OGC2022
Optoelectronics Global Conference

The 7th Optoelectronics Global Conference (OGC 2022)

Virtual
December 6-11, 2022

Sponsored By

IEEE Photonics Society
Guangdong Chapter

Technical Sponsored By

IEEE Photonics Society

Hosted By

南方科技大学
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Local Host

CIOE
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中国国际光电高峰论坛
CHINA INTERNATIONAL OPTOELECTRONIC CONFERENCE

CONTENTS

About OGC 2022

The big leaps in optoelectronic technology and academia have drawn increasing attention from the industry community which is always in searching of innovative solutions. IEEE Optoelectronics Global Conference (OGC) was created to pave the way to connecting optoelectronic academia and industry as well as connecting China and the rest of the world.

The 7th Optoelectronics Global Conference (OGC 2022) will be held virtually from December 6-11, 2022. OGC 2022 is sponsored by IEEE Photonics Society Guangdong Chapter, hosted by Department of Electrical and Electronic Engineering, Southern University of Science and Technology.

The conference aims to promote interaction and exchange of various disciplines among professionals in academia and industry at home and abroad. In addition, it also serves to turn technologies into industrial applications. It's expected that 300-500 professionals will attend the conference.

OGC will be an ideal platform for scholars, researchers and professionals to exchange insights and discuss the development of the optoelectronics industry. It will be a perfect gathering to learn about new perspectives, technologies and trends which might push the boundaries of the technology and eventually creates a broader future for optoelectronics applications.

9 symposia are being arranged in the conference with the topics covering precision optics, optical communications, lasers, infrared applications, and fiber sensors. Welcome the professionals, experts, managements and students from the universities, research institutions, military enterprises, and optoelectronic companies to attend the conference.

Symposia

- Laser Technology
- Optical Communication and Networks
- Near-infrared, Mid-infrared and Far-infrared Technologies and Applications
- Quantum Optics and Information
- Fiber-Based Technologies and Applications
- Optoelectronic Devices and Applications
- Biophotonics and Optical Biomedicine
- Data Center Optical Interconnects and Networks
- Silicon Photonics

Special Sessions

- Emerging Technologies for Wide Bandgap Semiconductors and Information Displays
- Translational Photomedicine and Biophotonics
- THz Metamaterials and Device Applications

Workshops

- Optical Fiber Upgrade
- Computational Imaging
- Optoelectronics Sustainable Development

Conference Committee

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- **Qikun Xue,** Southern University of Science and Technology, China
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- **Perry Shum,** Southern University of Science and Technology, China
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- **Wenqing Liu,** Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China
- **Shaohua Yu,** China Information Communication Technologies Group Corporation, China
- **Ying Gu,** The General Hospital of the People's Liberation Army, China

Symposia Chairs

S1. LASER TECHNOLOGY

- **Guiyao Zhou,** South China Normal University, China
- **Tianye Huang,** China University of Geosciences (Wuhan), China
- **Jinhui Yuan,** The University of Science and Technology Beijing, China

S2. OPTICAL COMMUNICATION AND NETWORKS

- **Lei Deng,** Huazhong University of Science and Technology, China
- **Xiaodan Pang,** KTH Royal Institute of Technology, Sweden
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- **Jianping Li,** Guangdong University of Technology, China
- **Qi Yang,** Huazhong University of Science and Technology, China
- **Xijia Zheng,** Google LLC, Sunnyvale, CA, USA

S3. NEAR-INFRARED, MID-INFRARED AND FAR-INFRARED TECHNOLOGIES AND APPLICATIONS

- **Longqing Cong,** Southern University of Science and Technology, China
- **Guixin Li,** Southern University of Science and Technology, China
- **Guoxing Zheng,** Wuhan University, China
- **Yuanmu Yang,** Tsinghua University, China
- **Benfeng Bai,** Tsinghua University, China

S4. QUANTUM OPTICS AND INFORMATION

- **Ming Ding,** Beihang University, China
- **Qiang Zhou,** University of Electronic Science and Technology of China, China
- **Yong-Chun Liu,** Tsinghua University, China
- **Xuejian Wu,** Rutgers University-Newark, USA

S5. FIBER-BASED TECHNOLOGIES AND APPLICATIONS

- **Yuwen Qin,** Guangdong University of Technology, China
- **Xia Yu,** Beihang University, China
- **Lei Wei,** Nanyang Technological University, Singapore
- **Youngjoo Chung,** Gwangju Institute of Science and Technology, South Korea

S6. OPTOELECTRONIC DEVICES AND APPLICATIONS

- **Ke Xu,** Harbin Institute of Technology, Shenzhen, China
- **Xiankai Sun,** The Chinese University of Hong Kong, China
- **Yu Yu,** Huazhong University of Science and Technology, China
- **Yaocheng Shi,** Zhejiang University, China

S7. BIOPHOTONICS AND OPTICAL BIOMEDICINE

- **Changfeng Wu,** Southern University of Science and Technology, China
- **Liwei Liu,** Shenzhen University, China
- **Wei Zheng,** Shenzhen institutes of Advanced Technology, Chinese Academy of Sciences, China
- **Xuantao Su,** Shandong University, China
- **Junle Qu,** Shenzhen University, China

S8. DATA CENTER OPTICAL INTERCONNECTS AND NETWORKS

- **Qunbi Zhuge,** Shanghai Jiao Tong University, China
- **Yongli Zhao,** University of Posts and Telecommunications, China
- **Jianqiang Li,** Kuaishou Technology, China
- **Minggang Chen,** Tencent, China
- **Xian Zhou,** University of Science and Technology Beijing, China

S9. SILICON PHOTONICS

- **Mingbin Yu,** Shanghai Institute of Microsystem and Information Technology, China
- **Zeng Li,** Huawei Technologies CO., LTD., China
- **Xiao Xi,** National Information Optoelectronics Innovation Center, CICT, China
- **Di Liang,** Hewlett Packard Labs, USA

Special Sessions Chairs

T1. EMERGING TECHNOLOGIES FOR INFORMATION DISPLAYS AND LIGHTING

- **Xiaowei Sun,** Southern University of Science and Technology, China
- **Samuelson Lars,** SUSTech, China / Lund Univ, Sweden
- **Weitao Song,** Beijing Institute of Technology, China
- **Yifan Peng,** Hong Kong University, China
- **Pai Liu,** Southern University of Science and Technology, China

T2. TRANSLATIONAL PHOTOMEDICINE AND BIOPHOTONICS

- **Gina Jinna Chen,** Southern University of Science and Technology, China
- **Linbo Liu,** Nanyang Technological University, Singapore
- **Guanghui Wang,** Nan Jing University, China
- **Jing Dong,** Harvard University, USA

T3. THZ METAMATERIALS AND DEVICE APPLICATIONS

- **Chunmei Ouyang,** Tianjin University, China
- **Yuanmu Yang,** Tsinghua University, China
- **Caihong Zhang,** Nanjing University, China
- **Longqing Cong,** Southern University of Science and Technology, China

Workshops Chairs

Workshop <Optical Fiber Upgrade>

- **Zhenggang Lian,** Yangtze Optical Electronics Co., China
- **Xian Feng,** Jiangsu Normal University, China
- **Meisong Liao,** Shanghai Institute of Optics and Fine Mechanics, CAS, China
- **Chong Hou,** Huazhong University of Science and Technology, China

Workshop <Computational Imaging>

- **Fucai Zhang**, Southern University of Science and Technology, China
- **Chao Zuo**, Nanjing University of Science and Technology, China
- **Liangcai Cao**, Tsinghua University, China

Workshop <Optoelectronics Sustainable Development>

- **Xiaohui Wei,** Huizhou University, China
- **Perry Shum,** Southern University of Science and Technology, China
- **Dan Luo,** Southern University of Science and Technology, China

Special Events Chairs

C1. OPTOELECTRONICS INNOVATION CHALLENGE

- **Qizhen Sun,** Huazhong University of Science and Technology, China
- **Lei Wei,** Nanyang Technological University, Singapore
- **Jiajia Chen,** Chalmers University of Technology, Sweden
- **Fei Luo,** FLT Inc. USA
- **Xin Gong,** FemtoFiberTec GmbH, German

Guideline for Virtual Attendance

Platform: Zoom

- For Users from mainland China please download: www.zoom.com.cn/download
- For General Users please download: https://zoom.us/support/download
- Zoom Help Center: https://support.zoom.us

Time Zone

- China Standard Time (CST) UTC/GMT+08:00
- Please make sure that both the clock and the time zone on your computer are set to the correct China Time

Device

- A computer with an internet connection (wired connection recommended)
- USB plug-in headset with a microphone (recommended for optimal audio quality)
- Webcam (optional): built-in or USB plug-in

Environment

- Quiet Environment
- Stable Internet Connection
- Proper lighting

Sign In and Join

- Join a meeting without signing in: A Zoom account is not required if you join a meeting as a participant, but you cannot change the virtual background or edit the profile picture
- Sign in with a Zoom account: All the functions are available

Voice Control Rules

- The host will mute all participants while entering the meeting.
- Speakers can unmute microphone when it is his or her turn for presentation.

Conference Recording

- The whole conference will be recorded. We appreciate your proper behavior and appearance.
- The recording will be used for the conference reports among the committee. It won't be distributed to or shared with anyone else, and it shall not be used for commercial or illegal purpose. It will only be recorded by the staff; the presenters are not allowed to record.

Meeting Room of Zoom

Naming Manner

Role	Format	Example
Session Chair	Session Number-SC-Name	TS01-SC-Abby
Presenter	Session Number-Paper ID-Name	TS01-G27700-Alex
Listener	Listener-Name	Listener-Aron

Online Room

Zoom Online Room	Meeting ID	Zoom Link
Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998
Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649
Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439
Room 4	868 4632 7948	https://us02web.zoom.us/j/86846327948
Room 5	811 1444 8699	https://us06web.zoom.us/j/81114448699
Room 6	842 3086 5539	https://us02web.zoom.us/j/84230865539

Agenda Overview

December 6, 2022

*For online device test, please enter the room in which you will be giving the presentation.

Time	Activity	Zoom ID	Meeting Room	Zoom Link
10:00-12:00 Break 14:00-17:00	Online Device Test	Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998
	Online Device Test	Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649
	Online Device Test	Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439
	Online Device Test	Room 4	868 4632 7948	https://us02web.zoom.us/j/86846327948
	Online Device Test	Room 5	811 1444 8699	https://us06web.zoom.us/j/81114448699
	Online Device Test	Room 6	842 3086 5539	https://us02web.zoom.us/j/84230865539

December 7, 2022

Time	Activity		Meeting Room	Zoom ID
09:30-09:40	Opening Ceremony	*Message from general chair:* Perry Shum, Southern University of Science and Technology, China	Room 1	867 3001 0998
09:40-10:20	Plenary Speech 1	Min Gu University of Shanghai for Science & Technology, China	Room 1	867 3001 0998
10:20-11:00	Plenary Speech 2	Henry Chapman The University of Hamburg, Germany	Room 1	867 3001 0998
End of the Day				

December 8, 2022

Time	Activity		Meeting Room	Zoom ID
09:30-11:15	TS01	Laser Technology	Room 1	867 3001 0998
09:30-11:30	TS02	Optical Communication and Networks	Room 2	873 1454 0649
09:30-11:30	TS03	Near-infrared, Mid-infrared and Far-infrared Technologies and Applications	Room 3	848 7078 8439
09:30-11:30	TS04	Quantum Optics and Information	Room 4	868 4632 7948
09:30-11:15	TS05	Fiber-Based Technologies and Applications	Room 5	811 1444 8699
09:00-10:30	W2-A	Computational Imaging	Room 6	842 3086 5539
10:45-12:15	W2-B	Computational Imaging	Room 6	842 3086 5539

Time	Activity		Meeting Room	Zoom ID
Lunch Break				
13:30-15:30	TS06	Optoelectronic Devices and Applications	Room 1	867 3001 0998
13:30-15:00	TS07	Biophotonics and Optical Biomedicine	Room 2	873 1454 0649
13:30-15:00	TS08	Data Center Optical Interconnects and Networks	Room 3	848 7078 8439
13:30-15:15	TS09	Silicon Photonics	Room 4	868 4632 7948
13:30-14:45	TS10	Emerging Technologies for Information Displays and Lighting	Room 5	811 1444 8699
13:30-15:35	W2-C	Computational Imaging	Room 6	842 3086 5539
Break				
16:00-17:45	TS11	Translational Photomedicine and Biophotonics	Room 1	867 3001 0998
15:30-17:15	TS12	THz Metamaterials and Device Applications	Room 2	873 1454 0649
15:30-17:15	TS13	Laser Technology	Room 3	848 7078 8439
15:30-17:30	TS14	Optical Communication and Networks	Room 4	868 4632 7948
15:30-17:15	TS15	Fiber-Based Technologies and Applications	Room 5	811 1444 8699
16:00-17:30	W2-D	Computational Imaging	Room 6	842 3086 5539
End of the Day				

December 9, 2022

Time	Activity		Meeting Room	Zoom ID
09:30-11:15	TS16	Optoelectronic Devices and Applications	Room 1	867 3001 0998
09:30-11:15	TS17	THz Metamaterials and Device Applications	Room 2	873 1454 0649
09:30-11:30	TS18	Near-infrared, Mid-infrared and Far-infrared Technologies and Applications	Room 3	848 7078 8439
09:30-11:00	TS19	Quantum Optics and Information	Room 4	868 4632 7948
09:30-11:15	TS20	Fiber-Based Technologies and Applications	Room 5	811 1444 8699
Lunch Break				
13:30-15:15	TS21	Optoelectronic Devices and Applications	Room 1	867 3001 0998
13:30-15:00	TS22	Biophotonics and Optical Biomedicine	Room 2	873 1454 0649
13:30-15:00	TS23	Data Center Optical Interconnects and Networks	Room 3	848 7078 8439

Time	Activity		Meeting Room	Zoom ID
13:30-15:15	TS24	Silicon Photonics	Room 4	868 4632 7948
13:30-15:00	TS25	Emerging Technologies for Information Displays and Lighting	Room 5	811 1444 8699
Break				
15:30-17:15	TS26	Translational Photomedicine and Biophotonics	Room 1	867 3001 0998
15:30-17:15	TS27	THz Metamaterials and Device Applications	Room 2	873 1454 0649
15:30-17:30	TS28	Laser Technology	Room 3	848 7078 8439
15:30-17:15	TS29	Optical Communication and Networks	Room 4	868 4632 7948
15:30-17:30	TS30	Near-infrared, Mid-infrared and Far-infrared Technologies and Applications	Room 5	811 1444 8699
End of the Day				

December 10, 2022

Time	Activity		Meeting Room	Zoom ID
09:30-11:00	TS31	Quantum Optics and Information	Room 1	867 3001 0998
09:30-11:15	TS32	Fiber-Based Technologies and Applications	Room 2	873 1454 0649
09:30-11:15	TS33	Optoelectronic Devices and Applications	Room 3	848 7078 8439
09:30-11:30	TS34	Data Center Optical Interconnects and Networks	Room 4	868 4632 7948
09:30-11:15	TS35	Silicon Photonics	Room 5	811 1444 8699
Lunch Break				
13:30-15:15	TS36	THz Metamaterials and Device Applications	Room 1	867 3001 0998
13:30-15:00	TS37	Laser Technology	Room 2	873 1454 0649
13:30-15:15	TS38	Optical Communication and Networks	Room 3	848 7078 8439
13:30-15:15	TS39	Near-infrared, Mid-infrared and Far-infrared Technologies and Applications	Room 4	868 4632 7948
13:30-15:15	TS40	Fiber-Based Technologies and Applications	Room 5	811 1444 8699
13:30-15:00	W1-A	Optical Fiber Upgrade	Room 6	842 3086 5539
Break				
15:30-17:15	TS41	Optoelectronic Devices and Applications	Room 1	867 3001 0998
15:30-17:15	TS42	Data Center Optical Interconnects and Networks	Room 2	873 1454 0649

Time	Activity		Meeting Room	Zoom ID
15:30-17:45	TS43	Silicon Photonics	Room 3	848 7078 8439
15:30-17:15	TS44	THz Metamaterials and Device Applications	Room 4	868 4632 7948
15:30-17:00	TS45	THz Metamaterials and Device Applications	Room 5	811 1444 8699
15:45-17:45	W1-B	Optical Fiber Upgrade	Room 6	842 3086 5539
End of the Day				

December 11, 2022

Time	Activity		Meeting Room	Zoom ID
09:30-11:15	TS46	Optoelectronic Devices and Applications	Room 1	867 3001 0998
09:30-11:15	TS47	Optoelectronic Devices and Applications	Room 2	873 1454 0649
09:30-11:15	TS48	Fiber-Based Technologies and Applications	Room 3	848 7078 8439

Plenary Speech

Plenary Speech 1 on Dec. 7

Chair: Yiyang Luo, Chongqing University, China

Time	Room No.	Room ID	Zoom Link
09:40-10:20	Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Min Gu

University of Shanghai for Science & Technology, China

Bio

Professor Gu is Executive Chancellor and Distinguished Professor of University of Shanghai for Science and Technology. He was Distinguished Professor and Associate Deputy Vice-Chancellor at RMIT University, and a Laureate Fellow of the Australian Research Council, Pro Vice-Chancellor, and a University Distinguished Professor at Swinburne University of Technology. He is an author of four standard reference books and has over 550 publications in nano/biophotonics. He is an elected Fellow of the Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering as well as Foreign Fellow of the Chinese Academy of Engineering. He is also an elected fellow of SPIE, Optica, IEEE, AIP, InstP and COS. He was President of the International Society of Optics within Life Sciences, Vice President of the Board of the International Commission for Optics (ICO) (Chair of the ICO Prize Committee) and a Director of the Board of Optica (formerly OSA) (Chair of the International Council). He was awarded the Einstein Professorship, the W. H. (Beattie) Steel Medal, the Ian Wark Medal, the Boas Medal and the Victoria Prize. Professor Gu is a winner of the 2019 Dennis Gabor Award (SPIE) and the 2022 Emmett Norman Leith Medal (Optica)

Speech

Optoelectronics for Artificial Intelligence

Abstract: Research in optoelectronics has transformed the society in every sector of our life due to the emerging capability of the nanoscale manipulation of light in multiple physical dimensions. On the other hand, artificial intelligence based on ever-increasing computing power including neuromorphic computing has heralded a disruptive horizon in many ways of our life. Further, nano-optoelectronics including superresolution optics has provided various tools that can access the nanoscale sub-cellular studies, leading to an opportunity for the understanding of brain functionality. Thus a cross-dispensary field that integrates those exciting advancement for artificial intelligence photonics has come to age. In this talk, we will present two focused areas, superresolution nanolithography and optically digitalised holography for the development of optical artificial neural networks.

Plenary Speaker

Plenary Speech 2 on Dec. 7

Chair: Yiyang Luo, Chongqing University, China

Time	Room No.	Room ID	Zoom Link
10:20-11:00	Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Henry Chapman

The University of Hamburg, Germany

Bio

Henry Chapman FRS is a director of the Center for Free-Electron Laser Science at the Deutsches Elektronen-Synchrotron and the University of Hamburg in Germany. He carried out his PhD in X-ray optics at The University of Melbourne, Australia, work for which he was awarded the Bragg Gold Medal from the Australian Institute of Physics. Henry develops methods in coherent X-ray imaging and in exploiting the short pulse durations and extreme intensities of free-electron lasers to obtain room-temperature macromolecular structures. He is currently developing serial femtosecond crystallography using FEL and synchrotron radiation and extending it to the smallest possible crystals: that is, single molecules. For this work he was awarded the Leibniz Prize of the German Research Foundation (DFG), the Roentgen Medal, an honorary doctorate of Uppsala University, and the Aminoff Prize for crystallography from the Royal Swedish Academy of Sciences.

Speech

Imaging Macromolecules with X-ray Laser Pulses

Abstract: Free-electron lasers produce spatially coherent X-ray pulses with a peak brightness more than a billion times that of beams at modern synchrotron radiation facilities. This has provided a disruptive new technology, in several senses of the word. A single focused X-ray FEL pulse completely destroys a small protein crystal placed in the beam, but not before that pulse has passed through the sample and given rise to a diffraction pattern. This principle of diffraction before destruction has given the methodology of serial femtosecond crystallography for the determination of macromolecular structures from tiny crystals without the need for cryogenic cooling. Consequently, it is possible to carry out high-resolution diffraction studies of dynamic protein systems with time resolutions ranging from below 1 ps to milliseconds, from samples under physiological temperatures and other conditions. The high intensity and coherence of the X-ray beam can also be exploited for novel phasing approaches, ranging from preferential ionisation of elements to the use of intensity measurements between Bragg peaks. Even now, a decade after the first experiments at X-ray free-electron laseres we have not fully explored the limits of the technique.

Workshop

Workshop 1 on Dec. 10

W1-A Optical Fiber Upgrade

Chair Meisong Liao, Shanghai Institute of Optics and Fine Mechanics, CAS, China

Room No.	Room ID	Zoom Link
Room 6	842 3086 5539	https://us02web.zoom.us/j/84230865539

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Yufen Wang	China Building Materials Academy, China
14:00-14:30	Invited Talk	Wei Ding	Jinan University, China
14:30-15:00	Invited Talk	Wei Yan	Nanyang Technological University, Singapore

Paper Detail

Invited Talk	**Title:** Overview of optical silica glass for high power laser devices **Speaker:** Yufen Wang **Affiliation:** China Building Materials Academy, China **Bio:** Wang Yufen was the president of the Quartz and special glasses Institute of China Building Materials Academy, and the executive director of Quzhou Golden Glen Quartz Co., Ltd. She also serves as Deputy Director of Quartz Glass Professional Committee of China Architectural and Industrial Glass Association, expert of National Science and Technology Award expert database, Member of the National Technical Committee for Glass Standardization, expert of Beijing Municipal Science and Technology Commission, member of Optical Glass Standardization Technical Committee of CSTM Standard Committee, member of photoelectric testing Standardization Technical Committee of CSTM Standard Committee, member of CSTM/FC03 Special Glass Technical Committee, etc. She has been engaged in the research of quartz and special glass for a long time since she joined the China Building Materials Academy in 1986. Achieved a number of initiatives in large diameter composite quartz tubes, quartz tungsten transition sealing glass, vertical chemical vapor deposition quartz glass, etc. She has provided key supporting materials for China's electronics, aerospace, shipping, nuclear energy, weapons, aviation and other fields, and made important contributions to China's national defense and economic construction. So far, she has presided over and completed more than 20 national projects, such as major national projects, military scientific research, international cooperation, etc., and won 6 provincial and ministerial science and technology awards, more than 20 authorized patents, more than 20 papers, 5 standards, 2 published monographs, and won the title of "Top Ten Women in the fourth National Building Materials Industry". **Abstract:** This report first briefly introduces the types and production technology of quartz glass, and then introduces the factors that affect laser damage characteristics of optical silica glass and solutions to improve laser damage threshold. Finally, the research progress of our company in high-quality fused quartz used in high-power laser devices in recent years is mainly introduced.

Invited Talk	**Title:** Auxiliary Techniques for Advanced Anti-Resonant Hollow-Core Fiber **Speaker:** Wei Ding **Affiliation:** Jinan University, China **Bio:** As an OSA senior member, Wei Ding is a full professor at the Institute of Photonics Technology, Jinan University in Guangzhou. He received the B.S. and the M.S. degrees in physics and electronic engineering from Peking University in 1999 and in 2002, respectively. He received his Ph.D. degree from the University of Bath (U.K.) in 2007. After working as a Research Fellow at the University of Technology of Troyes (France) and Bath University (UK) from 2007 to 2011, he joined Institute of Physics, Chinese Academy of Sciences as an Associate Professor, and then moved to the current affiliation. He has published more than 60 papers in journals of Nature Communications, Laser & Photonics Reviews, Photonics Research, etc with h-index of 20. His research spans over diverse aspects of micro-structured optical fiber, integrated photonics, optical fiber communications, nonlinear optics, and nanophotonics. **Abstract:** To further enhance the applicability of anti-resonant hollow-core fiber (AR-HCF), advanced fiber-optic techniques must be developed. In this talk, I will report on a compilation of our recent progresses, ranging from ultralow-loss (< 0.1 dB) plug-&-play HCF interconnections, ultimately-low temperature sensitivity of propagation delay (40 times lower than standard silica glass fiber), to non-invasive characterization of inner structures of AR-HCFs (with the resolution of 0.3 μm). For achieving these aims, we have made efforts to minimize the mode mismatches at fiber interfaces, to regulate air-flowing behavior inside ARFs, and to develop a spectroscopic scatterometric measurement technique. We believe that the development of these novel optic approaches will enable new possibilities for AR-HCF based applications in long haul.
Invited Talk	**Title:** Intelligent Optoelectronic and Electronic Fibers and Textiles **Speaker:** Wei Yan **Affiliation:** Nanyang Technological University, Singapore **Bio:** Dr. Yan is a jointly appointed Nanyang Assistant Professor (class 2021) at the School of Electrical and Electronic Engineering (EEE) and the School of Materials Science and Engineering (MSE) at the Nanyang Technological University (NTU), Singapore. Prior to his appointment at NTU, he was a postdoctoral associate at the Research Laboratory of Electronics at the Massachusetts Institute of Technology (MIT), Cambridge, USA from September 2018 to December 2021, and a Scientist at the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland from November 2017 to August 2018. He holds a PhD in Materials Science and Engineering from EPFL (2017), for which he was awarded the 2019 Professor René Wasserman Award (the only winner), and the Best Graduate Student at EDMX Research Day, EPFL, Switzerland. His research interests focus on the development of novel materials, peculiar structure and unique functions for next-generation human-interfaced flexible and soft electronics enabling unique solutions to grand challenges in various fields such as healthcare, medicine, energy, neuroscience, robotics and textiles. He has made several research breakthroughs. He has published over 20 articles in high-profile international journals, such as Nature (1), Nature Nanotechnology (2), Advanced Materials (4), and Nature Communications (2) as well as 4 US patents. His research work has been highlighted by many prestigious media and journals, such as Nature, Science, Nature Nanotechnology, Nature News, Nature Podcast, National Science Review, MIT, EPFL, US Army, Chinese Academy of Sciences, Science and Technology Daily, China, China Science Daily, The Wall Street Journals, etc. He has been selected as a finalist for the Falling Walls Science Breakthroughs of the Year 2022 in Engineering and Technology, the recipient of Professor René Wasserman Award in 2019 (the only winner) , IEEE Best Young Scientist Award in 2021, and the finalist of Falling Walls Lab Thailand 2022. He serves as Editorial Advisory Board of "Nanotechnology" (IOP Science) and Editorial Board member of "Advanced Fiber Materials" (Springer Nature).

Abstract: Fibers, ancient yet largely underdeveloped forms, are the common building blocks of a broad spectrum of product forms from textiles to aircraft constructs. While ubiquitous, these fibers are produced at scale from essentially single materials. In this talk, I will present a new generation of fibers that incorporate a variety of functional materials, such as semiconductors, metals, dielectrics and chips. These novel fiber electronics and optoelectronics enable intelligent textiles that see, hear and speak, sense, communicate, harvest and store energy, as well as "compute".

Workshop 1 on Dec. 10

W1-B Optical Fiber Upgrade

Chair Zhenggang Lian, Yangtze Optical Electronics Co., China

Room No.	Room ID	Zoom Link
Room 6	842 3086 5539	https://us02web.zoom.us/j/84230865539

Time	Paper ID	Speaker	Affiliation
15:45-16:15	Invited Talk	Fei Yu	Shanghai Institute of Optics and Fine Mechanics, China
16:15-16:45	Invited Talk	Chaotan Sima	Huazhong University of Science and Technology, China
16:45-17:15	Invited Talk	Shun Wu	Wuhan Institute of Technology, China
17:15-17:45	Invited Talk	Jing Zhang	China University of Geosciences, China

Paper Detail

Invited Talk	**Title:** The tailoring of dispersion of photonic crystal fiber and applications **Speaker:** Fei Yu **Affiliation:** Shanghai Institute of Optics and Fine Mechanics, China **Bio:** Fei Yu received his B.S. and M.S. degrees in physics electronics from the Beijing Institute of Technology, Beijing, China, in 2008 and 2010, respectively. He received the Ph.D. degree in optics from the University of Bath, Bath, U.K., in 2014. He is currently a professor with Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences. His research interests include optical fiber design and applications.
Invited Talk	**Title:** Laser Gas Detection and Advanced Acoustic Identification Instrument **Speaker:** Chaotan Sima **Affiliation:** Huazhong University of Science and Technology, China **Bio:** Dr. Chaotan Sima, Associate Professor of Huazhong University of Science and Technology (HUST), IEEE senior member, Marie-Curie Fellowship. In 2006, he graduated from HUST with bachelor degree. In 2013, He obtained the PhD degree in optoelectronics at the Optoelectronics Research Centre in the University of Southampton, UK. After temporal R&D industry experience , he joined the School of Optical and Electronic Information in HUST and Next Generation Internet Access National Engineering Research Center in 2014. He has been awarded the European Marie-Curie Fellowship in 2019. His research interests include advanced optical gas sensing, integrated planar devices and implementation, and special fiber. He has authored/co-authored over 50 international publications, some of which are invited. He has been the PI for over 10 grants including projects from National Natural Science Foundation of China and National Key National Key Research and Development Project. He serves as an editorial member of Optical and Quantum Electronics, and a frequent reviewer of tens of OPTICA, IEEE and IET technical journals. He is also the TPC member of several international conferences, as well as a IEEE senior member since 2021 and a member of OPTICA and CSOE. **Abstract:** The talk introduces the research and engineering progress on the optical acoutstic sensing component and instrument, including the advancecd photoacoustic spectroscopy. Some key components are

	investigated and employed in the gas detection product and engineering cabinet.
Invited Talk	**Title:** Fiber-based Sensing and Laser Spectroscopy **Speaker:** Shun Wu **Affiliation:** Wuhan Institute of Technology, China **Bio:** Shun Wu received her BS in physics from Beijing Normal University in 2005 and joined Yoke khin Yap's group at Michigan Technological University in the USA for her master course. For her PhD, she joined Professor Kristan Corwin's group at Kansas State University in Manhattan, KS, USA. Her PhD work was focused on developing optical frequency reference based on portable optical fiber freuqency comb. After she completed her PhD in 2014, she joined Prof. Dan Stamper Kurn's group at University of California, Berkeley, as a post-doc working on laser cooling and trapping of dual-species (Li and Rb) ultracold atoms. She joined Wuhan Institute of Technology in Dec. 2017 to work as a full-time faculty. **Abstract:** Optically referenced combs demonstrate superior short-term instability which potentially surpass the current best RF references. We demonstrate an optical frequency comb referenced to a gas-filled hollow-core fiber using direct-comb saturated absorption spectroscopy. The resulting optical frequency comb exhibits short-term stability (6×10^{-12} at 100 ms) exceeding that of the GPS-disciplined Rb oscillator by an order of magnitude, indicating the stability of the optical reference is transferred to the comb teeth. In particular, the fiber comb optically referenced to a gas-filled fiber reference represents a large step towards an all-fiber portable frequency metrology system with low short-term instability, independent of the global positioning system (GPS).
Invited Talk	**Title:** In-fiber Fabrications and Material Science of Semiconductor Core Fibers **Speaker:** Jing Zhang **Affiliation:** China University of Geosciences, China **Bio:** Jing Zhang received her B.E. degree in optical engineering from Huazhong University of Science and Technology (China) in 2012, her master degree from Paris-Sud University (France) in 2015, and her Ph.D. degree from Nanyang Technological University (Singapore) in 2019. In December 2020, she joined School of Mechanical Engineering and Electronic Information at China University of Geosciences (Wuhan) as a professor. Her main research interests are advanced multi-functional multi-material fiber, fiber-shaped optoelectronic devices, and functional sensor devices. **Abstract:** With the development of fiber fabrication technologies and material science, optical fibers with glass cladding and semiconductor cores have been achieved, including but not limited to silicon-core fibers and germanium-core fibers. They show great potential for use in a wide range, such as optics, optoelectronics, detectors, and nonlinear response media. This report discusses the basic fabrication methods of semiconductor core fibers and examines progress in the underlying in-fiber fabrication methods and materials sciences for multifunctional fiber-shaped devices and recrystallization of fiber cores, with achievements and prospects tied to these semiconductor core materials.

