Optics and Fine Mech, China;* [2]*Chongqing Univ., China*. Enhanced amplified spontaneous emission has been obtained from perovskite $CsPbBr_3$ quantum dots embedded in waterless silica spheres. The blinking characteristic of $CsPbBr_3/SiO_2$ has been suppressed and photostability has been improved significantly.

Th2H.6 • 12:00
Flexible Dielectric Microsphere-Embedded Film for Enhanced-Raman Spectroscopy, Cheng Xing[1], Yinzhou Yan[1], Yijian Jiang[1]; [1]*Beijing Univ. of Technology, China*. A dielectric microsphere-embedded film was developed as a flexible Raman enhancer, which provides a >10-fold enhancement ratio and can be coupled with traditional SERS active substrates for ultrasensitive Raman trace-detection.

Th2H.7 • 12:15
Narrow-linewidth Lasing and Kerr Soliton Comb with a Regular Laser Diode, Nikolay G. Pavlov[3,2], Grigory Lihachev[1,2], Andrey Voloshin[2], Sergey Koptyaev[4], Michael L. Gorodetsky[1,2]; [1]*Lomonosov Moscow State Univ., Russia;* [2]*Russian Quantum Center, Russia;* [3]*Moscow Inst. of Physics and Technology, Russia;* [4]*Samsung R&D Inst. Russia, Russia*. We demonstrate single-frequency lasing with ultra-narrow linewidth and coherent soliton comb generation from a regular multi-frequency Fabry-Perot laser diode to self-injection locked to an optical crystalline high-Q microresonator.

Th2I • Polarization Effects and Optical Networking—Continued

Th2I.6 • 11:45
Non-Equal Granularity Light-Tree based Multicast Flow Aggregation Scheme in Elastic Optical Datacenter Networks, Xin Li[1], Ying Tang[1], Tao Gao[1], Lu Zhang[1], Shanguo Huang[1]; [1]*State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ of Posts & Telecom, China*. A non-equal granularity light-tree (NeGLt) which supports the user-desired spectrum allocation is designed for multicast flow aggregation (MFA) scheme. Simulations show that NeGLt-MFA can greatly reduce spectrum consumption and has an extensive application scope.

Th2I.7 • 12:00
Routing Algorithm Based on DTN Protocols for Free-Space Optical MANET, Yufei Luo[1], Zhan Gao[1], Anhong Dang[1]; [1]*Peking Univ., China*. Optical mobile ad-hoc networks suffer from the atmospheric turbulence. A new kind of routing algorithm based on disruption-tolerant network protocols is proposed. The proposed scheme improves the delivery ratio by 40% in severe network environment.

Th2I.8 • 12:15
Using Multi-Layer Perceptron to Estimate the OSNR of Unestablished Lightpaths, Dong Fu[1], Min Zhang[1], Bo Xu[1], Baojian Wu[1], Kun Qiu[1]; [1]*Univ of Electronic Science & Tech China, China*. We investigate a multi-layer perceptron framework to predict the OSNR of unestablished lightpaths considering interference effects and optical monitoring uncertainties. It achieves more than 99% accuracies when the errors are less than 0.5 dB.

Th2J • Advanced Modulators—Continued

Th2J.4 • 11:45
Mach-Zehnder Modulators Based on Hybrid Silicon and Lithium Niobate Platform, mingbo he[1], Xinlun Cai[1]; [1]*Sun Yat-Sen Univ., China*. We design and demonstrate a silicon and LN hybridly integrated Mach-Zehnder interferometer modulators. The fabricated devices show a half-wave electro-optic modulation efficiency of 2.25V.cm and data rates up to 5Gbps.

Th2J.5 • 12:00
Analysis of Ultra-High Speed Mach-Zehnder Hybrid Polymer/Sol-Gel Waveguide Modulators, Yasufumi Enami[1,2], Atsushi Seki[3], Shin Masuda[4], Jingdong Luo[4], Alex Jen[4,5]; [1]*Kochi Univ. of Technology, Japan;* [2]*College of Optical Sciences, Univ. of Arizona, USA;* [3]*Advantest Laboratory, Japan;* [4]*Chemistry, City Univ. of Hong Kong, Hong Kong;* [5]*Material Science and Enigineering, Univ. of Washington, USA*. The bandwidth of >130 GHz for the hybrid modulators is calculated numerically and analytically based on experimentally obtained device parameters. The measured reduction of electro-optic response is 1.5 dB at a frequency of 67 GHz for the modulator with the electrode length of 5 mm.

Th2J.6 • 12:15
Unified Design Scenarios on Broadband Modulators and Polarizers with Graphene-Hybrid Silicon Waveguides, Yuan Meng[1], Shengwei Ye[2], Yijie Shen[1], Futai Hu[1], Rongguo Lu[2], Yong Liu[2], Mali Gong[1]; [1]*State Key Laboratory of Precision Measurement Technology and Instruments, Dept. of Precision Instrument, Tsinghua Univ., China;* [2]*State Key Laboratory of Electronic Thin Films and Integrated Devices, School of Optoelectronic Information, Univ. of Electronic Science and Technology of China, China*. A comprehensive analysis with unified design scenarios upon graphene-laminated silicon waveguides is presented. By judiciously designing effective mode index, versatile device functionalities can be achieved. A broadband polarization-independent amplitude modulator is also demonstrated.

Th2K • Imaging Technologies—Continued

Th2K.4 • 12:00 Invited
Multispectral Imaging Based on Random Dispersion Structures and Conversion Materials, Tao Yang[1], Qing-feng Geng[1], Xiao Shen[1], Xing-ao Li[1], Wei Huang[1], Ho-pui Ho[2]; [1]*Nanjing Univ of Posts & Telecomm, China;* [2]*Dept. of Biomedical Engineering, The Chinese Univ. of Hong Kong, Hong Kong*. Spatiospectral response of random dispersion structures is used for the retrieval of 400 wavelengths over an infrared spectral range 1530-1570 nm. Transmission spectra of 4 FBGs are reconstructed with a monochromatic CCD.

Th2L • Distributed Fiber Sensing—Continued

Th2L.4 • 11:45
Processing Differential Brillouin Gain Spectrum by Support Vector Machine in DPP-BOTDA, Huan Wu[1], Liang Wang[1], zhiyong zhao[2], Nan Guo[2], Chester C.T. Shu[1], Chao Lu[2]; [1]*The Chinese Univ. of Hong Kong, Hong Kong;* [2]*The Hong Kong Polytechnic Univ., Hong Kong*. SVM has been applied to successfully extract temperature from differential BGSs in DPP-BOTDA of different spatial resolution. Compared with LCF, SVM has better performance under high spatial resolution and low SNR with shorter processing time.

Th2L.5 • 12:00
Distributed Stress Measurement in Polarization-Maintaining Fiber Based on Polarization-OTDR, Zejia Huang[1], Chongqing Wu[1], Zhi Wang[1], Jian Wang[1], Lanlan Liu[1]; [1]*Beijing Jiaotong Univ., China*. A novel scheme based on polarization-sensitive optical time-domain reflectometry (P-OTDR) for distributed stress measurement in polarization-maintaining fiber (PMF) is proposed with spatial resolution of 1 meter and positioning accuracy of 0.5 meter.

Th2L.6 • 12:15
Measuring Very Low Frequency with Phase-OTDR assisted by an Auxiliary Interferometer, Feng Wang[1], Quan Yuan[1], Tao Liu[1], Xuping Zhang[1]; [1]*College of Engineering and Applied Sciences, Nanjing Univ., China*. A phase-OTDR assisted by an auxiliary interferometer is proposed. The minimum detectable frequency can reach to 0.1 Hz on a 5 km sensing fiber with 10 m spatial resolution.

12:30–14:00 Lunch

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

14:00–15:30
Th3A • Vectorial Light Sources
Presider: Jiajing Tu; Univ. of Science & Technology Beijing, China

Th3A.1 • 14:00 Invited
Square-wave Dynamics in the Er:Yb-doped Double-clad Fiber Laser, yichang meng[1,2], Georges Semaan[1], Fatma Benbraham[1,4], Meriem Kemel[1], Mohamed Salhi[1], Andrey Komarov[3], Francois . Sanchez[1]; [1]*Universite d'Angers, France;* [2]*School of Sciences, Hebei Univ. of Science and Technology, China;* [3]*Russian Academy of Sciences, Russia;* [4]*Université de Carthage, Tunisia.* We have experimentally demonstrated dissipative soliton resonance (DSR) in double-clad Er:Yb-doped fiber lasers with dual amplifier figure-of-eight and ring cavity. In anomalous dispersion regime, different features of DSR are demonstrated.

Th3A.2 • 14:30
Low threshold tunable 2 μm optical vortex laser source, Roukuya Mamuti[1], Shungo Araki[1], Katsuhiko Miyamoto[1,2], Takashige Omatsu[1,2]; [1]*Chiba Univ., Japan;* [2]*Molecular chirality research center, Chiba Univ., Japan.* We report on a tunable 2 μm optical vortex laser source formed of a periodically poled stoichiometric lithium tantalite (PPSLT) optical parametric oscillator with a singly-resonant cavity configuration. A milli-joule level vortex output was generated at a low lasing threshold (1.2 mJ), with its wavelength being tuned within a range of 1.85-2.03 μm.

14:00–15:30
Th3B • High-field Technologies
Presider: Dangyuan Lei; The Hong Kong Polytechnic Univ., Hong Kong

Th3B.1 • 14:00 Invited
Short-scale Photon-phonon Interactions, Birgit Stiller[1], Moritz Merklein[1], Benjamin Eggleton[1]; [1]*Univ. of Sydney, Australia.* Using photon-phonon interactions, we experimentally demonstrate the storage of 200ps-long optical pulses for over 70 pulse widths. We moreover show that this concept is suitable for the non-reciprocal storage at multiple optical wavelengths.

Th3B.2 • 14:30
Relativistic high-order harmonic generation from laser plasmas using few-cycle laser pulses, Guangjin Ma[1,2], Dmitrii Kormin[3], Chunlai Li[2], Zhiping Zhou[1], Jin He[1,2], Laszlo Veisz[3,4]; [1]*School of Electronics Engineering and Computer Science, Peking Univ., China;* [2]*Shenzhen SoC Key Laboratory, PKU-HKUST Shenzhen-Hong Kong Institution, China;* [3]*Max-Planck-Institut fuer Quantenoptik, Germany;* [4]*Dept. of Physics, Umea Univ., Sweden.* We investigate relativistic high-order harmonic generation from intense few-cycle laser and plasma interactions via particle-in-cell simulations. Differences of spectral and temporal structures in XUV beam resulted from few-cycle and non-few-cycle driver pulses are compared.

14:00–15:30
Th3C • Germinum Modulators and Ge Photonics
Presider: Linjie Zhou; Shanghai Jiao Tong Univ., China

Th3C.1 • 14:00
High-contrast quantum-confined Stark effect in Ge/SiGe quantum well stacks on Si with ultra-thin buffer layers, Srinivasan Ashwyn Srinivasan[1,2], Clement Porret[1], Ewoud Vissers[1], Pieter Geiregat[2], Dries VanThourhout[1,2], Roger Loo[1], Marianna Pantouvaki[1], Joris Van Campenhout[1]; [1]*imec, Belgium;* [2]*Univ. of Ghent, Belgium.* Quantum-confined Stark effect with a record absorption contrast of 2.5 for 1V swing is demonstrated in Ge/GeSi quantum well stacks grown on Si using ultra-thin buffer layers, targeting future integration in a silicon photonics platform.

Th3C.2 • 14:15
56 Gb/s Si/GeSi Optical Modulator, Lorenzo Mastronardi[1], Mehdi Banakar[1], Ali Khokhar[1], Nannicha Hattasan[1], Teerapat Rutirawut[1], Thalia Domínguez Bucio[1], Kasia Grabska[1], Callum Littlejohns[1,2], Alexandre Bazin[1], Goran Mashanovich[1], Frederic Gardes[1]; [1]*Univ. of Southampton, UK;* [2]*Silicon Technologies Centre of Excellence, NTU, Singapore.* We present experimental measurements of an EAM modulator developed on an 800 nm SOI platform. Measurements show a dynamic ER of 5.2 dB at 56 Gb/s at 1566 nm and power consumption of 44 fJ/bit.

Th3C.3 • 14:30
Optical Waveguides by Germanium Ion Implantation on Silicon-on-Insulator Platform, Xia Chen[1], Milan M. Milosevic[1], Ali Khokhar[1], David Thomson[1], Graham Reed[1]; [1]*Univ. of Southampton, UK.* We demonstrated a new type of integrated photonic waveguides formed by Ge ion implantation in the silicon slab on silicon-on-insulator platform. They were successfully fabricated and characterised, and can be potentially erased by laser annealing.

14:00–15:30
Th3D • Power Scaling and Plasmonics
Presider: Sui Zhan; China Academy of Engineering Physics, China

Th3D.1 • 14:00
Detection of histamine using molecular imprinted hydrogel coated SPR based fiber optic probe, Vivek Semwal[1], Banshi D. Gupta[1]; [1]*Indian Inst. of Technology, Delhi, India.* In the present study, we report a surface plasmon resonance based fiber optic sensor for histamine detection utilizing molecular imprinted hydrogel as a sensing layer. The sensor works in the range 1-10 μM histamine concentration.

Th3D.2 • 14:15
Potassium ion-selective SPR sensor based on GO-chitosan nanocomposite for agriculture application, Banshi D. Gupta[1], Anisha Pathak[1], Vivek Semwal[1]; [1]*Indian Inst. of Technology, Delhi, India.* Fabrication and characterization of a fiber optic potassium ion sensor based on surface plasmon resonance using 18-crown-6 doped GO-chitosan nanocomposite have been carried out for soil nutrients. The sensor operates in the range 0-200 μM.

Th3D.3 • 14:30
Preparation Progress of Low-NA Yb Doped Large Mode Area Silica Fiber Origin From Sol-Gel Method, Chunlei Yu[1]; [1]*Shanghai Inst of Optics & Fine Mechanics, China.* The progress of Low refractive index Yb doped silica core glass origin from sol-gel method and the application on LMA PCF fiber is introduced.

14:00–15:30
Th3E • Waveguide Devices II
Presider: Xin Gai; City Univ. of Hong Kong, Hong Kong SAR

Th3E.1 • 14:00 Invited
UWB Signal Processing Based on Silicon Photonic Integrated Circuits, Ke Xu[1]; [1]*College of Chemistry, Univ. of California Berkeley, USA.* Abstract not available.

Th3E.2 • 14:30 Invited
Detailed characterization of free-carrier generation and recombination in silicon nano-waveguides, Paulo C. Dainese[1]; [1]*Univ. of Campinas, Brazil.* We review recent results on free-carrier dynamics in silicon nanowaveguides. Linear and nonlinear generation rates are accurately characterized, while the recombination dynamics is observed to be dominated by a trap-assisted mechanism.

14:00–15:30
Th3F • Integrated Microwave Photonics II
Presider: Guillermo Carpintero; Universidad Carlos III de Madrid, Spain

Th3F.1 • 14:00 Invited
An Integrated Optoelectronic Oscillator, Ming Li[1]; [1]*Inst. of Semiconductor, CAS, China.* In this paper, we proposed and experimentally demonstrate a novel integrated OEO, in which the optical parts are manufactured using a monolithically integrated InP technology platform and the electrical part assembles on a single PCB.

Th3F.2 • 14:30 Invited
Chip-based Reconfigurable Microwave Photonic Filter and Time Delay Line, Simin Li[1], Jing Feng[1], Shilong Pan[1]; [1]*Nanjing Univ. Aeronaut. Astronaut., China.* We propose an approach to realize a reconfigurable microwave photonic filter and time delay line using a single optical micro-ring resonator (MMR). Based on the multi-wavelength single sideband modulation, the MMR responses are mapping to microwave frequency with tunable center frequency and magnitude.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

14:00–15:30
Th3G • Structured 2D Surfaces
Presider: Arno Rauschenbeutel, Humboldt-Universitat zu Berlin, Germany

Th3G.1 • 14:00 Tutorial
Ultrathin Structured 2D Surfaces: Hybridizing 2D Materials & Metasurfaces, Chengwei Qiu[1]; [1]*National Univ. of Singapore, Singapore.* Interfacial engineering via artificially constructed nanostructures hold great potentials for advanced light-matter interactions. I will discuss the fundamental and emerging results for meta-photonic devices by hybridizing metasurfaces and 2D materials.

14:00–15:30
Th3H • Entanglement and Squeezed States I
Presider: Jin-Shi Xu; Univ of Science and Technology of China, China

Th3H.1 • 14:00 Invited
Engineering Narrowband Biphotons, Shengwang Du[1]; [1]*Hong Kong Univ of Science & Technology, Hong Kong.* We describe quantum state engineering of narrowband biphotons in diverse degrees of freedom, including time frequency, polarization, and position momentum. These biphotons are produced from spontaneous four-wave mixing in atomic ensembles.

Th3H.2 • 14:30
Periodic suppression and enhancement of spontaneous two-photon emission via interference, Dong-Gil Im[1], Yosep Kim[1], Yoon-Ho Kim[1]; [1]*Dept. of physics, POSTECH, Korea.* We demonstrate that an effective boundary condition can be introduced to spontaneous two-photon emission by making use of a continuous-wave multi-mode pump. This effect results in periodic suppression and enhancement of spontaneous two-photon emission via interference over the pump coherence length.