Workshop 2 on Dec. 8

W2-A Computational Imaging

Chair Changlin Zheng, Fudan University, China

Room No.	Room ID	Zoom Link
Room 6	842 3086 5539	https://us02web.zoom.us/j/84230865539

Time	Paper ID	Speaker	Affiliation
09:00-09:25	Invited Talk	Yiming Li	Southern University of Science and Technoolgy, China
09:25-09:50	Invited Talk	Peng Gao	Xidian University, China
09:50-10:15	Invited Talk	Liangcai Cao	Tsinghua University, China
10:15-10:30	G27770	Bowen Wang	Nanjing University of Science and Technology, China

Paper Detail

Invited Talk	**Title:** Field dependent deep learning enables high-throughput whole-cell 3D super-resolution imaging **Speaker:** Yiming Li **Affiliation:** Southern University of Science and Technoolgy, China **Bio:** Yiming Li is an associate professor in the department of Biomedical Engineering at Southern University of Science and Technology. He received his B. Eng. in Biomedical Engineering at Shanghai Jiao Tong university in 2009, his master in Medical Physics at Heidelberg University in 2010, and his PhD in Biophysics at Karlsruhe Institute of Technology in 2015, under the supervision of Prof. Uli Nienhaus. Afterwards, he was an EMBL-EIPOD postdoctoral fellow at European Molecular Biology Laboratory (EMBL, Heidelberg) and a visiting scholar at Yale University (2016-2019). He has published many papers in high-impact international scientific journals, including Nature Methods, Nature Communications, Optics Letters, etc. The software he developed earned the first place in the SMLM challenge 2016, the most prestigious software contest in the field. Yiming's research interests including development of cutting-edge 3D super-resolution imaging techniques and their biological applications. **Abstract:** Single-molecule localization microscopy (SMLM) in a typical wide-field setup has been widely used for investigating sub-cellular structures with super resolution. However, field-dependent aberrations restrict the field of view (FOV) to only few tens of micrometers. Here, we present a deep learning method for precise localization of spatially variant point emitters (FD-DeepLoc) over a large FOV covering the full chip of a modern sCMOS camera. Using a graphic processing unit (GPU) based vectorial PSF fitter, we can fast and accurately fit the spatially variant point spread function (PSF) of a high numerical aperture (NA) objective in the entire FOV. Combined with deformable mirror based optimal PSF engineering, we demonstrate high-accuracy 3D SMLM over a volume of ~180 × 180 × 5 μm3, allowing us to image mitochondria and nuclear pore complex in the entire cells in a single imaging cycle without hardware scanning - a 100-fold increase in throughput compared to the state-of-the-art.
Invited Talk	**Title:** Quantitative phase microscopy and phase correlation spectroscopy **Speaker:** Peng Gao

	Affiliation: Xidian University, China **Bio:** Peng Gao, Ph.D, Professor at Xidian University. He studied Physics and received his Ph.D. at the Xi'an Institute of Optics and Precision Mechanics (XIOPM), CAS, in 2011. He was a "Humboldt Fellow" (2012-2014) and Marie-Curie Fellow (IEF) (2014-2018). He is currently appointed as a professor at Xidian University. His research interest includes super-resolution optical microscopy, quantitative phase microscopy and fluorescence correlation spectroscopy. So far, he has authored over 100 peer-reviewed papers in Nature Photonics, Adv. Opt. Photon., Nanophotonics, etc. Currently, he is an associate editor of Frontiers in Physics, and young editorial board member of Infrared and Laser Engineering, Chinese Laser Press, and Modern Applied Physics. **Abstract:** In this talk, we will introduce flat-fielding quantitative phase contrast microscopy (FF-QPCM), as a label-free technique to image transparent samples. FF-QPCM features a high spatiotemporal resolution of 245 nm and 250 Hz and strong immunity against external disturbance. Moreover, the combination of quantitative phase imaging with correlation spectroscopy provides a novel, label-free technique to measure the dynamics of flowing particles, such as blood flow. We demonstrate the first technique with imaging dynamic processes of intracellular organelles, including mitochondrial fusion and fission, filaments, and vesicles' morphologies in apoptosis. We demonstrate the second technique with the measurement on flowing yeast microparticles, PMMA microparticles, diluted mouse blood, and notably, in-vivo measurement of blood flow in zebrafish.
Invited Talk	**Title:** Pixel super-resolution phase retrieval algorithms for digital holography **Speaker:** Liangcai Cao **Affiliation:** Tsinghua University, China **Bio:** Liangcai Cao received his BS/MS and PhD degree from Harbin Institute of Technology and Tsinghua University, in 1999/2001 and 2005, respectively. Then he became an assistant professor at Department of Precision Instruments, Tsinghua University. He is now tenured professor and director of the Institute of Opto-electronic Engineering, Tsinghua University. He was a visiting scholar at UC Santa Cruz and MIT in 2009 and 2014, respectively. His research interests are holographic imaging and holographic display. He is SPIE fellow and OPTICA fellow. **Abstract:** The imaging quality of in-line digital holography is challenged by the twin-image and aliasing effects because sensors only respond to intensity and pixels are of finite size. As a result, pixel super-resolution phase retrieval serves as the essential ingredient for high-fidelity holographic imaging. Specifically, phase retrieval aims to encode the phase of the wavefield by transferring it into intensity variations by physical means and then numerically recover the phase and amplitude distributions via optimization algorithms. Pixel super-resolution, on the other hand, aims to surpass the Nyquist sampling limit by similar physical encoding and numerical recovery procedures, pushing the resolution toward the diffraction limit. In this work, we revisit the pixel super-resolution phase retrieval problem from a computational imaging perspective, with an emphasis on two issues: signal encoding and signal decoding. We first present a rigorous analysis of the physical encoding scheme for subpixel and phase information based on signal processing theory. On the algorithmic side, we propose a unified optimization framework for pixel super-resolution phase retrieval by recasting it as an inverse problem. In particular, we introduce the iterative projection algorithms and gradient descent algorithms for solving this problem. The basic building blocks, namely the projection operator and the Wirtinger gradient, are derived. We studied in detail the error-reduction (ER) algorithm and the Wirtinger gradient descent algorithm as two examples that are well-known to the optical community. Their close relationship and different formulations are discussed and analyzed. In addition to the two classes of algorithms, we further proposed several strategies that help improve the performance of the algorithms. Considering the ill-posed nature of pixel-super-resolved phase retrieval problem, current algorithms require a large number of measurements and rely heavily on an accurate initialization. To tackle these two problems, we introduced an adaptive smoothing strategy that is robust against different

	initialization, and a total-variation-based regularization method that helps reduce the number of measurement while still yielding competitive performance. The proposed theoretical framework is verified by both simulated and experimental data, and generalizes well to various physical settings, facilitating further applications for lensless on-chip microscopy.
G27770	**Title:** Far-field super-resolution detection based on computational imaging **Author(s):** Bowen Wang, Qian Chen, Chao Zuo **Speaker:** Bowen Wang **Affiliation:** Nanjing University of Science and Technology, China **Abstract:** We report a new computational super-resolution (SR) imaging technique, termed as coded aperture super-resolution imaging (CASR), which is to modulates the point spread function (PSF) of the imaging system by rotating the aperture pattern. The pattern is designed in an anisotropic manner so that the PSF spreads across multiple pixels and contains clues about high-frequency structure. A fundamental difference between our approach and conventional multi-image super-resolution is that CASR accounts for the diffraction effect explicitly with no need for relative motion between the scene and the detector. With CASR, we design and construct two sets of programmable aperture photoelectric imaging systems in the visible (550 nm) and long-wave infrared (8-14 μm) spectrum. The achievable equivalent Nyquist sampling frequency of the detectors is increased to 3.57× and 3.32×, respectively, which significantly improves the imaging resolution and realizes high-resolution imaging in a large field of view. Furthermore, due to its preponderances of fast response, no mechanical movement, and anti-airflow disturbance, we achieved excellent super-resolution ability for infrared and visible spectrum at 2km, with 2K and 4K imaging resolution respectively. Besides that, we propose a deep-learning-based infrared-visible images fusion method based on encoder-decoder architecture. The image fusion task is reformulated as a problem of maintaining the structure and intensity ratio of the infrared-visible image. Compared with other state-of-the-art approaches, our experimental results achieve superior performance in terms of both visual effects and objective assessments. In addition, it can stably provide high-resolution reconstruction results consistent with the human visual observation while bridging the resolution gap between the infrared-visible images.

Workshop 2 on Dec. 8

W2-B Computational Imaging

Chair Liangcai Cao, Tsinghua University, China

Room No.	Room ID	Zoom Link
Room 6	842 3086 5539	https://us02web.zoom.us/j/84230865539

Time	Paper ID	Speaker	Affiliation
10:45-11:10	Invited Talk	Ping Su	Tsinghua Shenzhen International Graduate School, China
11:10-11:35	Invited Talk	Qilin Sun	The Chinese University of Hong Kong, Shenzhen, China
11:35-11:50	W2005	Jiaji Li	Nanjing University of Science and Technology, China
11:50-12:15	Invited Talk	Jie Xu	Shenzhen University, China

Paper Detail

Invited Talk	**Title:** Fast particle fields restoration based on digital holography **Speaker:** Ping Su **Affiliation:** Tsinghua Shenzhen International Graduate School, China **Bio:** Dr. Ping Su received her doctor's degree in optical engineering from Tsinghua University, 2010, and is currently an associate professor in Division of Advanced Manufacturing, Tsinghua SIGS. She is a reserved talent in Shenzhen. She has been a visiting scholar at Nanyang Technological University, Singapore, for one year. She has published more than 30 peer-reviewed SCI-indexed papers. Her research interests include fundamentals and novel applications of diffractive optics and holography, solar blind ultra-violet communications. **Abstract:** Particle fields consisting of bubbles, droplets, aerosols, biological cells, or other small objects are of interest across many scientific domains. Digital holography (DH) is able to restore three-dimensional (3D) information and measure particle size, shape, and position from one-shot hologram. Thus, it has emerged as a powerful tool for 3D particle field imaging. Recently, machine learning has been under-utilized in DH and achieved great performance. In this study, we use DH to restore a particle field, a hologram of the particle field is reconstructed to generated raw-reconstructed images by utilizing backward Fresnel propagation. The raw-reconstructed images experience a DC term, twin-images, defocus images of other particles and noise induced by the optical system. We propose the use of a U-net model to extract in-focus particles at ground truth z and eliminate the DC term, twin-images, defocus images of other particles and noise induced by the optical system, meanwhile, the in-focus particles are encoded into pixels in the output images of the U-net model. The coordinates of pixels represent the coordinates of particles, and the gray value of pixels represents the diameter of particles. The special characterization method for particles greatly accelerates the information extraction from the output images. Finally, a 3D particle field is restored from one hologram.
Invited Talk	**Title:** Computational Imaging and End-to-end Optics Design **Speaker:** Qilin Sun **Affiliation:** The Chinese University of Hong Kong, Shenzhen, China

	Bio: Qilin Sun is an Assistant Professor at the School of Data Science, the Chinese University of Hong Kong, Shenzhen. Prof. Sun received B. Sc from the School of Optical and Electronic Information, Huazhong University of Science and Technology in 2015. From 2015 to 2021, he was a Ms./Ph.D. student at Visual Computing Center, King Abdullah University of Science and Technology. His research interests are end-to-end computational camera design, computational photography, optics, depth/transient imaging, physical-based rendering and simulation, deep learning, and optimization. Besides, Prof. Sun is the founder of PointSpread Technology, which aims to lead the revolution of computational photography. **Abstract:** Imaging systems have long been designed in separated steps: the experience-driven optical design followed by sophisticated image processing. Such a general-propose approach achieves success in the past but left the question open for specific tasks and the best compromise between optics and post-processing, as well as minimizing costs. Driven from this, a series of works are proposed to bring the imaging system design into end-to-end fashion step by step, from joint optics design, point spread function (PSF) optimization, phase map optimization to a general end-to-end complex lens camera. This frameworks offer competitive alternatives for the design of modern imaging systems and several challenging imaging applications.
W2005	**Title:** Transport of intensity diffraction tomography with non-interferometric synthetic aperture for three-dimensional label-free microscopy **Author(s):** Jiaji Li, Qian Chen, Chao Zuo **Speaker:** Jiaji Li **Affiliation:** Nanjing University of Science and Technology, China **Abstract:** We present a new label-free three-dimensional (3D) microscopy technique, termed transport of intensity diffraction tomography with non-interferometric synthetic aperture (TIDT-NSA). Without resorting to interferometric detection, TIDT-NSA retrieves the 3D refractive index (RI) distribution of biological specimens from 3D intensity-only measurements at various illumination angles, allowing incoherent-diffraction-limited quantitative 3D phase-contrast imaging. The unique combination of z-scanning the sample with illumination angle diversity in TIDT-NSA provides strong defocus phase contrast and better optical sectioning capabilities suitable for high-resolution tomography of complex multi-layer biological samples. Based on an off-the-shelf bright-field microscope with a programmable lightemitting-diode (LED) illumination source, we demonstrate the achievable imaging resolution of TIDT-NSA at 206 nm laterally and 0.52 um axially with a high-NA oil immersion objective and validate the 3D RI tomographic imaging performance on various unlabelled fixed and live samples, including human breast cancer cell lines MCF-7, human hepatocyte carcinoma cell lines HepG2, mouse macrophage cell lines RAW 264.7, multicellular Caenorhabditis elegans (C. elegans), and live Henrietta Lacks (HeLa) cells. These results establish TIDT-NSA as a new non-interferometric approach to optical diffraction tomography and 3D label-free microscopy, permitting quantitative characterization of cell morphology and time-dependent subcellular changes for widespread biological and medical applications.
Invited Talk	**Speaker:** Jie Xu **Affiliation:** Shenzhen University, China

Workshop 2 on Dec. 8

W2-C Computational Imaging

Chair Fucai Zhang, Southern University of Science and Technology, China

Room No.	Room ID	Zoom Link
Room 6	842 3086 5539	https://us02web.zoom.us/j/84230865539

Time	Paper ID	Speaker	Affiliation
13:30-13:55	Invited Talk	Changlin Zheng	Fudan University, China
13:55-14:20	Invited Talk	Shoucong Ning	National University of Singapore, China
14:20-14:35	G27760	Haozhi Sha	Tsinghua University, China
14:35-14:50	G27774	Guangyi Huang	Fudan University, China
14:50-15:05	G27776	Yang Yin	Fudan University, China
15:05-15:20	G27773	Runnan Zhang	Nanjing University of Science and Technology, China
15:20-15:35	G27783	Jiachen Wu	Tsinghua University, China

Paper Detail

Invited Talk	**Title:** Computational phase imaging in aberration corrected transmission electron microscopy **Speaker:** Changlin Zheng **Affiliation:** Fudan University, China **Bio:** Changlin Zheng is a professor at department of physics, Fudan University. He obtained the bachelor and master degree in physics from Naning University, and Ph.D degree in physics from Humboldt University of Berlin, Germany. His research interest is focused on developing advanced coherent imaging techniques in transmission electron microscopy and the applications to physics and material science. In 2018, he was awarded the John Sanders Medal. **Abstract:** Modern transmission electron microscopy (TEM) enables imaging materials down to single atom level. Such extreme resolution is achieved by using high-energy electrons with picometer wavelength to interact with matter, and using aberration correctors to precisely correct the electron optics. While the beam energy is several orders higher than the atomic potential, only the phase but not the amplitude of the incident electron beam will be modified. Thus, the phase of the electron wave carries the materials' fundamental structure information. The recent development of aberration correction techniques not only improves the spatial resolution, but also provides a unique platform for developing advanced phase imaging techniques in TEM. The corrector flattens the phase oscillation introduced by the lens aberrations up to a high angular range, and leaves significant space for specified phase modulation and subsequent phase retrieval. In this presentation, we will introduce several novel computational phase imaging techniques based on aberration-corrected TEM, and the applications to materials characterization and lens aberration diagnosis.

Invited Talk	**Title:** High precision electron ptychography **Speaker:** Shoucong Ning **Affiliation:** National University of Singapore, China **Bio:** Dr. Ning Shoucong got his Bachelor's Degree at the University of Science and Technology of China in 2013 and got his Ph.D. degree at the Hong Kong University of Science and Technology in 2017. Now he is a senior research fellow working with Prof. Stephen Pennycook at the National University of Singapore. The main research interest of Dr. Ning Shoucong focuses on electron ptychography and its application in material and biological sciences, novel 3D atomic-scale imaging techniques based on electron microscopy. Dr. Ning Shoucong has published over 35 SCI papers, including 8 nature/science series journals. **Abstract:** Correcting positional errors caused by scanning instabilities is a vital step for robust and quantitative ptychographic reconstructions. However, the robustness of the iterative ptychographic reconstruction becomes a big concern during the simultaneous optimization of the probe, object and scan positions using available position correction methods when various types of positional errors appear. Additionally, these methods meet more challenges in electron ptychography with atomic precision due to the strong correlations between the computed positional errors and reconstructed objects. Here, we propose a series of constrained gradient descent (CGD) methods to suppress these correlations and successfully recover the intrinsic information of the imaged sample with a well-built flowchart integrating these CGD methods. Positional errors covering the full frequency range are considered in our CGD methods, scanning artifacts such as the affine transformation, scan distortion, flags/skips, and scan noise can be effectively eliminated within a single scan. A picometer precision is experimentally achieved by evaluating the deformation of the reconstructed perfect lattice of 1H-MoS_2 monolayers when adopting this flowchart. Consequently, a wide application of high-precision ptychography imaging based on our CGD methods is expected in the study of the deformation in crystalline materials.
G27760	**Title:** Deep sub-angstrom resolution imaging by electron ptychography with misorientation correction **Author(s):** Haozhi Sha, Jizhe Cui, and Rong Yu **Speaker:** Haozhi Sha **Affiliation:** Tsinghua University, China **Abstract:** Super-resolution imaging of solids is essential to explore the local symmetry breaking and derived material properties. Electron ptychography is one of the most promising schemes to realize super-resolution imaging beyond aberration correction. In order to reach both deep sub-angstrom resolution imaging and accurate measurement of atomic structures, however, it is still required for the electron beam to be nearly parallel to zone axis of crystals. Here we report an efficient and robust method to correct the specimen misorientation in electron ptychography, giving deep sub-angstrom resolution for specimens with large misorientations. The method largely reduces the experimental difficulties of electron ptychography and paves the way for widespread applications of ptychographic deep sub-angstrom resolution imaging.
G27774	**Title:** Off-axis scanning transmission electron holography for a direct phase imaging **Author(s):** Guangyi Huang,Wenhao He, Jiyuan Han,Changlin Zheng **Speaker:** Guangyi Huang **Affiliation:** Fudan University, China **Abstract:** Transmission electron microscopy (TEM) is one of the most popular techniques in materials characterization. In TEM, high energy electrons transmit though the sample and the electron exit wave carries abundant crystallographic or magnetic information of the object. Unfortunately, electron detector can only record the electron intensity distributions in real space or diffraction space. To fully reveal the structure information of the object, it is essential to recover the complete electron wavefront from the recorded electron intensities. In fixed beam TEM mode with parallel illumination, off-axis electron holography provides an elegant solution for the directly phase imaging. The object wave interferes with a reference wave which is transmitting through the vacuum. The object wave then can be easily reconstructed from the hologram through Fourier transform since

	the structure of the reference wave is already known. The reference wave is usually a tilted plane wave with uniform amplitude and phase. On the contrary, it is more challenging to make a direct phase imaging in scanning transmission electron microscopy (STEM) mode. At each scanning position, the highly focused electron probe only covers a small region of the sample. Thus, the far field Rochigram normally represents a complicate interference pattern constructed by the self-interference of the unknown object. In the commonly used scanning phase imaging methods such as ptychography, the phase information has to be retrieved through advanced computing by solving a set of equations associated with different probe positions. The neighbored probes needs to be overlapped to share the structure information. Here, we propose a different approach for STEM phase imaging, the off-axis STEM holography. We realize that two tilted plane waves (corresponding to two opposite linear phase ramps) in condensed aperture plane could generate two separate probes in real space. Accordingly, one of the probes could act as a reference probe when scan in the vacuum. The generated Rochigram is thus formed with the interference of the unknown object wave with a reference probe, and greatly simplifies the phase reconstruction process. We propose two individual methods to generate the opposite linear phase ramps in condensed aperture plane. In the first method, an electron biprism is put near the condenser aperture plane to generate a pair of tilted plane wave. After the Fourier transform, two separate probes could be generated in the sample plane. In the second approach, we also propose a biprism-free method to generate two probes by taking the advantages of the lens aberrations. Using two separate small apertures to choose symmetric positions in the condensed lens aperture plane, two gradually changed phase shifts with opposite signs would be formed within the apertures when a large defocus is applied. For both methods, we evaluate the probe separations by taking the electron optical parameters. The reconstruction procedure of the off-axis STEM will also be explained.
G27776	**Title:** Electrons TIE reconstruction with noise reduction **Author(s):** Yang Yin, Xian Li, Wenzhao Wang, Changlin Zheng **Speaker:** Yang Yin **Affiliation:** Fudan University, China **Abstract:** Transmission electron microscopy (TEM) is one of the most important tools in investigating the microstructure of materials down to the atomic scale. It has been widely applied in both fundamental research and industrial applications. In TEM, high-energy electrons transmit through a thin sample with a thickness of less than 100 nm. The incident beam energy is usually in the range of 30 keV to 300 keV, much higher than a single atomic Coulomb potential or the material mean inner potential. Thus, no electrons would be absorbed by the sample, except a few of them are scattered outside the apertures or lose some energies due to the inelastic excitation. In the dominated elastic scattering events, the phase information of the electron exit wave is crucial for resolving the structure of materials. Several phase imaging techniques have been developed in TEM. Off-axis electron holography is proved as a simple and reliable method, but it needs a dedicated electron optics element – the electron biprism. Additionally, high-frequency phase information may be lost during the off-axis holography reconstruction, since a low-pass aperture should be applied to separate the sideband from the centre band. In contrast, Transport of Intensity Equation (TIE) provides an elegant solution for quantitative phase imaging, simply by considering the natural behavior of wave propagation in free space. It only needs a sequence of TEM images with different defocus, which is achievable for most of the transmission electron microscopes fitted with a field emission gun. High-frequency information could also be reserved while no carrier frequency is applied in TIE. In practice, the low-frequency phase information of the sample could be affected in electrons TIE reconstruction. This is arising from the fact that a q-2 factor is multiplied to the differential intensity signal in the reciprocal space during the reconstruction. The low frequency noise will be amplified. A high pass filter would eventually remove the low frequency noise, but the phase information is also cut to certain frequency. In this talk, we will report a systematical study of the noise effects on the electrons TIE reconstruction. We evaluate the performance of the

	indirect electron detector and explore the influence of different high pass filters on improving the quality of the reconstructed phase. We also demonstrate a denoising method for the TIE reconstruction. Finally, we will demonstrate that an electron direct detecting camera with low noise would dramatically improve the phase quality of TIE.
G27773	**Title:** Coherence retrieval and multi-contrast microscopy imaging by transport of intensity stack **Author(s):** Runnan Zhang, Zewei Cai, Chao Zuo **Speaker:** Runnan Zhang **Affiliation:** Nanjing University of Science and Technology, China **Abstract:** We report a new coherence retrieval method based on the transport of intensity stack. We capture intensity images at different focal planes, corresponding to phase-space shearing projection, into four-dimensional (4D) phase space to create both high spatial and spatial frequency resolution phase space. We represent the optical field of an arbitrary coherent mode with the help of a typical function in phase space, i.e., the Wigner distribution function. Previous studies mainly focus on coherence measurement by means of interferometry. In addition, despite the sacrifice of both spatial and spatial frequency resolution, wavefront sensor is also a standard tool for coherence measurement. To overcome the existing problems, our method only requires z-scanning to achieve full-resolution coherent retrieval of the optical field without interferometric detection. Furthermore, without requiring hardware modifications, we introduced our coherence retrieval method into microscopic imaging. We apply our method to multi-contrast microscopic imaging with only an intensity stack, which has the potential to allow clinicians to view a sample with three separate contrast methods at once, enhancing the information available for diagnosis and disease discrimination.
G27783	**Title:** Robust reconstruction for Fresnel zone aperture lensless imaging **Author(s):** Jiachen Wu, Liangcai Cao **Speaker:** Jiachen Wu **Affiliation:** Tsinghua University, China **Abstract:** The Fresnel zone aperture (FZA) lensless imaging utilizes a Fresnel zone plate to encode the incident light as holographic pattern. However, twin image is produced by the back propagation method commonly used in digital holographic reconstruction. The background light intensity and noise without information in the encoded image further reduce the signal-to-noise ratio of the reconstructed image. To address the problems, we proposed a robust reconstruction method for FZA lensless imaging. By minimizing first-order difference of the residual between prediction and measurements with total variation regularization, it can effectively eliminate the interference of the constant term in the coded image and suppress twin image in reconstruction. Furthermore, we verify the feasibility of compressive reconstruction for FZA imaging under incomplete sampling. The reconstruction results show that the radiation sampling mode has higher image sampling efficiency than the rectangle sampling mode. The experiments demonstrate a moderate quality image could be achieved by only 7.3% measurements. The proposed method is feasible to build multiply sensors architecture for FZA imaging, so that high-resolution image could be obtained by using several small size sensors instead of a large size sensor.

Workshop 2 on Dec. 8

W2-D Computational Imaging

Chair Chao Zuo, Nanjing University of Science and Technology, China

Room No.	Room ID	Zoom Link
Room 6	842 3086 5539	https://us02web.zoom.us/j/84230865539

Time	Paper ID	Speaker	Affiliation
16:00-16:25	Invited Talk	Liangping Xia	Yangtze Normal University, China
16:25-16:50	Invited Talk	Shuming Jiao	Peng Cheng Laboratory, China
16:50-17:15	W2001	Tao Liu	Southern university of science and technoolgy, China
17:15-17:30	G27788	Shuo Peng	Beijing Institute of Technology, China

Paper Detail

Invited Talk	**Title:** Continuous surface micro-structured optical chips and applications **Speaker:** Liangping Xia **Affiliation:** Yangtze Normal University, China **Bio:** Master's supervisor and Professor of Yangtze Normal University, Young scholar of Bayu scholars program, Top ten scientific and technological workers of the 5th Chongqing Electronic Society. Main research topics are micro-/ nano- optical theory, micro-/ nano-structure fabrication and applications. The research achievements got the 1st class reward of science and technology of the 8th China Optical Engineering Society. He published 50 scientific research papers, got 20 invention patents, and presided over 2 NSFC and more than 10 other research projects. **Abstract:** Lens is a basic optical device in optical imaging, detection and communications. When the size of the lens is limited to micrometer dimension, the device is the continuous surface micro-structured optical chip. However, the fabrication of such chips is difficult with conventional method due to the small aperture size and continuous configuration. The method of mask moving lithography is proposed to solve the problem. The fabrication theory, development and processes are built to satisfy the fabrication of continuous surface micro optical chip. With this method, a lot kinds of continuous surface micro-structured optical chips could be fabricated such as the microlens array, micro cylinder lens array, phase compensator and engineered diffuser. In addition, as the commercial products, the chips of microlens array are used in coupling of multi-channel optical communications, the chips of engineered diffuser are used in time of flight 3D imaging sensing and in AR-HUD display.
Invited Talk	**Title:** Single-pixel imaging for non-imaging interactive tasks **Speaker:** Shuming Jiao **Affiliation:** Peng Cheng Laboratory, China **Bio:** Dr. Shuming Jiao is currently an assistant researcher in Peng Cheng Laboratory, Shenzhen, China. He received his PhD degree in electronic engineering from City University of Hong Kong in 2016. He has been actively engaged in the interdisciplinary investigation between computer algorithms and optics. His research

	interest includes holographic three-dimensional imaging and display, single-pixel compressive imaging, optical information processing, optical computing, image processing, information security and machine leaning. He received Hong Kong PhD Fellowship Scheme (2012) and Postdoctoral Fellowship, Pearl River Talent Plan of Guangdong Province (2016). He has published more than 20 papers as the first author or corresponding author in peer-reviewed journals such as Optics Letters, Optics Express, IEEE Transactions on Industrial Informatics and Engineering. He received Distinguished Paper Award in International Conference on Display Technology 2020 (ICDT 2020) organized by Society for Information Display. **Abstract:** Single-pixel imaging (SPI) is a novel optical imaging technique by replacing the pixelated sensor array in a conventional camera with a single-pixel detector. The object image is sequentially illuminated by various projection patterns and the total light intensity of object scene is collected as a single-pixel light intensity for each illumination. Finally, a single-pixel light intensity sequence can be obtained after many illuminations and the object image can be computationally reconstructed. To certain extent, SPI can be considered as a physical implementation of compressive sensing. As a unique feature of SPI, the design of illumination patterns and the amount of object image information to be acquired can be flexibly controlled. In previous works, SPI is usually used for capturing object images or performing image processing tasks. In our recent works, we investigate using SPI for several non-imaging tasks. These works are favorable for implementing the next-generation of intelligent, privacy-preserving and optical-computing-based cameras. (1) Optical machine learning with a single-pixel detector. A fast object classification scheme based only on a very limited number of single-pixel intensity values with almost no digital post-processing in SPI is proposed. Unlike conventional SPI, the target object is only illuminated by a few patterns and the object image is not reconstructed. A single-pixel imaging model is considered to inherently coincide with the linear classifier model in machine learning. The several optimal illumination patterns for the classification task can be designed with an iterative algorithm from a set of training images. The classification result can be revealed from the index of the highest single-pixel intensity value. Like an optical computer, the system can perform the classification of number digits, traffic sign images and fashion product images in an all-optical manner. (2) Visual cryptography in SPI. Visual cryptography (VC) is combined with SPI in two novel ways. It is pointed out that the overlapping of visual key images in VC is similar to the superposition of pixel intensities by a single-pixel detector in SPI. In the first scheme, QR-code VC is designed by using opaque sheets instead of transparent sheets. The secret image can be recovered when identical illumination patterns are projected onto multiple visual key images and a single detector is used to record the total light intensities. In the second scheme, the secret image is shared by multiple illumination pattern sequences and it can be recovered when the visual key patterns are projected onto identical items. The application of VC can be extended to more diversified scenarios by our proposed schemes. (3) Solving combinational optimization problems with evolutionary SPI. An Ising machine model is implemented optically with evolutionary SPI for solving combinational optimization problems including number partition and graph maximum cut. In SPI, the Hamiltonian function can be considered as an inner product between a map of weighting factors and a correlation map of spinning states. The former one is represented by a grayscale object image and the latter one is represented by a programmable binary illumination pattern. The recorded single-pixel light intensity value is equivalent to the opposite of the Hamiltonian function. Based on the feedback of single-pixel intensity values, a group of illumination patterns are gradually evolving and our proposed scheme can finally optimize the Hamiltonian function and obtain an optimized solution.
W2001	**Title:** Performance enhancement of Coherent Modulation Imaging in the presence of missing data **Author(s):** Tao Liu, Meng Sun, Fucai Zhang **Speaker:** Tao Liu **Affiliation:** Southern University of Science and Technoolgy, China **Abstract:** Coherent diffraction imaging (CDI) has been widely applied to synchrotron x-ray imaging and electron

	microscopy. In the far-field geometry, CDI posts high requirements on detector; specifically, the dynamic range, pixel size, and diffraction data integrity. Coherent modulation imaging (CMI) releases the requirement on the dynamic range of detector by inserting a phase plate between the sample and detector. Here, we extend the current CMI method by modifying the modulus constraint to recover the missing part of diffraction pattern. Nine folds of extrapolation in area of diffraction pattern have been shown feasible in experiment; while sixteen folds in simulation. In addition, the result of our method has noticeable improvement over the traditional method in terms of visual quality. The proposed method provides a way to alleviate the nonideal effects in data acquisition introduced by beamstop, modulus gap, limited dynamic range, and limited detector size for CMI.
G27788	**Title:** Hybrid calibration procedure for structured light field system **Author(s):** Shuo Peng, Liquan Dong, Yayu Zhai, Shaohui Zhang, Yao Hu, Qun Hao **Speaker:** Shuo Peng **Affiliation:** Beijing Institute of Technology, China **Abstract:** A typical structured light field system consists of a light field camera and a pattern projector. By combining Fringe Projection Profilometry and light field imaging technology, the phase distribution characteristics of each position and each angle of the scene under test could be obtained, thus providing more information dimensions, and therefore improving the robustness and dynamic range of three-dimensional (3D) measurement. System calibration is a decisive factor for high-efficiency and high precision measurement. However, the complicated structure and working method make the calibration of structured light field system usually costly and cumbersome. In this paper, we propose a hybrid calibration approach combining the flexibility of the stereo vision method and high precision characteristics of the phase-coordinate mapping method. The feasibility of the proposed method has been verified in actual experiments with typical 3D targets.

Technical Session

Technical Session on Dec. 8

TS01 Laser Technology

Chair Dongmei Huang, The Hong Kong Polytechnic University, China

Room No.	Room ID	Zoom Link
Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Ai-Ping Luo	South China Normal University, China
10:00-10:30	Invited Talk	Dongmei Huang	The Hong Kong Polytechnic University, China
10:30-10:45	G277120	Yu-Yang Lou	Chongqing Normal University, China
10:45-11:00	G27777	Yifei Zhao	South China Normal University, China
11:00-11:15	G27764	Chonghao Wu	Harbin Institute of Technology (Shenzhen), China

Paper Detail

Invited Talk	**Title:** Narrowband spatiotemporal mode-locked Yb-doped fiber laser. **Speaker:** Ai-Ping Luo **Affiliation:** South China Normal University, China **Bio:** Ai-Ping Luo received the Ph.D. degree in optical engineering from the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai, China, in 2004. Since 2004, she has been with the School of Information and Optoelectronic Science and Engineering, South China Normal University, Guangzhou, China, where she is currently a Professor. From 2007 to 2008, she was an academic visitor at the École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland. She is the author or coauthor of more than 130 international journal and conference papers. Her current research interests include fiber-based devices, fiber lasers, and nonlinear fiber optics. **Abstract:** We demonstrate an all fiber narrow bandwidth spatiotemporal mode-locked (STML) Yb-doped fiber laser based on a CNT/PVA film. The mismatched structure with different fibers forms a multimode interference bandpass filter, which supports the narrow bandwidth STML operations. A wavelength-tunable pulse with a bandwidth narrowing to pm level and almost no chirp is generated. What's more, different pulse states are achieved, including multiple pulses and harmonics. In order to give an insight into the generation of the narrow bandwidth STML pulses, numerical simulations are performed. The obtained results propose a new method for achieving narrow bandwidth all-fiber STML lasers, and such a laser has a great potential application in fields of optical communication and optical measurement, as well as supplies a favorable platform for studying the evolution dynamics of multimode solitons.
Invited Talk	**Title:** Fourier domain mode locked laser and its applications **Speaker:** Dongmei Huang **Affiliation:** The Hong Kong Polytechnic University, China

	Bio: Dr. Dongmei Huang received her B.Eng. in Measuring and Control Technology and Instrumentation from Huazhong University of Science and Technology in 2014, Wuhan, China, and M.S. in College of Optoelectronic Engineering from Chongqing University in 2017, Chongqing, China and PhD in the Department of Electronic and Information Engineering from the Hong Kong Polytechnic University in 2020, Hong Kong. Since then she joined the Hong Kong Polytechnic University as a Postdocotral Fellow. Currently, she is a Research Assistant Professor in the Department of Electrical Engineering, the Hong Kong Polytechnic University. Her research focuses on the mode locked fiber lasers, swept fiber lasers and applications in OCT and LiDAR, WGM microresonator and fiber optics sensors. **Abstract:** The Fourier domain mode-locked (FDML) laser was proposed to overcome the limitations of buildup time by inserting a long fiber delay in the cavity to store the whole swept signal and it has attracted much interest in both theoretical and experimental studies. This talk presents the theoretical models to understand the dynamics of the FDML laser and the experimental techniques to realize high speed, wide sweep range, long coherence length, high output power, and highly stable swept signals in FDML lasers, and applications of FDML laser will be presented.
G277120	**Title:** Routes to Chaos in Semiconductor Quantum Dot Laser Subject to optical Feedback **Author(s):** Yu-Yang Lou, Xing-Yu Wang, Jian-Wei Wu **Speaker:** Yu-Yang Lou **Affiliation:** Chongqing Normal University, China **Abstract:** In this talk, the research on the nonlinear dynamics of semiconductor quantum dot laser with two time-delayed optical feedbacks is numerically investigated. Results show that the nonlinear dynamics behaviors of the laser are very sensitive to the rich system parameters in which both feedback strength and bias current are easily controlled to significantly influence the nonlinear dynamics including the periodic state and chaotic state. By judiciously adjusting the bias current of the laser or the feedback strength in the external cavity, period one, period doubling, quasi-period, and chaos are achieved. The feedback level-related bifurcation diagrams are analyzed in detail while fixing another feedback level at a constant or varying the bias current. These results can give insight into the quantum dot laser–based applications in various optical technologies.
G27777	**Title:** ErYb co-doped double-clad fiber amplifiers with average gain of 29dB by high concentration doping **Author(s):** Yifei Zhao, Yifan Zhang, Shizhuo Xi, Guiyao Zhou **Speaker:** Yifei Zhao **Affiliation:** South China Normal University, China **Abstract:** We proposed an ErYb co-doped double-clad fiber amplifier. By adjusting the ion doping concentration of the gain medium in the core, the gain characteristics of the EYDFA are theoretically analyzed. In the experiment, through the setup of the cladding pumped optical amplifier system, the absorption value of the fiber to 976nm pump light reaches 2.06db/m, and the average gain of 29dB is obtained in the 1531-1567nm band. The corresponding noise figure varies from 4.9 to 11.6 dB.
G27764	**Title:** Multiple states of dissipative soliton resonance based on a figure-8 fiber laser **Author(s):** Chonghao Wu, Yong Yao **Speaker:** Chonghao Wu **Affiliation:** Harbin Institute of Technology (Shenzhen), China **Abstract:** Passively mode-locked fiber lasers have been extensively investigated in the past few decades due to their compact structure, low cost, ability to provide a good platform for studying soliton dynamics in nonlinear systems. Researchers have found that the peak-power-clamping effect achieved by a saturable absorber with a sinusoidal transmission function is vital in obtaining dissipative soliton resonance (DSR) pulses. In order to further investigate the generation and evolution of DSR pulse in a laser cavity, nanosecond DSR pulses with different features are studied in a figure-8 mode-locked fiber laser. The experimental results show that by inserting a segment of highly nonlinear fiber (about one kilometer) into the nonlinear amplifying loop mirror

	(NALM), two types of DSR pulse with different peak power and pulse duration can be observed. The total cavity length is ~1021 m and the fiber laser operates in the anomalous dispersion regime. Since the saturation power of a NALM is inversely proportional to product of splitting ratio and loop length, we choose a large splitting ratio and a large loop length to reduce the saturation power in NALM. As a result of the peak-power-clamping effect inducing by this design, multiple states of DSR square pulses are generated. The pulse trains, autocorrelation traces, optical spectra and radio frequency spectra of these two types of DSR pulse are provided. The output pulse of the fiber laser is quite stable, and the noise in the laser cavity is effectively suppressed. The DSR pulse has a quasi-square profile. When the pump power is increase from 96 mW to 261 mW, the peak power of DSR pulse is basically unchanged, while the pulse energy and pulse duration can monotonically increase. The energy of a single DSR pulse is large, and the pulse energy will continue to increase with the increase of pump power. Since the peak power of DSR pulse is low, the corresponding spectral 3dB bandwidth is narrow. Furthermore, when the pump power and polarization controller orientation are changed appropriately, in addition to the fundamental DSR state, different orders of harmonic DSR pulses with a tunable duration can be generated respectively. The physical mechanism on switching and evolution of different DSR pulses is analyzed and we point out that the variation of nonlinear losses and spectral filtering effect in the laser cavity play an important role in the generation of different DSR pulses. These phenomena will contribute to better understanding of the characteristics and nonlinear dynamics of DSR square pulses in passively mode-locked fiber lasers.

Technical Session on Dec. 8

TS02 Optical Communication and Networks

Chair Chen Chen, Chongqing University, China

Room No.	Room ID	Zoom Link
Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Xiaosong Yu	Beijing University of Posts and Telecommunications, China
10:00-10:30	Invited Talk	Xiaomin Liu	Shanghai Jiao Tong University, China
10:30-11:00	Invited Talk	Di Zhang	Kuaishou Technology, China
11:00-11:15	G27732	Zhenming Liang	China Telecom Research Institute, China
11:15-11:30	G2771	Xiangwei Zeng	Ludong University, China

Paper Detail

Invited Talk	**Title:** Security Analysis in Quantum Key Distribution Networks When Integrated with Classical Optical Networks **Speaker:** Xiaosong Yu **Affiliation:** Beijing University of Posts and Telecommunications, China **Bio:** Xiaosong Yu received his Ph.D. degree from Beijing University of Posts & Telecommunications (BUPT), and he was a visiting scholar at UC Davis. He is currently with State Key Laboratory of Information Photonics and Optical Communications (IPOC) at BUPT. His research focuses on quantum key distribution optical networks, optical network optimization, software defined optical networks, and so on. **Abstract:** From the initial key delivery facility, quantum technologies are expected to be further integrated with classical optical networks. In this presentation we will discuss possible new forms of security threats in the integrated networks and relevent countermeasures to them.
Invited Talk	**Title:** Combining AI and physics for digital-twin optical networks **Speaker:** Xiaomin Liu **Affiliation:** Shanghai Jiao Tong University, China **Bio:** Xiaomin Liu received the B.S. Degree in information engineering from Shanghai Jiao Tong University in 2020. She is currently pursuing Ph.D. degree in the State Key Laboratory of Advanced Optical Communication Systems and Networks in Shanghai Jiao Tong University, China. Her current research interests include modeling, monitoring and optimization in optical networks. **Abstract:** For the past few years, artificial intelligence has been widely utilized for optical network applications. Based on AI techniques, the accuracy and efficiency of these applications can be improved. In future, fusing physics and AI can further improve the performance of the network control and management and achieve better reliability and interpretability. Possible directions for combining AI and physics are investigated and introduced for building self-driving optical networks.
Invited Talk	**Title:** The Road to Convergence of IP and Optical Networks **Speaker:** Di Zhang

	Affiliation: Kuaishou Technology, China **Bio:** Dr. Zhang Di is currently a network architect of Kuaishou Technology, Beijing, China, responsible for the R&D of datacenter optical networks, architecture design and new technology introduction. He received the Ph.D. degree in optical engineering from the Huazhong University of Science and Technology, Wuhan, China, in 2012. Before joining Kuaishou in 2020, he worked on the technology R&D and product operation in the field of ultra high speed, high density and tunable optical interconnects in Accelink Technologies from 2007. He leaded and participated in more than 10 national projects of 863 and 973 programs, national key R&D plans and major provincial scientific and technological innovation projects, applied more than 40 patents and published 14 international conference and journal papers. **Abstract:** Datacenter (DC) is the key infrastructure for internet-based applications such as short-video streaming, social networks as well as searching. Recently, the growing demand of high performance computing like artificial intelligence (AI) and machine learning (ML) have resulted in a dramatic increase of DC capabilities. As we know, optical interconnects have become the first choice to scale out both intra- and inter-DC networks, in order to keeping up with the increasing bandwidth demands of hype-scale DC, the importance of ‘co-design’ concept combining both IP and optical networks technologies has been raised. In this topic, we review the evolution of DC network and the optical interconnects industry, discuss the latest technologies enabling network simplification, e.g. Co-packaged optics, ZR/ZR+. The challenges for scaling the next generation DC bandwidth scaling are also studied.
G27732	**Title:** A SDN Enabled PON Controller based on Hierarchical Models **Author(s):** Zhenming Liang，Ziyao Yang，Jian Tang **Speaker:** Zhenming Liang **Affiliation:** China Telecom Research Institute, China **Abstract:** With the evolution of network architecture and changes in service requirements, operators are posing new challenges to Passive Optical Network (PON) operation and maintenance. In order to solve the lack of intelligent operation and maintenance capabilities of PON, this paper proposes a software defined network (SDN) enabled PON controller based on hierarchical models. PON controller is a codeless frameworks based on model-driven and graphical programming. The standardized YANG model enables the flexible and quick modelling and services handling of different professional levels’ services and networks in PON system. Based on Telemetry technology, a real-time and high-precision collection solution for PON network can be built, realizing allround and fined real-time visibility of network services. Besides, by introducing the artificial intelligence (AI) technology represented by machine learning and deep learning, automatic closed-loop operating status monitoring, analysis and decision-making of industrial PON networks can be realized, the intelligent level of network operation and maintenance can be improved, which aims to build an automated, visualized and intelligent PON.
G2771	**Title:** Evaluation method of polarization state characteristic in forward transmission **Author(s):** Zeng Xiangwei, Li Yahong, Chen Xueye, Zhang Quanzhong, Li Xiaoyu **Speaker:** Xiangwei Zeng **Affiliation:** Ludong University, China **Abstract:** An evaluation method to evaluate polarization state characteristic in forward transmission is introduced in this paper. To remedy the evaluation insufficient of Stokes parameters, we defined a new dimensionless parameter: RoPS (retention rate of polarization state). Its meaning is to describe the retention rate of polarization state of forward scattered light. Compared with Stokes parameters, the new parameter can avoid the effect introduced by calculation of orthogonal component intensity difference. In short, RoPS is a transformation of Stokes-Mueller calculation form. RoPS can avoid the effect introduced by calculation of orthogonal component intensity difference. This research offers potential application values in communication, detection, and so on.

Technical Session on Dec. 8

TS03 Near-infrared, Mid-infrared and Far-infrared Technologies and Applications

Chair Shun Wu, Wuhan Institute of Technology, China

Room No.	Room ID	Zoom Link
Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Ehab Awad	King Saud University, Saudi Arabia
10:00-10:30	Invited Talk	Shuting Fan	Shenzhen University, China
10:30-11:00	Invited Talk	Chuantao Zheng	Jilin University, China
11:00-11:30	Invited Talk	Haoyun Wei	Tsinghua University, China

Paper Detail

Invited Talk

Title: Optical nano-plasmonics for enhanced infrared detection

Speaker: Ehab Awad

Affiliation: King Saud University, Saudi Arabia

Bio: Ehab Awad has received his M.Sc. and Ph.D. in Electrical engineering from the University of Maryland College Park (UMCP), USA. He has received his B.Sc. and additional M.Sc. in Electrical engineering from Cairo University, Egypt. He is currently a Professor at the Electrical Engineering Department, King Saud University, Saudi Arabia. He worked as a postdoctoral research associate at the UMCP, USA. He is currently a senior member of the IEEE photonics society and Optica (formerly OSA, Optical Society of America). He has plenty of leading patents and publications in several international journals and conferences. He is the recipient of the Almarai award for his distinguished and innovative research work on nanoplasmonics. Several of his research works have received the spotlight through international media. He is a principal investigator with research expertise and interests in nanophotonics, optical plasmonics, optical metamaterials, silicon photonics, optical fibers, optical communications, optoelectronic devices, lasers, and infrared sensors.

Abstract: Infrared optical detection devices such as photodetectors, solar cells, cameras, and microbolometers are becoming smaller in size with a tiny effective active area in the range of a few micrometers or even nanometers. That comes at the expense of a smaller aperture area of the device, and in turn inefficient collection of infrared energy. Therefore infrared plasmonic optical antennas are becoming essential to efficiently collect optical energy from free space and concentrate it down to a device's tiny area. However, it is desirable to develop antennas with a broad bandwidth, polarization insensitivity, wide field-of-view, and reasonable plasmonic losses. That ensures collection of most incident infrared radiation and enhancement of optical power absorption efficiency.

In this talk, I will present several plasmonic optical antennas for enhanced optical absorption and detection, some of which have polarization discrimination capabilities. However, I will focus on an innovative optical antenna called optenna. It has a novel shape that looks like a Bundt baking pan and it is made of gold. The Bundt unit cell is arranged in a periodic array that can be placed on top of a thin film infrared absorbing layer. The optenna utilizes surface plasmons to squeeze both electric and magnetic fields of infrared radiation down to

	a 50 nm-wide area and thus can enhance optical absorption efficiency within the underneath thin film layer or guided graphene metamaterial. The optenna demonstrates polarization insensitivity and ultra-broad bandwidth with a large fractional bandwidth within the near, shortwave, and midwave infrared bands. It also shows a remarkable enhanced power absorption efficiency and a wide field of view. It is promising for applications in energy harvesting, imaging, sensors, free-space optical communications, and biomedical technology.
Invited Talk	**Title:** Progress in Terahertz biomedical applications **Speaker:** Shuting Fan **Affiliation:** Shenzhen University, China **Bio:** Shuting Fan graduated from Tianjin University in 2011 with a B. Eng degree. She received her Ph.D. degee from the Hong Kong University of Science and Technology in 2015. She was a Research Fellow at the University of Western Australia from 2015 to 2017. She joined Shenzhen University as an Assistant Professor in 2017. Her research Interests include terahertz Time-domain Spectroscopy, terahertz biomedical applications, and terahertz data processing techniques. **Abstract:** The sensitivity to water has made terahertz technology a potential tool for biomedical applications. Particularly, a large body of work has been devoted to cancer diagnosis with terahertz waves since the very first demonstration published in 2002. With the advancement of micro/nano fabrications, the detection of cancer in the terahertz frequencies has expanded from the macro-level (tissue) to micro-level (cell, DNA, and protein). In this talk, I will present the progress of terahertz biomedical applications, with emphasis on terahertz cancer detection, from both macro- and micro-levels.
Invited Talk	**Title:** On-chip waveguide gas sensors based on mid-infrared absorption spectroscopy **Speaker:** Chuantao Zheng **Affiliation:** Jilin University, China **Bio:** Chuantao Zheng is a Professor in State Key Laboratory of Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University, China. His research interests include infrared laser spectroscopy and gas sensing system. He achieved the young and middle-aged leading scientific and technological innovation talents in Jilin Province in 2018. He is a senior member of China Optical Society, a senior member and director of the Optical Society. Jilin province, and also a member of organizing committee of national laser spectral technology academic forum. In 2005, 2007 and 2010 he obtained the bachelor, master and Ph. D degree from Jilin University. In September 2013, he became an associate professor. In December 2016, he became a doctoral supervisor. From September 2015 to September 2016, he went to Rice University as a visiting scholar. He was appointed as a full professor in September 2018. He has undertaken 17 projects of National Natural Science Foundation of China, national key R & D program and national science and technology program. As a first or corresponding author, he has published 184 papers (114 indexed by SCI and 70 by EI). He has applied for 13 national invention patents (11 authorized), published one academic monograph, and won the Jilin Natural Science Academic Achievement Award in 2014.
Invited Talk	**Title:** Fast Coherent Raman spectro-imaging with delay-spectral focusing dual comb method **Speaker:** Haoyun Wei **Affiliation:** Tsinghua University, China **Bio:** Haoyun Wei is an Associate Professor in the Department of Precision Instrument at Tsinghua University. He received his Ph.D. degree in optical Engineering from Tsinghua University in 2007. His research interests include optical interferometry, optical frequency comb, laser spectroscopy, and Raman spectroscopy. He has published more than 60 peer-reviewed papers and has won the first prize of Beijing science and technology award, the first prize of science and technology progress award of China society for measurement, etc. **Abstract:** Rapid multiplex coherent anti-Stokes Raman scattering (CARS) spectroscopy shows great advantages in real-time dynamic process visualizations, clinical diagnosis, abundant microplastic assessment, etc. Dual-comb CARS (DC-CARS), circumventing slow-acquisition spectrometers or mechanical motion inertia,

	holds the promise to offer high-speed measurement. However, it is currently suffered from low duty cycle (<1%) and limited spectral coverage (<1500 cm-1). In this talk, We demonstrate a novel delay-spectral focusing dual-comb (DC) CARS scheme based on two fiber combs with 100-MHz repetition rates. By combining the particular advantages of DC asynchronous optical sampling and spectral-focusing instantaneous single molecular vibration excitation, flexible detection in fingerprint region and high-wavenumber region is achieved. Further, a rapid delay-focusing method with intra-cavity electro-optic modulation is applied to actively control the DC relative delay scanning in the Raman shift region of interest. The spectral acquisition rate is improved more than 1000-fold up to 40,000 spectra/s, while keeping spectral resolution (~10 cm-1) and signal-to-noise ratio (~260) stable along with active acquisition rate tuning. The prospect of rapid acquiring multiplex CARS spectra without the sacrifice of spectral resolution or need for the coherence of pulse source offers huge potential in rapid monitoring circumstances, such as flow cytometry and microspectroscopic imaging in biomedicine.

Technical Session on Dec. 8

TS04 Quantum Optics and Information

Chair Yongmin Li, Shanxi University, China

Room No.	Room ID	Zoom Link
Room 4	868 4632 7948	https://us02web.zoom.us/j/86846327948

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Jin Wang	Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences, China
10:00-10:30	Invited Talk	Anhui Liang	Shandong University of Science and Technology, China
10:30-11:00	Invited Talk	Yong-Chun Liu	Tsinghua University, China
11:00-11:30	Invited Talk	Guangzong Xiao	National University of Defense Technology, China

Paper Detail

Invited Talk	**Title:** Mass-energy Jiont test of the equivalence principle at using atoms with specified mass and internal energy **Speaker:** Jin Wang **Affiliation:** Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences, China **Bio:** Jin Wang, a professor of Innovation Academy for Precision Measurement Science and Technology, CAS. He graduated from Anhui Institute of Optics and Fine Mechanics, CAS in 1999 with a doctorate degree. He was engaged in cooperative research in the Blackett Laboratory of Imperial College London in 1999, and was a senior visiting scholar at Stanford University in the United States from 2006 to 2007. He mainly engaged in the experimental research of cold atom interferometer, designed and realized a 10-meter atom interferometer and tested equivalence principle using atoms at a high level. He applied atom interferometer technology to inertial measurement, and successfully developed atom sensors. He published more than 70 SCI papers, 1 monograph, 2 chapters, and obtained 16 authorized invention patents. **Abstract:** We use rubidium atoms with specified mass and internal energy to carry out a joint mass-energy test of the equivalence principle (EP). We improve the four-wave double-diffraction Raman transition method (4WDR) we proposed before to select atoms with a certain mass and angular momentum state, and form a dual-species atom interferometer. By using the extended 4WDR to Rb-85 and Rb-87 atoms with different angular momenta, we measure their differential gravitational acceleration, and we determine the value of the Eötvös parameter, η, which measures the strength of the violation of EP. The Eötvös parameters of the four paired combinations, violation parameter of mass and that of internal energy are obtained. This work opens a door for joint tests of two attributes beyond the traditional pure mass or energy tests of EP with quantum systems.
Invited Talk	**Title:** Optimal Form of Uncertainty Principle and Their Applications in Quantum Communication, Quantum Computing and Quantum Measurement **Speaker:** Anhui Liang

	Affiliation: Shandong University of Science and Technology, China **Bio:** Professor Anhui Liang is the second level professor, Shandong University of Science & Technology, China. He held several positions, e.g. Chief Scientist, FiberHome Technologies; Deputy Director of University Academic Committee, Nanjing University of Posts and Telecommunications, and Tyco Submarine Systems Ltd. in USA etc. He has published more than 100 papers, plenary talks, invited talks and patents etc.. He has made significant contributions in the fields of optical fiber communications, vision， biological optical AI, quantum mechanics and Chinese meridian, sleep, AD, chromosome optical fibers and biological fibers. He has important contributions in 7 of 125 unresolved key questions listed by famous Science journal. He gave six super large internet lectures on these related topics, and over 600 thousand of audiences attended. The number of audiences to attend his internet lectures is biggest in single person internet lectures in Science and Technology in China. Their interview by Baidu Academic had 160 millions of exposure in the first month of the release. He has been interviewed by many national level newspapers and TV channels, e.g. People's Daily, Science and Technology Daily etc. He is China Overseas Chinese Contribution Award recipient ; Yearly Person of "Scientific Chinese". **Abstract:** Heisenberg's uncertainty principle is one of the three cornerstones of quantum mechanics interpretation, but the form of the traditional uncertainty principle is not optimal. We discover that the optimal form of the new uncertainty principle is a pair of equations. When dealing with entangled states, this pair of formulas can be several orders of magnitude more accurate than the traditional uncertainty principle, and can show the wave-particle duality more clearly. Although the hidden variables proposed by Einstein do not exist, we have discovered the existence of hidden parameters. At least six parameters are required to characterize a quantum state., where four of these six parameters are independent. There are only two parameters used in the traditional uncertainty principle, and we found that these two parameters are not enough to characterize a quantum state. In addition to the these two parameters defined by amplitudes in time and energy domains, we proposed it is necessary to have two parameters defined by phases in time and energy domains. We think that each of Einstein, Schrödinger's explanation and Copenhagen's explanation are only partly correct. One of the 125 unsolved key problems listed in "Science" magazine is: "Are there any deeper principles behind quantum uncertainty and non-locality?" We give a quantitative formula to measure the non-locality, and find that the relative net energy uncertainty is equal to the relative net non-locality. We think we can solve this key problem in principle. In this project, we shall study the applications of the new uncertainty principle in the frontiers of quantum research as well, e.g. quantum communication, quantum computing, and quantum measurement.
Invited Talk	**Title:** Hybrid skin-topological effect induced by gain and loss **Speaker:** Yong-Chun Liu **Affiliation:** Tsinghua University, China **Bio:** Yong-ChunLiu is an associate professor at Department of Physics, Tsinghua University,China. His research interests include quantum optics and quantum precisionmeasurement. He has published more than 70 papers, which are cited over 2200times, with a H factor of 28. He has been serving as an editorial board memberof scientific journals including Frontier of Physics, Acta Photonica Sinica. Hewas selected as a young Changjiang Scholar of the Ministry of Education ofChina, and won Rao Yutai fundamental optics award and Wang Daheng optics award. **Abstract:** Non-Hermitian topologicaleffects are of crucial importance both in fundamental physics and applications.In non-Hermitian systems, the interplay between the non-Hermitian skin effectsand topological effects lead to the hybrid skin-topological effects. Wediscover the gain-loss-induced hybrid second-order skin-topological effect andthe PT phase transition in skin-topological modes. By studying a non-HermitianHaldane model, we find that the topological edge modes are localized on specialtype of corners, exhibiting non-Hermitian skin effect, while the bulk modesremain extended. Such an effect originates from the

	interplay between gain,loss, and the chiral edge currents induced by the nonlocal flux, which can becharacterized by considering the properties of the edge sites as a one-dimensionalchain. We establish a relation between the skin-topological effect and the PTsymmetries belonging to different edges. Moreover, we discover the PT phasetransition with the emergence of exceptional points between pairs ofskin-topological modes. These results pave the way for manipulatingnon-Hermitian and topological properties through gain-loss control, and shedslight on studying PT phase transition in higher-dimensional systems.
Invited Talk	**Title:** In-vacuum loading technology of nanoparticles in the on-chip levitated optomechanical sensors **Speaker:** Guangzong Xiao **Affiliation:** National University of Defense Technology, China **Bio:** Guangzong Xiao received his B.Sc degree in physics from Wuhan University in 2005, and his M.Sc and Ph.D degrees in optical engineering from National University of Defense Technology in 2007 and 2012, respectively. He is currently an associate professor at National University of Defense Technology, where he leads the Optically Levitated Sensors Group. His main areas of interest include on-chip optical trapping and optically levitated sensors. **Abstract:** Optomechanics is concerned with the use of light to control mechanical objects. Micro- and nano-particles levitated in optical fields act as nanoscale oscillators, making them excellent low-dissipation optomechanical objects, with minimal thermal contact to the environment when operating in vacuum. Thus optically levitated nanoparticles offer enormous potential for precision sensing. Remarkable progress in trapping micro-scale and nanoscale spheres at high vacuum pressures was achieved by Li and Novotny, respectively. In 2010, Li et al. reported the measurement of the instantaneous velocity of a Brownian particle with counter propagating dual-beam optical tweezers . Gieseler et al. managed to cool its threespatial degrees of freedom by means of an active parametric feedback scheme and reported an optically trapped nanoparticle in high vacuum. These works indicated that, as a system couples optical field and mechanical oscillator, optical trapped particles in vacuum could be an ideal candidate for precision measurement, pushing the frontiers of sensitivity in an accelerometer , a force sensor , and so on. Monolithic optical trap will be potential for robust and portable on-chip sensors. However, the first thing we need to face is the trap loading. The trap loading in air is quite different from that in water. The adhension forces is usually much larger than optical forces and particle gravity. So, the initiation in water is quite easy, while that in air is hard. There are mainly three common methods for trap loading in vacuum: vibrations method using piezoceramics, pulse laser-assisted method and nebulization method. We have compared three common methods for optical loading in vacuum and give some simple comments. 1)To the date, vibration method is most commonly used, but it's less efficient . 2)The pulse laser-assisted method is most convenient, but not all the material could bear the peak laser power and resulted effects. 3) The nebulizer method is flexible. It is unable to decide which particle to be captured or how many particles are trapped.So, until now, efficient single-particle trap loading in vacuum remains a problem. The features of the in-vacuum loading in chips are quite different from those in regular setups. In regular setups, trap loading occurs in an open region, and it' s flexible, so we only need rough control of the loading parameters. In contrast, in-vacuum loading in chips occurs in a limited and settled structures, so it required fine control of the loading parameters. In order to achieve efficient single particle loading in chips, our group analyzed the major components of adhesion force. Then we found that van der Waals force and capillary force need be first fine controlled. We calculated and analyzed the adhesion forces between a smooth microsphere and a rough loader surface. The adhesion force reaches minimum with roughness around 10 nm. As the surface roughness decreases, the adhension force grows rapidly. As the roughness grows from 10nm, the adhesion force grows too, but slowly. So adhesion forces can be controlled to several nano-Newtons with the condition of optimal surface roughness. Besides, we also researched the dynamics of microsphere in the process of loading. The z axis(along the

	trapping beam) trajectory and velocity of the micosphere were figured, as well as the valid region of optical trap. It's obvious that there is a velocity region where the microsphere can be captured. The velocities of the particles decrease rapidly after detachment. That is because the viscous resistance is proportion to the velocity. We can get an optimal detachment velocity region when the initial position offset where the microsphere can be loaded.