14:00–15:30
Th3I • Signal Processing for Optical Transmsison
Presider: Jian Zhao; South China Univ. of Technology, China

Th3I.1 • 14:00
Performance improvement of ACO-OFDM system using OCT precoding combined with digital peak-clipping, Siyi Dong[1], J He[1], Ming Chen[2], Qinghui Chen[1], Rui Deng[1], Jie Ma[1], Lin Chen[1]; [1]*Hunan Univ., China;* [2]*Hunan Normal Univ., China.* Orthogonal circulant matrix transform precoding (OCT) combined with peak-clipping based PAPR reduction technique is firstly proposed for ACO-OFDM system and experimentally demonstrated in an IM/DD system with a cost-efficient directly modulated laser.

Th3I.2 • 14:15
Enhanced LDPC based differential iteration decoding Scheme for PDM 16-QAM Coherent Optical Communication Systems, Wenxiang Cao[1], J He[1], Zhihua Zhou[1]; [1]*Hunan Univ., China.* An enhanced LDPC based differential iteration decoding scheme is applied in 400-Gb/s PDM 16-QAM coherent optical communication systems. The simulation results show that, the system performance can be greatly improved by using the proposed method.

Th3I.3 • 14:30
Performance of Opto-Electronic Phase Conjugation in Intensity-Modulated Signal Transmission Systems, Masayuki Matsumoto[1], Shinogu Takeda[1]; [1]*Wakayama Univ., Japan.* Spectral inversion of intensity-modulated signals by an opto-electronic phase conjugator is demonstrated. It is shown that broad-linewidth (30MHz) DFB laser can be used as the local oscillator (LO) and frequency difference between the signal and LO as large as 14GHz is tolerated.

14:00–15:30
Th3J • 2D and Metamaterial
Presider: Howard Lee; Baylor Univ., USA

Th3J.1 • 14:00 Invited
Mid-infrared Optoelectronics in 2D Materials, Qijie Wang[1], Xuechao Yu[1], Alexander Dubrovkin[1]; [1]*Nanyang Technological Univ., Singapore.* In this talk, I am going to present our recent research in applying 2D materials for applications in the mid-infrared regime, such as room temperature broadband 2D material based photodetectors and ultraconfined phonon polariton devices.

Th3J.2 • 14:30 Invited
Integration and Nonlinearity of 2D Materials with Silica Microfibers, Fei Xu[1]; [1]*Nanjing Univ., China.* We will show several kinds of two-dimensional-material-microfiber-integrated devices and the optoelectronic and nonlinear applications (e.g., second harmonic generation and detector) will also be discussed.

14:00–15:30
Th3K • Microscopy
Presider: Chao Zuo; Nanjing Univ of Science and Technology, China

Th3K.1 • 14:00 Invited
Recent Technology Development in Optical Diffraction Tomography for 3D Cell Imaging, Renjie Zhou[1]; [1]*The Chinese Univ. of Hong Kong, Hong Kong.* Optical diffraction tomography (ODT) is becoming an important cell imaging tool. To enable more biomedical imaging applications, we are recently developing more advanced ODT systems that have high imaging speed as well as depth selectivity.

Th3K.2 • 14:30
Probing and Imaging Vectorial Optical Field by Heterodyne Near-field Microscopy and Nanopolarimetry, Benfeng Bai[1], Lin Sun[1], Tong Cui[1], Jia Wang[1]; [1]*Tsinghua Univ., China.* We report near-field microscopic theory and methods that employ heterodyne technique and nanopolarimetry for probing and imaging vectorial features of optical field in nanostructures, including the spin-orbit interaction and magnetic field component of optical field.

14:00–15:30
Th3L • Novel Fiber Structures
Presider: Guiyao Zhou; South China Normal Univ., China

Th3L.1 • 14:00 Invited
A Novel Structure of Microfiber-based Sensor for Onsite/in-situ Detection of Heavy Metal Ions, Xuping Zhang[1], Wenbin Ji[1], Stephanie H. Yap[2], Guanghui Wang[1], Yi Xin Zhang[1], Ken Tye Yong[2], Sweechuan tjin[2]; [1]*Nanjing Univ., China;* [2]*Nanyang Technological Univ., Singapore.* We propose a novel sensing structure for onsite/in-situ detection of heavy metal ions based on a non-adiabatic microfiber sandwiched by two fiber Bragg gratings (FBG). The surface of the microfiber is functionalized with chelating agent.

Th3L.2 • 14:30
Relative Humidity Measurement Based On Micro Fiber with Quantum Dot gel coating, Siqi Hu[1], Guofeng Yan[2], Chunzhou Wu[1], Sailing He[1]; [1]*Zhejiang Univ., China;* [2]*Zhejiang Lab, China.* A optical fiber relative humidity sensor based on a microfiber with quantum dot gel coating was proposed and experimentally demonstrated. The RH Sensitivity of 37.7 /%RH was obtained with good repeatability.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th3A • Vectorial Light Sources—Continued

Th3A.3 • 14:45
Tunable repetition rate mode-locked all-fiber laser with cylindrical-vector beams output, Ruishan Chen[1], Junna Yao[1], Fangling Sun[1], Jinghao Wang[1], Anting Wang[1], Hai Ming[1]; [1]*Dept. of Optics and Optical Engineering, Univ of Sci & Tech of China, China.* We propose and demonstrate a mode-locked all-fiber cylindrical-vector beam (CVB) laser with high efficiency and tunable repetition rate. By controlling the intra-cavity polarization states, both azimuthally polarized and radially polarized beams are selectively obtained under harmonic mode-locking (HML) states.

Th3A.4 • 15:00
All-fiber actively Q-switched cylindrical vector beam laser based on a mode selective coupler, Tiantian Ruan[1], Hongdan Wan[1], Jie Wang[1], Zuxing Zhang[1], Lin Zhang[1]; [1]*Nanjing Univ. of Posts&telecomm, China.* High purity, pulsed cylindrical vector beams (CVBs) can be generated by using a mode selective coupler (MSC) as the transverse mode converter and mode splitter in an all-fiber actively Q-switched fiber laser

Th3A.5 • 15:15
Power- and Frequency-Scalable Modulation of the Optical Orbital Angular Momentum, Jean-Francois Bisson[1], Katsuhiko Miyamoto[2], Takashige Omatsu[2]; [1]*Universite de Moncton, Canada;* [2]*Graduate school of Engineering, Chiba Univ., Japan.* We present a device that can modulate the orbital angular momentum (AOM) of a laser beam. The proposed design can be scaled up to several GHz using existing commercial devices.

Th3B • High-field Technologies—Continued

Th3B.3 • 14:45
Spatiotemporal analysis of XUV pulse generaion in gas HHG, Lifeng Wang[1], Hao Li[1], Ying Zhang[1]; [1]*SIMTech, Singapore.* We numerically analysis spatiotemporal profile of HHG. A detailed physical picture of HHG over four-dimensional spatiotemporal spaces is studied for the first time, which may benefit potential applications like super-resolution XUV imaging, XUV tweezer.

Th3B.4 • 15:00
Phase-matched soft x-ray high-order harmonics driven by loosely focused TW femtosecond infrared pulses, Kotaro Nishimura[1,2], Yuxi Fu[1], Akira Suda[2], Katsumi Midorikawa[1], Eiji J. Takahashi[1]; [1]*Attosecond Science Research Team, RIKEN Center for Advanced Photonics, Japan;* [2]*Dept. of Physics, Tokyo Univ. of Science, Japan.* We generate high-flux soft x-ray phase-matched high-order harmonics driven by loosely focused 80-mJ, 45-fs, 1.55-μm infrared pulses. The maximum harmonic photon energies attained are 270 and 350 eV in Ne and He, respectively.

Th3B.5 • 15:15
Controlled HHG with a Sub-Cycle mJ-Level Parametric Waveform Synthesizer, Roland E. Mainz[1,2], Yudong Yang[1,2], Giulio Maria Rossi[1,2], Fabian Scheiba[1,2], Giovanni Cirmi[1,2], Franz Kaertner[1,2]; [1]*Center for Free-Electron Laser Science, Germany;* [2]*Physics Dept. and CUI, The Hamburg Centre for Ultrafast Imaging, Germany.* We present high-harmonic generation (HHG) driven with a sub-cycle mJ-level parametric waveform synthesizer. The HHG yield and spectral shape can be controlled by varying the carrier-envelope phase and the relative phase in the synthesizer channels.

Th3C • Germinum Modulators and Ge Photonics—Continued

Th3C.4 • 14:45 Invited
Mid-infrared Germanium Photonic Integrated Circuits for on-chip Biochemical Sensing, Zhenzhou Cheng[1], Ting-Hui Xiao[1], Ziqiang Zhao[1], Wen Zhou[2], Mitsuru Takenaka[1], Hon K. Tsang[2], Keisuke Goda[1]; [1]*The Univ. of Tokyo, Japan;* [2]*The Chinese Univ. of Hong Kong, Hong Kong.* We report our recent progress on mid-infrared germanium photonic integrated circuits. Specifically, a suspended-membrane waveguide, focusing subwavelength grating coupler, microring resonator, and photonic crystal nanocavities are demonstrated based on a germanium-on-insulator wafer.

Th3C.5 • 15:15
Mid-Infrared Photonic Technology on Silicon-on-Insulator (SOI) Platform, Hong Wang[1]; [1]*Nanyang Technological Univ., Singapore.* Development of Si-photonic devices covering the MIR range based on SOI platform is reported. A new Ge-on-silicon nitride platform for the applications beyond the wavelength of 3.8 um will also be discussed.

Th3D • Power Scaling and Plasmonics—Continued

Th3D.4 • 14:45
High power all-fiberized oscillator based on tapered fiber, Hanwei Zhang[1], Baolai Yang[1], Xiaolin Wang[1], Chen Shi[1], Pu Zhou[1], Xiaojun Xu[1]; [1]*National Univ. of Defense Technology, China.* In this letter, we demonstrate a high power all-fiberized, tapered Yb-doped fiber based oscillator for the first time. The output laser is more than 260 W with fundamental mode operation and further power increasing is possible.

Th3D.5 • 15:00 Invited
High Power Mid-infrared Supercontinuum Sources: Current Status and Future Perspectives, Deepak Jain[1], Ole Bang[1,2]; [1]*DTU Fotonik, Denmark;* [2]*NKT Photonics, Denmark.* Mid-infrared fiber based supercontinuum sources have great potential for several applications. This paper reviews their current status of power scaling and discusses the challenges and future development in power scaling.

Th3E • Waveguide Devices II—Continued

Th3E.3 • 15:00
Multi-Photon Fabrication of Ultra-compact Optical Waveguides in Polydimethylsiloxane, Ye Pu[1], Giulia Panusa[1], Jieping Wang[1], Christophe Moser[1], Demetri Psaltis[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* We demonstrate the fabrication of ultra-compact, low-loss optical waveguides in polydimethylsiloxane through multiphoton polymerization, without a photoinitiator, using laser direct writing. The transmission loss was measured 0.03 dB/cm in the 650-700 nm band.

Th3E.4 • 15:15
Depressed circular cladding waveguide lasers in Nd:YAG crystal inscribed by femtosecond laser, Shi-Ling Li[1]; [1]*Qufu Normal Univ., China.* Depressed cladding waveguides were fabricated in Nd:YAG crystals with a loss of 0.40 dB/cm. They showed laser operation at 1064 nm. Multi- and single-modes waveguide lasers were realized. A slope efficiency of 32.6% was obtained.

Th3F • Integrated Microwave Photonics II—Continued

Th3F.3 • 15:00
Integrated Kerr optical frequency comb-based broadband RF channelizer, Xingyuan Xu[1], Jiayang Wu[1], Thach Nguyen[2], Sai Tak Chu[3], Brent E. Little[4], Roberto Morandotti[5], Arnan Mitchell[2], David Moss[1]; [1]*Swinburne Univ. of Technology, Australia;* [2]*RMIT Univ., Australia;* [3]*City Univ. of Hong Kong, Hong Kong;* [4]*Chinese Academy of Science, China;* [5]*INRS, Canada.* A broadband RF channelizer based on an integrated micro-comb source is demonstrated, with 19GHz RF bandwidth and spectral slice resolution of 1.04 GHz. This approach offers reduced complexity and potential cost for microwave signal detection.

Th3F.4 • 15:15
A Tunable Microwave Frequency Multiplication System Based on Injection Locking without Photodetector, Shuaishuai Wang[1], Ju Wang[1], Tianyu Li[1], Chuang Ma[1], Tianyuan Xie[1], Yang Yu[1], Jinlong Yu[1]; [1]*Tianjin Univ., China.* Using a directly modulated laser to injection locking the high-order sideband of modulated light, multiplication frequency is detected at its radio frequency port. Instead of employing photodetector, the proposed tunable frequency multiplication system costs low obviously.

15:30–16:00 Coffee Break

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th3G • Structured 2D Surfaces—Continued

Th3G.2 • 15:00 Invited

2D Materials for Inkjet Printing of Optoelectronics and Photonics, Meng Zhang[1], Tawfique Hasan[2]; [1]*Beihang Univ., China;* [2]*Univ. of Cambridge, UK.* We present printable and uniform optical saturable absorber devices fabricated using inkjet-printing technique for high performance ultrafast laser sources. Such fabrications technique significant expand the scope for achieving mass-production, low-cost photonic and optoelectronic devices.

Th3H • Entanglement and Squeezed States I—Continued

Th3H.3 • 14:45

Experimental observation of quantum correlations between measurement errors using entangled photon pairs as a probe, Masataka Iinuma[1], Yutaro Suzuki[2], Masayuki Nakano[1], Holger Hofmann[1]; [1]*Hiroshima Univ., Japan;* [2]*Kyoto Univ., Japan.* We experimentally observed a quantum correlation between two measurement errors in a joint measurement by using entangled photon pairs as a probe. The results obtained exceed the limits of classical statistics.

Th3H.4 • 15:00

Quantum interferometric spectroscopy, Rui-Bo Jin[1], Ryosuke Shimizu[2]; [1]*Wuhan Inst. of Technology, China;* [2]*The Univ. of Electro-Communications, Japan.* The difference- and sum-frequency distribution of the biphoton wavefunctions were extracted by applying a Fourier transform on the time-domain Hong-Ou-Mandel interference (HOMI) and the NOON state interference (NOONI) patterns.

Th3H.5 • 15:15

Closed-Loop Operation of Optical Lattice Clock at National Time Service Center, Qinfang Xu[1], Mojuan Yin[1], Yebing Wang[1], Jie Ren[1], Yang Guo[1], Hong Chang[1]; [1]*National Time Service Center, China.* The Hz-level spectroscopy of ^{87}Sr clock transition in an optical lattice is demonstrated. The fractional frequency difference averages of ^{87}Sr optical lattice clock is achieved to 6×10^{-17} at an average time of 3000 s.

Th3I • Signal Processing for Optical Transmsison—Continued

Th3I.4 • 14:45

DFT-spread Combined with Pre-compensation scheme for UWB-over-fiber System, Changqing Xiang[1], J He[1], Kaiquan Wu[1], Yaoqiang Xiao[1]; [1]*Hunan Univ., China.* A DFT-spread combined with pre-compensation scheme is proposed in 64QAM MB-OFDM UWBoF system. By using it, the simulation results show that transmission performance of system improves by 3.3dB compared to that without DFT-spread and pre-compensation.

Th3I.5 • 15:00

High Stability Frequency Transfer over a 35 km Fiber Link Based on Injection-Locked OEO, Yang Yu[1], Jinlong Yu[1], Zixiong Wang[1], Ju Wang[1], Tianyuan Xie[1], Chuang Ma[1]; [1]*Tianjin Univ., China.* A 10 GHz frequency transfer experiment was realized over a 35 km fiber link. An injection-locked optoelectronic oscillator was used in the remote site for stabilization of the phase noise.

Th3I.6 • 15:15

Multiple-User SC-FDMA System with Sub-Nyquist Receiver and PAPR Reduction, Hao-Hsiang Chang[1], Wen-Huang Chen[1], Chao-Wei Chen[1]; [1]*National Chiao Tung Univ., Taiwan.* We demonstrate 43.63-Gbps SC-FDMA with 0.5-GSample/s sampling-rate receiver for each 32-user. Meanwhile, PAPR reduction is included in the proposed SCFDMA system. We also compare results with L-FDMA, I-FDMA, and OFDM utilizing high sampling-rate ADC.

Th3J • 2D and Metamaterial—Continued

Th3J.3 • 15:00

Spectral Line Shape and Modulation Response of Asymmetric Non-Hermitian Photonic Meta-Molecules, Anastasios Bountis[1]; [1]*Nazarbayev Univ., Kazakhstan.* A photonic dimer of two optically coupled lasers is analyzed as an optical meta-molecule for non-Hermitian photonic applications. Spectral signatures of exceptional points and Hopf bifurcations are shown for generic asymmetric configurations. A significant enhancement in the small signal modulation response under differential pumping is observed.

Th3J.4 • 15:15

The Comparative Aging Study for Different Co-precipitation Methods of Quantum Dots in NaCl Solids, Yu-Ming Huang[1], Chung-Ping Yu[1], Li-Ann Ke[1], Chung Ping Huang[3], Shu-Hsiu Chang[2], Chien-Chung Lin[1]; [1]*Inst. of Photonic System, National Chiao-Tung Univ., Tainan, Taiwan., Taiwan;* [2]*Inst. of Imaging and Biomedical Photonics, National Chiao-Tung Univ., Taiwan;* [3]*Inst. of Lighting and Energy Photonics, National Chiao-Tung Univ., Taiwan.* A comparative study about colloidal quantum dot and NaCl co-precipitation methods was set up. After the 300-hour aging tests, the samples made by saturated-salt method is better in terms of degradation and spectral characteristics.

Th3K • Microscopy—Continued

Th3K.3 • 14:45

A programmable time-stretch microscopy based on dispersion-tuned swept laser, Xin Dong[1], Xi Zhou[1], Chi Zhang[1], Xinliang Zhang[1]; [1]*Wuhan National Lab for Optoelectronics,, China.* Dispersion-tuned swept laser (DTSL) is applied to the ultrafast time-stretch microscopy for the first time, and achieves large and programmable time-stretch ratio with minimum dispersion and suitable modulation frequency within the laser cavity.

Th3K.4 • 15:00

Imaging biological specimens and advanced materials with correlative far-field near-field microscopy, Stefan G. Stanciu[1], Denis E. Tranca[1], Catalin Stoichita[1], Radu Hristu[1], George A. Stanciu[1]; [1]*Universitatea Politehnica din Bucuresti, Romania.* We discuss an imaging approach that allows a better understanding of nanoscale datasets collected with Apertureless Scanning Near-Field Optical Microscopy, based on a multimodal system that incorporates multiple ASNOM and far-field Laser Scanning Microscopy variants.

Th3K.5 • 15:15

Spurious Transmission in Liquid Crystal Tunable Filter Operation in Microscopy, Wynn Dunn Gil Improso[1], Paul Leonard Atchong C. Hilario[2], Giovanni A. Tapang[1]; [1]*National Inst. of Physics, Philippines;* [2]*Electrical and Electronics Engineering Inst., Univ. of the Philippines Diliman, Philippines.* We investigate the effect of incidence angle to the transmitted power of a liquid crystal tunable filter (LCTF) with a 632nm laser source. Spurious transmission in other wavelengths was observed in non-normal incidence angles

Th3L • Novel Fiber Structures—Continued

Th3L.3 • 14:45

Enhanced Nanoparticle Detection with Quasi-droplet Modes, Jonathan Ward[1], Fuchuan Lei[1], Sile Nic Chormaic[1]; [1]*Okinawa Inst of Science & Technology, Japan.* We demonstrate nanoparticle sensing with quasi-droplet modes in an ultrathin-walled hollow whispering gallery resonator. Experimental results show 400 MHz mode shifts for interaction with 100 nm particles and a corresponding linewidth broadening of 75 MHz.

Th3L.4 • 15:00

Ultra-Low-Loss Spliceless Fiber Ring Resonators for Resonant Micro-Optic Gyroscopes, Yi Lin[1], Huilian Ma[1], Zhonghe Jin[1]; [1]*School of Aeronautics and Astronautics, Zhejiang Univ., China.* A new record for ultra-low-loss spliceless fiber ring resonators, to the best of our knowledge, is demonstrated experimentally. The measured finesse and Q-factor of the 60-cm long fiber ring resonator are 1324 and 3.7×10^{8}, respectively.

Th3L.5 • 15:15

Sub-nano-Tesla, Shield-less, Field Compensation-Free Inelastic Wave Mixing Magnetometry for Bio-magnetism, Lu Deng[1], Yvonne Y. Li[2], Feng Zhou[1], Eric Y. Zhu[3], Edward W. Hagley[1]; [1]*National Inst of Standards & Technology, USA;* [2]*Harvard Medical School, Dana-Farbe Cancer Inst., USA;* [3]*Electrical Engineering, Univ. of Toronto, Canada.* We report an inelastic-wave-mixing-enhanced Zeeman-coherence atomic magnetometry scheme that results in sub-nT magnetic field detection at human-body temperatures without employing magnetic field shielding, field compensation, and RF-modulation spectroscopy.

15:30–16:00 Coffee Break

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

16:00–18:00
Th4A • Characteristics of Shortpulse Lasers

Presider: Zhi-Chao Luo; South China Normal Univ, China

Th4A.1 • 16:00
Ultra-Compact Frequency-Stabilized Lasers at Visible Wavelengths, Kazumichi Yoshii[1,2], Yusuke Hisai[1,2], Junia Nomura[1,2], Feng-Lei Hong[1,2]; *[1]Yokohama National Univ., Japan; [2]JST, ERATO, MINOSHIMA Intelligent Optical Synthesizer Project, Japan.* We have developed iodine-stabilized lasers using ultra-compact diode laser modules at 531, 561 and 594 nm. The achieved frequency stabilities were typically 4×10^{-13} at an averaging time of 1000 s.

Th4A.2 • 16:15
256 MHz, 1 W femtosecond fiber laser at 780 nm for two-photon microscopy, Wan Yang[1], Danlei Wu[1,2], Guanyu Liu[1], Bingying Chen[1], Lishuang Feng[2], Zhigang Zhang[1], Aimin Wang[1]; *[1]Peking Univ., China; [2]Beihang Univ., China.* A robust 780 nm femtosecond fiber laser was demonstrated with 191 fs pulse width, 256 MHz repetition rate and 1 W average power. It is ideal for two-photon microscopic imaging.

Th4A.3 • 16:30
Stable and Synchronized Time-lens Source for Real-Time Characterization of Noise-Like Pulses, Bowen Li[1], Jiqiang Kang[1], Ying Yu[1], Pingping Feng[1], Kenneth Kin-Yip Wong[1]; *[1]Univ. of Hong Kong, Hong Kong.* Stable and synchronized reference pulses are generated from a time-lens source, triggered by noise-like pulses in a mode-locked fiber laser. This represents an essential step towards single-shot measurement of temporal details inside the noise-like pulses.

16:00–18:00
Th4B • Nonlinear Optical Technologies

Presider: Birgit Stiller; Univ. of Sydney, Australia

Th4B.1 • 16:00 Invited
Dissipative polarization domain walls as persisting topological defects, Stephane Coen[1,2], Bruno Garbin[1,2], Julien Fatome[3], Yadong Wang[1,2], François Leo[4], Gian-Luca Oppo[5], Stuart G. Murdoch[1,2], Miro J. Erkintalo[1,2]; *[1]Physics, The Univ. of Auckland, New Zealand; [2]The Dodd-Walls Centre, New Zealand; [3]Université de Bourgogne Franche-Comté, France; [4]Université Libre de Bruxelles, Belgium; [5]Univ. of Strathclyde, UK.* We experimentally demonstrate the existence of dissipative polarization domain walls in a normally dispersive Kerr resonator. We excite and trap them with appropriate external signals thus realizing an all-optical buffer for topological data.

Th4B.2 • 16:30
Self-Focusing Suppression in Ultrahigh-Intensity Lasers, Efim A. Khazanov[1], Vald Ginzburg[1], Anton Kochetkov[1]; *[1]Inst. of Applied Physics, Russia.* We experimentally confirmed that free space run acts as a spatial filter and drastically suppresses small-scale self-focusing in laser beam with intensity order of TW/cm^2. The measurements were done by two independent techniques.

16:00–18:00
Th4C • Novel Laser System and its Applications

Presider: DongSheng Ding; Univ. of Science and Technology of China, China

Th4C.1 • 16:00 Invited
High Power 2μm Fiber Laser and its Applications, Xia Yu[1]; *[1]Precision Measurements Group, Singapore Inst. of Manufacturing Technology, Singapore.* We report our work on high power thulium-doped fiber lasers at 2 μm, including high repetition rate high average power laser based on resonant pumping, high-energy laser based on CPA and medium power CW lasers.

Th4C.2 • 16:30
High Temperature Operation of Integrated Optical Fiber, Christopher Holmes[1], Paul Gow[1], Alex Jantzen[1], Alan Gray[1], Senta Scholl[1], james gates[1], Peter Smith[1]; *[1]Univ. of Southampton, UK.* Integrated optical fiber is a planarized format, enabling ruggedized integrated functionality for silica optical fiber. This work is the first demonstration showing the platform's operation at temperatures exceeding 1000°C.

16:00–18:00
Th4D • High Power CW Lasers and Coherent Combining

Presider: Wenn Jing Lai; Nanyang Tech Univ., China

Th4D.1 • 16:00 Invited
Advances in High Power Beam Combinable Fiber Lasers, Pu Zhou[1]; *[1]National Univ of Defense Technology, China.* We will review the research progress on high power beam combinable fiber lasers, then we will demonstrate our recent progress in our group: a 4 kW level narrow-linewidth fiber laser based on tandem pumping scheme.

Th4D.2 • 16:30
Quantum Limits of Coherent Beam Combining, Gerd Leuchs[2,3], Christian R. Mueller[1], Florian Sedlmeir[1], Sourav Chatterjee[1], Nicoletta Haarlammert[4], Cesar Jauregui[5], Thomas Schreiber[4], Jens Limpert[5], Andreas Tünnermann[4,5], Christoph Marquardt[1,2]; *[1]Max Planck Inst. for the Science of Light, Germany; [2]Physics, Univ. Erlangen-Nürnberg, Germany; [3]Inst. of Applied Physics, Russian Academy of Sciences, Russia; [4]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany; [5]Inst. of Applied Physics, Univ. of Jena, Germany.* We report the first quantum mechanical noise limit calculations for coherent beam combining and compare our results to quantum-limited amplification. We highlight a favourable noise scaling for both pure and noisy input states.

16:00–18:00
Th4E • Plasmon-enhanced Spectroscopies and Imaging

Presider: Dangyuan Lei; The Hong Kong Polytechnical Univ., Hong Kong

Th4E.1 • 16:00 Invited
Harnessing Surface Plasmons with Structured-surface and Structured-light, Xiaocong L. Yuan[1]; *[1]Shenzhen Univ., China.* In this presentation, structured surfaces and structured light are introduced to manipulate SPPs with more degrees of freedom, yielding many attractive techniques such as super-resolved imaging, ultra-high sensitive bio-sensing, surface-enhanced Raman spectroscopy.

Th4E.2 • 16:30
Plasmono-Atomic Interactions at the Fiber Tip, Eng Aik Chan[1], Giorgio Adamo[1], Syed Abdullah Aljunid[1], Martial Ducloy[1,3], David Wilkowski[1], Nikolay Zheludev[1,2]; *[1]Nanyang Technological Univ., Singapore; [2]Univ. of Southampton, UK; [3]Univ. Paris13, France.* Plasmono-atomic interaction affecting hyperfine structure of atomic lines can be detected at the end of optical fiber bearing metamaterial nanostructure which paves the way for a new type of ultra-compact fiberized atoms-metamaterial devices.

16:00–18:00
Th4F • Radio Over Fiber and Optical Wireless Communication

Presider: Kun Zhu; The Hong Kong Polytechnical Univ., Hong Kong

Th4F.1 • 16:00 Invited
Highly stable dissemination of microwave and millimeter wave signals over fiber-optic links, Yi Dong[1], Weilin Xie[1], Wei Wei[1], Zhangweiyi Liu[1], Xiaocheng Wang[1], Nan Deng[1]; *[1]Beijng Insititute of Technology, China.* Highly stable microwave and millimeter wave signal dissemination over fiber-optic links is realized based on the transfer of high frequency optically-carried signals relying on the microwave photonics assisted precise phase and frequency discrimination and control.

Th4F.2 • 16:30 Invited
Power-over-Fiber for Radio-over-Fiber-Based Distributed Antenna Systems, Motoharu Matsuura[1]; *[1]Graduate School of Informatics and Engineering, Univ. of Electro-Communications, Japan.* Power-over-fiber is one of the essential technologies for simultaneously transmitting data and power in a same optical fiber. This paper introduces power-over-fiber towards practical applications of radio-over-fiber-based distributed antenna systems for future mobile networks.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

16:00–18:00
Th4G • 2D Photonics Devices
Presider: Han Zhang, Shenzhen Univ., China

Th4G.1 • 16:00 Invited

Two-Dimensional Layered Materials/Silicon Heterojunctions for Energy and Optoelectronic Applications, Jiansheng Jie[1]; [1]*Inst. of Functional Nano and Soft Materials Laboratory (FUNSOM), Soochow Univ., China*. We report investigation on 2D layered material/silicon heterojunction based photovoltaic and optoelectronic devices to solve the problem of low light absorption of monolayer materials as well as difficulties in controllable doping and p-n junction fabrications.

Th4G.2 • 16:30 Invited

On-Chip Nanowire Photonic Devices, Limin Tong[1]; [1]*Zhejiang Univ., China*. By integrating free-standing optical nanofibers and nanowires with microfluidic channels or silicon photonic chips, we show on-chip nanowire photonic devices including optical sensors, interferometers, modulators and light emitting devices with small footprints and high flexibility.

16:00–18:00
Th4H • Novel Photonic Structures
Presider: Xuming Zhang; The Hong Kong Polytechnic Univ., Hong Kong

Th4H.1 • 16:00 Invited

Optofluidic Lattice and Single Bacteria and Nanoparticle Manipulation, Ai-Qun Liu[1]; [1]*Nanyang Technological Univ., Singapore*. Three different types of optical hopping mechanisms are studied in the optofluidic chip and also trap different bacteria in the optofluidic lattice. The particle enabled bacteria hopping can be used for the antibody screening and direct binding efficiency measurement.

Th4H.2 • 16:30 Invited

Plasmoinc Enhancement for Optoelectronic Devices, Dao Hua Zhang[1]; [1]*Nanyang Technological Univ., Singapore*. We present split ring resonators (SRRs) and their applications, two-dimensional metallic square hole array enhanced mid-wave infrared photodetectors with room temperature detectivity of 8 x 109 Jones and new type of two-terminal millimetre wave photodetectors with a room temperature noise equivalent power of 1.5×10-13 W Hz-1/2 .

16:00–18:00
Th4I • Optical Access Technologies
Presider: Songnian Fu; Huazhong Univ. of Science and Technology, China

Th4I.1 • 16:00 Invited

Simplified signal processing for high-speed PON, Lilin Yi[1], Lei Xue[1], Weisheng Hu[1]; [1]*Shanghai Jiao Tong Univ., China*. We have experimentally demonstrated symmetric 4*25 Gb/s TWDM-PON and 50 Gb/s TDM-PON based on 10G class devices. Low-cost DMLs are used as transmitter and simple optical signal process is used for bandwidth equalization and DSP simplification.

Th4I.2 • 16:30

Digital Orthogonal Filtering-Multiplexed Access over IMDD PON systems utilizing EML, Xiao I. Zhang[1], Chongfu Zhang[1], Chen Chen[2], Mingyue Zhu[1], Wei Jin[1], Kun Qiu[1]; [1]*Univ. Electron. Sci. & Technol. China, China*; [2]*School of Electrical and Electronic Engineering, Nanyang Technological Univ., Singapore*. We investigate the power budget performance of implementing a digital orthogonal filtering-multiplexed access (DFMA) technology for the passive optical network (PON) systems by using electro-absorption modulated lasers (EMLs)

16:00–18:00
Th4J • Entanglement and Squeezed States II
Presider: Li You; Tsinghua Univ. China

Th4J.1 • 16:00 Invited

Unconditional Shot-noise-limit Violation in Photonic Quantum Metrology, Geoffrey Pryde[1], Sergei Slussarenko[1], Morgan Weston[1], Helen Chrzanowski[2], Lynden Shalm[3], Varun Verma[3], Sae Woo Nam[3]; [1]*Griffith Univ., Australia*; [2]*Univ. of Oxford, UK*; [3]*National Inst. of Standards and Technology, USA*. We demonstrate the first unconditional violation of the shot noise limit in photonic NOON-state interferometry. Using ultrahigh-efficiency source and detectors we outperform ideal classical measurement without employing postselection, or correction for loss and imperfections.

Th4J.2 • 16:30

Multipartite Quantum Entanglement and Quantum Correlation from cascaded Four-wave Mixing Processes with spatial multiplexing, Jietai Jing[1]; [1]*East China Normal Univ., China*. Four-wave mixing (FWM) process with spatial multiplexing is a promising candidate for building quantum network. We experimentally investigate multipartite quantum correlation and theoretically study multipartite quantum entanglement from cascaded FWM processes.

16:00–18:00
Th4K • Imaging and Applications
Presider: Wen Chen; The Hong Kong Polytechnic Univ., Hong Kong

Th4K.1 • 16:00 Invited

High-temperature Optical Techniques Development and Its Application in Thermal Barrier Coatings, W. He[1], Huimin Xie[1], Q. Zhang[1], Y.J. Yin[1], Z.W. Liu[2], L.F. Wu[1], X.L. Dai[1]; [1]*AML, Dept. of Engineering Mechanics, Tsinghua Univ., China*; [2]*School of Aerospace Engineering, Beijing Inst. of Technology, China*. Owing to demanding operating environment and multilayered structure, the experimental characterization of thermal barrier coatings is challenging. Herein, our ongoing work on the high-temperature optical techniques for their deformation and residual stress measurements are reviewed.