Technical Session on Dec. 8

TS05 Fiber-Based Technologies and Applications

Chair Zinan Wang, University of Electronic Science and Technology of China, China

Room No.	Room ID	Zoom Link
Room 5	811 1444 8699	https://us06web.zoom.us/j/81114448699

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Howard Lee	University of California, Irvine, USA
10:00-10:30	Invited Talk	Yiyang Luo	Chongqing University, China
10:30-11:00	Invited Talk	Luming Zhao	Huazhong University of Science and Technology, China
11:00-11:15	G27763	Hanyu Zhao	University of Science and Technology Beijing, China

Paper Detail

Invited Talk	**Title:** "Meta"-Optical Fibers: Integration of Metaphotonics with Fiber Optics **Speaker:** Howard Lee **Affiliation:** University of California, Irvine, USA **Bio:** Howard Lee is currently an Associate Professor in the Department of Physics and Astronomy at UC Irvine. Before joining UCI, he was an Associated Professor in the Department of Physics at Baylor University and IQSE Fellow and visiting professor in the Institute for Quantum Science and Engineering (IQSE) at TexasA&M. He was a Postdoctoral Fellow at the Caltech, working with Prof. Harry Atwater in active plasmonics/metasurfaces. He received his PhD in Physics from the Max Planck Institute for the Science of Light in Germany in 2012 under the supervision of Prof. Philip Russell (2015 President of OSA). His current research focuses on active linear, nonlinear, and quantum plasmonic/metasurface/zero-index optics, quantum biophotonics and imaging, "meta"-fiber optics, and hybrid photonic-plasmonic on-chip optical devices. His work on nano-optics, plasmonics, and photonic crystals has led to 35 journal publications in various journals, such as Science, Nano Letters, Advanced Materials, ACS Photonics, and Laser & Photonics Reviews as well as 50 invited talks and 130 conference papers. Dr. Lee is a recipient of a 2021 iCANX Young Scientist Award, 2021 Finalist of Rising Stars of Light, 2020 SPIE Rising Researcher, a 2020 Baylor Outstanding Professor Award, a 2019 DARPA Director's Fellowship, a 2019 IEEE OGC Young Scientist Award, a 2018 NSF CAREER Award, a 2017 DARPA Young Faculty Award, a 2018 OSA Ambassador, a 2017 APS Robert S. Hyer Award, a 2018 Baylor Young Investigator Award, a 2016 Baylor Proposal Development Award, and a 2012 Croucher Postdoctoral Fellowship. He organized more than 10 technical sessions in nanophotonics/metasurfaces in international conferences (CLEO, META, PQE, MRS) and serves as Lead Symposium Organizer for plasmonic/metasurface symposiums at 2019-2021 MRS Fall Meeting and 2020-2022 MRS Spring Meeting. He is a Founding Associate Editor for OSA Continuum and Associate Editor for Nature Scientific Reports and Photonics journals. **Abstract:** Optical fiber is a well-established and efficient light-guiding medium. Although optical fiber is efficient for transmitting light, its functionality is limited by the dielectric material of the core, which has poor optoelectronic, magneto-optical, and nonlinear-optical responses and has a dielectric diffraction limit. Therefore,

	the optical properties of the optical fiber such as phase, amplitude, polarization, and mode profile, cannot be altered after the fiber drawing fabrication, thus limiting the development of novel in-fiber devices. Integration of new materials and nanostructures into fiber will enhance processing/transmission capabilities and novel functionalities. In this talk, I will present our recent development of “Meta”-optical fiber, an advanced optical fiber integrated with emerging nanophotonic concepts such as optical metasurfaces, plasmonic nanowires, and zero-index photonics. I will present the development of ultrathin optical metalens which is cascaded on the facet of a photonic crystal fiber that enables light focusing. I will also discuss the first experimental demonstration of zero-index resonance excitation in an optical fiber coated with AZO nanolayer and excitation of plasmonic resonances on holey optical fiber for advanced optical sensing and tip-enhanced Raman spectroscopy. These advanced “meta”-optical fibers open a pathway to revolutionary in-fiber lasers/spectroscopies, optical imaging/sensing, and optical communication devices.
Invited Talk	**Title:** Manipulation on self-assembled pulses in ultrafast lasers **Speaker:** Yiyang Luo **Affiliation:** Chongqing University, China **Bio:** Dr. Yiyang Luo received the PhD. in Optical Engineering from Huazhong University of Science and Technology, China in December 2017. And later, he joined in Huazhong University of Science and Technology as an Assistant Researcher till 2018. From September 2018 to December 2020, he worked as a Research Fellow in Nanyang Technological University, Singapore. From January 2021, he joined in Chongqing University as an Associate Professor. He is involved in the research on ultrafast fiber lasers and sensing applications. In particular, he developed multiplexed ultrafast fiber lasers for versatile pulse emission. He also gained insight into the internal dynamics of self-assembled pulses by using dispersive Fourier transform based real-time spectroscopy. Till now, he has published more than 40 Refereed Journal articles and possessed 5 patents. **Abstract:** In analogy to matter, the interaction of ultrashort pulses induces vivid multi-pulse dynamics. As a result, the ultrashort pulses can evolve into various self-assembled pulses such as soliton molecule, soliton crystal, soliton bunch etc. These pulse complexes will extend the application scenarios of ultrafast lasers. In this talk, we will report on our current research progress on the manipulation of the self-assembled pulses assisted with the real-time spectroscopy. The manipulation mechanism on the temporal separation and the phase evolution of self-assembled pulses are unveiled, particularly paving a new way to exceeding the binary coding limits.
Invited Talk	**Title:** Soliton Characterization by using the Nonlinear Fourier Transform method **Speaker:** Luming Zhao **Affiliation:** Huazhong University of Science and Technology, China **Bio:** Luming Zhao received the B.Eng. and M.Eng. degrees from Tsinghua University, Beijing, China, and the Ph.D. degree from Nanyang Technological University, Singapore. He is currently a professor with School of Optical and Electronic Information, Huazhong University of Science and Technology, Wuhan, China. His research interests include ultrafast optics, fiber oscillators, fiber amplifiers, and soliton dynamics. **Abstract:** Soliton features during propagation is described by using the Nonlinear Fourier transform (NFT). Fundamental soliton and high-order solitons can both be identified. Soliton order can be identified by the number of eigenvalues. The discrete spectrum rotates, along with the propagation in a single mode fiber, at a period determined by the temporal soliton evolution period. Soliton distillation is carried out for both fundamental soliton and high-order solitons. The results suggest that soliton characteristics can be well described in the nonlinear frequency domain by using the NFT method.
G27763	**Title:** Non-Invasive Optical Fiber Sensing Vital Signs Monitoring Based on Envelope Extraction BCG Data Processing **Author(s):** Hanyu Zhao, Guo Zhu, Fei Liu, Xiaojun Liu, Jinhui Yuan, Xian Zhou

	Speaker: Hanyu Zhao **Affiliation:** University of Science and Technology Beijing, China **Abstract:** An envelope-extraction-based ballistocardiography (BCG) data processing method is proposed with a non-invasive optical fiber sensor in this paper. The accuracy of heart rate calculation value can reach 1.28 ± 0.59 bpm (Mean Absolute Error ± Standard Deviation, MAE ± SD) for one minute of measured data. This designed system can identify human body status and analyze Heart Rate Variability (HRV).

Technical Session on Dec. 8

TS06 Optoelectronic Devices and Applications

Chair Xiaolong Chen, Southern University of Science and Technology, China

Room No.	Room ID	Zoom Link
Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Xiaolong Chen	Southern University of Science and Technology, China
14:00-14:30	Invited Talk	Jianan Duan	Harbin Institute of Technology (Shenzhen), China
14:30-15:00	Invited Talk	Guohui Li	Taiyuan Univerisity of Technology, China
15:00-15:15	G27778	Xingtan Liu	Beijing Institute of Control Engineering, China
15:15-15:30	G27724	Zhangwan Peng	Zhejiang University, China

Paper Detail

Invited Talk	**Title:** Light-matter interactions in layered two-dimensional materials **Speaker:** Xiaolong Chen **Affiliation:** Southern University of Science and Technology, China **Bio:** CHEN Xiaolong, is an assistant professor at Department of Electrical and Electronic Engineering in the Southern University of Science and Technology (SUStech). Before joining SUStech, he worked as postdoctoral researcher in University of Cambridge and Yale University. Dr. Chen is mainly engaged in the research of 2D-material-based-optoelectronics. Especially, he has done pioneer works on black-phosphorus and its applications in optoelectronics. In recent years, he has published more than 50 SCI academic papers in Light: Science & Applications, Nature Communications, Science Advances, Nano Today, ACS Nano and other journals with an H-index of 22. He also served as reviewer of Light: Science & Applications, Nature Communications and Science Advances. He was selected as Guangdong Zhujiang Young Talent Program 2019. **Abstract:** Two-dimensional (2D) materials, with layered van der Waals structures and atomically-thin thickness, offer a unique platform for investigating light-matter interactions. In this talk, I will focus on our recent two representative works on light-matter interactions in 2D materials. First, I will show that light-matter interactions can provide a convenient approach to investigate the antiferromagnetic properties of micrometer-size atomically-thin semiconducting materials, which is not accessible by the conventional technology. Then, we offer an effective optical method to probe the layer-dependent mechanical properties. Combining the theoretical model, we are able to extract key thermal and mechancal parameters in two-dimensional materials, such as black phosphorus and hBN.
Invited Talk	**Title:** Enhanced optical nonlinearities in epitaxial quantum dots lasers on silicon for future photonic integrated systems **Speaker:** Jianan Duan **Affiliation:** Harbin Institute of Technology (Shenzhen), China

	Bio: Jianan Duan received the Ph.D. degree in Optoelectronics from University of Paris-Saclay, France, in 2019. From 2019 to 2020, he was the Post-Doctoral Researcher with Telecom Paris, Institut Polytechnique de Paris, France. Since 2021, he has been an Assistant Professor at Harbin Institute of Technology, Shenzhen, China. His current research interests include advanced semiconductor laser, silicon photonics and laser dynamics. **Abstract:** The four-wave mixing conversion efficiency of epitaxial quantum dot laser on silicon is much higher than that of quantum well laser. These results are important for self-mode-locked pulse production and high-bandwidth optical frequency comb generation for future photonic integrated systems.
Invited Talk	**Title:** Engineered tetraexciton confinement in 2D-Perovskites for laser applications **Speaker:** Guohui Li **Affiliation:** Taiyuan Univerisity of Technology, China **Bio:** Dr. Guohui Li, associate Professor, College of Physics and Optoelectronics, Taiyuan University of Technology. Sanjin Talents. Research interests includes: Novel optoelectronic devices, Nonlinear Optics, Precision spectroscopy. Preside over several national and provincial research projects including: The key research program of Shanxi province; The key research program of Lvliang city; The commercialization cultivation program of Shanxi college research findings; National Natural Science Foundation of China. Published more than 40 peer reviewed paper including Advanced functional materials, Laser Photonic Reviews, Advanced optical materials, Photonics research. Applied more than 20 invention patents. Given more than 20 oral talks on academic conferences including 5 invited talks. **Abstract:** Solution-processed qusai-two-dimensional perovskites have been pursued as low-threshold, high gain lasing media thanks to their naturally formed quantum-well structure which enable existence of stable excitons at high pump densities. Although stable continuous-wave lasing has been demonstrated, they have not yet approached the excitonic stimulation emission. Small <n> phase 2D perovskites combine the advantage of efficient energy funneling and large exciton binding energy. Here, we show that small <n> phase 2D perovskites giving rise to stimulation emission from multi-excitons at room temperature. Under femtosecond pulsed pumping, an ultralow stimulated emission threshold of 14.04 uJ/cm2 has been achieved. Stimulated emission in devices mixed with moderate <n> phase 2D perovskites is from exciton recombination and has a higher threshold of 18.72 uJ/cm2. Stimulated emission in devices mixed with large <n> phase 2D perovskites will be hampered by bimolecular recombination resulting the highest threshold of 32.75 uJ/cm2.
G27778	**Title:** Influence of Target Layout on the Accuracy of Monocular Vision 6DOF Spatial Pose Measurement **Author(s):** LIU Xingtan, HUA Baocheng, LIU Qihai,DENG Loulou ,LIU Jing, TAO Liqing, WU Xiuyu, LEI Kaiyu **Speaker:** Xingtan Liu **Affiliation:** Beijing Institute of Control Engineering, China **Abstract:** The method of pose measurement using computer monocular vision is widely used in the field of six-degree-of-freedom(6DOF) pose measurement in industry, aerospace and other fields. By analyzing the factors that affect the accuracy of monocular pose measurement, the research on the target layout of cooperative positioning is carried out. First, a sub-millimeter monocular spatial positioning simulation system is built, and the key components of the target layout are defined as Target Scale(TS) and Elevation Difference(ED); then, as the input, the 6DOF measurement accuracy of the monocular spatial positioning system under different conditions is obtained. The results show that the three-axis position accuracy is better than 0.5mm, and is affected by the positive correlation between the TS and the ED, and the axial variation is more significant. The three-axis attitude accuracy is better than 0.03° (1.8 arcseconds), which is greatly positive affected by the TS, and the axial pose is more robust than azimuth pose.
G27724	**Title:** Modeling and Analysis of High-Speed Modified Uni-Travelling-Carrier Photodiodes under high optical power injection **Author(s):** Zhangwan Peng, Wanshu Xiong, Ruoyun Yao, Chaodan Chi, Chen Ji Yiti Xiong

	Speaker: Zhangwan Peng **Affiliation:** Zhejiang University, China **Abstract:** We simulated InGaAs/InP Modified Uni-Traveling-Carrier Photodiodes (MUTC-PDs) with different reverse bias voltages under high optical power injection, using a commercial device level simulator Apsys. By optimizing the absorber layer structure and the operating voltage, this work achieved an MUTC-PD design with an opto-electric responsivity of 0.16A/W and over 300GHz 3-dB bandwidth under 10 mW/μm2 optical injection density.

Technical Session on Dec. 8

TS07 Biophotonics and Optical Biomedicine

Chair Quan Liu, Xiamen University, China

Room No.	Room ID	Zoom Link
Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Kai Sun	Dalian University of Technology, China
14:00-14:30	Invited Talk	Zhehai Zhou	Beijing Information Science and Technology University, China
14:30-15:00	Invited Talk	Lingjie Kong	Tsinghua University, China

Paper Detail

Invited Talk	**Title:** In vivo real-time optical detection of biomolecules with implantable polymer-dot transducer **Speaker:** Kai Sun **Affiliation:** Dalian University of Technology, China **Bio:** Kai Sun is associate professor (2021.03 – now) of Key Lab on Molecular Recognition and Imaging of Liaoning Province, College of Bioengineering, Dalian University of Technology. In 2018, He get Ph.D. (2012.09 - 2018.06) from State Key Lab on Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University. After that, he engaged in assistant researcher (2018.07 - 2019.03) in Department of Biomedical Engineering at Southern University of Science and Technology, and postdoctoral fellow (2019.03 - 2021.03) at University of Washington. His research focused on the biological and medical applications of the polymer nanoparticle technology, such as sensing, diagnosis, therapy, imaging, etc. He is currently a Guest Editor of Biosensors, Member of Technical Committee of International Conference on Biomedical and Bioinformatics Engineering (ICBBE) and International Conference on Bioinformatics and Biomedical Technology (ICBBT). **Abstract:** Small molecules participate extensively in various life processes. However, specific and sensitive detection of small molecules in a living system is highly challenging. We describe a general strategy for in vivo real-time dynamic monitoring of small molecules by a luminescent polymer-dot transducer. The optical transducer combined with an oxygen-consuming enzyme can sensitively detect small-molecule substrates as the enzyme-catalyzed reaction depletes its internal oxygen reservoir in the presence of small molecules. In addition, we further build a miniaturized optical detection platform, an enzyme cascade reaction system, a tissue microenvironment fluctuation calibration system, and an anti-inflammatory hydrogel implant, etc., to achieve long-term stability, real-time dynamics, and high-precision monitoring of small biological molecules. Relevant research is of great significance for accurate and personalized health care for patients, and lays a solid foundation for promoting the innovative development of optical technology in clinical testing and public health.
Invited Talk	**Title:** Optical Tweezers and its application in Raman Spectroscopy **Speaker:** Zhehai Zhou **Affiliation:** Beijing Information Science and Technology University, China **Bio:** He is now working in BISTU as a professor, and his main research interests focus on optical measurement and biomedical detection technology, such as 3D imaging, OCT, Optical tweezers, Raman Spectroscopy, and

	so on. He obtained his Bachelor, Master and PhD degrees from Tsinghua University in 2000, 2004 and 2011 respectively. In past about 20 years, he has published about 110 peer-reviewed journal papers and 40 patents. **Abstract:** Optical tweezers have become important tools for cells trapping and manipulation in biomedical fields. In the report, the optical tweezers will be introduced and an kind of single-cell laser Raman tweezers will be presented, which can be used in single-cell Raman spectroscopy analysis.
Invited Talk	**Title:** Soft optical fiber sensing and its biomedical applications **Speaker:** Lingjie Kong **Affiliation:** Tsinghua University, China **Bio:** Dr. Lingjie Kong is an associate professor at Tsinghua University, Beijing. He received PhD degree from Tsinghua University in 2012. After that, he continued the postdoctoral research at Harvard University, Janelia Research Campus/Howard Hughes Medical Institute, and Purdue University, sequentially. Since 2017, he joined the faculty of the Department of Precision Instrument, Tsinghua University. His research interests include biomedical optics and its biomedical applications. **Abstract:** Wearable, soft sensors are promising in human-computer interaction, healthy monitoring, and smart robots, etc. Recent years have seen the rapid development of wearable electronics, however, its application is limited by the disadvantage in being susceptible to electromagnetic interference (EMI). In comparison, soft optical fiber sensors have advantages in being immune to EMI, soft, and biocompatible, thus meeting the urgent needs in healthcare monitoring. Our group has developed a series of soft, wearable fiber sensors for applications in human motion monitoring and in vivo sensing of biophysical and biochemical parameters. In this talk, I will introduce our latest advances.

Technical Session on Dec. 8

TS08 Data Center Optical Interconnects and Networks

Chair Shaohua Hu, University of Electronic Science and Technology of China, China

Room No.	Room ID	Zoom Link
Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Yongcheng Li	Soochow University, China
14:00-14:30	Invited Talk	Tao Gui	Huawei Technologies, China
14:30-15:00	Invited Talk	Tao Yang	Beijing University of Posts and Telecommunications, China

Paper Detail

Invited Talk	**Title:** Service Provisioning in WSS-based All-Optical Data Center Network with Dragonfly Topology **Speaker:** Yongcheng Li **Affiliation:** Soochow University, China **Bio:** Yongcheng Li received his B.Sc. degree and PhD from Soochow University, China, in 2011 and 2017, respectively. Currently, he is an associated researcher with the School of Electronic and Information Engineering of Soochow University. His research interests include optical network optimization, ROADM architecture, and large-scale optical switching **Abstract:** Dragonfly is an important network topology for data centers to efficiently serve high-performance computing (HPC) traffic flows. In this paper, we construct a WSS-based all-optical data center network (DCN) with Dragonfly topology and investigate its routing, wavelength, and time slot allocation (RWTA) problem. Two heuristic algorithms, including the shortest-path-based (SP) algorithm and the least-delay-path-based (LDP) algorithm, are proposed. Simulation results show that the LDP algorithm is efficient in improving the performance of the proposed all-optical DCN with Dragonfly topology in terms of task completion time (TCT).
Invited Talk	**Title:** Self-Homodyne Coherent Bidirectional Transmission for Next-Generation Data Center Interconnects **Speaker:** Tao Gui **Affiliation:** Huawei Technologies, China **Bio:** Tao Gui received the Ph.D. degree from The Hong Kong Polytechnic University, Kowloon, Hong Kong, in 2018. After graduation, he joined the Optical Research Department of Huawei Technologies as a Principal Engineer. His current research interests include various aspects of coherent fiber-optic communication systems. **Abstract:** The coherent technique is the future trend for 800G/1.6Tbits DC interconnect application. The self-Homodyne coherent bidirectional Transmission scheme is introduced and analyzed for the key practical problem of power consumption and cost saving.
Invited Talk	**Title:** Optical Labels Enabled Optical Network Performance Monitoring **Speaker:** Tao Yang **Affiliation:** Beijing University of Posts and Telecommunications, China **Bio:** Tao Yang, Ph.D., working at Beijing University of Posts and Telecommunications, his research interests include large-capacity long-distance optical transmission, optical network monitoring and management, etc.

	So far, he has published more than 40 papers in IEEE/OSA journals and international conferences such as OFC and CLEO, and applied for more than 10 national invention patents (6 have been authorized). As the project leader, he presided over the National Natural Science Foundation of China, the Beijing Municipal Natural Science Foundation, the China Postdoctoral Science Foundation and other projects. **Abstract:** Optical performance monitoring (OPM) technology, especially the optical power and OSNR of each WDM channel, are of great importance and significance that need to be performed to ensure stable and efficient operation and maintenance of network itself. In this paper, we present our recent research activities and progresses on optical-label enabled OPM. Simulation results of WDM system show that the maximum error of channel power monitoring and OSNR estimation are less than 0.6dB after 20-span transmission. It confirms that the optical-label enabled OPM has lower cost and higher efficiency for mass deployment in practical WDM networks.

Technical Session on Dec. 8

TS09 Silicon Photonics

Chair Kan Wu, Shanghai Jiao Tong University, China

Room No.	Room ID	Zoom Link
Room 4	868 4632 7948	https://us02web.zoom.us/j/86846327948

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Ching Eng Png	Institute of High Performance Computing (IHPC), A*Star, Singapore
14:00-14:30	Invited Talk	Zejie Yu	Zhejiang University, China
14:30-15:00	Invited Talk	Tian Zhang	Beijing University of Posts and Telecommunications, China
15:00-15:15	G27761	Aolong Sun	Fudan University, China

Paper Detail

Invited Talk

Title: Advancing Silicon Photonics Using forward modeling and inverse designs

Speaker: Ching Eng Png

Affiliation: Institute of High Performance Computing (IHPC), A*Star

Bio: Jason Png is Director of the Electronics and Photonics Department at Institute of High Performance Computing (IHPC), A*Star, Singapore. He received his PhD degree from the University of Surrey, UK, MBA from INSEAD, France and Tsinghua University, China. Dr. Png's current research interests span from quantum and high-speed photonics/plasmonics to electromagnetics.

For his work, he received accolades including the prestigious Royal Academy of Engineering Prize, Vebleo Scientist Award, IET Innovation Award - Software Design (highly commended), IEE Hudswell Scholarship, Skolkovo Prize at INSEAD Venture Competition, and Spring TECS Proof-of-Value grant. Dr. Png is elected Fellow of the IET and Vebleo. He serves on SPIE Photonics West technical program committee and is Founding Chair for URSI Singapore Chapter. He is passionate about mentoring and diversity in science.

Abstract: Design and modeling of photonic components entails the forward problem of finding the optical response for a given photonic geometry, which in turn is solved numerically via Maxwell equations. This is computationally expensive especially evaluating large simulation domains and batches, hence forward modeling presents a significant bottleneck. Another approach is deriving appropriate photonic geometries for a known optical response, or popularly known as inverse modeling. The solution to the inverse problem cannot be directly evaluated and is challenging to solve due to existence of multiple local optima caused by the non-convex nature of the solution space. Despite numerous advances, inverse problem solutioning to pinpoint optical device based on known constraints and targeted performance specifications remain elusive. By using a soft computing methodology, machine learning can potentially revamp the designing process of photonics components. Machines learning has been shown to be effective for capturing, interpolating, and optimizing multi-dimensional phenomena. Hence, by combing traditional hard photonic computing with machine learning opens up exciting possibilities to achieve accelerated and novel design discoveries. In this work, we demonstrate via modeling the key aspects of optical modal solutioning via machine learning, prediction of group index, and programmable power dividers.

Invited Talk	**Title:** Compact and High-Speed Electro-Optic Modulator **Speaker:** Zejie Yu **Affiliation:** Zhejiang University, China **Bio:** Dr. Yu obtained his bachelor's degree from Zhejiang University (ZJU) and Ph. D. degree from the Chinese University of Hong Kong (CUHK). Later he worked as a postdoctoral fellow at CUHK and then joined the College of Optical Science and Engineering of ZJU as a tenure-track professor in 2020. Dr. Yu mainly works in integrated photonics to develop the next generation of optical communication and computation systems. Up to now, he has published more than 30 papers all in reputational journals, including Nature Communications, Optica, Light: Science & Applications, etc. Dr. Yu has also been invited to give invited talks at many conferences, nominated as a technical program committee (TPC) member for ACP, served as a session organizer for PIERS, and selected as a young editor of Journal of Semiconductors. **Abstract:** Electro-optic modulators have wide applications in various areas including optical communication, microwave photonics, Lidar, optical computation, etc. Recently, thin-film-LiNbO3-on-insulator becomes a popular platform to explore electro-optic modulation where light can be confined within a subwavelength scale, so efficient electric field and light interaction can be obtained. Presently, different kinds of electro-optic modulators ranging from visible to mid-infrared spectrum have been demonstrated based on different passive structures, such as MZIs, microring cavities, photonic crystal cavities, waveguide gratings, etc. Here, we propose and demonstrate a high-performance LiNbO3 electro-optic modulator based on a new 2×2 Fabry–Perot cavity. In this structure, the input and reflected beams are separated by introducing asymmetric multimode-waveguide gratings, enabling TE0−TE1 mode conversion. The measured results indicate that the fabricated modulator features a low excess loss, a high extinction ratio, a compact footprint, and high modulation speeds. The demonstrated modulator is promising for high-speed data transmission and signal processing.
Invited Talk	**Title:** Inverse design for the nanophotonic devices and systems using artificial intelligence algorithm **Speaker:** Tian Zhang **Affiliation:** Beijing University of Posts and Telecommunications, China **Bio:** Zhang Tian, got a Ph. D. from Huazhong University of Science and Technology in 2016, now works as an associate professor at School of Electronic Engineering in Beijing University of Posts and Telecommunications. From November 2016 to January 2019, she worked as postdoctoral researcher in BUPT. At present, she is mainly engaged in the research of intelligent optical computing, inverse design of photonic devices, and micro-nano photonics. In recent years, she has published more than 50 SCI academic papers in Photonics Research, Optics Letters, Optics Express, Journal of Lightwave Technology, etc., and are cited more than 860 in Google Scholar. She is responsible for National Natural Science Foundation of China, General Program and Special Program of Chinese Postdoctoral Science Foundation, and is as a main participator in Beijing Municipal Science and Technology Project and other projects. **Abstract:** The nanophotonic devices and systems, whose feature size near or below the scale of the electromagnetic wavelength, have been widely used in many field, such as processing and transmission of information, imaging, sensing and so on. With the coming of the big data and 6G era, nanophotonic devices and systems are developing towards miniaturization, low energy consumption, functional complexity, etc. The traditional design methods of devices and systems, based on physical mechanism analyzing or theoretical model constructing, can no longer meet the needs. The design and optimization of nanophotonic devices and systems are limited by computationally expensive, time-inefficient, and even with no theoretical models. Luckily, the artificial intelligence algorithm, which has been studied vigorously in recent years, provides a completely new way for exploiting the tremendous parameter space. This report will introduce our works and some thinking on this field.

G27761	**Title:** Silicon Photonic Integrated Reservoir Computing Processor with Ultra-high Tunability for High-speed IM/DD Equalization **Author(s):** Aolong Sun, An Yan, Penghao Luo, Junwen Zhang and Nan Chi **Speaker:** Aolong Sun **Affiliation:** Fudan University, China **Abstract:** Intensity modulation and direct detection (IM/DD) technology still dominates the optical fiber communication region for the sake of cost and energy efficiency. Reservoir Computing (RC), a special machine learning algorithm suitable for sequence models, has recently been applied to reduce the inter-symbol interference (ISI) caused by dispersion and Kerr nonlinearity in IM/DD systems. In this paper, we designed and numerically simulated a Photonic Integrated Reservoir Computing Processor (PIRCP) with two recurrent nodes using a standard silicon-on-insulator platform. The PIRCP exhibits ultra-high tunability of phase, intensity, delay time and detuning frequency of the optical carrier, which greatly facilitates parameter sweeping for the obtaining of the optimal processing performance. To validate the efficiency of our design, we implemented the PIRCP along with a Feed Forward Equalizer (FFE) in the receiver-end, and finally achieved sub HD-FEC performance for 112 Gbps/λ transmission over 60 km standard single-mode fiber (SSMF) with an ROP of -15 dBm, showing an improvement of 5 dBm compared with non-RC scheme.

Technical Session on Dec. 8

TS10 Emerging Technologies for Information Displays and Lighting

Chair Qilin Sun, The Chinese University of Hong Kong, Shenzhen, China

Room No.	Room ID	Zoom Link
Room 5	811 1444 8699	https://us06web.zoom.us/j/81114448699

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Xinxing Xia	Shanghai University, China
14:00-14:30	Invited Talk	Zheng Gong	Institute of Semiconductors, Guangdong Academy of Science, China
14:30-14:45	G27791	Zhuang Wang	Anhui University, China

Paper Detail

Invited Talk	**Title:** Towards wearable AR near-eye displays with holographic optical elements **Speaker:** Xinxing Xia **Affiliation:** Shanghai University, China **Bio:** Dr. Xinxing Xia is currently an Associate Research Professor at Shanghai University from 2019. He received his PhD on optical engineering at State Key Laboratory of Modern Optical Instrumentation, Zhejiang University in 2014, and received his BA on information engineering at Zhejiang University in 2008. He was a Research Fellow at Nanyang Technological University from 2016 to 2019. From 2014 to 2016, he was a postdoctoral researcher at the University of North Carolina at Chapel Hill, and visited BeingThere Centre at Nanyang Technological University as a key researcher. His research interest mainly focuses on 3D displays and acquisition, VR/AR displays, computational imaging and some related applications on 3D telepresence. **Abstract:** To achieve AR near-eye displays with compact form-factor, large FOV and extended eyebox, we propose some novel methods with holographic optical elements. The system designs of both holographic and Maxwellian-view near-eye display are presented and the corresponding near-eye display prototypes are implemented to confirm the proposed method.
Invited Talk	**Title:** Large-area, programmable assembly of Micro-LEDs for display applications **Speaker:** Zheng Gong **Affiliation:** Institute of Semiconductors, Guangdong Academy of Science, China **Bio:** Dr. Gong is a professor at the Institute of Semiconductors, Guangdong Academy of Sciences, China. He worked in the UK for more than 12 years. He used to be a a R&D manager at mLED Ltd (UK), and a Research scientist at Oculus @ Facebook. His research interest is mainly focused on new display technologies, semiconductor materials & devices, and flexible electronics . He has published more than 100 academic and conference papers in related fields, and applied for more than 50 patents. After returning to China, he founded Foshan Debao Display Technology Co., Ltd in 2019. **Abstract:** Micro-LED display is an emerging display technology which has received intensive research due to its high brightness, low power consumption, and fast switching time. However, its commercialization is being hindered by some technical obstacles. Among these challenges, Micro-LED mass-transfer is one of the biggest technical obstacles to be solved. Although several techniques such as stamp transfer, and fluid assisted

	transfer have been proposed, they commonly suffer from poor transfer yield, high transfer cost, and low transfer accuracy. Here, we report a rational strategy by synergizing adhesion control and tunable surface topography via patterned light irradiation to achieve large-scale, programmable assembly of Micro-LEDs based on a photo-sensitive polymer. The technique proposed here is ink friendly and compatible with non-planar integration. Large-scale transfer printing is enabled by flood exposure of the photosensitive polymer, which results in the polymer switching from the strong adhesion state to the weak adhesion state. Masked UV exposure, on the other hand, provided an additional means to modulate the polymer surface topography. In the latter case, the indented regions of the polymer surface switch to the non-contact state because of the gap formed between the inks and the polymer. With this mask-mediated surface topography, as well as the adhesion switching, micro-LEDs can be assembled in a programmable format based on users' needs. The technique can be also used to assemble other ink materials such as indium tin oxide (ITO), gallium nitride (GaN), and gold membranes onto various substrates, revealing its good combability with the assembly of diverse microscale inks. Conformal integration of GaN Micro-LEDs onto curvy surfaces have also been demonstrated by using this technique, highlighting its potential for flexible displays.
G27791	**Title:** A solver for devices of subwavelength lamellar gratings **Author(s):** Zhuang Wang, Chuan Shen, Liu Wang, Bin Wang, Daofeng He and Sui Wei **Speaker:** Zhuang Wang **Affiliation:** Anhui University, China **Abstract:** A solver for subwavelength lamellar gratings is created synchronized with the development of a light modulator for holographic video display Grating Liquid Crystal on Silico (GLCoS) and is regarded as an important part of the whole R&D work. In this way it not only gives computational support in the whole design process including physical concept descriptions, verifications, predictions, fabrications and other experimental activities but also provides a support platform for further product development. Based on the generic Fourier modal method, we focus on the electrodynamics specific to conductors (Au, Al) and charge carriers in semiconductors (Indium Tin Oxide, ITO) in SPPs (Surface Plasmon Polaritons) and permittivity characteristics of the materials to make the solver oriented towards subwavelength (metal, semiconductor) lamellar gratings. Further, we analyze and calculate the optical characteristics of subwavelength lamellar gratings composed of ITO and Au. The results of these calculations not only agree with the results of actual GLCoS device tests to the same order of accuracy but also demonstrate the validity and accuracy of the solver.