Th4K.2 • 16:30 Invited

Seeing the Unseen Using Micro-Optical Coherence Tomography, Si Chen[1], Xinyu Liu[1], Nanshuo Wang[1], Xianghong Wang[1], Linbo Liu[1]; [1]*Nanyang Technological Univ., Singapore*. Micro-optical coherence tomography technologies improve the spatial resolution of OCT by an order of magnitude. These technical advances, including interferometric spectral combination and multiple aperture synthesis enable subcellular level spatial resolution of intact biological tissues in vivo and ex vivo for the first time.

16:00–18:00
Th4L • Optical Fiber Gratings, Sensors & Technology
Presider: Xinyong Dong; China Jiliang Univ., China

Th4L.1 • 16:00 Invited

Long-Period Fiber Grating Sensors Based on High Order Mode Coupling, Yunqi Liu[1]; [1]*Shanghai Univ., China*. We demonstrate the fabrication of long-period fiber gratings and helical long-period gratings in specialty fibers using focused carbon dioxide laser. The mode coupling and sensing characteristics of the gratings were investigated experimentally and theoretically.

Th4L.2 • 16:30

Spectral modulation and refractive index sensing characteristics of Ex-TFG coated with gold nanoshell, Huafeng Lu[1], Jiao Lu[1], Bin-bin Luo[1], Shenghui Shi[1], Mingfu Zhao[1]; [1]*Chongqing Key Laboratory of Optical Fiber Sensor and Photoelectric Detection, Chongqing Univ. of Technology, China*. Excessively tilted fiber grating (Ex-TFG) sensor coated by gold nanoshell is reported, showing that both of the increase of refractive index sensitivity and intensity change of TM mode are greater than those of TE mode.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th4A • Characteristics of Shortpulse Lasers—Continued

Th4A.4 • 16:45
Timing Jitter of High Repetition Rate Mode-locked Fiber Lasers, Yan Wang[1], Haochen Tian[2], Yuxuan Ma[1], Youjian Song[2], Zhigang Zhang[1]; *[1]Peking Univ., China; [2]Tianjin Univ., China.* We characterized the timing jitter of two 880 MHz Yb-doped mode-locked fiber lasers using the optical cross-correlation technique. The lowest residual timing jitter is 3.5 fs rms (integrated from 5MHz to 100 kHz).

Th4A.5 • 17:00
Chromium and cobalt doped saturable absorbers for passively Q-switched visible lasers, Hiroki Tanaka[1,2], Elena Castellano-Hernández[2], Christian Kränkel[2,3], Shogo Fujita[1], Fumihiko Kannari[1]; *[1]Keio Univ., Japan; [2]Center for Laser Materials, Leibniz Inst. for Crystal Growth, Germany; [3]Inst. of Laser-Physics, Universität Hamburg, Germany.* We present a detailed characterization of Cr^{4+} and Co^{2+}-doped oxides as saturable absorbers for the visible spectral region. The first visibly emitting Q-switched laser utilizing a Co^{2+}:$Gd_3Ga_5O_{12}$ saturable absorber is demonstrated.

Th4A.6 • 17:15
Intensity Noise Comparison of Mode-Locked Fiber Lasers Based on Nonlinear Amplifying Loop Mirror and Nonlinear Polarization Rotation, Sijia Wang[1], Peng Qin[1]; *[1]Qian Xuesen Laboratory of Space Technology, Chinese Academy of Space Technology, China.* We demonstrate ~82% reduction in the rms relative intensity noise (10 Hz–100 kHz) of mode-locked fiber lasers by the nonlinear amplifying loop mirror compared with nonlinear polarization rotation, under similar 30-nm output spectral bandwidth.

Th4B • Nonlinear Optical Technologies—Continued

Th4B.3 • 16:45
Single shot measurement of the femtosecond laser pulse, Qingwei Yang[1], Jun Kang[1], Ziruo Cui[1], Ailin Guo[1], Haidong Zhu[1], Meizhi Sun[1], Ping Zhu[1], Qi Gao[1], Xinglong Xie[1], Jianqiang Zhu[1]; *[1]Shanghai Inst. of Optics and Fine Mechanics, China.* To meet the requirements of single shot femtosecond laser pulse diagnostic, some methods have been taken. Through carefully design and experiment, a single shot autocorrelator suit for the SGII 5PW laser facility is achieved.

Th4B.4 • 17:00
Time-resolved circular-dichroism spectrometer for coherent control experiments, Yuma Saito[1], Hironori Ito[1], Kazuhiko Misawa[1,2]; *[1]Dept. of Applied Physics, Tokyo Univ. of Agriculture and Tech., Japan; [2]Inst. of Global Innovation Reserach, Tokyo Univ. of Agriculture and Tech., Japan.* We developed a time-resolved circular-dichroism spectrometer to conduct coherent control experiments of chiral materials. The spectrometer yielded satisfactory results for two reference samples, chiral camphor sulfonic acid and $[Ru(bpy)_3]^{2+}$

Th4B.5 • 17:15
Spectral dynamics measurement using a free-space angular-chirp-enhanced delay cavity, Ying Yu[1], Xiaoming Wei[1,2], Jianglai Wu[1], Jingjiang Xu[1], Kenneth Kin-Yip Wong[1], Kevin K. Tsia[1], Yiqing Xu[1,3]; *[1]Univ. of Hong Kong, Hong Kong; [2]California Inst. of Technology, USA; [3]Zhejiang Univ., China.* We present a study of spectral dynamics measurement using the lately invented apparatus named free-space angular-chirp enhanced delay (FACED) cavity. The shot-to-shot spectra are observed and the corresponding spectral correlation maps are analyzed.

Th4C • Novel Laser System and its Applications—Continued

Th4C.3 • 16:45 Invited
Nonlinear Plasmonics with Extremely High-Q Resonances, Harald W. Giessen[1]; *[1]Universiteit Stuttgart, Germany.* Abstract not available.

Th4C.4 • 17:15
Thermal Regimes of Laser Reduction of Graphene Oxide, Sergey E. Svyakhovskiy[1], Nikita Minaev[2], Stanislav Evlashin[3]; *[1]M. V. Lomonosov Moscow State Univ., Russia; [2]Inst. of Laser and Information Technology of Russian Academy of Sciences, Russia; [3]Skolkovo Inst. of Science and Technology, Russia.* The far-reaching method of the graphene oxide photoreduction has been developed for the robust production of graphene nanoflakes. We study the influence of photoreduction spectra on optical and electrical properties and the material surface wettability.

Th4D • High Power CW Lasers and Coherent Combining—Continued

Th4D.3 • 16:45
Coherent Beam Combining for Ultrashort Intensity Laser Systems, Yan-Qi Gao[1]; *[1]Shanghai Inst. of Laser Plasma, China.* Three kinds of factors, including phase distribution, spectral dispersion and longitudinal chromatism, are investigated for ultra-short beam combining. General control requirements are given. High-quality combining is realized, and time jitter is less than 150 attosecond.

Th4D.4 • 17:00 Invited
Withdrawn.

Th4E • Plasmon-enhanced Spectroscopies and Imaging—Continued

Th4E.3 • 16:45
Plasmon hybridization in plasmonic dimer-on-film nanocavity for photoluminescence enhancement, Guangcan Li[1], Meng Qiu[1], Dang Yuan Lei[1]; *[1]The Hong Kong Polytechnic Univ., Hong Kong.* We demon-strate a plasmonic nanoparticle-dimer-on-film nanocavity with plasmon hybridization-induced quality factor improvement, which exhibits ~200 times photoluminescence intensity enhancement and ~4.6 times linewidth reduction.

Th4E.4 • 17:00
Surface enhanced infrared absorption spectroscopy suing super absorbing metasurface with sub-5-nm gaps, Dengxin Ji[1], Qiaoqiang Gan[1]; *[1]State Univ. of New York at Buffalo, USA.* We developed a super absorbing metamaterial surface with sub-5-nm gaps and demonstrated its application for boosted surface enhanced infrared absorption spectroscopy using its extremely enhanced localized field.

Th4E.5 • 17:15
Plasmonic Narrow Bandpass Filters Based on Metal-Dielectric-Metal for Multispectral Imaging, Xin He[1], Nicholas O'Keefe[1], Dechuan Sun[1], Yajing Liu[1], Hemayet Uddin[2], Ampalavanapillai Nirmalathas[1], Ranjith R. Unnithan[1]; *[1]the Univ. of Melbourne, Australia; [2]Melbourne Centre for Nanofabrication, Australia.* This paper presents a novel plasmonic filter design to reduce the full width half maximum (FWHM) of transmission spectrum based on hexagonal array of holes with Metal-Dielectric-Metal structure for multispectral imaging applications.

Th4F • Radio Over Fiber and Optical Wireless Communication—Continued

Th4F.3 • 17:00
Nonlinearity mitigation in multi-band OFDM IF over Fiber system using signal spectral power shaping, InHo Ha[1], Hyoung-Joon Park[1], Sang-kook Han[1]; *[1]Yonsei Univ., Korea.* A nonlinear mitigation technique with spectral shaping of signal power is proposed in analog multi-IF over Fiber link using OFDM signal. Its feasibility was experimentally verified through EVM performance and channel linearity.

Th4F.4 • 17:15 Invited
RoF links in the front-haul network for the future 5G communications, Diego Perez-Galacho[1], Victor Nacher-Castellet[1], Salvador Sales[1]; *[1]PRL, ITEAM, Universitat Politècnica Valencia, Spain.* Radio over Fiber together with Spatial Division Multiplexing appears as the best suitable solution to implement next generation 5G fronthaul. This approach has been use to demonstrate RF optical links of 10km distance with up to 1000Mbps data rate for a BER below 10^{-3}.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th4G • 2D Photonics Devices—Continued

Th4G.3 • 17:00
High Speed Single-Layer Graphene-Si Electro-Absorption Modulator, Chiara Alessandri[2,1], Inge Asselberghs[1], Steven Brems[1], Cedric Huyghebaert[1], Joris Van Campenhout[1], Dries VanThourhout[2], Marianna Pantouvaki[1]; [1]*imec, Belgium;* [2]*Ghent Univ., Belgium*. We demonstrate a single-layer graphene electro-absorption modulator on Si waveguides with modulation depth of 0.026 dB/um for 6.5 Vpp and 17 GHz 3dB bandwidth.

Th4G.4 • 17:15
Anomalous Photoresponse Based on 2D Material Gated Transistors, Nan Guo[1], Huicong Chang[1], Junku Liu[1], Yi Jia[1], Lin Xiao[1]; [1]*Qian Xuesen Lab of Space Technology, China*. We report on a WSe_2 gated transistor. The photocarriers excited in WSe_2 enhance the conductivity of WSe_2. Negative gate voltages are applied to the ZnO channel through WSe_2. Remarkable negative photocurrents are obtained.

Th4H • Novel Photonic Structures—Continued

Th4H.3 • 17:00
Demonstration of Pseudospin-dependent topological charge transformation in photonic graphene, Daohong song[1], Xiuying Liu[1], Shiqi Xia[1], Zhixuan Dai[1], Liqin Tang[1], Jingjun Xu[1], Zhigang Chen[1,2]; [1]*The MOE Key Laboratory of Weak-Light Nonlinear Photonics, TEDA Applied Physics Inst. and School of Physics, Nankai Univ., China;* [2]*Dept. of Physics and Astronomy, San Francisco State Univ., USA*. Momentum-matched selective excitation of two sublattices with vortex beams leads to direct observation of pseudospin-dependent conical diffraction and topological charge transformation, including spin-orbital angular momentum conversion arising from inherent degree-of-freedom in photonic graphene.

Th4H.4 • 17:15
Switchable Topological Edge States in Next-Nearest-Neighbour Coupled Resonator Lattices, Daniel Leykam[1], Sunil Mittal[2,3], Mohammad Hafezi[2,3], Yidong Chong[4]; [1]*Inst. for Basic Science, Korea;* [2]*Joint Quantum Inst., USA;* [3]*Universtiy of Maryland, USA;* [4]*Nanyang Technological Univ., Singapore*. We find that next-nearest-neighbour coupling in ring resonator lattices induces topological transitions and one-way edge modes. We design topological waveguides that are easily switchable using thermal, electro-optic, or nonlinear effects, enabling robust on-chip photon routing.

Th4I • Optical Access Technologies—Continued

Th4I.3 • 16:45
Experimental Demonstration of Optical MIMO NOMA Passive Optical Network, Bangjiang Lin[1], Xuan Tang[1], Chun Lin[1], Zhenlei Zhou[1], Haiguang Zhang[1], Zabih Ghassemlooy[1]; [1]*Chinese Academy of Sciences, Quanzhou Inst. of Equipment Manufacturing, China*. We experimentally demonstrate an optical MIMO NOMA-PON system, which offers a higher system capacity. The MIMO demultiplexing and the inter-user interference mitigation are realized with efficient channel equalization.

Th4I.4 • 17:00
Wavelength Control Techniques for Tunable LD-based Colorless ONUs in WDM PON, Bingchang Hua[1], Zhiguo Zhang[1], Yanxu Chen[1], Qi Guo[1], Cheng Ju[1], Xue Chen[1], Rengzhong Guo[2], Chenying Jiang[2]; [1]*State Key Laboratory of Information Photonics and Optical Communications (Beijing Univ. of Posts and Telecommunications), China;* [2]*Information and Telecommunication branch,Jiujiang Electric Power Supply Company, China*. A colorless light source is indispensable for low-cost and plug-and-play ONUs in WDM PON. Four kinds of wavelength control methods for tunable LD-based colorless light source used in colorless ONU are designed and experimentally measured.

Th4I.5 • 17:15 Invited
A High-Speed and Long-Reach UWOC Link, Chung-Yi Li[1], You-Ruei Wu[1], Zhen-Han Wang[1], Yong-Nian Chen[1], Hai-Han Lu[1], Wen-Shing Tsai[2]; [1]*National Taipei Univ. of Technology, Taiwan;* [2]*Dept. of Electrical Engineering, Ming Chi Univ. of Technology, Taiwan*. A high-speed (5 Gbps) and long-reach (52.5 m) underwater wireless optical communication link is demonstrated. Competent bit error rate and constellation map are acquired over a 50-m GI-POF transport with a 2.5-m underwater link.

Th4J • Entanglement and Squeezed States II—Continued

Th4J.3 • 16:45
First Demonstration of nonlocal two-way quantum clock synchronization on fiber link, Fei Y. Hou[1,2], Ruifang Dong[1], Runai Quan[1,2], Xiao Xiang[1], Tao Liu[1], Shougang Zhang[1]; [1]*National Timer Service Center, China;* [2]*Univ. of Chinese Academy of Sciences, China*. We have demonstrated a two-way quantum clock synchronization by using frequency entangled pulses. For two clocks separated by 20km fiber, a timing stability of 0.85ps was achieved at averaging time of 5120s with a synchronization accuracy of 10ps.

Th4J.4 • 17:00
Binary Homodyne Detection for Observing Quadrature Squeezing in Satellite Links, Christian R. Mueller[1,2], Kaushik P. Seshadreesan[1,2], Christian Peuntinger[1,2], Christoph Marquardt[1,2]; [1]*Quantum Information Processing, MPI for the Science of Light, Germany;* [2]*Dept. of Physics, Univ. of Erlangen-Nuremberg (FAU), Germany*. We demonstrate the efficiency of homodyne detection with merely one bit of detector resolution and we analyze the feasibility of quadrature squeezing detection in satellite links using optical communication technology already in orbit.

Th4J.5 • 17:15
Second-order temporal interference with thermal light: Interference beyond the coherence time, Yong Sup Ihn[1], Yosep Kim[1], Vincenzo Tamma[2], Yoon-Ho Kim[1]; [1]*Pohang Univ. of Sci. and Tech., Korea;* [2]*Faculty of Science, Univ. of Portsmouth, UK*. We report an experimental demonstration for a counter-intuitive phenomenon in multi-path interferometer with thermal light. The second-order interference between two pairs of correlated optical paths emerges even for the much longer time delay in each pair than the source coherence time.

Th4K • Imaging and Applications—Continued

Th4K.3 • 17:00 Invited
Overcoming the Multiple Scattering Limit for Bio-Imaging, Jung-Hoon Park[1]; [1]*Ulsan National Inst of Science & Tech, Korea*. Multiple scattering still remains as the ultimate barrier for in-vivo deep tissue imaging. Here, we will discuss our efforts to overcome multiple scattering and enable diffraction limitied, or even sub-wavelength resolution imaging through highly scattering media and living biological tissue.

Th4L • Optical Fiber Gratings, Sensors & Technology—Continued

Th4L.3 • 16:45
Humidity Sensor Based on Long Period Grating Coated with Polyethylene Glycol/ Polyvinyl Alcohol, Yunlong Wang[1], Yunqi Liu[1], Fang Zou[1], Chen Jiang[1], Lu Huang[1], Tingyun Wang[1]; [1]*Shanghai Univ., China*. A novel relative humidity sensor based on long period grating coated with polyethylene glycol /polyvinyl alcohol film is reported. The sensor has a high sensitivity (1.2902 nm/RH) in RH range of 60% to 95% RH.