Technical Session on Dec. 8

TS11 Translational Photomedicine and Biophotonics

Chair Ruochong Zhang, A*STAR, Institute of Bioengineering and Bioimaging, Singapore

Room No.	Room ID	Zoom Link
Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Time	Paper ID	Speaker	Affiliation
16:00-16:30	Invited Talk	Qiongyu Guo	Southern University of Science and Technology, China
16:30-17:00	Invited Talk	Tianxun Gong	University of Electronic Science and Technology of China, China
17:00-17:30	Invited Talk	Xiaojun Yu	Northwestern Polytechnical University, China
17:30-17:45	G277125	Jiaqi Hu	Southern University of Science and Technology, China

Paper Detail

Invited Talk	**Title:** Endovascular photothermal embolization for cancer treatment **Speaker:** Qiongyu Guo **Affiliation:** Southern University of Science and Technology, China **Bio:** Dr. Qiongyu Guo is an assistant professor at the Southern University of Science and Technology, Shenzhen, China. She earned her BS degree in Polymer Science and Engineering from the University of Science and Technology of China in 2004. She obtained her PhD in Macromolecular Science and Engineering at the Case Western Reserve University in 2010. She received her postdoctoral training in Biomedical Engineering at the Johns Hopkins University. She has authored more than 30 peer-reviewed research publications and review articles. Her research focuses on engineering biomaterials through translational approaches so that the clinical use may be realized to enhance human health and well-being. She specialized in developing drug delivery systems and functional biomaterials for tissue engineering and cancer treatments. She has extensive experience on biomimetic artificial cornea, biodegradable drug-eluting stent, shape memory nanosystem, light activated cell migration and musculoskeletal regeneration. **Abstract:** Photothermal therapy has become an attractive strategy that applies optical radiation to actuate photothermal effect of nanomaterials for cancer treatment. However, even near infrared (NIR) laser irradiation still presents insufficient light penetration depth into the tumor tissue, showing one of the main bottlenecks of the photothermal treatment. Here we propose a treatment paradigm using an endovascular laser to achieve photothermal embolization in the entrance of tumor feeding artery. We found that the optical laser could be successfully delivered through the artery and selectively produced local heat-induced thrombosis in the feeding artery, which completely blocked the whole feeding vasculature and led to the cellular apoptosis throughout the tumor tissue. Such a treatment paradigm may open a new route to improve the photothermal therapy by circumventing the need of heat treatment of the whole tumor and minimizing the undesired damage of surrounding healthy tissue.
Invited Talk	**Title:** Surface Enhanced Raman Scattering Sensors for pesticide residue and disease detections **Speaker:** Tianxun Gong

	Affiliation: University of Electronic Science and Technology of China, China **Bio:** Tianxun Gong obtained his Ph.D degree from Nanyang Technological University on 2015. He also worked in Singapore Bioimaging Consortium, A*STAR from 2012 to 2016. Tianxun Gong is currently an Associate Professor at University of Electronic Science and Technology of China. His research field focused on smart nano sensor technology, especially the applications of biomedical detection. **Abstract:** Surface Enhanced Raman Spectroscopy (SERS) is able to provide “finger prints” information of the molecules in samples, even in ultra-low concentration. Due to the different characteristic of the samples, various SERS platforms need to be developed. In my talk, I will introduce design and fabrication of various type of SERS chips. Moreover, I will introduce their applications on pesticide residue detections and biomedical detections.
Invited Talk	**Title:** Micro-optical coherence tomography (uOCT) and its imaging applications **Speaker:** Xiaojun Yu **Affiliation:** Northwestern Polytechnical University, China **Bio:** Xiaojun Yu received his Ph.D degree from Nanyang Technological University, Singapore, in 2015. From Jan. 2015 to Aug. 2017, he worked as a postdoctoral research fellow with the same University. He is currently an associate professor with Northwestern Polytechnical University, China. His main research interests include high-resolution OCT imaging and its applications, and biomedical signal/image processing and analysis. **Abstract:** Optical coherence tomography (OCT) is an emerging non-invasive high-resolution optical imaging tool. Owing to its capability of providing cellular/sub-cellular cross-sectional and three-dimensional (3D) tissue microstructure images, OCT has been adopted in various imaging fields for the understanding and diagnosis of different human diseases. Spatial resolution is one of the key properties determining the performances of an OCT system, and has attached extensive research interests over the past decades. In this talk, the main principles of the micron level high-resolution OCT, i.e., micro-OCT system, and its imaging applications that have been carried out in our lab is briefly introduced. The future topics and its ongoing applications in our group are also discussed.
G277125	**Title:** Optimal Raman spectral classification model based on Differentiable Architecture Search of Hybrid Structure Network for disease diagnosis **Author(s):** Jiaqi Hu, Jinna Chen, Chenlong Xue, Yanqun Xiang, Guoying Liu, Hong Dang, Dan Lu, Huanhuan Liu, Longqing Cong, Zhen Gao, Haibin Su and Perry Ping Shum **Speaker:** Jiaqi Hu **Affiliation:** Southern University of Science and Technology, China **Abstract:** Identification and classification are important application areas of surface-enhanced Raman spectroscopy (SERS). Substance is identified via the chemical finger-print function of Raman spectroscopy. Diseases can be diagnosed through bio-fluidic Raman spectrum analysis and classification accordingly. Since bio-fluidic, such as serum，urine，and tissue fluid contains various substances, Raman spectrum is too complex to be classified manually. The optimization of deep learning classification model is critical in diagnosis accuracy improvement. Here we propose, for the first, applying DARSHN algorithm in automatic diagnosis model design and optimization. DARSHN was applied to serialize the discrete search space. Optimal structural solution was generated through approximate gradient descent subsequently. This research suggested that DARSHN can be used in the optimization of classification models automatically and effectively. Its advantages in the application of serum SERS-based cancer diagnosis compared to residual network spectral classification models were shown in this paper.

Technical Session on Dec. 8

TS12 THz Metamaterials and Device Applications

Chair Yandong Gong, Beijing Information Science and Technology University, China

Room No.	Room ID	Zoom Link
Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Zhen Gao	Southern University of Science and Technology, China
16:00-16:30	Invited Talk	Nan Chi	Fudan University, China
16:30-17:00	Invited Talk	Kebin Fan	Nanjing University, China
17:00-17:15	T3001	Wanying Liu	Tianjin University, China

Paper Detail

Invited Talk	**Title:** Experimental exploration of three-dimensional photonic topological phases **Speaker:** Zhen Gao **Affiliation:** Southern University of Science and Technology, China **Bio:** Zhen GAO is a tenure-tracked Associate Professor of Southern University of Science and Technology (SUSTech). He received PhD in 2018 from School of Physical and Mathematical Sciences in Nanyang Technological University, Singapore, following his B.S. degree in 2009 and M. S. degree in 2012 from Zhejiang University in Hangzhou, all majored in Electrical Engineering. His current research interests include electromagnetic wave theory and applications, photonic crystals, spoof plasmonics, metamaterials, topological photonics, and terahertz technology. As the first author or corresponding author, he has published more than 30 papers on Nature, Nature Communications, Physical Review Letters and Advanced Materials. He received National Distinguished Youth Expert in 2020, the Chinese Government Award for Outstanding Self-financed Student Award in 2016, Ten Major Advances in Chinese Optics in 2019 and The National-level Talent in Shenzhen. **Abstract:** Recently, the concept of topological phase of mater has revolutionized the whole research area of photonics and subsequently sparked the emerging field of topological photonics with promising applications in robust one-way waveguides, topological lasers and on-chip communications. In general, photonic topological phases can be classified into three different types: one-dimensional (1D) photonic topological phases that support zero-dimensional (0D) localized states, two-dimensional (2D) photonic topological phases that support 1D edge states, and three-dimensional (3D) photonic topological phases that support 2D surface states. In this report, we will focus on the 3D photonic topological phases that include 3D photonic topological insulators, 3D unconventional photonic Weyl semimetals and 3D photonic topological Chern insulators.
Invited Talk	**Title:** AI-Enabled Intelligent Visible Light Communications **Speaker:** Nan Chi **Affiliation:** Fudan University, China **Bio:** Professor Nan Chi is with School of Information Science and Engineering, Fudan University, China. She

	received the BS degree and PhD degree in electrical engineering from Beijing University of Posts and Telecommunications, China. She is the author or co-author of more than 300 papers and has been cited more than 9000 times. She has been awarded as The National Science Fund for Distinguished Young Scholars, the New Century Excellent Talents Awards from the Education Ministry of China, Shanghai Shu Guang scholarship. Her current research interests include advanced modulation format, optical packet/label switching, optical fiber communication and visible light communication. She is a fellow of the OSA. **Abstract:** Visible light communication transmits (VLC) signals in a spectrum range of 400-800Thz, which owns a very different physical property compared with both con-ventional wireless transmission and optical communication. Communication with visible light provides benefits of electromagnetic interference resistance, vast spectrum resources, and high-speed transmission capabilities. In this talk we present a detailed overview of advances of machine learning in VLC system and verify its excellent ability for future high-speed and high-quality VLC system, including optimal coding, channel emulator, MIMO, channel equalization, and optimal decision.
Invited Talk	**Title:** All-Dielectric Terahertz Metasurfaces and Their Applications **Speaker:** Kebin Fan **Affiliation:** Nanjing University, China **Bio:** Kebin Fan is an associate professor in the School of Electronic Science and Engineering at Nanjing University, China. He was a Research assistant professor in the Department of ECE at Duke University before joining Nanjing University in 2020. Dr. Fan's research interests include investigation of dynamic metasurfaces, and their applications to imaging and sensing in millimeter-wave, terahertz and infrared ranges. He has published more than 50 peer reviewed papers, including Nature, PRL, Advanced Materials, Optica, etc and three issued patents. **Abstract:** All-dielectric metasurfaces, consisting of artificially engineered dielectric composites, can support both electric and magnetic multipoles, thereby indicating a new platform for control waves beyond the limits associated with metallic metasurfaces. Here, through modifying the geometry of all-dielectric structures and material loss of the constituents, I will show that a host of unconventional physical scattering responses can be achieved at terahertz frequencies, including symmetric/asymmetric perfect absorption, Huygens' matasurfaces, bound state in the continuum and their corresponding dynamic responses. Further, I will also demonstrate terahertz imaging and sensing applications based on these all-dielectric metasurfaces. The versality of the all-dielectric metasurfaces demonstated here can be scaled to other frequency ranges, offering a new path for applications requiring ultrafast response, large modulation depth, or spatial filtering.
T3001	**Title:** Generation of multi-channel terahertz quasi-perfect vortex beams by multifunctional metasurfaces **Author(s):** Wanying Liu, Quan Xu, Jianqiang Gu **Speaker:** Wanying Liu **Affiliation:** Tianjin University, China **Abstract:** Vortex beams carrying orbital angular momentum (OAM) open a new perspective in various terahertz research. The multi-channel vortex beams generation is a corner stone for OAM-related applications, especially for OAM mode division multiplexing, in which the vortex beams with different topological charges could be explored as independent channels for high-speed and large-capacity communication. However, there are two difficulties for multi-channel vortex beams generation at terahertz frequency: a) Conventional OAM mode conversion devices, for example, phase plate, are not only bulky and complex but decrease the efficiency of optical systems due to the insertion loss. b) The divergence angle of vortex beams is dependent on the topological charge, which is a challenge for OAM-related applications including MDM based communications, surface plasmon excitation and spinning objective detection. Thereby multi-channel and divergence controllable terahertz vortex beam generation holds the key to promoting the development of OAM related terahertz research. In this talk, we introduce the concept of quasi-perfect vortex beam (Q-PVB) with a controllable

	divergence angle independent of the topological charge and present the experimental demonstration of multi-channel Q-PVBs' generation by all-dielectric multifunctional metasurfaces. By superimposing specific phase functions together into the metasurfaces, multiple vortex beams and four-channel Q-PVBs with different topological charges are generated as well as focused at separated positions. High resolution characterization of terahertz electric field shows the good quality and broadband properties of Q-PVBs. Interestingly, compared with conventional perfect vortex beam, Q-PVB displays a smaller divergence angle and thinner ring width. The metasurfaces proposed here provide a promising avenue to realize multi-channel vortex beams generation in compact terahertz systems, benefiting OAM related researches such as mode division multiplexing, vortex beam related plasmonic enhancement and spinning objective detection.

Technical Session on Dec. 8

TS13 Laser Technology

Chair Junqing Zhao, Shenzhen Technology University, China

Room No.	Room ID	Zoom Link
Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Junqing Zhao	Shenzhen Technology University, China
16:00-16:30	Invited Talk	Qian Li	Peking University Shenzhen Graduate School, China
16:30-16:45	G27775	Yifan Zhang	South China Normal University, China
16:45-17:00	G27797	Jingsheng Huang	Chongqing University, China
17:00-17:15	G2772	Tatiana Soloveva	"POLYUS" Research Institute of M.F. Stelmakh, Russia

Paper Detail

Invited Talk	**Title:** Nonlinearity-Engineering Fiber Lasers and Amplifiers **Speaker:** Junqing Zhao **Affiliation:** Shenzhen Technology University, China **Bio:** Junqing Zhao received the Doctor of Engineering degree in Optical Engineering from Shenzhen University, Shenzhen, China, in 2014, for research on pulsed fiber lasers. Since then, his research has covered device, system, and application aspects of fiber lasers and amplifiers, successively with the Shenzhen Key Laboratory of Laser Engineering, Shenzhen University, China, the Optoelectronics Research Centre (ORC), University of Southampton, U.K., and the Jiangsu Key Laboratory of Advanced Laser Materials and Devices, School of Physics and Electronic Engineering, Jiangsu Normal University, Xuzhou, China. As an associate professor, he is currently with the Key Laboratory of Advanced Optical Precision Manufacturing Technology of Guangdong Higher Education Institutes and the College Physics Teaching and Experiment Center, Shenzhen Technology University, Shenzhen 518118, China. He has published over 60 peer-reviewed articles. He was ranked among the world's top 2% scientists according to the list released by Stanford University in 2021. He is a Senior Member of IEEE and Life Member of the Optical Society of America. **Abstract:** Under most circumstances, nonlinearity (NL) takes a deleterious role that it can severely distort optical pulses: recasting the spectral profile, breaking the temporal envelop, lowering the pulse coherence, etc. Those can even be much more considerable in various fiber systems, such as fiber lasers, fiber amplifiers, long-haul fiber links, etc. Thus, regarding the NL issues a lot of effort has been put in purpose for weakening the induced undesired effects. Interestingly, however, our and other groups' recent works demonstrated that NL can sometimes offer remarkable usefulness in shaping optical pulses especially in fiber lasers as well as in some particular fiber amplifiers. In this talk I will show how the NL can be beneficial in those fiber systems, which mainly include: 1. NL engineering: locally and globally 2. NL schemes: waveguiding fiber components and resonating subsystems

	3. NL-induced peak power clamping (PPC) effect 4. Several PPC-related regimes: a comparative study 5. NL-engineered fiber amplifiers: gain-managed NL
Invited Talk	**Title:** Epsilon-near-zero photonics and fiber laser with intra-cavity epsilon-near-zero effect **Speaker:** Qian Li **Affiliation:** Peking University Shenzhen Graduate School, China **Bio:** Qian Li received the Bachelor of Science degree from Zhejiang University, Hangzhou, China, in 2003, the Master of Science degree from the Royal Institute of Technology (KTH), Stockholm, Sweden, in 2005, and the Ph.D. degree from the Hong Kong Polytechnic University, Hong Kong, in 2009. After graduation she was a Visiting Scholar at the University of Washington, Seattle and Postdoctoral Fellow at the Hong Kong Polytechnic University. In 2012 she joined School of Electronic and Computer Engineering (ECE) in Peking University as an Assistant professor. Since 2013 she is Associate Professor at ECE. Her research interests include ultrafast optics, nonlinear optics, and integrated optics. Dr. Li is members of Institute of Electrical and Electronics Engineers (IEEE) since 2012 and senior member of the Optical Society of America (OSA) since 2019. From March 2017 to April 2019, she is Vice Chair of IEEE ED/SSC Beijing Section (Shenzhen) Chapter and Chair for EDS. From 2015 she is an advisor of OSA Student Chapter in Peking University Shenzhen Graduate School. From 2019 she is an advisor of Peking University Shenzhen Graduate School IEEE Photonics Society Student Branch Chapter. From 2022, She is vice dean of School of Electronic and Computer Engineering, Peking University Shenzhen Graduate School. **Abstract:** Epsilon-near-zero (ENZ) materials are a kind of near-zero-index materials with extraordinary optical properties, high tuning flexibility and CMOS compatibility, which can play an important role in optical communication and laser technology. In this talk, I will overview the basics of ENZ photonics and our related researches such as ENZ modulators, ultrafast switching, ENZ multilayers for light absorption, etc. In particular, I will introduce our recent work in a fiber laser cavity with ENZ nanolayers, which provides a deeper insight into the ultrafast ENZ photonics and offers a new approach to study superconducting and quantum-mechanical systems.
G27775	**Title:** 7-core erbium-ytterbium co-doped microstructured fiber amplifier **Author(s):** Yifan Zhang, Yifei Zhao, Weichao Ma, Guiyao Zhou **Speaker:** Yifan Zhang **Affiliation:** South China Normal University, China **Abstract:** Recently, multi-core fibers have performed prominently in the field of space division multiplexing (SDM) due to their multi-channel characteristics. As an important component of the SDM system, multi-core fiber amplifiers face huge challenges compared to single-channel amplifiers in front-end and back-end coupling devices, pumping methods, and amplification performance. Based on this, we propose and develop a 7-core erbium-ytterbium co-doped microstructured fiber amplifier (7CEYDFA) for efficient multi-core fiber amplification. By using air holes to surround the inner cladding, the double cladding structure can effectively isolate the pump light. At the same time, the specially prepared high concentration doped core rare earth material can ensure that 7CEYDFA can achieve efficient amplification within only 90cm. Through experimental tests, 7CEYDFA achieved a gain of 20.9dB at 1532nm.
G27797	**Title:** Ultrafast multi-scale single-pixel imaging with high resolution by comprehensive utilization of the time-frequency-phase information of a mode-locked laser **Author(s):** Jingsheng Huang, Yulong Cao, and Tao Zhu **Speaker:** Jingsheng Huang **Affiliation:** Chongqing University, China **Abstract:** Optical time-stretch imaging (OTSI) has shown potential in diverse fields for its capability of acquiring images at high speed and high resolution. However, its wide application is hindered by single imaging

	dimension. To expand imaging dimensions and scales, an ultrafast single-pixel imaging scheme with multiscale imaging capability is proposed. On the basis of conventional OTSI systems, depth information is encoded onto the frequency and phase of the temporal interference pattern with the help of the Michelson interferometer structure. Specifically, the proposed system mainly consisted of the spatial disperser (space-to-wavelength encoding) and the temporal disperser (wavelength-to-time stretching). A self-made mode-locked laser with a bandwidth of 50nm and a repetition frequency of 50MHz is used as the illumination light source. In the spatial disperser, the pulse laser beam was first launched by a fiber collimator and then split into two paths through a beam splitter (BS) with power splitting ratio 10:90, forming a reference arm and a sample arm in a Michelson interferometer configuration. In the sample arm, an entire row of surface and depth information for a reflective sample is encoded onto the time, frequency and phase of a spatially dispersed ultrafast beam. In the reference arm, an appropriate optical path difference is used as a reference for the depth of the object to be measured by adjusting the position of the mirror. In the temporal disperser, the combined optical pulse train goes through the dispersive element to achieve frequency-to-time mapping, its spectrum is thus encoded on the time axis. Then, the single-shot spectrum is decoded to reconstruct three-dimensional (3D) imaging by combining with spectral interferometry (SI) and homodyne interferometry (HI). Among them, the SI extracts depth information by locating the peaks of the Fourier transform of the temporal interferogram. The resolution of this method is determined by the spectral range and the wavelength resolution of the detection system. Corresponding to the light source used in this experiment, this method can provide a depth resolution of about 20 microns. What's more, to perform multi-scale depth information extraction, HI is further utilized, and the depth resolution of hundreds of nanometers is verified by extracting the phase information of the temporal interferogram. One demodulation idea of the method is to use the phase difference to infer the variation of the depth, so as to perform depth imaging below the wavelength of the surface of the object to be measured. Another demodulation idea is to treat the corresponding structure of each wavelength as a single-frequency laser interferometer. Then convert the phase accumulation amount corresponding to each wavelength into depth accumulation. Each technique provides depth measurement range and resolution which can be complementary to each other. A 3D imaging with 100nm depth resolution of a United States Air Force (USAF) 1951 resolution chart is achieved. Furthermore, multiscale 3D imaging of a stepped sample was demonstrated. With the help of comprehensive utilization of time-frequency-phase information and time-stretch technique, the imaging system with a vertical resolution better than 100 nm over a 7.5 mm range and a 50MHz line-scan frame rate is demonstrated.
G2772	**Title:** Comparison of quasi-four-frequency and four-frequency Zeeman laser gyros with different types of biasing **Author(s):** Evgenii Kuznetsov, Yury Golyaev, Yury Kolbas, Igor Savelev, Tatiana Soloveva **Speaker:** Tatiana Soloveva **Affiliation:** "POLYUS" Research Institute of M.F. Stelmakh, Russia **Abstract:** Among laser gyros, being the most precise inertial sensors nowadays, multi-oscillator laser gyros of a new generation are especially promising. Instead of mechanical biasing for eliminating frequency lock-in, they use physical optical methods, increasing their accuracy and resistance to external mechanical impacts. Here we consider Zeeman laser gyros, whose important advantage is the "pure optical path" (without intra-cavity elements). Two modifications of such laser gyros are considered – quasi-four-frequency and four-frequency. The results of experimental measurements of the input-output characteristics with different types of rectangular alternating frequency biasing are presented: with a single biasing (meander) and with a combined biasing (two different meanders). Comparative results confirm the advantages of the combined frequency biasing, improving the linearity of the input-output characteristic by 4 times.

Technical Session on Dec. 8

TS14 Optical Communication and Networks

Chair Yongli Zhao, Beijing University of Posts and Telecommunications, China

Room No.	Room ID	Zoom Link
Room 4	868 4632 7948	https://us02web.zoom.us/j/86846327948

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Chen Chen	Chongqing University, China
16:00-16:30	Invited Talk	Yixiao ZHU	Shanghai Jiao Tong University, China
16:30-17:00	Invited Talk	Jianing Lu	Tencent Corp., China
17:00-17:15	G27737	Penghao Luo	Fudan University, China
17:15-17:30	G27752	Yuzhong Ma	Soochow University, China

Paper Detail

Invited Talk	**Title:** Enhancing visible light communication with index modulation **Speaker:** Chen Chen **Affiliation:** Chongqing University, China **Bio:** Chen Chen (Member, IEEE) received the B.S. and M.Eng. degrees from the University of Electronic Science and Technology of China, Chengdu, China, in 2010 and 2013, respectively, and the Ph.D. degree from Nanyang Technological University, Singapore, in 2017. He was a Post-Doctoral Researcher with the School of Electrical and Electronic Engineering, Nanyang Technological University, from 2017 to 2019. He is currently a Research Professor with the School of Microelectronics and Communication Engineering, Chongqing University, Chongqing, China. His research interests include optical wireless communication, optical access networks, Internet of Things, and machine learning. **Abstract:** In recent years, index modulation has been shown as a promising technique for visible light communication (VLC) systems. Particularly, index modulation can be applied in various domains of VLC systems, such as frequency, space, and so on. In this speech, we will introduce our recent works about index modulation-aided VLC systems. Our results show that the performance of VLC systems can be greatly enhanced by applying index modulation.
Invited Talk	**Title:** Spectrally-efficient and High-fidelity Radio-over-Fiber Interfaces for Future Mobile Fronthaul **Speaker:** Yixiao ZHU **Affiliation:** Shanghai Jiao Tong University, China **Bio:** Yixiao Zhu received the B.S. and Ph.D. degree from the School of Physics, and the State Key Laboratory of Advanced Optical Communication Systems and Networks, Department of Electronics Engineering, Peking University, Beijing, in 2014 and 2019, respectively. He is currently a postdoc with Shanghai Jiao Tong University. His research interests include high-speed optical transmission systems, optical access network, and mobile fronthaul. He frequently serves as a reviewer for Optics Letters, Optics Express, JOCN, etc. **Abstract:** With the advent of 5G Era, the emerging bandwidth-hungry broadband services such as VR/AR,

	4K/8K high-definition videos, and cloud computing have brought heavy data traffic for the cloud radio access network (C-RAN). So far, a variant of digital and analog radio-over-fiber (RoF) technologies has been proposed to deliver wireless signals in the mobile fronthaul, i.e. the fiber link connecting baseband unit (BBU) and remote radio unit (RRU). Toward larger capacity and higher fidelity, both spectral efficiency (SE) and recovered signal-to-noise ratio (SNR) are important metrics to evaluate the performance of RoF schemes. In this talk, we first review and compare several previously reported schemes. To overcome the SNR ceiling of fronthaul link, we then introduce delta-sigma modulation and cascaded digital-analog RoF schemes. The SNR-bandwidth trade-off is discussed. The transmission experiment is presented in detail to validate the fundamental scaling law of SNR. In addition, we further provide an outlook on the RoF interface design for future mobile fronthaul in 5G-advance and 6G.
Invited Talk	**Title:** Efficient station type design in optical transmission systems **Speaker:** Jianing Lu **Affiliation:** Tencent Corp., China **Bio:** Jianing Lu was born in Zhejiang Province, China, in 1993. He received the Ph.D. degree in Photonics Research Centre, Department of Electronic and Information Engineering, The Hong Kong Polytechnic University, Hong Kong and he received the B.Eng. and the M. Eng. degrees in optical and electrical information engineering, in 2015 and 2018, from Huazhong University of Science and Technology, Wuhan, China. He joined Tencent Corp. in 2021. His research is focused on optical networks. **Abstract:** In optical fiber transmission systems, the quality of transmission (QoT) of the signal at the receiver-side must meet the DSP threshold. In order to ensure the QoT performance and flatness for all channels, it is often necessary to introduce dynamic gain equalizer (DGE) with a higher cost comparing with that of inline amplifier. From the perspective of performance and cost, we need to design a proper station type scheme with the lowest cost on the premise of ensuring that acceptable QoT. At the same time, the required time should be as short as possible. In this work, QoT estimation combined with genetic algorithm is chosen. For QoT estimation, ASE noise, nonlinear noise, transceiver noise and filtering penalty are considered as impairments of the signal. For the bidirectional optical path between the business point pairs, the full-channel condition is considered to obtain the QoT performance including OSNR, GSNR, BER, and Q-factor. The genetic algorithm is further employed to accelerate the station type recommendation scheme. Efficient station type design can be realized.
G27737	**Title:** Study of Filter-based Neuromorphic Photonic Reservoir Computing for Signal Equalization in 224Gbps Sub-carrier Modulation IM-DD Short Reach Optical Fiber Communication System **Author(s):** Penghao Luo, An Yan, Aolong Sun, Guoqiang Li, Sizhe Xing, Jianyang Shi, Ziwei Li, Chao Shen, Junwen Zhang and Nan Chi **Speaker:** Penghao Luo **Affiliation:** Fudan University, China **Abstract:** The ever-increasing requirements for bandwidth in edge places higher demands on the transmission capacity and data rate of short-reach intensity-modulation and direct-detection (IM/DD) optical fiber communication systems. Advanced digital signal processing (DSP), such as neural network (NN), is verified to be a good way to improve system performance, but the complicated DSP process always means high power consumption and slow processing speed. Reservoir Computing (RC) is a machine learning algorithm suitable for time-series-based problem, which has a faster computing speed than recurrent NN (RNN). The inherent randomness of RC makes us find its potential of signal equalization in all-optical domain. In this paper, we numerically studied a neuromorphic photonic RC signal processing scheme in IM/DD system with low hardware complexity, and realize the all-optical RC through two sets of optical filter nodes. Subcarrier modulation (SCM) signal is applied to study the filter-based neuromorphic photonic RC scheme, in comparison to traditional equalization methods. Simulation results show that the photonic RC equalization can bring orders of magnitude

	improvement in BER over traditional schemes, and the performances of different Quadrature Amplitude Modulation (QAM) formats are also studied. Finally, the architecture implementation of photonics RC for 224Gbps SCM signal over 80km standard single-mode fiber (SSMF) transmission in C-band is numerically demonstrated.
G27752	**Title:** Coupling Efficiency Analysis for Optical Fiber with Different Core Diameters **Author(s):** Yuzhong Ma, Zijing Huang, Lin Sun, Gordon Ning Liu **Speaker:** Yuzhong Ma **Affiliation:** Soochow University, China **Abstract:** The loss of optical fiber link has a significant impact on the performance of optical fiber communication. In the short-distance optical interconnection, the quality of optical fiber connection is one of the main factors affecting the link loss, especially the influence of optical fiber coupling offset on the optical fiber coupling efficiency. In this paper, we build a model to quantitatively analyze the relationship between coupling offset and coupling efficiency. The simulation results show that a large core fiber has a higher tolerance to coupling offset compared with a traditional fiber.

Technical Session on Dec. 8

TS15 Fiber-Based Technologies and Applications

Chair Guochao Wang, National University of Defense Technology, China

Room No.	Room ID	Zoom Link
Room 5	811 1444 8699	https://us06web.zoom.us/j/81114448699

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Yu Cheng	Guilin University of Electronic Technology, China
16:00-16:30	Invited Talk	Guochao Wang	National University of Defense Technology, China
16:30-16:45	G2777	Shiying Xiao	Beijing Jiaotong University, China
16:45-17:00	G27755	Yuanyuan Yao	Nanjing University, China
17:00-17:15	G27716	Yefen Wei	Huaqiao University, China

Paper Detail

Invited Talk	**Title:** Research on ultra-broadband fiber light source based on erbium-bismuth co-doped fiber **Speaker:** Yu Cheng **Affiliation:** Guilin University of Electronic Technology, China **Bio:** Prof. Yu Cheng Guilin University of Electronic Technology (2019- present) Prof. Yu Cheng received the Ph.D. degree from the Wuhan University of Technology, Wuhan, P.R.China, in 2006, on the research of rare earth doped tellurite glass for use as candidate for broadband fiber amplifier. In 2008, he started as a Research Fellow in the Optoelectronics Research Centre (ORC) at the University of Southampton, U.K. In 2010, he he started as a Research Fellow in PPMG at the University of Bath, U.K. His research interests are ultra-low loss fiber, rare earth doped fiber, PMF, broadband EDFA, OFDR, metamaterials etc. He has many years work experience in industry, for example Fiberhome telecommunication Company in China, Yangtze Optical Fibre and Cable Joint Stock Limited Company in China. He was honored with “3551 Optics Valley Talent” by WuHan city, Hubei Province, P.R.C. in 2012. He was honored with “Innovative and Entrepreneurial Talent” by Jiangsu Province, P.R.C. in 2017. **Abstract:** Abstract: A new type of bismuth-erbium co-doped fiber was fabricated by MCVD process, and its fluorescence spectrum ranged from 1300nm to 1700nm. In order to deeply study this ultra-broadband fiber light source, the effects of fiber length, pump power, bismuth-erbium doping concentration and light source structure on the near-infrared luminescence properties and upconversion luminescence of bismuth-erbium co-doped fibers are discussed. Experiments showed that the optimization of fiber length, pump power, light source structure and doping concentration of bismuth-erbium ions is beneficial to improve the fluorescence intensity of the fiber at 1450~1700nm. The doping concentration of bismuth-erbium will affect the luminescence efficiency of the fluorescence spectrum. By testing the up-conversion luminescence, it is proved that the reason for the decline of the fluorescence luminescence efficiency is due to the presence of strong up-conversion luminescence.