Th4L.4 • 17:00
Simultaneous Measurement of Tilt Angle and Temperature Based on a Taper-Shaped Polymer Incorporating a Fiber Bragg Grating, Jhe-Yong Guo[1], Meng-Shan Wu[1], Cheng-Ling Lee[1], Chi-Feng Lin[1], Wen-Fung Liu[2]; [1]*National United Univ., Taiwan;* [2]*Dept. of Electrical Engineering, Feng Chia Univ., Taiwan*. We propose a novel taper-shaped polymer incorporating a fiber Bragg grating (FBG) for simultaneously measuring tilt angle (q) and temperature (T). Experimental results show that both parameters can be simultaneously measured with good discrimination.

Th4L.5 • 17:15
Sensing characteristics of sampled Bragg gratings produced in helical fibers, Peng Ma[2,1], Gaoyang Chen[2], Jie Li[2], Li-Peng Sun[2], Chuang Wu[2], Bai-Ou Guan[2]; [1]*Jinan Univ., China;* [2]*Inst. of Photonics Technology, Jinan Univ., China*. We investigate the sensing characteristics for a sampled Bragg grating formed in a helical single-mode fiber. This sensor features structural simplicity, high integration, flexibility, and low cost, and thus has prospects in practical applications.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th4A • Characteristics of Shortpulse Lasers—Continued

Th4A.7 • 17:30
Influence of Intra-Cavity Loss on Mode-Locking of Fiber Lasers, Goran Kovacevic[1], Takuma Shirahata[1], Pengtao Yuan[1], Sze Y. Set[1], Shinji Yamashita[1]; [1]*RCAST, Univ. of Tokyo, Japan*. We experimentally characterize the influence of intra-cavity loss on mode-locking of fiber lasers using a variable attenuator and NPR. We back-up our results numerically and hope they will open a path to high loss components in fiber lasers, like optical chips or high percentage output couplers.

Th4A.8 • 17:45
1/1.5 μm dual-band high-energy square-wave mode-locked fiber laser based on Er/Yb-codoped double cladding fiber, Songlin Zhang[1], Weiqi Liu[1], Chunyu Guo[1], Shuangchen Ruan[1], Peiguang Yan[1], Jinzhang Wang[1], Ping Hua[1], Xiaogang Ge[1]; [1]*Shenzhen Univ., China*. A 1 μm/1.5 μm dual-band simultaneously mode-locked fiber laser with high-energy square-wave pulses has been demonstrated based on a common Erbium/ Ytterbium-codoped double cladding fiber.

Th4B • Nonlinear Optical Technologies—Continued

Th4B.6 • 17:30
Compression of optical pulses using a free-space angular-chirp-enhanced delay cavity, Ying Yu[1], Xiaoming Wei[1,2], Jianglai Wu[1], Jingjiang Xu[1], Kenneth Kin-Yip Wong[1], Kevin K. Tsia[1], Yiqing Xu[1,3]; [1]*Univ. of Hong Kong, Hong Kong;* [2]*California Inst. of Technology, USA;* [3]*Zhejiang Univ., China*. We present a study of compression of optical pulses using a free-space angular-chirp enhanced delay (FACED) cavity. The amount of induced dispersion can be adjusted by simply modifying the geometry of the FACED cavity.

Th4B.7 • 17:45
Time-domain Ptychographic Retrieval of Over-octave-spanning IR Pulses from XFROG Measurement, Y. C. Lin[1], Yasuo Nabekawa[1], Katsumi Midorikawa[1]; [1]*RIKEN, Japan*. We present the application of time-domain ptychographic algorithm for reconstructing both the over-octave-spanning IR spectrum and gate pulses recorded by an XFROG setup. The two pulses are reliably characterized from a single XFROG spectrogram.

Th4C • Novel Laser System and its Applications—Continued

Th4C.5 • 17:30 Invited
High power femtosecond FCPA laser and its application in VUV sources generations, Zhigang Zhao[1], Yohei Kobayashi[1]; [1]*Univ. of Tokyo, Japan*. 10.7-eV source with improved beam profile and stability was prepared by employing a specially designed Lens-Window-Prism (LWP) device, driven by a homemade fiber chirped pulse amplifier (FCPA) laser system at 1 MHz.

Th4D • High Power CW Lasers and Coherent Combining—Continued

Th4D.5 • 17:30
1.5kW All-Fiber Continuous-Wave Laser, Kui Y. Song[1], Yuanhong Yang[1], Xuexia Zhang[2]; [1]*Beihang Univ., China;* [2]*Inst. of Laser Engineering, Beijing Univ. of Technology, China*. A prototype of 1.5kW fiber laser with the center wavelength 1080 nm has been demonstrated and developed, and the corresponding optical-to-optical conversion efficiency is 73.3%. The Stimulated Raman Scattering (SRS) is well suppressed.

Th4D.6 • 17:45
A 900-Watt quasi-CW diamond Raman laser, Sergei Antipov[1], Alexander Sabella[2], Soumya Sarang[1], Robert J. Williams[1], David J. Spence[1], Richard P. Mildren[1]; [1]*Macquarie Univ., Australia;* [2]*Defence Science and Technology Group, Australia*. A high beam quality diamond Raman laser operating in the quasi-CW regime with 900 W output power in 100 μs pulses was demonstrated above the modelled cavity stability limit. A 40× brightness enhancement was measured.

Th4E • Plasmon-enhanced Spectroscopies and Imaging—Continued

Th4E.6 • 17:30
Au-Nanoparticles Fabricated Using femtosecond pulse for Surface-Enhanced Raman Spectroscopy, Wending Zhang[1], Cheng Li[1], Kun Gao[1], Fanfan Lu[1], Feng Gao[2], Ting Mei[1]; [1]*Northwestern Polytechnical Univ., China;* [2]*Nankai Univ., China*. Au-nanoparticles (Au-NPs) substrates for surface-enhanced Raman spectroscopy (SERS) are fabricated by scanning an Au-film using femtosecond pulse. The Au-NPs SERS substrates exhibit high activity and excellent reproducibility.

Th4E.7 • 17:45
Label-free Imaging to Single Nanoparticle by Surface Plasmon Polariton In-plane Scattering, Xuqing Sun[1], Hongyao Liu[1], Liwen Jiang[1,2], Wei Xiong[1], Yaqin Chen[1], Xinchao Lu[1]; [1]*Inst. of Microelectronics of Chinese Academy of Sciences, China;* [2]*Univ. of Chinese Academy of Sciences, China*. We study the physical mechanism of surface plasmon polariton in-plane scattering with single nanoparticle, which is vital to understand the electromagnetic interaction with nanoparticle. Also, the polarized bright spot is linear with the nanoparticle's size.

Th4F • Radio Over Fiber and Optical Wireless Communication—Continued

Th4F.5 • 17:45
Experimental Characterization of Variable Background Light to APD-Based OWC System Performance, Daomin Chen[1], Chao Li[1], Zhengyuan Xu[1]; [1]*Univ of Science and Technology of China, China*. Characterization of variable background light from a blue LED to an LD/APD-based optical wireless communication (OWC) link performance was experimentally investigated. The results reveal both APD's gain and bandwidth degrade the performance, ignoring shot noise.

18:30–20:30 Post Deadline Papers

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Th4G • 2D Photonics Devices—Continued

Th4G.5 • 17:30
Enhanced Self-Phase Modulation in Graphene-integrated Silicon Waveguides, Qi Feng[1], Hui Cong[1], Wenqi Wei[1,2], Bin Zhang[1], Jianhuan Wang[1], Jieyin Zhang[1], Ting Wang[1], Jianjun Zhang[1]; [1]*Inst. of Physics, CAS, China;* [2]*School of Physics and Technology, Wuhan Univeristy, China.* Silicon-on-insulator waveguides covered with graphene in different lengths have been fabricated. We demonstrated the enhanced self phase modulation and Kerr nonlinearity in graphene-integrated silicon waveguides.

Th4G.6 • 17:45
The substrate influence on the optoelectronic properties of 2D materials, Linjun Li[1], Bo Liu[2], Weijie Zhao[2], Goki Eda[2], Kianping Loh[2]; [1]*Zhejiang Univ., China;* [2]*national Univ. of singapore, Singapore.* 2D materials are known for their highly susceptible to environmental influence. Here we show the influence of different substrates to the exciton/trion related bandgap engineering of two typical materials, MoS_2 and WS_2 nanosheets.

Th4H • Novel Photonic Structures—Continued

Th4H.5 • 17:30
Chiral Light-matter Interaction in Dielectric Photonic Topological Insulators, Sang Soon Oh[1], Ben Lang[2], Daryl M. Beggs[1], Diana L. Huffaker[1], Matthias Saba[3], Ortwin Hess[3]; [1]*Cardiff Univ., UK;* [2]*Univ. of Bristol, UK;* [3]*Imperial College London, UK.* A unidirectional chiral edge mode in photonic topological insulators can be selectively excited by a circularly-polarized dipole source. We show that the directionality is also determined by the position of the dipole source.

Th4H.6 • 17:45
Fabrication Of Dual-focus Microlens Array By Using Dynamic Optical Projection Stereolithography, Ouyang Xia[1], Zhengkun Yin[1,2], Jushuai Wu[1], A. Ping Zhang[1], Changhe Zhou[2]; [1]*Dept. of Electrical Engineering, The Hong Kong Polytechnic Univ., Hong Kong;* [2]*Shanghai Inst. of Optics and Fine Mechanics, Chinese Academy of Sciences, China.* A new optical fabrication technology for fabrication of dual-focus microlens array is presented. We experimentally demonstrated that the surface of microlens can be precisely tailored by the technology to engineer the focal structure of microlens.

Th4I • Optical Access Technologies—Continued

Th4I.6 • 17:45
High Speed Geometrically Shaped 8-QAM modulation based Underwater Visible Light Communication System, Xingbang Wu[1], Fangchen Hu[1], Shangyu Liang[1], Nan Chi[1]; [1]*Fudan Univ., China.* We demonstrate an underwater VLC system at 1.2m transmission distance with geometrically shaped 8-QAM modulation. The best performance can be achieved by utilizing circle 8QAM modulation and the highest data rate is 1.4 Gb/s.

Th4J • Entanglement and Squeezed States II—Continued

Th4J.6 • 17:30
1.5-μm Narrow-band Two-photon Source for Long-distance Quantum Communication, Kazuya Niizeki[1], Kohei Ikeda[1], Mingyang Zheng[2], Xiuping Xie[2], Kotaro Okamura[3], Nobuyuki Takei[4,5], Naoto Namekata[6], Shuichiro Inoue[6], Hideo Kosaka[1], Tomoyuki Horikiri[1,7]; [1]*Dept. of physics, Yokohama National Univ., Japan;* [2]*Jinan Inst. of Quantum Technology, China;* [3]*Kanagawa Univ., Japan;* [4]*Inst. for Molecular Science, Japan;* [5]*SOKENDAI (The Graduate Univ. for Advanced Studies), Japan;* [6]*Nihon Univ., Japan;* [7]*JST, PRESTO, Japan.* We demonstrate a narrow-band telecom two-photon source for long-distance quantum ommunication. The second-order cross-correlation function reveals narrow linewidth of 2.4 MHz and the highest spectral brightness of 3.94×10^5 pairs/(s•MHz•mW).

Th4J.7 • 17:45
Spatially resolved control of ac-Stark shifts in cold atomic ensemble, Mateusz Mazelanik[1], Adam Leszczynski[1], Michal Lipka[1], Michal Parniak[1], Michal Dabrowski[1], Wojciech Wasilewski[1]; [1]*Univ. of Warsaw, Poland.* We demonstrate spatially resolved control of fictitious magnetic fields generated by an optically induced ac-Stark shift as a versatile tool to efficiently prepare complex spin patterns in cold atomic ensemble.

Th4K • Imaging and Applications—Continued

Th4K.4 • 17:30
Internal Strain Imaging of Visibly-Opaque Black Rubbers by Terahertz Polarization Spectroscopy, Atsuto Moriwaki[1], Makoto Okano[1], Shinichi Watanabe[1]; [1]*Keio Univ., Japan.* We succeed to develop the internal strain imaging technique for visibly-opaque black rubbers using terahertz polarization spectroscopy. Our novel method allows the nondestructive and contactless evaluation of the internal triaxial strain without any preprocesses.

Th4K.5 • 17:45
Fast and high-quality object reconstruction based on Fourier spectrum acquisition in single-pixel imaging, Yin Xiao[2,1], Wen Chen[2,1]; [1]*Dept. of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., China;* [2]*The Hong Kong Polytechnic Univ. Shenzhen Research Inst., China.* In single-pixel imaging, Fourier spectrum acquisition method is applied to generate an initial guess in Gerchberg-Saxton-like algorithm to reduce measurement number, improve convergence rate and recover high-quality object at the same time.

Th4L • Optical Fiber Gratings, Sensors & Technology—Continued

Th4L.6 • 17:30
Characteristics of CO_2-laser Inscribed Polarization-maintaining Fiber Helical Long Period Gratings, Chen Jiang[1], Yunqi Liu[1], Yunhe Zhao[1], Tingyun Wang[1]; [1]*Shanghai Univ., China.* **Abstract:** We demonstrate the fabrication of helical long period gratings inscribed in polarization-maintaining fiber using CO_2-laser, the effects of writing parameters on the gratings characteristics to the surrounding refractive index was investigated experimentally.

Th4L.7 • 17:45
Advanced Fiber Brag Grating Hydrogen Sensor by UV-Irradiation, Shiwen Yang[1,2], Xuexiang Zhong[1,2], Minghong Yang[1,2]; [1]*Wuhan Univ. of Technology, China;* [2]*National Engineering Laboratory for Fiber Optics Sensing Technology, China.* Ultraviolet light was induced into the FBG hydrogen sensing system to improve the repeatability of the sensor, experiment results show that the relative error in 40 tests under UVirradiation has been reduced by 54.2%.

18:30–20:30 Post Deadline Papers

08:00–18:00 Registration, *S221 Foyer of HKCEC*

08:30–10:00
F1A • Mid infrared Lightsource

Presider: Jinhui Yuan; Beijing Univ. of Posts and Telecommunications, China

F1A.1 • 08:30
High-Efficiency Watt-Level Mid-Infrared Fiber Lasers Beyond 3 μm using Dy:ZBLAN, Robert I. Woodward[1], Matthew Majewski[1], Gayathri Bharathan[1], Darren D. Hudson[1], Alex Fuerbach[1], Stuart D. Jackson[1]; *[1]Macquarie Univ., Australia.* We demonstrate an optimized in-band-pumped dysprosium fiber laser with 73% slope efficiency and 1.1 W output at 3.15 μm: the first watt-level fiber source in the 3.0–3.4 μm region and highest ever efficiency mid-IR fiber laser.

F1A.2 • 08:45
Handedness control of a mid-infrared 3.5 μm optical vortex MgO:PPLN parametric oscillator, Yusufu Taximaiti[1], Ranziguli Fulati[1], Sujian Niu[1], Katsuhiko Miyamoto[2], Takashige Omatsu[2]; *[1]Xinjiang Normal Univ., China; [2]Chiba Univ., Japan.* We generate the first millijoule-level tunable mid-infrared (3.362-3.677μm) optical vortex output with a topological charge *l* of ±1 by a 1 μm vortex pumped quasi-phase matching MgO-doped periodically poled lithium niobate (MgO:PPLN) optical parametric oscillator.

F1A.3 • 09:00
Low-threshold dual-waveband 3 μm and 2 μm pulse generation based on hybrid pumping, Yiwen Shi[1], Jianfeng Li[1], Hongyu Luo[1], Yao Xu[1], Fei Liu[1], Ying Gao[1], Yong Liu[1]; *[1]Univ of Electronic Science & Tech China, China.* Using hybrid pumping of CW laser diode at 1150 nm and Tm^{3+}-doped pulsed fiber laser at 1950 nm, we demonstrate a dual-waveband Ho^{3+}-doped ZBLAN pulsed fiber laser at ~2 and ~3 μm with low threshold of 1.7 W at 2 μm. Maximum output power of 136.6 and 26 mW at 2971.9 and 2062.3 nm were obtained with the repetition rate of 50 and 25 kHz, respectively.

08:30–10:00
F1B • Fiber Devices III

Presider: Liang Wang; The Chinese Univ. of Hong Kong, Hong Kong

F1B.1 • 08:30 Invited
3D printing, photonics and the IoT, John Canning[1,2], Kevin Cook[1]; *[1]Univ. of Technology Sydney, Australia; [2]Univ. of Sydney, Australia.* 3D-print prototyping and custom packaging is easier, rapid and increasingly low cost, circumventing traditional approaches, disrupting manufacture and greatly accelerating the IoT.

F1B.2 • 09:00
Laser performances of Yb-doped aluminophosphosilicate fiber under γ-radiation, Ying Y. Wang[1], Cong Gao[1], Kun Peng[1], Li Ni[1], Xiaolong Wang[1], Huan Zhan[1], Yuwei Li[1], Lei Jiang[1], Aoxiang Lin[1], Jianjun Wang[1], Feng Jing[1]; *[1]China Academy of Engineering Physics, China.* Laser performances of Yb-doped aluminophosphosilicate fiber were investigated under γ-radiation. The slope-efficiency and insert loss were sensitive to γ-radiation and exhibited obvious degradation. Effects of Al/P-codoping on radiation-induced photodarkening and dopant-chosen for radiation-hardening were discussed.

08:30–10:00
F1C • Emerging Technologies in Microwave Photonics

Presider: Simin Li; Nanjing Univ. Aeronaut. Astronaut., China

F1C.1 • 08:30 Invited
Key Techniques of Orbital Angular Momentum based Wireless Communication, Shilie Zheng[1]; *[1]Zhejiang Univ., China.* OAM based wireless communications have drawn much attention, however the inherent characteristics of OAM waves pose several challenges. In this paper some key techniques are proposed to solve such problems of OAM based communications.

F1C.2 • 09:00
Nonlinear Dynamics of Microwave State Switching in a Semiconductor Laser with Feedback, Jia Xin Dong[1], Sze-Chun Chan[1,2]; *[1]Dept. of Electronic Engineering, City Univ. of Hong Kong, China; [2]State Key Laboratory of Millimeter Waves, City Univ. of Hong Kong, China.* State switching in a semiconductor laser with feedback is investigated both experimentally and numerically. Toggled between stable and oscillatory states, the laser dynamics generates a microwave signal with a transient time below 0.7 ns.

08:30–10:00
F1D • Entanglement and Squeezed States III

Presider: Guofeng Zhang; The Hong Kong Polytechnic Univ., Hong Kong

F1D.1 • 08:30 Invited
Productions of Many Atom Entangled States and Their Interferometric Applications, Li You[1]; *[1]Tsinghua Univ., China.* Interferometric precision with N uncorrelated particles is bounded by the standard quantum limit (SQL). We report deterministic generations of entangled atomic states as well as their sensing precisions more than 8dB beyond the SQL.

F1D.2 • 09:00
Generation of ultra-short wavelength two-photon NOON state for high precision quantum metrology, Bao-Sen Shi[1], Zhi-Yuan Zhou[1], Shi-Long Liu[1]; *[1]Key Lab. of Quantum Information, China.* 525-nm two-photon NOON-state is generated by quantum frequency up-conversion of 1547-nm photon pairs. The up-converted two photons are highly indistinguishable with nearly perfect Hong-Ou-Mandel-interference and two-photon visibility high enough to beat the standard quantum limit.

08:30–10:00
F1E • Optical Fiber Sensing and Microfluidics

Presider: Zhiyong Zhao; The Hong Kong Polytechnic Univ., Hong Kong

F1E.1 • 08:30 Tutorial
New Approaches to Optical Fiber Sensing, Ali Masoudi[1], Angeliki Zafeiropoulou[1], Andrei L. Donko[1], Wanvisa Talataisong[1], Rand M. Ismaeel[1], Martynas Beresna[1], Gilberto Brambilla[1]; *[1]Univ. of Southampton, UK.* Optical fibre sensors can be classified in point, quasi-distributed and distributed sensors. This tutorial will review the different types of optical fibre sensors, with a focus on recent developments that can improve sensitivity, synamic range and resolution.

08:30–10:00
F1F • Related Technologies and Applications for Imaging, Display and Storage

Presider: Tao Yang; Nanjing Univ of Posts & Telecomm, China

F1F.1 • 08:30
Fabrication of Flexible White Light Emitting Diodes from Photoluminescent Polymer Materials with Excellent Color Quality, Yung-Min Pai[1], Chih-Hao Lin[1], Cheng-huan Chen[1], Hao Chung Kuo[1]; *[1]National Chiao Tung Univ., Taiwan.* This study flexible light-emitting diodes. Ultra-violet flip-chip for the pumping source and combined with polymer and quantum dot films achieved excellent CRI values (Ra = 96 and R9 = 96), with high reliability, demonstrating high suitability

F1F.2 • 08:45
A Laser Beam Homogenization Technology Based on Diffractive Optical Component and Corresponding Experimental Research, Xin Cai Zhao[1], Peng Gao[1], Maojie Ran[1], Ningwen Liu[1], Lihua Chang[1], Jian Li[1], Weifeng Wen[1], Qixian Peng[1]; *[1]Inst. of fluid physics,CAEP, China.* We proposed a method of laser beam homogenization based on diffractive optical components. Experiments show that the homogenization system and the image processing reduce the focal spot non-uniformity from 37.02% to 8.6%.

F1F.3 • 09:00
A Real-time, Precise Artery Pulse Monitor System Based on Graphene-Coated Fiber, Shengyao Xu[1], Zhang Y. An[1], Yuan X. Guang[1], Zhengyang Li[1], Siyao Zang[1], Yongqing Huang[1]; *[1]Beijing Univ. of Posts and Telecomm, China.* A precise radial artery pulse monitor system integrated the graphene-coated fiber was designed and fabricated. The device is low-powered and wearable while ensuring the accuracy of the pulse signals by means of real-time signal processing.

08:00–18:00 Registration, *S221 Foyer of HKCEC*

F1A • Mid infrared Lightsource—Continued

F1A.4 • 09:15
High tunable bandwidth 2μm single-frequency fiber laser for next-generation gravitational wave detection, Shuxian Qi[1], Yubin Hou[1], Qian Zhang[1], Pu Wang[1]; [1]*Beijing Univ. of Technology, China*. We demonstrate a low noise, GHz sweeping bandwidth all silica fiber single-frequency distributed Bragg reflection laser and a 160W power fiber amplifier at 1992.6 nm for next-generation gravitational wave detection.

F1A.5 • 09:30
Flat-gain Wide-band Thulium-based Fiber Laser, Elizabeth M. Lee[2,1], Jiaqi Luo[2,1], Biao Sun[2], Junhua Ji[2], Vincent Larry Ramalingam[2,1], Xia Yu[2], Qijie Wang[1]; [1]*School of Electrical & Electronic Engineering, Nanyang Technological Univ., Singapore;* [2]*Precision Measurements Group, Singapore Inst. of Manufacturing Technology, Singapore*. We report a design method for flat-gain wide-band all-fiber laser using cascaded bidirectional pumping of multi-segment thulium-doped fibers. Experimental demonstration of two-fiber setup achieved the widest reported 3-dB bandwidth of 178nm centered at 1944nm.

F1A.6 • 09:45
High-repetition-rate gain-switching at 2.103 μm pumped by h-shaped pulses, Hongyu Luo[1], Jianfeng Li[1], Fei Liu[1], Yiwen Shi[1], Yong Liu[1]; [1]*Univ Electronic Sci & Tech China (UESTC), China*. We demonstrate h-shaped pulse generation in a NPR mode-locked thulium-doped fiber laser at 1.98 μm. Its potential as a pump for a high-repetition-rate (1.435 MHz) gain-switched holmium-doped fiber laser at 2.103 μm is presented.

F1B • Fiber Devices III—Continued

F1B.3 • 09:15
Employing Tricyclic Fusion Method to Splice a Silicon Cored Fiber with a Single Mode Fiber, Yung-Lin H. Hsu[2], Lon Wang[2], Nian Jia-Ruei[1], Tsai Yao-Yang[1]; [1]*Mechanical Engineering, Taiwan;* [2]*Electrical Engineering, Photonics and Optoelectronics, Taiwan*. A silicon cored fiber (SCF) spliced with a single mode fiber (SMF) by employing a novel method called Tricyclic Fusion is shown to have lower splicing loss as compared with the use of a conventional fusion splicer.

F1B.4 • 09:30
Analyzing the mode distribution of few-mode fiber by mode-frequency mapping, Hailong Zhou[1], Jianji Dong[1], Su Chen[2], Lei Shen[2], Xinliang Zhang[1]; [1]*Huazhong Univ of Science & Technology, China;* [2]*State key laboratory of optical fiber and cable manufacture technology, Yangtze optical fiber and cable joint stock limited company, China*. The fiber modes are mapped to different frequencies by using dynamic phase masks. The complex amplitudes at these frequencies indicate the amplitudes and phases of the fiber modes.

F1B.5 • 09:45
Characterizing the Single mode - Multimode - Multimode (SMm) device for exciting a single radial mode in a multimode fiber, Nitin Bhatia[1,2], Partha Mondal[1], Shailendra Varshney[1]; [1]*Indian Inst. of Technology Kharagpur, India;* [2]*NIIT Univ., India*. We demonstrate an all-fiber method to determine the wavelengths at which a fabricated SMm device provides a single mode output. This method is quick and does not require measurement of the modal weights.

F1C • Emerging Technologies in Microwave Photonics—Continued

F1C.3 • 09:15
Demonstration of spectral holes in homogenous Brillouin gain profile in microwave domain, Siva Shakthi A[1], Anjali B. Yelikar[1], Ravi Pant[1]; [1]*IISER Thiruvananthapuram, India*. We report demonstration of room temperature artificial spectral hole burning in microwave domain. Narrow spectral hole with 3 dB linewidth ~6 MHz and depth > 35 dB are burned in homogenously broadened Brillouin gain spectra.

F1C.4 • 09:30
Tunable Suppression Ratio and SFDR Enhanced Single Sideband Generation on an Integrated Platform, Awanish Pandey[1], Shankar K. Selvaraja[1]; [1]*Indian Inst. of Science, India*. On-chip side-band suppression with enhanced SFDR and tunable suppression ratio (5dB-44dB) is demonstrated over 42Km SMF. 100 $dBHz^{2/3}$ SFDR is achieved by suppressing the 3IMD with back drop port of a self-coupled micro ring resonator.

F1C.5 • 09:45
Generating Multiple Chirped Microwave Waveforms Using an Integrated Arrayed Waveguide Sagnac Interferometer, Parisa Moslemi[1], Martin Rochette[1], Lawrence R. Chen[1]; [1]*McGill U., Canada*. We demonstrate an integrated multi-channel spectral shaper in silicon photonics for generating two chirped microwave waveforms simultaneously with a central frequency of ~ 45 GHz and RF chirps of -273.3 GHz/ns and +233.1 GHz/ns and time bandwidth products of 17.8 and 26.9.

F1D • Entanglement and Squeezed States III—Continued

F1D.3 • 09:15
Enhanced Fluorescence Collection from Color Centers via Channeling Through a Diamond Pyramid, Victor Leong[1], Sumin Choi[1], Gandhi Alagappan[2], Leonid Krivitsky[1]; [1]*Data Storage Inst., A*STAR, Singapore;* [2]*Inst. of High Performance Computing, A*STAR, Singapore*. We study silicon-vacancy centers in commercial diamond AFM tips. Fluorescence collection is enhanced by ~15× when collected at the base due a channeling effect given by the tapered geometry.

F1D.4 • 09:30
Experimental two-way communication with one photon, Francesco Massa[1], Amir Moqanaki[1], Joshua A. Kettlewell[3,4], Flavio Del Santo[1], Borivoje Dakic[1,2], Philip Walther[1]; [1]*Univ. of Vienna, Austria;* [2]*Inst. for quantum optics and quantum information (IQOQI), Austrian Academy of Science, Austria;* [3]*Singapore Univ. of Technology and Design, Singapore;* [4]*Centre for Quantum Technologies, National Univ. of Singapore, Singapore*. We experimentally demonstrate that quantum superposition permits two-way communication between two distant parties that can exchange only one photon and show that the transmitted bits and the direction of communication remain private

F1D.5 • 09:45
Generation of near IR correlated photon pairs in optical nano-fibers, Jin-Hun Kim[1], Yong Sup Ihn[1], Heedeuk Shin[1], Yoon-Ho Kim[1]; [1]*Pohang Univ of Science & Technology, Korea*. We report the generation of near-IR nondegenerate correlated photon pairs in a 13-cm-long optical nano-fiber. The coincidence-to-accidental ratio (CAR), 400 has been achieved at average pump power of 70 μW.

F1E • Optical Fiber Sensing and Microfluidics—Continued

F1E.2 • 09:30
Unprocessed whole blood sensing using micropost-embedded microfluidics with guided-mode resonance, Chan Te Hsiung[1], Meng-Zhe Tsai[1], Yang Chen[1], Cheng-Sheng Huang[1], Hsin-Yun Hsu[2], Pei-Ying Hsieh[2]; [1]*Mechanical Engineering, National Chiao Tung Univ., Taiwan;* [2]*Applied Chemistry, National Chiao Tung Univ., Taiwan*. We demonstrate a Lab-on-a-chip (LOC) system for whole blood sensing. The LOC consists of a microfluidic chip including an array of microposts for cell filtration and a label-free guided-mode resonance biosensor for real-time quantification.

F1E.3 • 09:45
Optical fiber-tip microfluidic refractive-index sensors, Mian Yao[1,2], Ouyang Xia[2], A. Ping Zhang[2], Hwa-Yaw Tam[2], Ping Kong A. Wai[1]; [1]*Dept. of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong;* [2]*Dept. of Electrical Engineering, The Hong Kong Polytechnic Univ., Hong Kong*. We present a miniature refractive-index sensor based on a fiber-top suspended mirror device. An optical 3D μ-printing technology was demonstrated to fabricate ultrathin suspended diaphragms on the end face of optical fiber for microfluidic sensing.

F1F • Related Technologies and Applications for Imaging, Display and Storage—Continued

F1F.4 • 09:15
Computational Analysis of Optically Pumped Quantum Dots Array on the Glass for Micro-LED Applications, Chung Ping Guang[1], Chien-Chung Lin[3], Shu-Hsiu Chang[2], Yu-Ming Huang[3], Chung-Ping Yu[3], Hao-Chung Kuo[4]; [1]*Inst. of Lighting and Energy Photonics, National Chiao-Tung Univ., Taiwan;* [2]*Inst. of Imaging and Biomedical Photonics, National Chiao-Tung Univ., Taiwan;* [3]*Inst. of Photonic System, National Chiao-Tung Univ., Taiwan;* [4]*Inst. of Electro-Optical Engineering, National Chiao-Tung Univ., Taiwan*. An optical simulation of tri-pixel structure quantum dot display was evaluated numerically. The light cross-talk phenomenon is obtained by analyzing optical field distribution from various lens design and glass thicknesses.

F1F.5 • 09:30
A Hole-filling Method for DIBR Based on Convolutional Neural Network, Yongrui Li[1], Xinzhu Sang[1], Duo Chen[1], Peng Wang[1], Huachun Wang[1], Jinhui Yuan[1,2], Kuiru Wang[1], Binbin Yan[1]; [1]*State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ. of Posts and Telecommunications, China;* [2]*Photonics Research Centre, Dept. of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong*. There are holes for images generated by Depth-Image-Based Rendering (DIBR) method due to occlusion of foreground. An algorithm to fill holes based on convolutional neural networks is presented. PSNR of the image after filling holes is 32.65dB.

F1F.6 • 09:45
Broadband Achromatic Aplanatic Flat Doublet in Mid-infrared, Hao Chenglong[1,2], Changyuan Yu[1,3], Cheng-Wei Qiu[1]; [1]*National Univ. of Singapore, Singapore;* [2]*National Univ. of Singapore (Suzhou) Research Inst., China;* [3]*The Hong Kong Polytechnic Univ., Hong Kong*. We propose a broadband achromatic aplanatic flat doublet, which works at 3.8 μm to 4.4 μm. The combination of sapphire flat lens and fused silica flat lens suppress the chromatic aberration and off-axial aberrations simultaneously.

10:00–10:30 Coffee Break

Room S223

10:30–12:30
F2A • Laser Comb Technologies
Presider: Guoqing Chang; Center for Free Electron Laser Science, USA

F2A.1 • 10:30
Half-cycle mJ-level CEP-stable Pulses from Parametric Waveform Synthesis, Giulio Maria Rossi[1,2], Roland E. Mainz[1,2], Fabian Scheiba[1,2], Yudong Yang[1,2], Giovanni Cirmi[1,2], Franz Kaertner[1,2]; [1]*DESY - CFEL, Germany;* [2]*Physics Dept. and The Hamburg Centre for Ultrafast Imaging, Univ. of Hamburg, Germany.* Nearly transform-limited, carrier-envelope phase stable, 3.4 fs pulses with central wavelength of 1.8 μm are generated via parametric waveform synthesis. The mJ-level energy, at 1 kHz repetition rate, allows for waveform-controlled bright high-harmonic generation.

F2A.2 • 10:45
Nonlinear amplification for a 10 W, 750-MHz Yb:fiber frequency comb, Hirotaka Ishii[1], Bo Xu[1,2], Yuxuan Ma[1,3], Isao Matsushima[1,2], Yoshiaki Nakajima[1,2], Thomas Schibli[4], Zhigang Zhang[3], Kaoru Minoshima[1,2]; [1]*The Univ. of Electro-Communications, Japan;* [2]*Japan Science and Technology Agency, ERATO MINOSHIMA Intelligent Optical Synthesizer Project, Japan;* [3]*Peking Univ., China;* [4]*Univ. of Colorado, USA.* In this study, a self-referenced 750-MHz Yb:fiber frequency comb was amplified to achieve an average power of 10 W with nonlinear amplification. Pulse duration of 107 fs and a clear comb structure was obtained.