	Finally, a high-brightness ultra-broadband light source in the S+C+L band is obtained through the multi-parameter equalization method.
Invited Talk	**Title:** Fiber-integrated High-performance Raman Light Generation for Cold Atom Interferometry **Speaker:** Guochao Wang **Affiliation:** National University of Defense Technology, China **Bio:** Dr. Guochao Wang is a post-doctor in College of Intelligence Science and Technology, National University of Defense Technology, and he is also a senior researcher in High-tech Institute of Xi′an. Dr. Wang received the B.S. degree, the M.S. degree and the Ph.D. degree from the National University of Defense Technology (NUDT), Changsha, China, in 2008, 2010 and 2015, respectively. His current research interests include quantum precision measurement, precision spectroscopy and optical metrology, microwave-photonic-based sensing and measurement. **Abstract:** Raman-type cold atom interferometers, having been proved as powerful tools for quantum sensing, are playing increasingly important roles in state-of-the-art fundamental physics tests and quantum sensing scenarios with applications over a broad range from the test of Einstein's equivalence principle, determination of the Newtonian gravitational constant to precise inertial measurement, such as gravity, gravity gradient, and rotations. In a Raman-type cold atom interferometer, two counter-propagating Raman light beams, each of which has dual frequencies with a gap tuned to Raman resonance corresponding to a certain radio frequency, are used to stimulate Raman transitions between two ground states. As the performance of Raman light directly determines the accuracy and sensitivity of the atom interferometer, high-performance Raman light, characterized in terms of narrow linewidth, low phase noise, pure spectrum, stable power ratio and power, is essential for high precision atom interferometry. Thanks to the already-matured fiber-based laser technology in the telecom C-band, such as narrow line-width fiber lasers, Er-doped fiber amplifiers, nonlinear optical waveguides, and electro-optic modulators, fiber-integrated Raman light of atom interferometer can be generated from them in compact size, low cost, high power and good reliability. This talk focuses on the fiber-based technologies we propose for high-performance Raman light generation, for instances, single-sideband-modulated Raman light based on fiber Bragg grating, the power ratio stabilization method of electro-optic-modulated laser pairs based on VIPA etalon, the power and power ratio stabilization method of the modulated Raman from fiber integrated module, all of which has shown full potential in quantum sensing.
G2777	**Title:** Strain and Temperature Discrimination by Fourier Analyzing Transmission Spectrum of an In-fiber Mach-Zehnder Interferometer **Author(s):** Shiying Xiao, Beilei Wu, Zixiao Wang, Youchao Jiang, Chunran Sun **Speaker:** Shiying Xiao **Affiliation:** Beijing Jiaotong University, China **Abstract:** An approach for strain and temperature discrimination is proposed and demonstrated by Fourier analyzing the transmission spectrum of a Mach-Zehnder interferometer (MZI) which consists of two peanut tapers and a polarization maintaining fiber (PMF). The high resolution together with the ease-of-fabrication and robustness of the sensor allow the MZI sensor combining with Fourier analysis a competitive approach for simultaneous strain and temperature sensing applications.
G27755	**Title:** Research on Early Fault Identification Technology of Sound Barrier Based on ϕ-OTDR **Author(s):** Yuanyuan Yao，Ningmu Zou，Chi Zhang，Qianyi Gao，Yiming Wan，Ruofan Wang，Shisong Zhao，Feng Wang，Yixin Zhang，Xuping Zhang **Speaker:** Yuanyuan Yao **Affiliation:** Nanjing University, China **Abstract:** In recent years, the scale of high-speed rail in China has grown rapidly, with a traffic mileage of 40,000 kilometers. Over 40 percent of railways have built sound barriers to ease the impact of the noise on residential areas along the railway. The sound barrier is usually composed of the following three parts: H-typed

	steel column, sound absorption board, and rubber articles. The H-typed steel column is fixed along the edge of the track. Four sound absorption boards of aluminum alloy material are inserted from top to bottom between the two columns. Taking advantage of the damping effects of the elastic joint, the rubber articles are used as connection components. However, if the rubber articles are aged or damaged, the sound absorption boards will become loose. At this time, under the repeated motivation of the air turbulent force generated by the high-speed train driving, the sound absorption boards may fall off, which will generate great safety risks, leading to major economic losses. Therefore, to prevent such accidents, it is necessary to monitor the sound barrier online. In this way, faults can be identified and diagnosed at an early stage. The traditional sound barrier detection method mainly uses the visual acquisition unit to regularly inspect the sound barrier along the railway. When the sound barrier just begins to loss, there are no obvious characteristics in its outside appearance, making it difficult to detect the fault point visually. In addition, this method is susceptible to severe weather such as rain and fog, and the identification accuracy is not high. In comparison to the visual method, the distributed optical fiber strain sensing method such as the Brillouin Optical Time Domain Reflectometer (BOTDR) is real-time and is not affected by weather conditions. By detecting the Brillouin frequency shift, continuous measurement of the strain parameters can be realized in space and time domains, so as to determine the state of the sound barrier according to the change of the strain. However, this method has a stringent requirement that optical fiber must be pre-stretched in order to determine the strain coefficient, and it is sensitive to both strain and temperature changes, so temperature differences in the space may cause the strain measurement error, reducing the identification accuracy. Since the sound barrier does not produce significant strain changes at an early stage, monitoring strain parameters also cannot enable early fault recognition. To address the above problems, this paper proposes a sound barrier early fault identification method based on phase-sensitive optical time domain reflectometry (ϕ-OTDR). The status of the sound barrier can be checked by monitoring vibrations induced by transitory intense impacts from trains. First, we fixed the optical fiber in an inverted "V" shape between two nearby sound barriers continuously without pre-stretched requirement, so that it can capture individual vibration characteristic of each sound absorption board. Second, the sound barrier will be forced to vibrate due to the excitation caused by the train, and after the train goes by and there is no external force stimulating the vibration pattern of the sound barrier, the vibration power spectrum would be dominated by the inherent frequency of the structure. As a result, the vibration signal after the train passes has the intrinsic feature of the sound barrier, and the signal is chosen for data processing at this moment. A field experiment was carried out in the construction section of the Hangzhou Hu-Hang Railway. A data sets of 405 samples were obtained. After feature extraction and classification, average recognition accuracy of 82.3% has been obtained even under complex field environment. The results show that, comparing to these traditional monitoring methods, the proposed system has the advantages of a simple structure and no temperature influence, as well as the ability to realize early fault identification, providing a feasible technical route for the early fault detection of the high-speed railway sound barrier.
G27716	**Title:** In-fiber Mach–Zehnder interferometer based on racetrack shape waveguide via femtosecond laser **Author(s):** Tianhao Wu, Wenqing Yang and Zhifang Wu **Speaker:** Yefen Wei **Affiliation:** Huaqiao University, China **Abstract:** In recent years, femtosecond (fs) laser has been successfully used to inscribe waveguide in the cladding of optical fibers by inducing local refractive index (RI) changes of the fiber material in a positive or negative way. We propose an in-fiber Mach–Zehnder interferometer (MZI) based on a racetrack shape waveguide inscribed by fs laser. The radius of the semicircular waveguide is 25μm. Keeping the radius constant, we prepare three samples by varying the length of straight waveguides. The length of the straight waveguide of these three samples are 1500μm, 2000μm and 3000μm, respectively. With the increase of the

	length of straight waveguide, the free spectral range decreases accordingly. We test the sample with a straight waveguide length of 3000μm. We place the sample into an electric oven (with an accuracy of ±0.1°C) and gradually increase its temperature from 25°C to 95°C with a step of 10°C. The temperature sensitivity is -58 pm/℃. With the increase of axial stress, the shift of the dip wavelength can hardly be observed from 0 to 4000με, which indicates that this in-fiber MZI is insensitive to axial strain. But in the torsion angle range of 0 to 360°, the sample shows very sensitive to torsion, with a sensitivity of 2 nm/((rad/m)). Such in-fiber MZI is compact and robust, and has great potential for applications requiring torsion measurements.

Technical Session on Dec. 9

TS16 Optoelectronic Devices and Applications

Chair Jianan Duan, Harbin Institute of Technology (Shenzhen), China

Room No.	Room ID	Zoom Link
Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Ruijun Wang	Sun Yat-sen University, China
10:00-10:30	Invited Talk	Yaocheng Shi	Zhejiang University, China
10:30-11:00	Invited Talk	Jiu-an Lv	Westlake University, China
11:00-11:15	G277105	Liu Han	University of Science and Technology Beijing, China

Paper Detail

Invited Talk

Title: Widely tunable semiconductor lasers enabled by photonics integration

Speaker: Ruijun Wang

Affiliation: Sun Yat-sen University, China

Bio: Ruijun Wang is an associate professor in the School of Electronics and Information Technology at Sun Yat-sen University. Prior to this, he was a postdoctoral researcher in the Institute for Quantum Electronics at ETH Zurich. He received his PhD in 2017 in Photonics Engineering from the Ghent University-IMEC.

His research interest includes the photonics integrated circuits, semiconductor lasers and mid-infrared photonics. He has authored or co-authored over 50 refereed publications in international journals (e.g., Nature Communications, Optica, ACS Photonics, Photonics Research, IEEE JSTQE) and conferences.

Abstract: The use of widely tunable single-longitudinal-mode semiconductor lasers can significantly reduce the cost of dense wavelength-division-multiplexing (DWDM) systems. In addition, widely tunable lasers are also highly desirable for multi-species trace gas spectroscopy. Photonics integration platform, such as silicon and thin film lithium niobite (TFLN) photonic integrated circuits (PICs), can provide ultra-compact and low-loss laser feedback circuits and optical filters. Therefore, integration of optical gain materials with these PICs enables advanced wavelength tuning schemes. Here we present our work on the development of widely tunable semiconductor lasers for optical communication and sensing application based on photonic integration: (1) Widely tunable O-band III-V/TFLN hybrid external cavity lasers were realized using a low-loss TFLN PIC as the laser feedback cavity and wavelength selection component. A wavelength tuning over 40 nm and side mode suppression ratio better than 60 dB is demonstrated. (2) Heterogeneously integrated widely tunable III-V-on-silicon Vernier lasers operating in the 2.3 μm wavelength range are realized using two silicon microring resonators as the wavelength tuning components. The lasers are employed to measure the absorption lines of CO in a broad spectral range. (3) A III-V-on-silicon distributed feedback (DFB) laser array covering 150 nm wavelength span in the 2.3 μm range is presented. Using this DFB laser array as the light source, tunable diode laser absorption spectroscopy of several gases was realized. We also will show that the on-chip beam combined DFB array can be employed to perform broadband spectroscopic sensing without mode hopping.

Invited Talk	**Title:** Silicon-based on-chip reconfigurable filter and optical add-drop multiplexer **Speaker:** Yaocheng Shi **Affiliation:** Zhejiang University, China **Bio:** Prof. Yaocheng Shi is from College of Optical Science and Engineering, Zhejiang University, Hangzhou, China. Prof. Shi's research activities are focused on silicon photonic integrated devices for optical communications, optical interconnections, as well as optical sensing. Prof. Shi has published more than 150 peer reviewed papers, including Nature Communications, Laser & Photonics Reviews, ACS Photonics etc, and his papers have been cited by >5000 times. He is the receiptant of National Natural Science Fund for Excellent Young Scholars in 2019. **Abstract:** Reconfigurable optical add-drop multiplexer (ROADM) which enables any channel to be switched and routed flexibly is a key element in the multiplexing system. For an MDM-PDM-WDM hybrid system, mode, polarization as well as wavelength are involved, thus it becomes a challenge to develop a novel ROADM enabling the add/drop of any channels of mode/polarization/wavelength. We will present a 96 channels ROADM for the hybrid MDM/PDM/WDM system and also direct-access mode-division multiplexing switches.
Invited Talk	**Title:** Photomorphogenesis of Diverse Autonomous Traveling Waves in a Monolithic Soft Artificial **Speaker:** Jiu-an Lv **Affiliation:** Westlake University, China **Bio:** Dr. Jiu-an Lv received his B. Sc. and M.S. degrees in the department of chemistry from northwest university, China, in 2005 and 2008, respectively. After that, he served as a process engineer at the China aerospace science and technology corporation for three years. In 2011, he began to study liquid crystal polymer materials at Fudan university and obtained Ph. D degree in 2016. Then he worked in the department of Materials in Fudan University as a postdoctoral researcher between 2016 and 2018. He joined Westlake University as an Assistant Professor in March 2018. **Abstract:** Biological organisms possess the remarkable ability to morph their soft, sheet-like tissues into wavy morphologies and self-oscillate to make traveling waves, enabling myriad functionalities in propulsion, locomotion, and transportation. In contrast, current man-made soft robotic system cannot adaptively make wavy morphologies and concurrently achieve wave propagation, because controllable actuation of desired 3D morphologies in entirely soft materials is a formidable challenge due to their continuously deformable bodies that own a large number of actuatable degrees of freedom. Here, we report a bioinspired robotic system that not only allows photomorphogenesis of on-demand 3D wavy morphologies, but also enables autonomous wave propagation in monolithic soft artificial muscle. This system employs a conceptually different design strategy based on a combination of two principles derived from plant morphogenesis and undulatory motion of ray fish. The former offers a shaping principle based on differential growth that enables morphing monolithic soft artificial muscle into target wavy configurations, while the latter inspires a driving principle that induces autonomous propagation of shaped waves by rhythmic motor patterns. This waving system can be used as adaptive "soft engines/motors" that enable directional locomotion, intelligent transportation of cargo, and autonomous propulsion. It even produces programmable, complex artificial peristaltic waves. Our design allows controllable formation of 3D wavy morphologies and autonomous wave behaviors in the soft robotic system would be useful for broad applications in adaptive, self-regulated mechanical systems for advanced robotics, soft machines, and energy harvest.
G277105	**Title:** Design of LED Array Control Module For Optical Camera Communication **Author(s):** Liu Han, Wang Jianping and Lu Huimin **Speaker:** Liu Han **Affiliation:** University of Science and Technology Beijing, China **Abstract:** Visible light communication technology is a communication system that uses light-emitting diodes as the emission source and electronic devices equipped with cameras or photodiodes as the receiving end. Optical

	camera communication, also known as optical imaging communication, belongs to a special kind of visible light communication, using image sensors as receivers . In this paper, an LED array control module for optical camera communication is designed, which realizes the data generation and signal transmission functions of the transmitter of the optical imaging communication system, and performs signal output and data transmission tests in indoor and outdoor environments.

Technical Session on Dec. 9

TS17 THz Metamaterials and Device Applications

Chair Fei Fan, Nankai University, China

Room No.	Room ID	Zoom Link
Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Jingbo Wu	Nanjing University, China
10:00-10:30	Invited Talk	Fei Fan	Nankai University, China
10:30-11:00	Invited Talk	Ying Zhang	Yunnan Normal University, China
11:00-11:15	G27729	Xiaodong Cai	Shanghai University, China

Paper Detail

Invited Talk	**Title:** Programmable terahertz devices for projection display and imaging **Speaker:** Jingbo Wu **Affiliation:** Nanjing University, China **Bio:** Jingbo Wu received the B.S. degree in Electronic Information Science and Technology in 2005, the M.S. degree in Radio Physics in 2008, and the Ph.D. degree in Electromagnetic Field and Microwave Technology in 2012 from Nanjing University, China. He was a Radio Frequency Engineer in Huawei Company from 2008 to 2009. From 2012 to 2016, he was a Postdoctoral Researcher in University of Leeds and University of Cambridge, UK. From 2016, he joined School of Electronic Science and Engineering, Nanjing University and is an associate professor currently. His research interest includes terahertz metamaterials, superconductor electronics and terahertz spectroscopy. **Abstract:** Terahertz (THz) technology has broad applications in wireless communication, radar, imaging, and other fields. The coding and programmable metasurfaces offer an effective route to realize the intelligent THz environment reconfiguration and information processing, which is crucial for these applications. Here we report our recent progress on terahertz programmable metasurface. We developed an electrically addressable metasurface with non-volatile memory using vanadium dioxide. The programmable metasurface can generate and store multi-level THz images for projection display. Based on the electro-optic effect of liquid crystal, we demonstrated a dual-color spatial light modulator at THz frequencies. We realized the compressive imaging with the self-calibration algorithm to eliminate the errors due to the nonuniformity of the pixels and THz source. We believe this work will contribute to developing THz holography and imaging with high fidelity.
Invited Talk	**Title:** Terahertz magneto-optical non-reciprocal chirality regulation and unidirectional transmission devices **Speaker:** Fei Fan **Affiliation:** Nankai University, China **Bio:** Fei Fan received the B.S. degree from the Tianjin University and the Ph.D. degree in optical engineering from Institute of Modern Optics, Nankai University. He is currently the professor with the Institute of Modern Optics and the deputy director of Department of optoelectronic technology and science, Nankai University. His

	research interests include terahertz microstructure functional devices and terahertz spectroscopy. **Abstract:** This report will describe two recent works of our team on terahertz magneto-optical microstructures. One is a wide-tunable terahertz waveguide isolator based on magneto-optical/metal asymmetric waveguide structure and non-reciprocal lateral spin edge state transmission. The second is a terahertz non-reciprocal chirality regulator and broadband isolator based on a magneto-optical mole metasurface structure. Both projects achieve wideband tunable high isolation unidirectional transmission and control of chiral spin states.
Invited Talk	**Title:** Integrated on-chip terahertz spoof surface-plasmon-polariton **Speaker:** Ying Zhang **Affiliation:** Yunnan Normal University, China **Bio:** YING ZHANG, received the M.Sc. degrees in condensed matter physics in 2014 form Yunnan Normal University and the Ph.D. degree in optic engineering in 2018 from Tianjin University, Tianjin, China. Her current research interests include terahertz time-domain spectroscopy, spoof surface plasmon polaritons and integrated optics devices. **Abstract:** Integrated optical devices whose dimensions are much smaller than their free-space counterparts have attracted considerable interest. In the terahertz (THz) regime, due to perfect conductivity of most metals, it is hard to realize a strong confinement of Surface plasmon polaritons (SPPs) although a propagation loss could be sufficiently low. We experimentally demonstrated a structure with periodic pillars arranged on a thin metal surface that supports bound modes of spoof SPPs at THz frequencies. For the development of integrated optical circuits, several components including straight waveguide, S-bend, Y-splitter and directional couplers were designed and characterized. Beyond that, We theoretically and experimentally demonstrate that rotated pillars could provide sufficient design degrees of freedom to enable versatile THz spoof SPP meta-devices. As a proof-concept demonstration, a series of on-chip meta-devices including the switch, the wavelength demultiplexer, and the splitters are presented. We believe that the devices proposed here will pave a new way for the development of flexible, wideband and compact photonic circuits operating at THz frequencies.
G27729	**Title:** Dynamical control of terahertz wavefronts using graphene metasurfaces **Author(s):** Xiaodong Cai, Shiyi Xiao **Speaker:** Xiaodong Cai **Affiliation:** Shanghai University, China **Abstract:** Dynamical controls on terahertz (THz) wavefronts are crucial for many applications, but available mechanism requests tunable elements with sub-micrometer sizes that are difficult to find in the THz regime. Here, different from the local-tuning mechanism, we propose an alternative approach to construct wavefront-control meta-devices combining specifically designed metasurfaces and globally tuned graphene layers. Coupled-mode-theory (CMT) analyses reveal that graphene serves as a tunable loss to drive the whole meta-device to transit from one functional phase to another passing through an intermediate regime, exhibiting distinct far-field (FF) reflection wavefronts. As a proof of concept, we design/fabricate a graphene meta-device and experimentally demonstrate that it can reflect normally incident THz wave to pre-designed directions with different polarizations under appropriate gating voltages. We finally design a graphene meta-device and numerically demonstrate that it can generate vectorial THz beams with continuously varying polarization distributions upon gating. These findings pave the road to realizing a wide range of THz applications, such as sensing, imaging, and wireless communications.

Technical Session on Dec. 9

TS18 Near-infrared, Mid-infrared and Far-infrared Technologies and Applications

Chair Qian Zhou, Tsinghua University, China

Room No.	Room ID	Zoom Link
Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Longqing Cong	Southern University of Science and Technology, China
10:00-10:30	Invited Talk	Lingling Huang	Beijing Institute of Technology, China
10:30-11:00	Invited Talk	Jianqiang Gu	Tianjin University, China
11:00-11:15	G2776	Suotao Dong	Changcun University of Science and Technology, China
11:15-11:30	G277109	Shuai Wang	Tsinghua University, China

Paper Detail

Invited Talk	**Title:** Active Terahertz Modulators with Dielectric Metasurfaces **Speaker:** Longqing Cong **Affiliation:** Southern University of Science and Technology, China **Bio:** Longqing Cong is an Associate Professor at SUSTech, working on terahertz photonics, metamaterials, photonic crystals and their applications in sensing, imaging and communications. Longqing has published 42 scientific papers with over 4100 citations and h-index of 31. **Abstract:** I will present the recent work in our group about effects of photon braking in a high Q terahertz metamaterial cavity. Coupled photons could be separated in the process of braking by injecting photocarriers and photon tone tuning is accomponyed due to the temporal change of cavity refractive index.
Invited Talk	**Title:** Holographic related techniques based on metasurface **Speaker:** Lingling Huang **Affiliation:** Beijing Institute of Technology, China **Bio:** Lingling Huang received her Double B.S. degree (both Science and Engineering B.S. degree) in Optoelectronics from Tianjin University and Nankai University, Tianjin, China, in 2009. And she received Ph. D. degree in Optical Engineering from Tsinghua University, Beijing, China, in 2014. Currently she is a professor in Beijing Institute of Technology. Her research activities are focused on nanophotonics and optical metasurfaces. She has published more than 80 SCI papers with about 5600 google scholar citations in recent years, including Nature Communications, Science Advances, Advanced Materials, Light: Science & Applications, Nano Letters and so on. She has been selected as Young Scholar of Changjiang River, Beijing Outstanding Young Scientist, et al. And she has been granted with several fundings from NSFC, Ministry of Science and Technology of China, and Beijing Municipal government. **Abstract:** Metasurfaces have represented unique advantages in holographic display due to their ability to arbitrarily modulate the wavefront of output light within subwavelength resolution. This distinct feature can make metasurface holography overcome some defects that exist in traditional holography method such as narrow

	bandwidth, small field-of-view (FOV), limited space-bandwidth as well as twin images. For the purpose of reconstructing several holographic images based on single metasurface and realizing dynamic holographic display, many multiplexed strategies have been demonstrated in recent years. The fundamental properties of light including frequency, polarization, incident angle and orbital angular momentum (OAM) are all the design freedoms that can be utilized. This talk summarizes progress on (1) an optical secret sharing scheme based on cascaded metasurface. This method can split and share encrypted holographic information with the help of multiple metasurface layers. (2) dynamic display of full-stokes vectorial holography based on metasurface. Such method can activate more polarization states in metasurface holography and improve the information capability of metasurface. Meanwhile, the demonstrated method may provide promising solutions to compact LiDAR, optical tweezers, dynamic and near-eye display, optical encryption and data storage.
Invited Talk	**Title:** Meta-atom-assisted photoconductive terahertz sources **Speaker:** Jianqiang Gu **Affiliation:** Tianjin University, China **Bio:** Jianqiang Gu received his Ph.D. from Tianjin University in 2010 and now is a professor at the Center for Terahertz Waves, Tianjin University. His research is mainly focused on terahertz functional devices based on metamaterials/metasurfaces, such as negative refractive index metasurfaces, PIT slow light metasurfaces, active modulators, stealth blankets, and meta-lenses. In recent years, he has focused on the research of achromatic metasurfaces and photoconductive antennas assisted by metamaterials, respectively. **Abstract:** Photoconductive terahertz emitters represented by photoconductive antennas (PCAs) and surface emission on semiconductors have been widely used in commercial terahertz systems. They have the advantages of low laser power requirements and broad bandwidth. However, efficiency has always been a pain point for further promotion of photoconductive terahertz sources. In this talk, the recent progress of the speaker's research group using nano- and micro-scale sub-wavelength artificial microstructures to enhance and control terahertz emission of photoconductive sources will be presented. We found that nano-scale meta-atoms can effectively enhance the efficiency of terahertz radiation from PCAs and semiconductor surfaces, while micron-scale meta-atoms integrated on PCAs' coplanar lines can effectively manipulate the spectral characteristics of the radiated terahertz pulses . It is worth emphasizing that all these studies are limited to optical pumping below 100 mW, so our study provides new ideas and experiences for the R&D of next-generation commercial-friendly terahertz sources.
G2776	**Title:** Research on 5.5 μm infrared filter applied to infrared thermometer **Author(s):** Suotao Dong, Xiuhua Fu and Cheng Li **Speaker:** Suotao Dong **Affiliation:** Changcun University of Science and Technology, China **Abstract:** With the expansion of novel corona-virus pneumonia's influence on the world, people's dependence on infrared thermometer guns is increasing. Meanwhile, the accuracy of temperature measurement is also increasing.In order to improve the measurement accuracy of the infrared temperature measuring gun and meet the requirements of rapid and accurate measurement of human body temperature, the core components for the infrared temperature measuring gun are developed and prepared in this paper. The film fogging phenomenon caused by the anisotropy of metal germanium and semiconductor properties is analyzed and solved by measuring the atomic force microscope image and infrared spectrum of the film, 5.5 micron infrared filter with high transmittance and good film quality was prepared by electron beam evaporation, resistance evaporation and ion source assisted deposition.
G277109	**Title:** Metasurface-based Poincaré sphere polarizer **Author(s):** Shuai Wang, Yuanmu Yang **Speaker:** Shuai Wang **Affiliation:** Tsinghua University, China

Abstract: As one of the most important properties of the light field, polarization has been widely used in applications ranging from microscopy to remote sensing. Polarization can be completely described by the state of polarization (SoP) and degree of polarization (DoP). SoP describes the trajectory of the electromagnetic field and can be classified as linear, circular, or elliptical. DoP is the intensity ratio of the polarized part of light and measures the coherence between two orthogonal polarization states. Linear polarizers, as the most widely adopted polarization manipulation element, can convert an incident beam into a linear polarization state. Recently, circular and elliptical polarizers have been proposed based on metasurface or metamaterials, such as helix nanostructure and diatomic metasurface. They allow a polarization through and prevent its orthogonal polarization state, leading to the generation of polarization located at an arbitrary position on the surface of the Poincaré sphere. However, polarization modulation based on light-matter interaction mostly focuses on SoP, which is a fully polarized state located at the surface of the Poincaré sphere, there are very few studies on the modulation of DoP, although the DoP plays an important role in light-matter interaction and carries the vital information of materials.

In this paper, we proposed a metasurface-based polarizer that can generate a polarization with modulated SoP and DoP, which is located at an arbitrary position at the surface and inside of the Poincaré sphere, named the Poincaré sphere polarizer. The metasurface contains freeform meta-atoms created by inverse design, inverse design can give the metasurface novel functions beyond the traditional method. When an unpolarized beam superposed by two orthogonal polarizations without fixed phase difference illuminates the metasurface, the transmittances of the arbitrary orthogonal polarizations can be individually controlled, leading to modulation of SoP and DoP. In the experiment, the Metasurface-based Poincaré sphere polarizers with three SoPs and three DoPs have been fabricated and demonstrated. Our research on the manipulation of DoP and SoP from the incident unpolarized beam is helpful to understand the deep mechanism when the material interacts with sunlight in the natural environment and improves the performance of imaging or detection systems based on polarization.

Technical Session on Dec. 9

TS19 Quantum Optics and Information

Chair Xun Guan, Tsinghua-Berkeley Shenzhen Institute, China

Room No.	Room ID	Zoom Link
Room 4	868 4632 7948	https://us02web.zoom.us/j/86846327948

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Wei Zhang	Tsinghua University, China
10:00-10:30	Invited Talk	Xiaoying Li	Tianjin University, China
10:30-11:00	Invited Talk	Zhiguo Wang	National University of Defense Technology, China

Paper Detail

Invited Talk	**Title:** Single-photon-level spectral sensor based on photon counting and compressive sensing **Speaker:** Wei Zhang **Affiliation:** Tsinghua University, China **Bio:** Wei Zhang received his Bachelor's degree in 1998 and Ph. D in 2003, respectively, from Electronic Engineering Department, Tsinghua University, China. Then he joined Institute of Information Optoelectronic Technology, Electronic Engineering Department, Tsinghua University. At present, he is a tenured professor of Tsinghua University and the vice director of the Institute of Information Optoelectronic Technology. His research interests include Micro/nano-photonic devices, integrated photonic quantum devices, photonic quantum information technologies, especially quantum communications and quantum imaging. **Abstract:** Spectral sensing and analysis of single-photon-level faint light has important applications on researches of material science and biology, and R&D of medicine, environment, security and so on. Traditionally, this sensing function is realized by monochromators and single-photon detectors. The monochromator selects photons in a narrow frequency band, then they are detected by the single photon detector and recorded by a photon counter. The spectrum of faint light is obtained by scanning the filter frequency of the monochromator. However, long measurement time is required in such a sensing process, limit its applications on scenarios requiring real-time measurement. We believe that improving the photon utilization in this measurement is the key point to reduce acquisition time of spectral information. In this talk, I will introduce our recent works about single-photon-level spectral sensor based on photon counting with high photon utilization, in which computational spectral reconstruction based on compressive sensing was applied.
Invited Talk	**Title:** Quantum light generation in standard and engineered optical fibers **Speaker:** Xiaoying Li **Affiliation:** Tianjin University, China **Bio:** Xiaoying Li graduated from Tianjin University as a B.S and M.S in 1985 and 1998, respectively. She received her Ph.D degree in physics from Shanxi University in 2001, and was a post-doctor in Northwestern University during 2002 – 2005. She joined Tianjin University in 2005. She is currently a professor at the College of Precision Instrument and Opto-electronics engineering. Her research interests are in quantum optics, quantum information and nonlinear optics.

	Abstract: Using the parametric process of four-wave mixing in silica core fibers, we demonstrate the development of various kinds of quantum light sources, including the pure state single photons, entangled photon pairs and temporally multiplexed entanglement.
Invited Talk	**Title:** Systematic Errors in the Comagnetometer Based on Xe Spins **Speaker:** Zhiguo Wang **Affiliation:** National University of Defense Technology, China **Bio:** Zhiguo Wang received his Ph.D. degree in Optical Engineering from National University of Defense Technology in 2010. He is currently an associate professor with the College of Advanced Interdisciplinary Studies, National University of Defense Technology. He owns over 10 issued CN patents and published more than 80 peer-reviewed research papers. His research interests include interactions between light and atoms, nuclear magnetic resonance, as well as spin sensors such as quantum gyroscopes, quantum magnetometers, and quantum comagnetometers. **Abstract:** The comagnetometers have been widely used in fundamental research, such as tests of spin-gravity coupling and searches for permanent electric dipole moments (EDMs). Systematic errors limit their performance and thus need to be studied in detail. In this report, we will analyze several systematics in the comagnetometer based on 129Xe and 131Xe spins, such as Bloch-Siegert shift, Damping shift, and frequency shift from phase lag in the closed-loop system.