F2A.3 • 11:00
Brillouin Lasing and Frequency Comb Generation in Bulk CVD Diamond, Robert J. Williams[1], Zhenxu Bai[1,2], Soumya Sarang[1], David J. Spence[1], Richard P. Mildren[1]; [1]*Macquarie Univ., Australia;* [2]*Harbin Inst. of Technology, China.* We report a Brillouin laser in diamond bulk pumped by a Raman-generated intracavity field at 1.24μm. Configurations for single-Stokes and frequency comb operation are demonstrated, foreshadowing new opportunities for extremely-bright lasers and on-chip diamond devices.

Room S224

10:30–12:30
F2B • Novel Plasmonics Nanostructures and Phenomena
Presider: Wending Zhang, Northwestern Polytechnical Univ., China

F2B.1 • 10:30 Invited
Anisotropic Plasmonic Light Scattering, Jianfang Wang[1]; [1]*Dept. of Physics, The Chinese Univ. of Hong Kong, Hong Kong.* Control of light propagation in space is important in optical and optoelectronic devices, photonic circuits and solar energy harvesting. Plasmonic nanostructures are demonstrated to scatter light in specific directions in space.

F2B.2 • 11:00
Designed conversion of spin and orbital angular momentum, Gun-Yeal Lee[1], Jangwoon Sung[1], Byoungho Lee[1]; [1]*Seoul National Univ., Korea.* A novel metasurface providing arbitrarily designed spin-orbit interactions of light has been proposed. Our theoretical and experimental demonstrations show the great potential of the phenomenon for various applications including optical communications and quantum optical process.

Room S225

10:30–12:30
F2C • Photonic Microwave Generation, Processing and Measurement
Presider: Motoharu Matsuura; Univ. of Electro-Communications, Japan

F2C.1 • 10:30 Invited
Microwave Nanophotonic Technologies for Instantaneous Frequency Measurement Systems, Maurizio Burla[1], Xu Wang[2], Ming Li[3], Lukas Chrostowski[2], Jose Azana[4]; [1]*ETH Zurich, Switzerland;* [2]*Univ. of British Columbia, Canada;* [3]*Inst. of Semiconductors, China;* [4]*Institut National de la Recherche Scientifique, Canada.* This paper describes recent solutions for microwave instantaneous frequency measurement (IFM) systems based on integrated microwave photonics, with particular emphasis on the use of waveguide Bragg gratings (WBG) as a possible approach for the creation of a monolithic photonic IFM system.

F2C.2 • 11:00
Wideband Microwave Frequency Down-Conversion with Optical Harmonics Intensifier and Low-Frequency Local Oscillator, Xinhai Zou[1], Shang Jian Zhang[1], Heng Wang[1], Mengke Wang[1], Zhiyao Zhang[1], Yali Zhang[1], Yong Liu[1]; [1]*Univ. of Electron. Sci&Tech of China, China.* A photonic-based method for wideband microwave frequency down-conversion is proposed and demonstrated by using a low-frequency electrical local oscillator and an optical harmonics intensifier through cascaded four-wave mixing in a semiconductor optical amplifier.

Room S226

10:30–12:30
F2D • Optical Technologies for Communications
Presider: Hai Han Lu; National Taipei Univ. of Technology, Taiwan

F2D.1 • 10:30 Invited
Silicon Photonics Tranceiver, Jinyu Mo[1]; [1]*MACOM, China.* In this talk, we discuss recent advance on integrated silicon photonics transceiver for data center applications, including optical passive alignment, 100G CWDM4 SiPh transmitter and PAM-4 transmission system based on silicon photonics.

F2D.2 • 11:00
High-Security Stream-Cipher Generation Employing Synchronized Random Bit Generation and RC4 Algorithm, Chenpeng Xue[1], Ning Jiang[1], Xiaoyan Zhao[1], Anke Zhao[1], Yanhua Hong[2], Kun Qiu[1]; [1]*Univ of Electronic Science & Tech China, China;* [2]*Bangor Univ., UK.* We propose a new stream-cipher generation scheme based on the correlated physical random bit generation with synchronized chaotic lasers and pseudo-random bit extension RC4 algorithm. The proposed scheme shows high-security, extensible rate and strong robustness.

Room S227

10:30–12:30
F2E • Laser Dynamics
Presider: Feng Li; The Hong Kong Polytechnic Univ., Hong Kong

F2E.1 • 10:30 Invited
Soliton Transient Dynamics in Ultrafast Fiber Lasers, Zhi-Chao Luo[1], Meng Liu[1], Aiping Luo[1], Wen-Cheng Xu[1], Qi Guo[1]; [1]*South China Normal Univ, China.* We review our recent results on the investigations of soliton transient dynamics in ultrafast fiber lasers, i.e., the buildup dynamics of dissipative soliton and conventional soliton, soliton explosions, rogue wave generation, real-time spectral features of vector soliton. Our findings may be useful for better understanding the soliton dynamics.

F2E.2 • 11:00
Generation of scalar and vector solitons in a bidirectional mode-locked fiber laser, Yang Xiang[1], Yiyang Luo[1], Bowen Liu[1], tao liu[1], Zhijun Yan[1], Deming Liu[1], Qizhen Sun[1]; [1]*Huazhong Univ of Science and Technology, China.* We report on a bidirectional fiber laser mode-locked by the nonlinear polarization rotation technique. Experimentally, the scalar and vector solitons are observed in the opposite directions of a fiber laser for the first time.

Room S228

10:30–12:30
F2F • Technologies and Approaches for Optical Transmission and Processing
Presider: Gabriella Cincotti; Univ. Roma Tre, Italy

F2F.1 • 10:30 Invited
Polarization Maintaining Few Mode Fibers for Space Division Multiplexing, Sophie LaRochelle[1], Alessandro corsi[1], Jun Ho Chang[1], Leslie Rusch[1], Younes Messaddeq[1]; [1]*Universite Laval, Canada.* We review proposals of polarization maintaining fibers for short reach MIMO-less space division multiplexing. We summarize transmission experiments with an elliptical ring core fiber and propose hole-assisted elliptical core designs to scale the capacity.

F2F.2 • 11:00 Invited
Distributed Raman Amplification for Combating Optical Nonlinearities in Fibre Transmission, Mingming Tan[1], Mohammad A. Al-Khateeb[1], Md A. Iqbal[1], Andrew Ellis[1]; [1]*Aston Univ., UK.* The paper reviews distributed Raman amplification technologies which can provide near symmetric signal power profiles, in order to maximize the efficiency of optical nonlinearity compensation in long-haul optical transmission systems using mid-link optical phase conjugation.

Room S223

F2A • Laser Comb Technologies—Continued

F2A.4 • 11:15
Continuous-Wave Brillouin Laser Using Bulk Diamond, Zhenxu Bai[1,2], Robert J. Williams[1], Ondrej Kitzler[1], Soumya Sarang[1], David J. Spence[1], Richard P. Mildren[1]; *[1]MQ Photonics Research Centre, Macquarie Univ., Australia; [2]National Key Laboratory of Science and Technology on Tunable Laser, Harbin Inst. of Technology, China.* We report a novel platform for Brillouin lasers in bulk, based on diamond. Continuous-wave lasing at 532.16-nm is demonstrated in a doubly-resonant ring cavity, from which we deduce a gain coefficient g_0 = 60 cm/GW.

F2A.5 • 11:30
Mode-resolved dual-comb spectroscopy with a free-running polarization-maintain fiber laser cavity, Zejiang Deng[1], Chao Wang[1], Yangcheng Ou[1], Zhiwei Zhu[1], Chenglin Gu[1], Yang Liu[1], Daping Luo[1], Wenxue Li[1]; *[1]East China Normal Univ., China.* A simple and robust dual-comb scheme with different repetition rates is demonstrated from a passively mode-locked polarization-maintain fiber cavity. With mutual coherent properties in a single cavity, mode-resolved spectroscopy is obtained with free-running state.

F2A.6 • 11:45
All-polarization-maintaining Er-fiber-based dual optical frequency combs with nonlinear amplifying loop mirror, Yoshiaki Nakajima[1,2], Yuya Hata[1], Kaoru Minoshima[1,2]; *[1]Univ. of Electro-Communications, Japan; [2]JST ERATO MINOSHIMA IOS Project, Japan.* An all-polarization-maintaining Er-fiber-based dual-comb fiber laser with nonlinear-amplifying-loop-mirror is demonstrated for realizing simple and robust dual-comb spectroscopy using two mutually coherent combs with slightly different repetition rates emitted from the laser cavity.

Room S224

F2B • Novel Plasmonics Nanostructures and Phenomena—Continued

F2B.3 • 11:15
Ultra-narrow Nanoslit Cavities for High-Q Resonances in the Visible Range, Kai Chen[1], Gary Razinskas[2], Henning Vieker[3], Heiko Gross[2], Xiaofei Wu[2], André Beyer[3], Armin Gölzhäuser[3], Bert Hecht[2]; *[1]Jinan Univ., China; [2]Universität Würzburg, Germany; [3]Universität Bielefeld, Germany.* We fabricated asymmetric nanoslit cavities by milling with helium ion microscope on the edge of single-crystal gold stripes with one end open to the air. The cavities exhibit high-Q multiple resonances in the visible range.

F2B.4 • 11:30
Asymmetric spin splitting of Gaussian beam reflected from an air-chiral interface, Chen Qi[1]; *[1]Jinan Univ., China.* We investigate systematically the chirality induced asymmetric spin splitting when Gaussian beams reflected from an air-chiral interface. We find that one spin component of the reflected beam can undergo large displacement near points of $|r_{pp}|=|r_{sp}|$.

F2B.5 • 11:45
Angle-insensitive Broadband Absorption in Tapered Patch Antennas, Lu Liu[1], Hao Peng[1], Xiangxiao Ying[1], Zhe Li[1], Yadong Jiang[1], Jimmy Xu[1,2], Zhijun Liu[1]; *[1]Univ of Electronic Science & Tech China, China; [2]Brown Univ., School of Engineering, USA.* Near-perfect broadband absorption is demonstrated in a tapered-strip patch antenna array for large angles up to 75°. The angle-insensitive absorption is attributed to an angle-independent coupling mechanism between multiple magnetic resonances and free-space incident light.

Room S225

F2C • Photonic Microwave Generation, Processing and Measurement—Continued

F2C.3 • 11:15
Microwave Generation by an Optoelectronic Oscillator with 1.55μm AlGaInAs/InP Microcavity Laser, Yue-De Yang[1]; *[1]Inst. of Semiconductors, CAS, China.* We demonstrate the optoelectronic oscillator based on a 1.55μm direct-modulated AlGaInAs/InP microcavity laser for microwave generation. Single sideband phase noise of -116 dBc/Hz at 10 kHz frequency offset is obtained for the generated signal.

F2C.4 • 11:30
Photonics based Microwave Frequency Shifter for Doppler Shift Compensation in High-Speed Railways, Ruiqi Zheng[1], Youxue Kong[1], Erwin Chan[2], Yuan Cao[1], Xudong Wang[1], Xinhuan Feng[1], Bai-Ou Guan[1]; *[1]Inst. of Photonics Technology, Jinan Univ., China; [2]School of Engineering and Information Technology, Charles Darwin Univ., Australia.* A photonic signal processor for removing the Doppler effect in high-speed railway mobile communication is simulated with results agree with theory. It is based on a time stretch/compress system to shift a microwave signal frequency.

F2C.5 • 11:45
Wideband Jamming Signal Generator Based on Dual Coherent Optical Frequency Combs, Hui Gao[1], Wenjuan Chen[2], Zhenzhou Tang[2], Dan Zhu[2]; *[1]Science and Technology on Antenna and Microwave Laboratory, China; [2]Nanjing Univ. of Aeronautics and Astronautics, China.* Jamming signal covering 11~15GHz generated from an intermediate frequency covering 3~4GHz based on dual coherent optical frequency combs was demonstrated. The SNR and the LO suppression of the generated signal were both greater than 50dB.

Room S226

F2D • Optical Technologies for Communications—Continued

F2D.3 • 11:15
Chaos communication using chaos synchronization of monolithic silicon micro-cavities, Yongjiao Niu[1], Jia-Gui Wu[1,2], Shaojie Wang[1], Ciwei Luo[1], Shukai Duan[1], Chee Wei Wong[2]; *[1]Southwest Univ., College of Electronic and Information Engineering, China; [2]Univ. of California, Fang Lu Mesoscopic Optics and Quantum Electronics Laboratory, USA.* We propose a long distance optics encryption system using silicon optomechanical (OM) micro-chips. Based on chaos synchronization between two slave OM micro-cavities, two 50Mb/s messages oppositely transmitted and effectively decrypted over 500 km.

F2D.4 • 11:30
Wideband Complexity-Enhanced Optical Chaos Generation and its Application for Fast Random Bit Generation, Anke Zhao[1], Ning Jiang[1], Chao Wang[1], Jing Zhang[1], Kun Qiu[1]; *[1]Univ of Electronic Science & Tech China, China.* A flat-spectrum optical chaos generation scheme which affords significant bandwidth enhancement and perfect time-delay-signature suppression is proposed and demonstrated. Based on this, true random bit generation can up to 800 Gb/s can be directly achieved.

F2D.5 • 11:45
Joint-Switching Characteristics of LCoS-Based Wavelength Selective Switches, Kosuke Yamashita[1], Masahiko Jinno[1]; *[1]Kagawa Univ., Japan.* We show that inter-subchannel crosstalk of a joint-switching wavelength-selective-switch based on a liquid-crystal-on-silicon spatial-light modulator significantly degrades while the applied optical attenuation increases even in an interleaved fiber arrangement.

Room S227

F2E • Laser Dynamics—Continued

F2E.3 • 11:15
Bidirectional mode-locked Er-fiber laser with symmetrical cavity configuration, Yuya Hata[2], Yoshiaki Nakajima[2,1], Kaoru Minoshima[2,1]; *[1]JST, ERATO MINOSHIMA Intelligent Optical Synthesizer Project, Japan; [2]The Univ. of Electro-Communications, Japan.* Bidirectional mode-locked Er-fiber laser with two saturable absorber mirrors and nonlinear polarization rotation is developed. Remarkable broad optical spectra in both directions with high relative stability is performed owing to symmetrical cavity configuration.

F2E.4 • 11:30
Picosecond and Femtosecond Operation of a Diode-pumped Nd,Gd:SrF_2 Laser, Vaclav Kubecek[1], Michal Jelinek[1], Miroslav Cech[1], David Vyhlidal[1], Fengkai Ma[2], Dapeng Jiang[2], Liangbi Su[2]; *[1]Czech Technical Univ. in Prague, Czechia; [2]CAS Key Laboratory of Transparent and Opto-functional Inorganic Materials, Shanghai Inst. of Ceramics, Chinese Academy of Sciences, China.* Passively mode-locked operation of diode-pumped Nd,Gd:SrF_2 laser is reported. Trains of 1.9 ps pulses at 1051 nm, 1.2 ps at 1059 nm, or 321 fs at 1053.5 nm were obtained for pump power lower than 1.3 W.

F2E.5 • 11:45
Observation of Soliton Molecules in a Fiber Laser Based on WS_2 Saturable Absorber, Bowen Liu[1], Yang Xiang[1], Yiyang Luo[1], Zhijun Yan[1], Yingxiong Qin[1], Qizhen Sun[1], Xiahui Tang[1]; *[1]Huazhong Univ. of Science and Technology, China.* We report the observation of soliton molecules in a WS_2 fiber laser. Experimentally, tightly bound soliton molecules and bunch of soliton molecules are respectively obtained which unveils the dynamics of soliton complexes in fiber lasers.

Room S228

F2F • Technologies and Approaches for Optical Transmission and Processing—Continued

F2F.3 • 11:30
Frequency Spacing and Offset Tunable Multiple-Frequency-Spaced Optical Comb Generation Using Multiple-Parallel Phase Modulator, Takahide Sakamoto[1], Akito Chiba[2]; *[1]National Inst of Information & Comm Tech, Japan; [2]Gunma Univ., Japan.* We propose reconfigurable optical comb generation using multiple-parallel phase modulator. Frequency spacing and offset of the generated combs are flexibly multiplied in several times against the driving frequency. Design criteria is clarified and numerically verified.

F2F.4 • 11:45
Rapid and accurate generation of Laguerre-Gaussian vortex beams using digital micromirror device, Lei Liu[1], Yesheng Gao[1], Xingzhao Liu[1]; *[1]Shanghai Jiao Tong Univ., China.* We propose a novel method for fast switchable, reconfigurable optical vortex beams generation with significantly high precision using a DMD. For Laguerre-Gaussian mode, the fidelity under the proposed method can reach 0.9969 and the corresponding RMSE can be as low as 0.0146.

Room S223

F2A • Laser Comb Technologies—Continued

F2A.7 • 12:00
An hybrid er:fiber femtosecond Laser for optical frequency comb applications, Yanyan Zhang[1,2], Lulu Yan[1,2], Pan Zhang[1], Bingjie Rao[1,2], Shougang Zhang[1,2], Haifeng Jiang[1,2]; [1]*National Time Center Service , China;* [2]*Univ. of Chinese Academy of Science , China*. An Er:fiber-based femtosecond laser employing nonlinear amplifier loop mirror (NALM) and nonlinear polarization evolution (NPE) mode-locking mechanisms is demonstrate. The hybrid laser combines advantages of good robustness of NALM and low noise feature of NPE.