Technical Session on Dec. 9

TS20 Fiber-Based Technologies and Applications

Chair Guoqing Wang, Shenzhen Institute of Information Technology, China

Room No.	Room ID	Zoom Link
Room 5	811 1444 8699	https://us06web.zoom.us/j/81114448699

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Huanhuan Liu	Southern University of Science and Technology, China
10:00-10:30	Invited Talk	Guoqing Wang	Shenzhen Institute of Information Technology, China
10:30-11:00	Invited Talk	Jianzhong Zhang	Harbin Engineering University, China
11:00-11:15	G27713	Tongle Yuan	Guilin University of Electronic Technology, China

Paper Detail

Invited Talk	**Title:** Optical Vortex Beam for Sensing Application **Speaker:** Huanhuan Liu **Affiliation:** Southern University of Science and Technology, China **Bio:** Dr. Liu Huanhuan is currently an Associate Research Professor in the Department of Electrical and Electronic Engineering in Southern University of Science and Technology. She received her Ph.D. degree from Nanyang Technological University (NTU), Singapore in 2014, worked as a postdoc at NTU from 2014 to 2016. She worked as an assistant professor in Shanghai University from 2016 to 2020. The main research directions are fiber optic sensing, fiber laser, and low-dimensional nanomaterial optical devices. In recent 10 years, she has published more than 40 peer-reviewed SCI journal papers, such as Nanophotonics, Optics Letters, etc. She won the excellent paper of the Photonics Global Conference in 2010, and won the "National Outstanding Self-financed International Student Scholarship" in 2014, won the honor of "Shanghai Young Oriental Scholar" in 2016, and won the second prize of Shanghai Science and Technology Progress Award in 2020. **Abstract:** We have proposed the generation of vortex beams including orbital angular momentum modes and cylindrical vector modes, and experimentally demonstrated vortex beams for magnetic-field, temperature, strain, and refractive-index sensing.
Invited Talk	**Title:** Tilted fiber grating for ultrafast optical imaging **Speaker:** Guoqing Wang **Affiliation:** Shenzhen Institute of Information Technology, China **Bio:** Dr. Wang is the assistant professor in Shenzhen Institute of Information Technology. He is the life member of OSA, SPIE and member of IEEE and IEEE Photonics Society. **Abstract:** We present a compact and high-efficient compressive sensing (CS) based single pixel imaging system using an in-fiber grating. The in-fiber grating, which is called 45 ° tilted fiber grating (TFG), is utilized as the in-line polarizer, a lateral diffraction device and a light emitter at the same time. A proof-of-principle experiment is performed. Data compression ratio from 5% to 25% are obtained using proposed imaging system. The proposed design solves the big data issue in the traditional time-stretch system. It has great potential in fast

	dynamic phenomena with low-cost and easy-access components.
Invited Talk	**Title:** Color tuning in Lanthanide ions doped upconversion nanocrystals **Speaker:** Jianzhong Zhang **Affiliation:** Harbin Engineering University, China **Bio:** Jianzhong Zhang received the B.S. degree in semiconductor physics from Lanzhou University, Lanzhou, China, in 2000, and the M.S. and Ph.D. degrees in optical engineering from Harbin Engineering University, Harbin, China, in 2004 and 2007, respectively. He was a research fellow with the University of New South Wales, Sydney, NSW, Australia, in 2006 and 2012, respectively. Since 2011, he has been a Professor with the College of Science, Harbin Engineering University. He is the deputy director of Key Lab In-Fiber Integrated Optics, Ministry of Education, China. He has authored more than 180 articles in refereed journals and conferences, edited two books and three book chapters, and holds 26 patents. He served the journals of optics express and measurement: sensors as an associate editor. His current research interests include optical glasses and nanomaterials, optical fiber devices, optical fiber sensing technologies, and their applications. **Abstract:** Color-tunable upconversion luminescence from lanthanide ions doped nanocrystals has wide prospects for applications like anti-counterfeiting and disease diagnosis/treatment. The main challenges of the current color tuning approaches are high color purity, high luminescent efficiency, compact material structure, and simple operation. This talk will review the development and latest progress of the upconversion color tuning works. The newly developed core-multi-shell structured upconversion nanocrystals will be emphatically introduced, as they are the most promising materials to achieve high quality upconversion color tuning. Finally, the future of this field will be briefly prospected.
G27713	**Title:** High Brightness Ultra Wideband Fiber Source **Author(s):** Tongle Yuan, Yu Cheng, Ming Chen, Libo Yuan, Sumei Huang, Jing Li **Speaker:** Tongle Yuan **Affiliation:** Guilin University of Electronic Technology, China **Abstract:** Novel bismuth-erbium co-doped fibers (BEDFs) are prepared by the modified chemical vapor deposition process, and its fluorescence spectra covers 1380~1700nm. The structure, fiber length, pump power and Erbium ion doping concentration are discussed in this paper to explore the properties of this ultra-wideband fiber light source based on BEDF. The experiments show that the optimization of the above parameters is beneficial in improving the fluorescence intensity of this fiber light source from 1450 nm to 1700 nm. The concentration of erbium ions affects the luminescence efficiency of the fiber. It is demonstrated that the decrease of the fluorescence luminescence efficiency is due to the presence of a strong upconversion luminescence via experiments described in this paper. Finally, a high-brightness ultra-broadband light source with a full spectral width of 320 nm is obtained through a multi-parameter equalization method, and its 5db bandwidth near 1550 nm can reach 51 nm, and the output power of the light source can reach 1.95 mW.

Technical Session on Dec. 9

TS21 Optoelectronic Devices and Applications

Chair Jiu-an Lv, Westlake University, China

Room No.	Room ID	Zoom Link
Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Mengyuan Ye	China University of Geosciences, China
14:00-14:30	Invited Talk	Yuefei Cai	Southern University of Science and Technology, China
14:30-15:00	Invited Talk	Kan Wu	Shanghai Jiao Tong University, China
15:00-15:15	G27771	Qixiang Gao	Chang Guang Satellite Technology Co., Ltd, China

Paper Detail

Invited Talk	**Title:** Multimode Silicon Photonics **Speaker:** Mengyuan Ye **Affiliation:** China University of Geosciences, China **Bio:** Mengyuan Ye received a B.E degree from Sun Yat-Sen University, a Ph.D. degree in optical engineering from Huazhong University of Science and Technology and is now an Associate Professor in China University of Geosciences. His research interests include silicon photonics, multi-mode manipulation and photonics integration. **Abstract:** As the rapid development of mode division multiplexing (MDM) technique, silicon integrated devices that could manipulate multimode signals are highly desired. We propose and demonstrate our recent progress on silicon based devices for multimode signal splitting, filtering and modulation.
Invited Talk	**Title:** Monolithic Integration of GaN HEMTs with microLEDs for Li-Fi and microdisplay **Speaker:** Yuefei Cai **Affiliation:** Southern University of Science and Technology, China **Bio:** Dr. Yuefei Cai was born in 1989. He got his bachelor degree in optoelectronics and master degree in physics electronics from Harbin Institute of Technology(HIT) in 2011 and 2013, respectively. Then he went to Hong Kong University of Science and Technology (HKUST) for his PhD degree, focusing on GaN optoelectronic devices such as integration of HEMT with LEDs. After his PhD graduation in 2018, he did his postdoc research in University of Sheffield and continued research in GaN optoelectronic devices. He joined Southern University of Science and Technology (SUSTech) in 2022. His research interests include GaN RF, optoelectronic and acoustic devices used for optical communication, display, sensing, etc. **Abstract:** As a wide bandgap semiconductor, GaN has many advantages such has a wide direct bandgap, large intrinsic breakdown voltage and high carrier mobility, enabling it suitable to be used for optoelectronic devices (LEDs) and power or radio frequency devices (HEMTs). In this talk, a monolithic integration of GaN HEMTs with microLEDs, including motivation, experimental details and results, will be given. For single HEMT-microLED device, a 1.2 GHz bandwidth can be achieved for c-plane multiple quantum

	wells(MQWs)-based light emitters, which is high enough for Li-Fi application. For HEMT-microLED arrays, an 8x8 microLED display with HEMTs being monolithically integrated will be demonstrated for AR/VR application.
Invited Talk	**Title:** Kerr soliton in a F-P fiber microresonator with weak GVD **Speaker:** Kan Wu **Affiliation:** Shanghai Jiao Tong University, China **Bio:** Dr. Kan Wu is currently a professor in the State Key Laboratory of Advanced Optical Communication Systems and Networks, Department of Electronic Engineering, School of Electronic Information and Electrical Engineering, Shanghai Jiao Tong University. He received B.S degree and M.S degree from Shanghai Jiao Tong University in 2006 and 2009, and Ph.D. degree from Nanyang Technological University in Singapore in 2013. His research interests include high-repetition-rate mode-locked lasers and photonic integration. Four of his papers have been the ESI hot papers and highly cited papers. He has invited papers published on Photonic Research, Optics Communications and Nanoscale Advances. Six of his papers have been cited more than 100 times each. His publications include Light Science and Applications, Nature Communications, Physical Review X and Optical Letters, etc. Dr. Kan Wu was awarded Excellent Young Scholars of NSFC in 2019. **Abstract:** Optical frequency combs based on microresonator has attracted huge interest for their revolutionary performance. Recently, many studies focus on the microcomb dynamics near zero-dispersion region. One obvious advantage of this scenario is that the ultra-broadband microcomb can be achieved. Besides, the bright soliton structures have been found and can counter-intuitively exist in normal-dispersion driven resonators when intracavity third-order dispersion dominates the field evolution. However, the microcomb dynamics in the anomalous-dispersion region with strong third-order dispersion have not been experimentally studied so far. Here, we report on the first experimental observation of anomalous-dispersion based zero-dispersion solitons in a fiber-based high Q Fabry-Perot microresonator. Benefiting from the ultra-small anomalous group velocity dispersion, we have also experimentally obtained 2/3-octave-spaning microcombs with a frequency interval of 10 GHz. This study complements the study of zero-dispersion soliton and will stimulate the research of microcombs near the zero-dispersion region.
G27771	**Title:** Wave-front Coding Technology to Extend Depth of Field in Remote Sensing Optical System **Author(s):** Qixiang Gao, Yuanhang Wang, Xing Zhong and Yu Li **Speaker:** Qixiang Gao **Affiliation:** Chang Guang Satellite Technology Co., Ltd, China **Abstract:** Wave-front coding technology refers to placing a phase mask at the aperture stop of a traditional optical system, modulating the wavefront and phase of the incident light field at the pupil, and finally using the digital image processing method to decode to realize computational imaging. Depth of Field (DOF) is a significant issue, the wavefront of the optical system is modulated by inserting a phase plate, so that optical modulation transfer function (MTF) and point spread function (PSF) are not sensitive to the changes of the object distances within a large depth of field range. Finally, image restoration is achieved by decoding, and clear images with a large depth of field are obtained. Compared with previous work, we innovatively proposed a high-order polynomial phase plate design, considering manufacturing difficulty as an optimization factor, and finally realized 200m-100km ultra-large depth-of-field imaging in a remote sensing optical system without a focusing mechanism.

Technical Session on Dec. 9

TS22 Biophotonics and Optical Biomedicine

Chair Yiming Li, Southern University of Science and Technology, China

Room No.	Room ID	Zoom Link
Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Na Ni	ShanghaiTech University, China
14:00-14:30	Invited Talk	Dan Zhu	Huazhong University of Science and Technology, China
14:30-14:45	G277128	Junxiong Zhou	Southern University of Science and Technology, China
14:45-15:00	G27719	Chenkun Ge	Northwestern Polytechnical University, China

Paper Detail

Invited Talk	**Title:** Interpretable Artificial Intelligence for Quantitative Blastocyst Assessment on Microscopy Imaging **Speaker:** Na Ni **Affiliation:** ShanghaiTech University, China **Bio:** Na Ni is an Associate Research Professor of Center of Adaptive System Engineering in ShanghaiTech University, China. She obtained Ph.D. degree from Network Technology Research Center, Nanyang Technology University (NTU) in Singapore. From 2009-2010, she worked as a research associate in A*Star Institute of Infocomm Research. From 2010 to 2019, she was an architect in GE Global Research Center Shanghai. Her research directions include computer vision, artificial intelligence, optical inspection and data management. She has published more than 30 SCI publications and has two authorized international patents. **Abstract:** Embryo selection relying on morphological appearance takes key impact on in vitro fertilization (IVF). In recent years, deep learning network, especially convolution neural networks (CNNs) has been utilized for assessing embryo quality. Although those studies have made significant improvements in grading of embryo quality, most of the previous works give a qualitative evaluation by classic classification network . In our work, we redefined blastocyst assessment as a regression task aiming to provide quantitative and consistent grading results. To the best of our knowledge, this is the first time to assess blastocyst quality based on regression task. Regression based network could provide a quantitative and accurate evaluation result. What's more, in order to make more accurate and interpretable prediction, we applied soft-attention mechanism in our network. Experiments confirmed that the effectiveness of the proposed approach for predicting blastocyst quality. Moreover, the visualized activation map makes the proposed network decision more interpretable.
Invited Talk	**Title:** Tissue optical clearing imaging: from in vitro to in vivo **Speaker:** Dan Zhu **Affiliation:** Huazhong University of Science and Technology, China **Bio:** Dr. Dan Zhu is a professor of Huazhong University of Science & Technology, Vice-Director of Wuhan National Laboratory for Optoelectronics, Director of Advanced Biomedical Imaging Facility. Her research interests mainly focus on tissue optical clearing imaging and applications. She is the pioneer in the field of in

	vivo tissue optical clearing，and also developed fast, label-compatible in vitro optical clearing methods. She has authored more than 150 papers including Science Advances, Nature Communications, et al. She is also Fellow of SPIE, and Secretary General & Vice President of Biomedical Photonics Committee of Chinese Optical Society. She serves for journals as associate editor of Journal of Biomedical Optics, guest editor or editorial member of Biomedical Optics Express, Scientific Reports, Journal of Innovative Optical Health Sciences, Frontier of Optoelectronics et al. **Abstract:** Biomedical optical Imaging techniques provide powerful tools for observing biomedical tissue structural and functional information. However, the high scattering of biological tissues limits the penetration of light, and decreases imaging resolution and contrast as light propagates deeper into the tissue. Fortunately, novel tissue optical clearing technique provide a way for solving the above problem. This presentation will introduce some progress in tissue optical clearing imaging, i.e., in vitro tissue optical clearing methods for whole organs imaging; in vivo skull/skin optical clearing window for imaging structural and functional of cutaneous / cortical vascular and cells.
G277128	**Title:** Adaptive dynamic analysis-based optical coherence tomography angiography for blood vessel tail artifacts suppression **Author(s):** Junxiong Zhou, Yuntao Li, Jianbo Tang **Speaker:** Junxiong Zhou **Affiliation:** Southern University of Science and Technology, China **Abstract:** Optical coherence tomography angiography (OCTA) for blood vessel 3-D structure imaging suffers from blood vessel tail artifacts when using a long decorrelation time (e.g., repeat B-scan acquisition in regular OCTA) or loss of micro vessel signal when using a short decorrelation time. In this work, we developed an adaptive first order field autocorrelation function (g1) analysis-based technique to suppress the tail artifacts under macro vessels while enhancing the dynamic signal of micro vessels.The proposed method is based on the differences of the decorrelation rate and the phase variations of g1 between the vessel voxels and the artifacts regions. A short or a long decorrelation time was applied to obtain the dynamic index of the tail artifacts region or the blood vessel region, respectively. Compared to the post image processing-based techniques, the proposed approach addresses this problem through the physical basis and shows a good performance in suppressing the tail artifacts while enhancing the detection of the micro vessels.
G27719	**Title:** Self-Supervised Denoising of single OCT image with Self2Self-OCT Network **Author(s):** Chenkun Ge, Xiaojun Yu, Mingshuai Li and Jianhua Mo **Speaker:** Chenkun Ge **Affiliation:** Northwestern Polytechnical University, China **Abstract:** In recent years, supervised deep learning of image denoising has attracted extensive research interests. Those methods usually required a large number of noisy/clean image pairs in training datasets. However, in most real situations, it is very difficult to obtain high-quality clean images such as optical coherence tomography (OCT) images. Therefore, it is of great significance to study a deep learning method for denoising without clean images, which only uses the input noisy image itself for training. In this article, for a single OCT image, we propose a novel self-supervised deep learning model called Self2Self-OCT network by improved the Self2Self network and added a loss function that can effectively remove the background noise of OCT images, which makes the whole training do not need correlative clean images. Specifically, we use gated convolution to replace the partial convolution layer of the encoder’s block in Self2Self. The input image and its Bernoulli sampling instance are put into our network respectively, and the background noise attenuation loss is added to loss function during training. The result is estimated from average of the predictions generated by multiple instances of the training model. The experiments with different OCT images show that proposed model not only has obvious advantages compared with the existing single deep learning methods and non-learning methods, but also surpasses the supervised learning of a small number of sample training.

Technical Session on Dec. 9

TS23 Data Center Optical Interconnects and Networks

Chair Shikui Shen, China Unicom, China

Room No.	Room ID	Zoom Link
Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Junjie Xie	China Academy of Information and Communication Technology, China
14:00-14:30	Invited Talk	Xueyang Li	Peng Cheng Laboratory, China
14:30-15:00	Invited Talk	Shaohua Hu	University of Electronic Science and Technology of China, China

Paper Detail

Invited Talk	**Title:** Standardization Status and Discussion on Test Method Of 400g And Above Data Center Optical Module **Speaker:** Junjie Xie **Affiliation:** China Academy of Information and Communication Technology, China **Bio:** Junjie Xie is currently working in China Academy of Information and Communication Technology. Her research field mainly focuses on the direction of high-speed optical communication ,including technical standardization，consultation, testing and certification work of optical modules and optoelectronic devices. **Abstract:** This is about status and development trend of data center optical module standard, including 400G, 800G and 1.6T. Besides, the test method of optical modules is also discussed.
Invited Talk	**Title:** Advanced direct detection systems for short-reach data center communications **Speaker:** Xueyang Li **Affiliation:** Peng Cheng Laboratory, China **Bio:** Dr. Xueyang Li is an assistant scientist at Peng Cheng Laboratory. He received his PhD degree in electrical engineering at McGill University under the supervision of Prof. David Plant. Prior to that, he studied at Zhejiang university (BEng & MEng), and CentraleSupelec (Dipl. Ing.). He has published 1 PCT patent and 27 papers in reputed journals and conferences in the field of optical communications. His research interest spans topics including self-coherent communications, data center interconnects and optical wireless communications. He will talk about advanced direct detection schemes for data center communications. **Abstract:** The data center IP traffic grows at an exponential rate driven by data-intensive applications including artificial intelligence and high-definition video streaming. Digital coherent technology has migrated from long-haul communications to data center interconnects and great efforts have been invested in developing more cost-effective and low-power coherent systems for data center communications at increasingly shorter distances. From another perspective, it is also viable to design advanced direct detection schemes that allow higher spectral efficiency and longer transmission distance by combining the performance advantages conventionally found in coherent systems with the cost-effectiveness of direct-detection systems. We will share our results on novel advanced direct detection systems and digital signal processing algorithms relevant for enhancing the system performance.

Invited Talk	**Title:** Key DSP Techniques for IMDD optical fiber transmissions with severe SSBI **Speaker:** Shaohua Hu **Affiliation:** University of Electronic Science and Technology of China, China **Bio:** Shaohua Hu received the BEng. degree from University of Electronic Science and Technology of China(UESTC) in 2015. He received the Doctor degree at UESTC in 2022. In 2020, he was a Visiting Ph.D. with the DSP Centre of excellence, Bangor University, Bangor, U.K. His research interests concentrate on the advanced DSP algorithms for high-speed optical fiber transmission systems. **Abstract:** In this speech, the most recent DSP advances in C-band IMDD fiber transmission systems are introduced to support a longer transmission distance for beyond 100 Gb/s system.

Technical Session on Dec. 9

TS24 Silicon Photonics

Chair Zhen Gao, Southern University of Science and Technology, China

Room No.	Room ID	Zoom Link
Room 4	868 4632 7948	https://us02web.zoom.us/j/86846327948

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Yating Wan	King Abdullah University of Science and Technology, Saudi Arabia
14:00-14:30	Invited Talk	Hairun Guo	Shanghai University, China
14:30-15:00	Invited Talk	Yi Zou	ShanghaiTech University, China
15:00-15:15	G277126	Yao Qiong	National University of Defense Technology, China

Paper Detail

Invited Talk	**Title:** On-chip lasers for Silicon Photonics **Speaker:** Yating Wan **Affiliation:** King Abdullah University of Science and Technology, Saudi Arabia **Bio:** Dr. Yating Wan received her B.Sc. degree at Zhejiang University, in 2012, and her Ph.D. degree in at Hong Kong University of Science and Technology in 2017. She joined Prof. John Bower's group at University of California, Santa Barbara as a postdoctoral research associate from 2017-2022 and then joining KAUST as an Assistant Professor in 2022. Dr. Yating Wan's research interests are in Silicon Photonics with special emphasis on integration of on-chip light sources for short-reach communication links. She is also interested in other related applications including biosensors/bioimaging, energy harvesting, machine vision, and quantum information processing. She received 2016-17 School of Engineering PhD Research Excellence Award in HKUST, 2021 CLEO Tingye Li Innovation Prize, 2018 PIERS Young Scientist Award, 2018 Rising Stars Women in Engineering Asia, 2020 Rising Stars Women in EECS and 2021 OGC Best Young Scientist Award. She has published more than 60 peer-reviewed research papers, including 33 first-author journal (23)/conference(10) papers, 7 journal covers, 1 postdeadline conference paper, and 1 book chapter. **Abstract:** Integrated silicon photonics has sparked a significant ramp-up of investment in both academia and industry as a scalable, power-efficient, and eco-friendly solution. At the heart of this platform is the light source, which in itself, has been the focus of research and development extensively. This talk sheds light and conveys our perspective on the current state-of-the-art in different aspects of application-driven on-chip silicon lasers. At the device-level, we explained the different approaches and efforts taken in integrating lasers in PIC chips, be they IV- or III-V-based lasers through different integrating methodologies while discussing the merits and associated obstacles of each route. Then, we highlighted the ongoing research in the most prominent system-level applications that can benefit greatly from PICs with on-chip lasers and show very promising prospects for development in optical communications and interconnects, to LiDAR, to bio-chemical sensing, to quantum and optical computing.
Invited Talk	**Title:** Intermode dispersion engineered photonic soliton combs

	Speaker: Hairun Guo **Affiliation:** Shanghai University, China **Bio:** Hairun Guo obtained his PhD at Technical University of Denmark (DTU) in 2014. In 2015-2018, he joined the laboratory of photonics and quantum measurements at Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland, as a postdoc scientist, where he was also granted the Marie Curie individual research fellowship. Since 2019, he received the position of professorship at the key laboratory of specialty fiber optics and optical access networks at Shanghai University. His research group is now focusing on emergent phenomena in ultrafast nonlinear optics and on applications based on optical frequency comb technique. Hairun has published more than 50 peer-reviewed journal articles, and has been invited to present his work in more than 20 international conferences. **Abstract:** Soliton microcombs have enabled miniatured and chip scale optical frequency combs for precise time and frequency measurement, Physically in the soliton regime, the comb can be largely engineered by the dispersion of the guided medium, in both terms of high-Q microresonators and photonic straight waveguides. Of particular interest is intermode dispersion that usually exists in devices that are intrinsically multi-mode, or can be induced in coupled waveguide or resonator systems for advanced engineering and for comb spectral tailoring. Here, we investigate soliton combs in the presence of intermode dispersion. We demonstrate soliton combs both in optical high-Q microresonators and in the process of photonic supercontinuum generation, which has featured spectral structure determined by the dispersion of the coupled mode. In details, the effect in microresonators would lead to a broadband enhancement on the soliton comb power and would enhance the soliton efficiency, whereas in the process of soliton spectral broadening (i.e. the supercontinuum process), a properly designed super-mode dispersion would lead to a super-flat comb spectrum, which is readily for precise comb spectroscopy including the dual comb spectroscopy. We would also introduce related applications based on such soliton combs
Invited Talk	**Speaker:** Yi Zou **Affiliation:** ShanghaiTech University, China **Bio:** Dr. Yi Zou is an assistant Professor in the School of Information Science and Technology at ShanghaiTech University. He received his Ph.D. in Electrical and Computer Engineering from the University of Texas at Austin in 2014. From 2015 to 2017 he worked in the College of Engineering and Applied Sciences at Nanjing University as a research associate professor. He joined the faculty of ShanghaiTech University in July 2017. Dr. Zou has published more than 50 peer-reviewed papers in major optics journals, including Photonics Research, IEEE Journal of Selected Topics in Quantum Electronics, Applied Physics Letters, Optics Letters, etc. His current research interests include integrated photonic open sensor platform, programmable photonic processor, and novel properties of artificial nanostructures and their applications.
G277126	**Title:** Optomechanical Cavity for Electrical Voltage Sensing **Author(s):** Qiong Yao, Ji Xia, Fuyin Wang, Chunyan Cao, Shuidong Xiong **Speaker:** Yao Qiong **Affiliation:** National University of Defense Technology, China **Abstract:** Devices for measuring physical, chemical, and biological phenomena must be able to detect electrostatic charge with high accuracy. A strong interaction between an optical cavity and a mechanical resonator is accomplished by a nanophotonic optomechanical cavity, which limits the light field at the nanoscale. It offers promise for applications in precision sensing thanks to its strong optomechanical coupling and high optical quality factor cavity. Using a zipper cavity and a suspended photonic crystal nanobeam (PCN) that functions as a moveable mechanical resonator, an integrated optomechanical electrometer for electrical voltage measurement is presented here.

Technical Session on Dec. 9

TS25 Emerging Technologies for Information Displays and Lighting

Chair Ping Su, Tsinghua Shenzhen International Graduate School, China

Room No.	Room ID	Zoom Link
Room 5	811 1444 8699	https://us06web.zoom.us/j/81114448699

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Zhaoxia Bi	Division of Solid State Physics/NanoLund, Lund University, Sweden
14:00-14:30	Invited Talk	Zhen Chen	Xuzhou GSR Semiconductor, China
14:30-15:00	Invited Talk	Christoph Ebner	Graz University of Technology, Austria

Paper Detail

Invited Talk

Title: A platform of InGaN platelets for Nano/Micro-LEDs emitting red, green and blue lights

Speaker: Zhaoxia Bi

Affiliation: Division of Solid State Physics/NanoLund, Lund University, Sweden

Bio: Zhaoxia Bi obtained his B.S. degree in physics in 2000 at Nanjing University, China. In the same university, he obtained his Ph.D. in Microelectronics and Solid State Electronics in 2005 with Prof. Rong Zhang. He then moved to Lund University, Sweden and conducted post-doctoral research on GaN nanowire growth in the group led by Prof. Lars Samuelson. His patent on GaN nanowire growth landed in GLO AB (a spin-out company from Lars group) and formed a core technology of GLO AB for micro-LED displays. In 2007, he joined GLO AB and continued research there on GaN nanowire LEDs. In 2011, he came back to Lars' group and have been working as a senior researcher until present. His current work is mainly on the long wavelength nitride emitters, through developing a template of ternary InGaN platelets. RGB LEDs grown on the individual InGaN platelets, in submicrometer sizes, can be assembled into micro-LEDs for the next-generation self-emissive displays.

Abstract: While nitride LEDs with chip sizes of above several hundreds of microns have been widely applied for solid state lighting nowadays, there is an urgent need to reduce the chip size so that such LEDs can be used as individual pixels for next generation self-emissive displays. While nitride micro-LEDs are chosen for the blue and green light, it is getting well accepted that the red micro-LEDs need to be made also on nitride materials, rather than AlInGaP. This is especially clear when the size of micro-LEDs shrinks to a few microns for AR/MR and HUD displays. At this size region, the nitride red LEDs out-perform the AlInGaP ones due to serious surface recombinations of the latter. For applications in optogenetics and bio-imaging, submicrometer (or nano) light sources need to be developed in order to increase the spatial resolution for treatment and imaging.

Typically, GaN films grown on sapphire substrates are used as templates for subsequent growth of InGaN light-emitting active layers. This LED structure encounters problems for long wavelength emissions where InGaN active layers need high indium contents. The increased strain and quantum-confined Stark effect make it challenging to improve the efficiency of red nitride LEDs. One solution to this is to replace the GaN template with InxGa1-xN, in order to reduce the strain in the InyGa1-yN active layers (x<y). However, this idea has not been well realized so far due to the difficulties of growing high quality ternary InGaN films, which arises from the lattice mismatch and large difference between GaN and InN.

	In this talk, we will present arrays of unique submicrometer sized InGaN platelets which are virtually free from dislocations and offer a smooth and high quality top c-plane for InGaN quantum well growth. The indium contents in such InGaN platelets can be tuned from 0 to 20%, so that the green and red-emitting InGaN quantum wells are grown with a low level of strain similar to highly efficient blue-emitting InGaN quantum wells on GaN films. The InGaN platelets are fabricated by truncating c-oriented hexagonal InGaN pyramids through either high temperature annealing or chemical mechanical polishing, forming a top c-plane. Arrays of InGaN pyramids are grown selectively from 100 nm-sized openings in a SiNx mask on top of a GaN film. The small contact/footprint between InGaN and GaN makes the strain low enough and no dislocation is formed in the InGaN pyramids. The InGaN quantum wells grown on the top c-plane of InGaN platelets, emitting red, green and blue lights, will be presented. In some cases we observe dark lines in cathodoluminescence images of red InGaN quantum well, which likely arise from stacking mismatch boundaries. We may also share some results on InN quantum dot growth on such InGaN platelets, aiming to obtain ultra-small light sources by growing only one quantum dot on one platelets.
Invited Talk	**Title:** Progress and challenges of MicroLED technologies and applications **Speaker:** Zhen Chen **Affiliation:** Xuzhou GSR Semiconductor, China **Bio:** Zhen Chen received his Ph.D. degree from Institute of Semiconductors, Chinese Academy of Sciences, Beijing, in 2002. He is currently the president at FastPower. He has held industrial positions at Bridgelux, LatticePower, glo, Nanosys working on AlInGaN LED, microLED and AlGaN/GaN electronics devices. **Abstract:** Micro light-emitting diode (microLED) technology is expected to be used in next-generation displays and other applications due to its many advantages. This presentation categorizes, reviews, and analyzes the main challenges and technical progress in the microLED displays manufacturing process, covering epitaxial growth, wafer fabrication, mass transfer, control circuit, and panel. The specific challenges of microLED manufacturing are also discussed, including full-color operation, reduced external quantum efficiency (EQE), low-efficiency and low-yield mass transfer, and structure and process design from a system perspective. In the epitaxial growth section, the requirements, problems, and technical developments of epitaxial growth, especially the growth of AlInGaN red LED, have been reviewed. The microLED chip characterization and fabrication section presents the reasons for the low EQE of microLEDs and the methods to overcome this problem. This section also includes the unique characteristics and theories of microLEDs, compared with those of traditional broad-area LEDs.
Invited Talk	**Title:** Coherency in Video See-Through Displays **Speaker:** Christoph Ebner **Affiliation:** Graz University of Technology, Austria **Bio:** Christoph Ebner holds a master's degree in Biomedical Engineering and is currently pursuing his Ph.D. at the Institute of Computer Graphics and Vision, Graz University of Technology. His research interests include computational mixed Reality displays, which lie at the intersection between optics, computer science, and human perception. **Abstract:** In this presentation, I will talk about our recent approaches toward visual coherence and providing coherent focus cues in mixed reality with a focus on video see-through displays. Specifically, I will presentNeural Cameras ", a method for learning camera characteristics to produce coherent renderings, and „ Video See-Through Mixed Reality with Focus Cues " an approach for solving the vergence accommodation conflict in video see-through head-mounted displays by providing near-correct focus cues.

Technical Session on Dec. 9

TS26 Translational Photomedicine and Biophotonics

Chair Qiongyu Guo, Southern University of Science and Technology, China

Room No.	Room ID	Zoom Link
Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Yuzhi Chen	Shenzhen University, China
16:00-16:30	Invited Talk	Qiaozhou Xiong	Shenzhen Innermedical Co. Ltd, China
16:30-17:00	Invited Talk	Quan Liu	Xiamen University, China
17:00-17:15	G277110	Feng Xu	Nanjing University, China

Paper Detail

Invited Talk	**Title:** Immunosensor based on optical fiber SPR technology **Speaker:** Yuzhi Chen **Affiliation:** Shenzhen University, China **Bio:** Yuzhi Chen is currently a research assistant professor at the College of Physics and Optoelectronic Engineering, Shenzhen University, China. He obtained Overseas High-caliber Personnel in Shenzhen. Currently, his research fields include optical fiber sensors, biological immunology detection technology, optical system design, optoelectronic semiconductor devices, optical fiber micro nano processing technology, surface plasmon resonance technology, etc. For more than ten years in the field of optical fiber sensor research, he has published more than 30 papers in high-level SCI journals such as “Biosensors and Bioelectronics”, “Sensors and Actuators B: Chemical”, “ACS Applied Nano Materials”, “Optics Express”, and “Optics Letters”. More than ten patents have been authorized and applied for. **Abstract:** In our topic, three types of optical fiber biosensors for immune detection will be presented . The first one is SPR biosensor based on hetero-core fiber structure, which can be applied to urine glucose detection. The second is the optical fiber SPR biosensor with high-efficiency immune modification, which can also improve the accuracy of immune detection. The third type is the plasmonic tapered-fiber interference sensor, which is used for simultaneously detecting the refractive index and temperature. These three optical fiber biosensors with micro size provide some new ideas for rapid and portable immune detection.
Invited Talk	**Title:** The development of multi-modality OCT endoscopy **Speaker:** Qiaozhou Xiong **Affiliation:** Shenzhen Innermedical Co. Ltd, China **Bio:** Dr. Xiong obtained his Ph.D. degree from Nanyang Technological University in 2020. He joined the Shenzhen Innermedical after graduation. He has been investigating high-performance and multi-modality endoscopy for 8 years, including ultra-high-resolution OCT and polarization-sensitive OCT, ultrasound+OCT endoscopy, and microscopic endoscopy. Currently, he is in charge of endoscopy R&D in Shenzhen Innermedical.