F2A.8 • 12:15
Numerical analysis on double frequency-spacing optical comb for optimization of RF signals driving I-Q MZM, Akito Chiba[1], Yuta Moteki[1], Nobuhiro Kobayashi[1], Takahide Sakamoto[2,3], Kazumasa Takada[1]; [1]*Gunma Univ., Japan;* [2]*NICT, Japan;* [3]*Japan Science and Technology agency, Japan*. A numerical simulation is conducted for generating double-frequency-spacing optical frequency comb by an in-phase and quadrature optical modulator. RF-signal condition driving the modulator has been optimized for generating the comb with low spectral-roughness.

Room S224

F2B • Novel Plasmonics Nanostructures and Phenomena—Continued

F2B.6 • 12:00
Plasmonic analogue of strong coupling in gold nanorods, Yixiao Gao[1], Limin Tong[1]; [1]*Zhejiang Univ., China*. We numerically analyze the plasmonic interaction between dipole mode in a gold nanorod and dark mode in a nanorod dimer. Spectral splitting satisfies the strong coupling criterion. Electromagnetic energy Rabi oscillation is also observed.

F2B.7 • 12:15
Point-like surface plasmon polariton source from complementary split-ring resonators, Jin-Kyu Yang[1]; [1]*Optical Engineering, Kongju National Univ., Korea*. We numerically studied about the point-like surface plasmon polariton source from the complementary split-ring resonator (CSRR). When the normal incident light was lineally polarized parallel to the symmetric axis of the CSRR, monopole-like point SPP source was excited.

Room S225

F2C • Photonic Microwave Generation, Processing and Measurement—Continued

F2C.6 • 12:00
Experimental Analysis of Multiple Beam Injection in SMFP-LD for Multi-RF Generation, Bikash Nakarmi[1], Hao Chen[1], Shilong Pan[1]; [1]*Nanjing Univ Aeronautics & Astronautics, China*. In this paper, we use injection locking with negative wavelength detuning in a single SMFP-LD to demonstrate multi-RF generation of same and different bands. Further, we analyzed different parameters required for multi-RF generation using SMFP-LD.

F2C.7 • 12:15
Microwave Photonic Upconverter With Frequency Doubling Based on Dual-Polarization Dual-Parallel Mach-Zehnder Modulator, Dayong Wang[1,2], Jingnan Li[1,2], Yunxin Wang[1,2], Jiahao Xu[1,2], Tao Zhou[3], Xin Zhong[3], Dengcai Yang[1,2], Feng Yang[1,2]; [1]*College of Applied Sciences, Beijing Univ. of Technology, China;* [2]*Beijing Engineering Research Center of Precision Measurement Technology and Instruments, Beijing Univ. of Technology, China;* [3] *Science and Technology on Electronic Information Control Laboratory, China*. A microwave photonic frequency upconverter based on dual-polarization dual-parallel Mach-Zehnder modulator is proposed. The frequency doubled upconversion signal is obtained by beat frequency between the +1st-order intermediate frequency sideband and the -2nd-order local oscillator sideband.

Room S226

F2D • Optical Technologies for Communications—Continued

F2D.6 • 12:00
Capacity of FSO systems over lognormal fading channels with generalized pointing errors, Ruben Boluda-Ruiz[2], Antonio Garcia-Zambrana[1], Beatriz Castillo-Vazquez[1], Carmen Castillo-Vazquez[3], Khalid Qaraqe[2]; [1]*Communications Engineering, Univ. of Málaga, Spain;* [2]*Electrical and Computer Engineering, Texas A&M Univ. at Qatar, Qatar;* [3]*Mathematical Analysis, Statistics and Operations Research and Applied Mathematics, Univ. of Malaga, Spain*. A novel approximate closed-form expression for the ergodic capacity of FSO communication systems over log-normal atmospheric turbulence channels with generalized pointing errors is obtained which is valid from low to high SNR.

F2D.7 • 12:15
Improvement of positioning accuracy in visible light positioning system using orthogonal frequency division multiple access, Yitong Xu[1], Zixiong Wang[1], Jiahui Sun[1], Jian Chen[2], Shiying Han[3], Changyuan Yu[4], Jinlong Yu[1]; [1]*Tianjin Univ., China;* [2]*Nanjing Univ. of Posts and Telecommunications, China;* [3]*Nankai Univ., China;* [4]*The Hong Kong Polytechnic Univ., Hong Kong*. We proposed a novel power allocation scheme to improve the positioning accuracy in VLP system using OFDMA. The signal's power is allocated to minimize the differences among errors of square of estimated transmission distances.

Room S228

F2E • Laser Dynamics—Continued

F2E.6 • 12:00
Selective generation of mode-locked and noise-like pulses in a dispersion-mapped Yb-doped fiber laser, Yuan-He Teng[1], Pin-Han Huang[1], Hsiao-Hua Wu[2], Ci-Ling Pan[1]; [1]*National Tsing Hua Univ., Taiwan;* [2]*Tunghai Univ., Taiwan*. We report an automatic fiber laser system which can selectively generate mode-locked pulse (MLPs) or noise-like pulses (NLPs) using 3-dB optical bandwidth as the feedback signal.

F2E.7 • 12:15
Influence of filter position on timing jitter suppression of large-dispersion femtosecond fiber lasers, Peng Qin[1], Sijia Wang[1]; [1]*China Academy of Space Technology, China*. The influence of filter position on timing jitter level of large-dispersion femtosecond lasers is studied. By locating the spectral filter after the dispersion compensation, low-jitter operation can be achieved with a variety of filter bandwidth.

F2F • Technologies and Approaches for Optical Transmission and Processing—Continued

F2F.5 • 12:00
High resolution photonic RF switching based on coherent Brillouin interactions, Anjali B. Yelikar[1], Siva Shakthi A[1], Ravi Pant[1]; [1]*IISER Thiruvananthapuram, India*. We report the demonstration of an electrically controlled two-channel microwave photonic switch of 40 dB extinction exploiting coherent interaction of Stokes and anti-Stokes fields associated with the stimulated Brillouin scattering in polarization maintaining fiber.

F2F.6 • 12:15
Joint Fine Time Synchronization and Channel Estimation for PDM-CO-OFDM System, Yuanxiang Chen[1], Yongtao Huang[1], Kaile Li[1], Yitong Li[1], Jianguo Yu[1]; [1]*Beijing Univ. of Posts and Telecommunications, China*. We propose a joint fine time synchronization and channel estimation method for PDM-CO-OFDM system. The method can effectively correct synchronous error of CHU sequence caused by CD and PMD and improve channel estimation accuracy. A signal Q-value improvement of 0.8 dB is achieved after 2400 km SSMF transmission.

12:30–14:00 Lunch

Afternoon Tours

Key to Authors and Presiders

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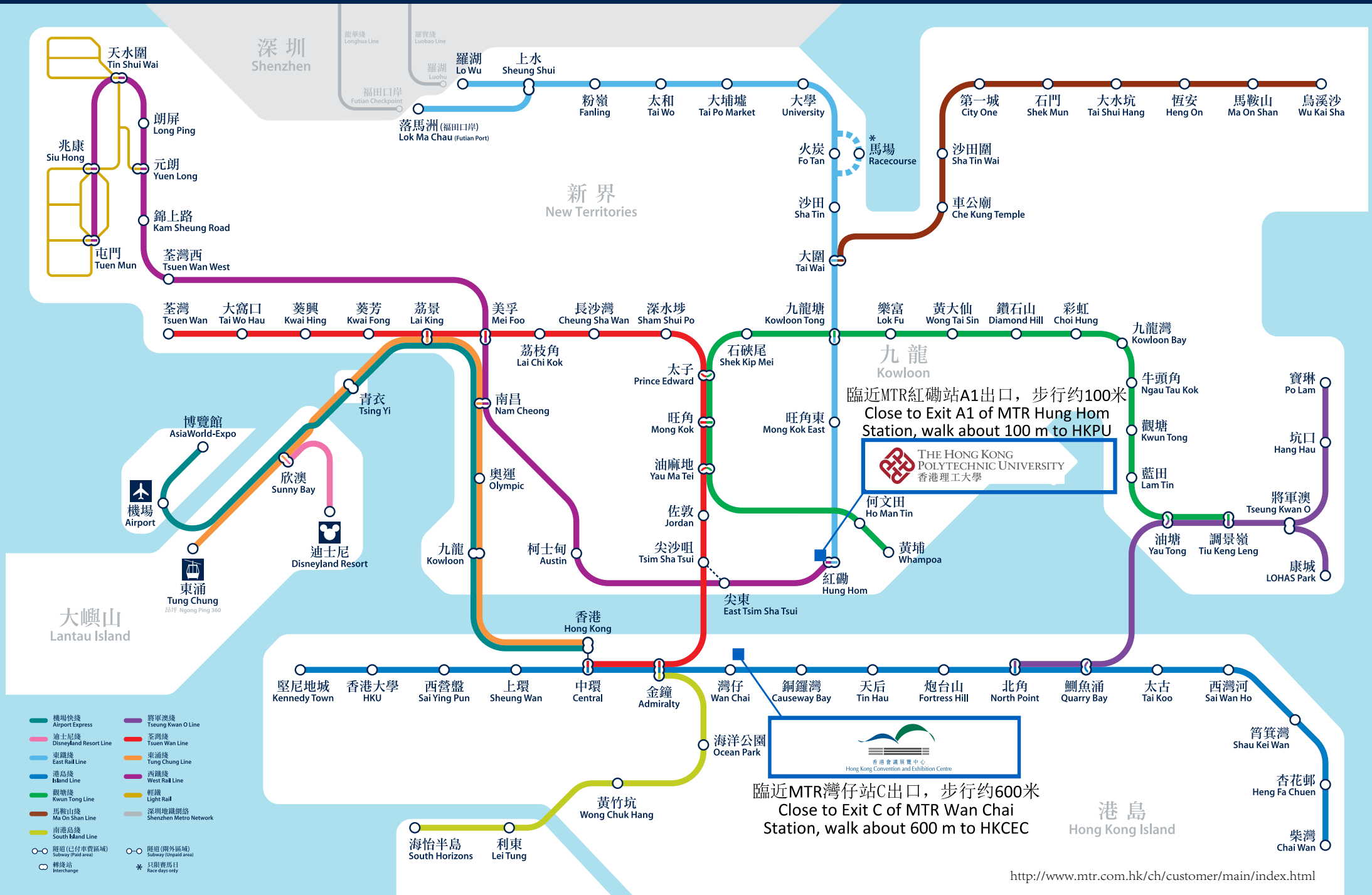
CLEO Pacific Rim 2018 Post-deadline Session (Room S421, 18:30-20:45, 2 August, 2018) *Presider: Changyuan Yu, The Hong Kong Polytechnic University*		Time
PDP.1	**Fiber-based high-dimensional quantum key distribution with twisted photons** Daniele Cozzolino[1], Davide Bacco[1], Beatrice Da Lio[1], Kasper Ingerslev[1], Yunhong Ding[1], Kjeld Dalgaard[1], Poul Kristensen[2], Michael Galili[1], Karsten Rottwitt[1], Siddharth Ramachandran[3], Leif Katsuo Oxenløwe[1] [1]*CoE SPOC, DTU Fotonik, Dep. Photonics Eng., Technical University of Denmark, Denmark* [2]*OFS-Fitel, Denmark* [3]*Electrical and Computer Engineering Department, Boston University, USA* We implement the first fiber-based orbital angular momentum (OAM) state highdimensional quantum key distribution protocol using four OAM modes, and demonstrate the highest secret key rate and longest transmission distance for OAM presented to date.	18:30-18:45
PDP.2	**Image Classification and Reconstruction through Multimode Fibers by Deep Neural Networks** Kakkava E.[1], Borhani N.[1], Pu. Y.[1], Moser C.[2], Psaltis D.[1] [1]*Optics Laboratory, School of Engineering, Ecole Polytechnique Fédérale De Lausanne, Switzerland* [2]*Laboratory of Applied Photonic Devices, School of Engineering, Ecole Polytechnique Fédérale De Lausanne, Switzerland* *A VGG-type classifier and a U-net deep neural network were used to classify a*nd restore the input image on a multimode fiber from the intensity only image of the speckle pattern at the output.	18:45-19:00
PDP.3	**Self-organized nonlinear gratings for ultrafast nanophotonics** Daniel D. Hickstein[1], David R. Carlson[1], Haridas Mundoor[2], Jacob B. Khurgin[3], Kartik Srinivasan[4], Daron Westly[4], Abijith Kowligy[1], Ivan Smalyukh[2], Scott A. Diddams[1,5], and Scott B. Papp[1,5] [1]*National Institute of Standards and Technology, U.S.A.* [2]*Department of Physics and Soft Materials Research Center, University of Colorado, U.S.A.* [3]*Department of Electrical and Computer Engineering, Johns Hopkins University, U.S.A.* [4]*Center for Nanoscale Science and Technology, NIST, U.S.A.* [5]*Department of Physics, University of Colorado, U.S.A.* We show how reconfigurable, self-organizing grating structures can be written in silicon nitride nanophotonic waveguides, using femtosecond pulses. These gratings provide simultaneous phase- and group-velocity matching for efficient broadband second-harmonic generation.	19:00-19:15
PDP.4	**Optical SNR Engineering using Warped Stretch** Jacky C.K. Chan, Bahram Jalali *Department of Electrical and Computer Engineering, UCLA, USA* We introduce a method for reversible engineering of signal to noise ratio of optical waveforms and discuss its potential for optical encryption and context-aware detection of weak signals in noisy environments.	19:15-19:30

PDP.5	**Polarization Insensitive Silicon-Indium Tin Oxide Based Electro-Absorption Modulator** Yin Xu[1,2], Feng Li[2,3], Jinhui Yuan[3,4], Zhe Kang[3], Dongmei Huang[3], Xianting Zhang[3], and P. K. A. Wai[3] *[1]Department of Electrical Engineering, The Hong Kong Polytechnic University, Hong Kong, China* *[2]The Hong Kong Polytechnic University Shenzhen Research Institute, China* *[3]Department of Electronic and Information Engineering, The Hong Kong Polytechnic University, Hong Kong, China* *[4]State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications, China* We propose a highly-efficient, low-loss, and polarization insensitive silicon-indium tin oxide electro-absorption modulator. High modulation efficiency of ~3.18 dB/μm and low insertion loss of <0.3 dB are achieved in a length of 8 μm.	19:30-19:45
PDP.6	**16nm resolution lithography using ultra-small gap bowtie apertures** Jin Qin, Liang Wang *Department of Optics and Optical engineering, University of Science and Technology of China, China* Here, we report a novel method to fabricate bowtie aperture with sub-15 nm gap. Utilizing a passive flexure stage for contact control, we present our recent lithography results with a record 16 nm resolution (FWHM).	19:45-20:00
PDP.7	**Bragg solitons in CMOS-compatible platform** Ezgi Sahin[1,2], Andrea Blanco-Redondo[3], Peng Xing[1], Doris K. T. Ng[4], Ching E. Png[2], Dawn T. H. Tan[1], Benjamin J. Eggleton[3] *[1]Photonics Devices and Systems Group, Singapore University of Technology and Design, Singapore* *[2]Institute of High Performance Computing, Agency for Science, Technology and Research, Singapore* *[3]Institute of Photonics and Optical Science (IPOS), The Sydney Nano Institute, School of Physics, The University of Sydney, Australia.* *[4]Institute of Microelectronics, A*STAR, Singapore* We demonstrate Bragg soliton dynamics on CMOS-compatible platform for the first time. We provide complete time-resolved measurements of record high-order soliton compression and show third-order dispersion induced fission in an ultra-silicon-rich nitride cladding-modulated Bragg grating.	20:00-20:15
PDP.8	**Versatile mid-infrared mode-locked fiber laser, electronically tunable from 2.97 to 3.30 μm** R. I. Woodward, M. R. Majewski, S. D. Jackson *MQ Photonics Research Centre, Macquarie University, Australia* We demonstrate the first dysprosium mode-locked laser: the longest wavelength and most widely tunable mode-locked fiber laser to date. Picosecond pulses are generated by a novel frequency-shifted feedback mechanism using an intracavity acousto-optic tunable filter.	20:15-20:30
PDP.9	**High-resolution Accurate Mosaic Imaging Technique for Laser Micro-fabrication using Motion-blur Compensation** Jerome de Leon[1], Kenichi Murakami[2], Tomohiko Hayakawa[3], Masatoshi Ishikawa[2,3] *[1]Department of Astronomy, Graduate School of Science, University of Tokyo, Japan* *[2]Department of Creative Informatics, University of Tokyo, Japan* *[3]Department of Information Physics and Computing, University of Tokyo, Japan* In this paper, high-resolution and accurate imaging and mosaicing techniques for laser micro-fabrication target are described. The effectiveness of methods are validated for capturing 0.5 μm/pixel images and mosaicing with featureless patterned images.	20:30-20:45

港鐵路綫圖 MTR system map



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