Invited Talk	**Title:** Accelerating optical spectroscopy with single-pixel detector **Speaker:** Quan Liu **Affiliation:** Xiamen University, China **Bio:** Dr. Quan Liu received a bachelor's degree in electrical engineering from Xidian University, Xi'an, China, a master's degree in electrical engineering from the Graduate School of University of Science and Technology of China in Beijing, China and a PhD degree in biomedical engineering from the University of Wisconsin, Madison, USA. He is currently a full professor in the School of Electronic Science and Engineering at Xiamen University in China after moving from Nanyang Technological University, Singapore. His research interest focuses on biomedical optical spectroscopy and imaging. Dr. Liu has published around seventy journal papers and held around twenty patents/patent applications in the field of biomedical optics. Dr. Liu is a senior member of SPIE. **Abstract:** Optical spectroscopy has been playing an important role in biomedical applications for sample characterization. Current commercial spectrometers predominantly use linear CCD/CMOS sensors for light detection because of their high resolution and high frame rate. However, these detectors are also limited by their small dynamic range, low/no gain and high dark noise as well as small bandwidth, which imposes an upper limit on the speed of optical spectra measurements. To address this challenge, we propose a new technique to take advantage of a single-pixel detector with a large bandwidth, such as photomultiplier tube, to accelerate practical spectral measurements by two to three orders of magnitude.
G277110	**Title:** Optically Levitated Conveyor Belt Based on Specular-Reflection Photonic Nanojet **Author(s):** Feng Xu, Song Zhou, Jiahui Zhang, Guanghui Wang, Fei Xu **Speaker:** Feng Xu **Affiliation:** Nanjing University, China **Abstract:** We have proposed an optically levitated conveyor belt based on specular-reflection photonic nanojet (s-PNJ). The trapped particles can suspend in the water and transport with the movement of hot spots caused by the deflection of exciting light. In addition, the rate of successful particle transporting can be up to 96.3% after the distance of 50 μm when the power intensity is as low as 0.2 mW/μm2

Technical Session on Dec. 9

TS27 THz Metamaterials and Device Applications

Chair Shiyi Xiao, Shanghai University, China

Room No.	Room ID	Zoom Link
Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Jining Li	Tianjin University, China
16:00-16:30	Invited Talk	Xiaofei Zang	University of Shanghai for Science and Technology, China
16:30-17:00	Invited Talk	Shiyi Xiao	Shanghai University, China
17:00-17:15	G27743	Shilei Liu	Tianjin University, China

Paper Detail

Invited Talk

Title: THz Metasurface Devices for Beam Control, Wavefront Mudulation and Biosensing

Speaker: Jining Li

Affiliation: Tianjin University, China

Bio: Associate Prof. Jining Li received the B.S. degree in Opto-electronic Science and Technology and the Ph.D. degree in Optics from Nankai University, in 2007 and 2013, respectively. From 2010 to 2012, he had an overseas visiting experience in T-ray Group at School of Electrical and Electronic Engineering, University of Adelaide, Australia. In 2015, he joined the Faculty of School of Precision Instrument and Opto-electronics Engineering, Tianjin University. His research interests include terahertz technology and terahertz functional devices based on metamaterials, for example the physical interaction mechanism of THz wave and novel materials, high-performance active THz functional devices and the applications in biomedical, and THz target imaging detection technology. He is a Committee Member of Basic Medical Imaging Branch of Tianjin Medical Imaging Technology Research Association, the Council Members of The Laser Society of Tianjin and The Optical Society of Tianjin. In recent years, he has been the principal investigator for four national and provincial research foundation projects, and several horizontal grants. He has published more than 70 contributed in journals, including Biomaterials, Biosensors and Bioelectronics, Carbon, Applied Physics Letters, Optics Express, etc.

Abstract: Terahertz(THz) radiation has many potential applications due to its special position in the electromagnetic spectrum. Compared to the rapidly developing THz sources and detectors, the development of various THz functional devices is still insufficient due to the large size of conventional materials. Metasurface is an ultra-thin planar array device with sub-wavelength artificial microstructure, which can realize the modulation of amplitude, phase and polarization of electromagnetic waves. The development of THz metasurface functional devices has filled the “THz gap” to a great extent. This report covers our progress on two types of THz metasurface functional devices. One is THz beam control and wavefront modulation devices. The dynamic modulation of THz circular dichroism is achieved using a metal-graphene hybrid chiral metasurface. Optical modulation of giant intrinsic chirality is achieved based on a lossless all-silicon metasurface with its photoconductivity effect. A back-reflections blocker based on metasurface quarter-wave plate and metal wire

	grid is proposed and demonstrated. These devices have excellent application prospects in the field of THz communication, imaging and radar. The other is THz biosensing devices. The sensitivity of the THz metasurface biosensor is greatly enhanced by the specific combination of DNA fragments with nanoparticles and by exploiting the interaction between graphene and biomolecules, providing a new approach to the diagnosis of various diseases. Our results offer further possibilities for the application of THz technology.
Invited Talk	**Title:** Metasurfaces for Phase/Polarization Manipulating and Imaging **Speaker:** Xiaofei Zang **Affiliation:** University of Shanghai for Science and Technology, China **Bio:** Prof. Xiaofei Zang, graduated from Shanghai Jiaotong University with a Ph.D. degree, is a Professor in the University of Shanghai for Science and Technology (USST). His current research interested includes Terahertz functional devices, Terahertz super-resolution imaging and Topological photonics etc. Up to now, he has published more than 60 papers, including >20 papers in Adv. Mater., Light Sci. & Appl., Laser. Photon. Rev., Adv. Opt. Mater., Appl. Phys. Lett., Opt. Lett., Opt. Exp., et al. He has been responsible for more than 10 projects at the national and ministerial/provincial levels, which include one project supported by the National 973 Project, two projects by National Natural Science Foundation of China, etc. He was selected as of Shanghai "Shuguang" Scholar, "Pujiang" Scholar, and "Shanghai young leading talent". **Abstract:** Metasurfaces, two-dimensional counterparts of metamaterials, have shown unprecedented capabilities in the local manipulation of the phase, intensity, and polarization profiles of electromagnetic waves, resulting in various functionalities such as generalized Snell′s law of refraction, metalenses, vortex beams, waveplates, imaging and ultra-thin/ultra-compact systems. Benefiting from the ultrathin characteristic, easy fabrication procedure and high-efficiency in manipulating wavefront of THz waves, a plethora of compact THz function devices such as broadband non-polarizing THz beam splitters, polarization converters, metalens, and waveplates can be realized. Here, we propose an approach to design the ultra-thin multi-channel THz beam splitters and polarization rotators based on reflection-type of geometric metasurface. The reflected beam is divided into four quasi-identical beams upon the illumination of a linearly-polarized THz beam, and the polarization for the reflected beams in each channel is rotated with an angle or invariable to the incident THz waves, demonstrating the multi-channel polarization rotators and beam splitters, respectively. The above approach can be extended to design metasurfaces for encoding (polarization-encoded) high-resolution color imaging. Unlike typical metasurface devices in which images are realized by amplitude or phase modulation, each pixel of color image here is marked with a polarization state, and thus allows polarization modulation-induced additive color mixing. The approach proposed here can be utilized to embed a color image, with precisely controlled brightness and contrast, onto a single dielectric metasurface. Furthermore, we propose and experimentally demonstrate an approach to realize multi-foci metalenses with polarization-rotated focal points by combing the phase and polarization modulation. Such a metalens owns the functionality of generating multiple focal spots with different polarization rotation directions under the illumination of linearly-polarizated THz waves. The longitudinal polarization-dependent imaging is experimentally demonstrated based on our design. In addition, we also propose an approach to realize terahertz polarization-insensitive metalens/axilens with extended focal depth using the geometric metasurfaces. Under the illumination of arbitrarily polarized light, it shows an $\approx 23\lambda$ focal region along the propagation direction, enabling longitudinal ultra-long working distance. As a proof-of-concept, longitudinal high tolerance of imaging is demonstrated based on the metalens.
Invited Talk	**Title:** Dynamically controlling terahertz wave-fronts with cascaded metasurfaces **Speaker:** Shiyi Xiao **Affiliation:** Shanghai University, China **Bio:** Shiyi Xiao received BSc degree in Department of Applied Physics from the Tongji University in 2007, Ph.D. degree from the Physics department, Fudan University in 2013, and worked as a research fellow at School of

	physics and astronomy at University of Birmingham from 2014 to 2016. He is currently a professor in the School of communicaions and information enginnering, Shanghai University. His research interests cover mainly meta-materials, nanophotonics and plasmonics. He has published over 40 papers in scientific journals including Nature Materials, Nature Communications, Phys. Rev. Lett., Nano Lett., etc. **Abstract:** Dynamically controlling terahertz (THz) wavefronts in a designable fashion is highly desired in practice. However, available methods working at microwave frequencies do not work well in the THz regime due to lacking suitable tunable elements with submicrometer sizes. Here, instead of locally controlling individual meta-atoms in a THz metasurface, we show that rotating different layers (each exhibiting a particular phase profile) in a cascaded meta-device at different speeds can dynamically change the effective Jonesmatrix property of the whole device, thus enabling extraordinary manipulations on the wavefront and polarization characteristics of a THz beam impinging on the device. After illustrating our strategy based on model calculations, we experimentally demonstrate two proof-of-concept metadevices, each consisting of two carefully designed all-silicon transmissive metasurfaces exhibiting different phase profiles. Rotating two metasurfaces inside the fabricated devices at different speeds, we experimentally demonstrate that the first meta-device can efficiently redirect a normally incident THz beam to scan over a wide solid-angle range, while the second one can dynamically manipulate both the wavefront and polarization of a THz beam. Our results pave the way to achieving dynamical controls on THz beams, which are useful in many applications, such as THz radar, and bio- and chemical sensing and imaging.
G27743	**Title:** Switchable multifunctional metasurfaces based on vanadium dioxide in the terahertz region **Author(s):** Shilei Liu;Hongyi Li;Jiajun Ma;Yi Liu;Chunmei Ouyang **Speaker:** Shilei Liu **Affiliation:** Tianjin University, China **Abstract:** Terahertz science and technology attracts more and more attention in the recent years due to its unique properties and promising application prospects. Here we proposed an active multi-functional metasurface in THz frequencies, whose functionalities could switch between the highly efficient absorption and broadband polarization conversion by changing the ambient temperature based on the phase-transition effect of Vanadium Dioxide(VO2). The structure of the proposed metasurface is polarization independent. And the simple design is easy to fabricate in experiment which is expected to enrich the THz modulators and functional devices.

Technical Session on Dec. 9

TS28 Laser Technology

Chair Chunyu Guo, Shenzhen University, China

Room No.	Room ID	Zoom Link
Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Xiaosheng Xiao	Beijing University of Posts and Telecommunications, China
16:00-16:30	Invited Talk	Chunyu Guo	Shenzhen University, China
16:30-16:45	G27765	Yu Yang	Harbin Institute of Technology (Shenzhen), China
16:45-17:00	G27733	Yusong Liu	Huazhong University of Science and Technology, China
17:00-17:15	G27725	Yang Li	Xi'an Technological University, China
17:15-17:30	G277112	Xiaosheng Xiao	Beijing University of Posts and Telecommunications, China

Paper Detail

Invited Talk	**Title:** Recent progress of spatiotemporal mode-locked multimode fiber lasers **Speaker:** Xiaosheng Xiao **Affiliation:** Beijing University of Posts and Telecommunications, China **Bio:** Xiaosheng Xiao received the B. E. and Ph.D. degrees from Tsinghua University, Beijing, China, in 2002 and 2007, respectively. From 2007 to 2008, he was with the Network Technology Research Centre, Nanyang Technological University, Singapore, as a Research Fellow. From 2009 to 2019, he was an assistant professor then an associate professor with the Department of Precision Instruments, Tsinghua University, Beijing, China. Since 2019, he has been an associate professor with the State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications, Beijing, China. His research interests include mode-locked fiber lasers, optical fiber communications, and fiber optics. **Abstract:** Spatiotemporal mode-locking, i.e., locking multiple longitudinal- and transverse-modes simultaneously in the laser cavity, is a general form of mode-locking. Comparing with traditional mode-locked lasers, there are much more nonlinear phenomena in spatiotemporal mode-locked (STML) lasers. In this talk, the recent progress of STML lasers will be presented.
Invited Talk	**Title:** High-power Mid-infrared ultrafast fiber lasers **Speaker:** Chunyu Guo **Affiliation:** Shenzhen University, China **Bio:** Chunyu Guo is currently a Professor at College of Physics and Optoelectronic Engineering, Shenzhen University. He was a visiting scholar of Optoelectronics Research Centre (ORC), University of Southampton. The main interests of his research are near-infrared and mid-infrared fiber lasers. He has been granted 11 invention patents (one has been transferred) and presides over many national scientific research projects, school-enterprise cooperation projects, and industrialization projects. He was selected for the outstanding

	young teacher cultivation projects in Shenzhen University, the high-level talent in Shenzhen, and the outstanding young teacher cultivation projects in Guangdong province. **Abstract:** High-power femtosecond Mid-infrared pulses are of great interest for many scientific and industrial applications. We first accomplished a high-power Mid-infrared ultrafast laser system consisting of a fluoride fiber mode-locked oscillator and a fluoride fiber amplifier. The oscillator is based on nonlinear polarization rotation technique. In the amplifier, a backward pumping scheme is employed to simultaneously realize pulse amplification and self-compression. The input signal polarization is optimized to suppress the Raman effect. The output pulses have 59 fs pulse durations with an average power of up to 4.1 W, corresponding to an estimated pulse energy of 42 nJ and a peak power of 715 kW. This constitutes the highest average power and the largest pulse energy for sub-100-fs pulses generated from a Mid-infrared fiber laser system to date. By cascading a fusion-spliced Dy:ZBLAN fiber amplifier with the above 2.8 μm high-power ultrafast fiber laser, a compact fluoride-fiber-based system that generates single solitons tunable from 3 to 3.8 μm has also been demonstrated. The Er:ZBLAN fiber amplifier acts as a power booster as well as a frequency shifter to generate Raman solitons up to 3 μm. The Dy:ZBLAN fiber amplifier transfers the energy from the residual 2.8 μm radiation into the Raman solitons using an in-band pumping scheme, and further extends the wavelength up to 3.8 μm. Common residual pump radiation and secondary solitons accompanying the soliton self-frequency shift (SSFS) are recycled to amplify Raman solitons, consequently displaying a higher output power and pulse energy, a wider shifting range and an excellent spectral purity. Stable 252 fs pulses at 3.8 μm with a record average power of 1.6 W and a pulse energy of 23 nJ are generated. This work provides an effective way to develop high-power widely-tunable ultrafast single-soliton MIR laser sources.
G27765	**Title:** Few-Layer Mo4/3B2T2 Saturable Absorber for Generating Conventional Soliton in Erbium-doped Fiber Laser **Author(s):** Yu Yang, Yong Yao Chong-hao Wu **Speaker:** Yu Yang **Affiliation:** Harbin Institute of Technology (Shenzhen), China **Abstract:** Passively mode-locked technology based on a saturable absorber (SA) is the main techniquby e which a fiber laser can be made to produce the pulse laser with an extremely short duration. These ultrafast fiber lasers play an important role in many fields, such as nonlinear optical frequency conversion, environmental sensing, laser surgery, laser material processing, and optical communications. Various kinds of two-dimensional (2D) materials have been used as SA, such as graphene, transition metal dichalcogenides, and black phosphrous. However, there are many challenges associated with these 2D materials. For example, the fabrication processes of mostly explored TIs and TMDs are relatively complicated and suffer from a low optical damage threshold. BPs are unstable and oxidize quickly when exposed to the atmosphere, which seriously affects the characteristics of the materials. Few-layer Mo4/3B2T2, as a new 2D materials, shows strong nonlinear absorption. Therefore, it is meaningful to investigate 2D material Mo4/3B2T2 as a SA to generate ultrafast fiber lasers and analysis the performances in ultrafast photonics fields. This work proposes a conventional soliton erbium-doped fiber laser using the few-layer Mo4/3B2T2 as an SA. Few-layer Mo4/3B2T2 were embedded in polyvinyl alcohol to form a few-layer Mo4/3B2T2- polyvinyl alcohol (PVA) film. Highly stable conventional soliton mode-locked pulses based on the few-layer Mo4/3B2T2-PVA film output were observed at 1560.57 nm with a 3 dB bandwidth, fundamental frequency, pulse width, and signal-to-noise ratio of 3.12 nm, 7.59 MHz, 1.08 ps, and 65.8 dB, respectively. Our experimental results demonstrate that the few-layer Mo4/3B2T2 exhibited good performance in creating soliton mode-locked fiber lasers as a promising SA.
G27733	**Title:** External manipulation of the internal arrangements of soliton molecules in passively mode-locked fiber lasers **Author(s):** Yusong Liu, Siyun Huang, Yixiang Sun, Haoguang Liu, Ran Xia, Yiyang Luo, Gang Xu, Qizhen Sun,

	Perry Ping Shum and Xiahui Tang **Speaker:** Yusong Liu **Affiliation:** Huazhong University of Science and Technology, China **Abstract:** Time-stretched spectroscopy based real-time measurement serves as an efficient access to investigate the frontier research on the versatile soliton molecular complexes, akin to matter molecules. In ultrafast fiber lasers, the formation of solitons is governed by the twofold balances of nonlinearity with dispersion, gain with loss. Besides soliton singlets, multiple mechanisms provide the possibilities for forming varieties of multi-soliton patterns, termed as soliton molecules. Assisted with dispersion managed transform technique, versatile internal motions of soliton molecules are deeply investigated, mostly related to the different arrangements of adjacent constituents. However, the variation of the number of multi-pulse soliton molecules yields a challenging research field, also considered as valuable assets for the research on striking analogy with matter molecules. Thus, it is in urgent need of exploring the inherent instability of dynamical soliton molecules propagating in fiber oscillators, further providing the possibilities for artificially controlling the number and arrangements of multi-pulse soliton molecules. Here, we report on the external manipulation of the internal arrangements of soliton molecules in passively mode-locked fiber lasers with near-zero dispersion. Towards flexible adjusting the intra-cavity polarization and pump power, the distinct switching between stationary soliton singlet and soliton pairs are experimentally captured. First of all, the stationary soliton singlet splits into two pulses with different pulse energy, which could be manifested by the modulation depth of the real-time spectra. Then the transition stage consists of around 300 roundtrips, depicting the chaotic characterization of the real-time optical spectra. After that, the stationary soliton pairs are built up after the transitory splitting of the soliton singlets. Relying on the flexible polarization control, the transition between soliton singlets and soliton pairs is captured, paving an efficient way towards the artificial manipulation of assembling multi-pulse soliton molecules in fiber lasers.
G27725	**Title:** Study on the influence of deposition temperature on the properties of lanthanum titanate films **Author(s):** Yang Li, Junqi Xu, Junhong Su, Shaobin Sun, Tong Wang，Zheng Liu **Speaker:** Yang Li **Affiliation:** Xi'an Technological University, China **Abstract:** The work aims to study the effect of deposition temperature on optical properties and residual stresses in Lanthanum titanate (H4) films. The LaTiO3 films were deposited by electron-beam thermal evaporation technique. The residual stress of LaTiO3 films on fused silica was characterized macroscopically and microscopically, using laser interferometry and AFM. The residual stresses and surface profile shape change were simulated using finite element analysis methods. It was confirmed that the deposition temperature did not affect the optical properties of the films，but did for residual stresses. The residual stress of LaTiO3 films changes from decreasing tensile stress to compressive stress as the deposition temperature increases. The deposition temperature is used to modulate the magnitude and transition of the residual stress in the films. There is a strong dependence between the residual stresses and the densities of surface columnar structures in LaTiO3 films. The effect of density of surface columnar structures is found as follows: the film with the lower density of surface columnar structures generally shows a tensile and high density easily transform into compress stress. This conclusion is also verified by the increase of the corresponding refractive index. The simulated surface profiles are basically overlapping with the measured data. The proposed model is validated for the simulation of residual stresses in monolayers.
G277112	**Title:** Comparison of the simulation algorithms for nonlinear pulse propagation in multimode fibers **Author(s):** Jiayu Lu, Lili Kong and Xiaosheng Xiao **Speaker:** Xiaosheng Xiao **Affiliation:** Beijing University of Posts and Telecommunications, China **Abstract:** Nonlinear dynamics of pulse propagation in single-mode fiber have been investigated extensively.

	Recently, with the wide use of multimode fiber in optical technologies such as fiber lasers, imaging, optical fiber communication systems etc., multimode fiber has gradually received attention. Therefore, the investigation of nonlinear pulse propagation in multimode fibers becomes more and more important. However, the numerical simulation of nonlinear pulse propagation in multimode fibers is a thorny problem. In this Presentation, we compare three simulation algorithms for the nonlinear propagation in multimode fibers. The first algorithm is Massively Parallel Algorithm, based on the Generalized Multimode Nonlinear Schrodinger equation (GMMNLSE); the second is, three-dimensional (3D) algorithm, based on the traditional Generalized Nonlinear Schrodinger Equation (GNLSE), which describes the propagation of whole 3D optical field in multimode fibers; and the third is Radial Coordinate (RC) algorithm, based on the RC GNLSE which is simplified from the GNLSE by the Hankel Transform. These three algorithms are compared from the aspects of operation speed, numerical error and applicable scenarios, and their advantages and disadvantages are analyzed. This investigation will provide some guidelines and suggestions for the numerical investigations of nonlinear pulse propagation in multimode fibers, including the fields of optical fiber communications with multimode fibers, nonlinear fiber optics, spatiotemporal mode-locking in multimode cavities, etc.

Technical Session on Dec. 9

TS29 Optical Communication and Networks

Chair Oskars Ozolins, KTH Royal Institute of Technology, Sweden

Room No.	Room ID	Zoom Link
Room 4	868 4632 7948	https://us02web.zoom.us/j/86846327948

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Mohammed Zahed Mustafa Khan	King Fahd University of Petroleum and Minerals, Saudi Arabia
16:00-16:30	Invited Talk	Gordon Ning Liu	Soochow University, China
16:30-17:00	Invited Talk	Nan Hua	Tsinghua University, China
17:00-17:15	G27714	Ximin Wang	Inner Mongolia University, China

Paper Detail

Invited Talk

Title: InAs/InP Quantum-dot/dash Laser Technology for Next-generation Hybrid Optical-Millimeter wave Infrastructures

Speaker: Mohammed Zahed Mustafa Khan

Affiliation: King Fahd University of Petroleum and Minerals, Saudi Arabia

Bio: Dr. Mohammed Zahed Mustafa Khan received the B.E. degree in Electronics and Communication Engineering from Osmania University, India, in 2001, M.S. and Ph.D. degrees in Electrical Engineering from King Fahd University of Petroleum and Minerals (KFUPM) and King Abdullah University of Science and Technology (KAUST), Saudi Arabia, in 2004 and 2013, respectively. He joined Hafr Al-Bain Community College, Saudi Arabia, in 2005, where he worked as a lecturer in the Electrical and Electronics Engineering Technology Department for five years. From 2014 to 2015, he was a SABIC Postdoctoral Research Fellow with Photonics Laboratory, KAUST. He joined the Electrical Engineering Department, KFUPM, in 2015, where he is currently an Associate Professor, and founder and director of "Optoelectronics Research Laboratory." His prior research involved developing numerical models for integrated optical device simulation. Currently, his research focuses on developing near-infrared and visible semiconductor lasers and systems for applications in optical communications. Dr. Khan is a senior member of IEEE and OSA and a member of SPIE.

Abstract: The generation of millimeter-waves (mmW) by optical means has taken center stage in recent years as a viable platform for next-generation networks. Thanks to the seamless integration of this technology with the existing optical fiber infrastructure. In this regard, InAs/InP quantum-dot/dash (Qdot/Qdash) nanostructure-based semiconductor lasers have garnered recent attention as a candidate light source for future hybrid mmW-optical heterogeneous networks. Thanks to the wide tuning lasing emission of InAs/InP Qdot/Qdash lasers spanning S- to U-band wavelength region and broadband lasing covering tens of nm emission bandwidth with several Fabry-Perot modes. Moreover, observation of inherent mode-locking in C-band and deployment of injection locking in L-band, a single InAs/InP Qdot/Qdash laser diode light source has shown tremendous potential to replace several laser devices in multi-source applications. This talk highlights recent progress on deploying these C- and L-band InAs/InP Qdot/Qdash laser diodes in ~25-150 GHz mmW technology. In particular, demonstrations of engaging this new class of devices in hybrid

	mmW-over-fiber-wireless networks and optical-mmW convergent networks will be presented, thus addressing energy-efficient green communication. These demonstrations, employing a single InAs/InP Qdot/Qdash laser device in multiplexed networks, substantiate the potential of these light sources for next-generation flexible and hybrid access networks.
Invited Talk	**Title:** Equalization for Optical PAM Data Center Interconnects **Speaker:** Gordon Ning Liu **Affiliation:** Soochow University, China **Bio:** Gordon Ning Liu is currently a Distinguished Professor with the School of Electronic and Information Engineering, Soochow University, Suzhou, China. He has more than 20 years' experience in optical communications. Before joining Soochow University, he was with Huawei Technologies Co., Ltd., HiSilicon Optoelectronics Co., Ltd., and Alcatel Shanghai Bell Co., Ltd. He has authored or coauthored about 70 papers in top journals and conferences, and filed about 20 patents. His recent research includes systems, algorithms and devices for the optical interconnect, switching and transmission. He has served or is serving in the technical program committees as chair or member of various reputed conferences, such as ECOC and OECC. **Abstract:** With the rapid development of optical data center interconnect, the requirement for data rate of client-side transceivers increases drastically. To meet the transmission rate demand, the recent pulse-amplitude modulation optical interconnects are discussed. To lower down the cost of the optical interconnects, low cost opto-electronic devices with strong bandwidth limitation and nonlinear distortion are employed. Moreover, the interplay between the fiber dispersion and square law photodetection leads to additional nonlinear inter-symbol interference. To handle the problem, various digital equalizers are introduced, which are reviewed in this paper.
Invited Talk	**Title:** Joint Optimization of Multidimensional Resources Allocation in Cloud Networking **Speaker:** Nan Hua **Affiliation:** Tsinghua University, China **Bio:** Dr. Nan Hua is an associate professor at Tsinghua University, Beijing, China. He received his B.S and Ph.D. degrees from Tsinghua University, in 2003 and 2009, respectively. In 2008, he went to the Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute (HHI) in Germany to conduct research studies. Since 2011, he joined the Department of Electronics Engineering, Tsinghua University and worked on optical switching networks. His areas of research include large-scale optical network control, all-optical switching technology, data center optical network, satellite optical network and high-precision network time synchronization. He has obtained more than 20 patents and published over 100 academic papers. **Abstract:** Cloud networking enables flexible service deployments and agile function managements. The convergence of cloud and networking requires the integration of transmission, computation, and storage resources. In this paper, a unified mathematical model on joint optimization of transmission, computation, and storage resources allocation is established, aiming at reducing the job completion time and improving the resource utilization efficiency. To so do, computation resources are first virtualized and then discretized in the time domain. Then we realize the coordination of routing process and transmission, computation resources in cloud networking. Simulation results demonstrate that the propose method could reduce the job completion time by 33%.
G27714	**Title:** High-Resolution Microwave Frequency Measurement Based on Optical Frequency Comb and Image Rejection Photonics Channelized Receiver **Author(s):** Ximin Wang, Yingxi Miao, Jialiang Chen, Caili Gong, Yongfeng Wei, Yuqing Yang **Speaker:** Ximin Wang **Affiliation:** Inner Mongolia University, China **Abstract:** A high-resolution microwave signal frequency measurement scheme based on optical frequency comb (OFC) and an image rejection microwave photonics channelized receiver is proposed. The scheme consists of two branches. The OFC is generated by cascaded Mach-Zehnder modulators (MZMs) in the upper

	branch. The optical carrier is frequency shifted by the optical frequency shifter (OFS) in the lower branch. The shifted optical carrier is sent to polarization modulator (PolM) to be modulated by the RF signal to be measured. The signal from the upper and lower branches are injected into 90-degree optical hybrid and divided into four outputs. The optical signal of each output is divided into channels by the wavelength division multiplexer (WDM) and beat by the balance photodetector (BPD). The back-end of the scheme adopts image rejection down-conversion method to prevent spectral aliasing in the measurement process. Simulation verifies the effectiveness of this scheme. The results show that the scheme can accurately measure microwave signals within the frequency range of 1-79 GHz.

Technical Session on Dec. 9

TS30 Near-infrared, Mid-infrared and Far-infrared Technologies and Applications

Chair Longqing Cong, Southern University of Science and Technology, China

Room No.	Room ID	Zoom Link
Room 5	811 1444 8699	https://us06web.zoom.us/j/81114448699

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Jinshui Miao	Shanghai Institute of Technical Physics of the Chinese Academy of Sciences, China
16:00-16:30	Invited Talk	Qian Zhou	Tsinghua University, China
16:30-17:00	Invited Talk	Yongquan Zeng	Wuhan University, China
17:00-17:15	G277104	Yibo Ni	Tsinghua University, China
17:15-17:30	G277106	Wenhe Jia	Tsinghua University, China

Paper Detail

Invited Talk	**Title:** Mixed-dimensional van der Waals heterojunction devices **Speaker:** Jinshui Miao **Affiliation:** Shanghai Institute of Technical Physics of the Chinese Academy of Sciences, China **Bio:** Jinshui Miao joined the Shanghai Institute of Technical Physics, Chinese Academy of Sciences (SITP-CAS) as a professor in 2020. Before joining SITP-CAS, he was a postdoctoral researcher at the Electrical and Systems Engineering of the University of Pennsylvania working with Professor Deep M. Jariwala since 2018. Jinshui Miao received his Ph.D. in Electrical Engineering from Michigan State University in May 2018 under supervision of Professor Chuan Wang. Jinshui Miao received his B.S. in Applied Physics and M.S. in Condensed Matter Physics from Shandong University (2011) and the University of Chinese Academy of Sciences (2014, advisor: Weida Hu), respectively. His current research areas include infrared physics and devices, bio-inspired infrared vision devices and systems and neural network infrared vision sensors, etc. He has published more than 50 papers with citations of more than 2000 (Google Scholar) since 2014. He served as an associate editor of IEEE Open Journal of Nanotechnology. **Abstract:** Two-dimensional (2D) layered materials, with strong light-matter coupling coefficient, quantum confinement, and ease of heterostructure construction, are emerged as alternative material platforms for high-performance photodetection technologies at room temperature. Nevertheless, as an infrared photodetector, the signal-to-noise ratio can be very low without the suppression of dark current. Meanwhile, the performance of 2D material photodetectors, is strongly affected by surface states resulting in the restricted electron-hole separation efficiency and low speed, and intrinsic ultrathin absorption thickness of low-dimensional materials suffers from low quantum efficiency. Understanding physical mechanisms of localized fields in nanoscale infrared photodetectors is of great importance to achieve high-performance infrared photodetection technology.
Invited Talk	**Speaker:** Qian Zhou **Affiliation:** Tsinghua University, China

	Bio: Dr. Qian Zhou received her Bachelor and Ph.D. degrees from Tsinghua University, Beijing. She is now an associate professor in Shenzhen International Graduate School, Tsinghua University. Her research focuses on micro-nano optics, infrared spectral analysis technique, and optical precision measurement with frequency comb and grating encoder.
Invited Talk	**Title:** Robust semiconductor lasers with topological photonic designs **Speaker:** Yongquan Zeng **Affiliation:** Wuhan University, China **Bio:** Yongquan Zeng is currently working at the School of Electronic and Information Engineering, Wuhan University. He is mainly engaged in the research of III-V infrared semiconductor lasers, and has made many innovative achievements in the frontier fields of topological lasers, random lasers, and chaotic microcavities. So far, he has published over 20 first-authored/co-authored research papers in high-impact journals, e.g. Nature, Science, ACS Photonics, Advanced Optical Materials, and Photonics Research. **Abstract:** Extended from condensed matter physics, the concept of topology has been applied to the regime of photonics and inspired a variety of robust photonic device applications such as optical delay lines, amplifiers, isolators as well as lasers. Nowadays, the research of topological photonics has evolved to higher dimensions, high-order topological phases, nonhermitian systems, as well as nonlinear systems. The new concepts or freedoms may contribute to better tailorability of photonic devices, e.g. semiconductor lasers. In this presentation, I will talk about utilizing topological concepts for semiconductor lasers with robust performance and novel functionalities. We first made use of the valley degree of freedom in photonic crystals to construct in-plane edge states with topological protection on a terahertz quantum cascade laser chip and realized the first electrically pumped topological lasers. The laser emission modes are evenly distributed along an unconventional triangular cavity and robust against the sharp corners as well as small structural perturbations. To engineer the operating frequency, we proposed to utilize the lattice symmetry of a two dimensional photonic higher-order topological lattice and gain/loss modulation freedom in an active semiconductor photonic system to realize single-mode lasing. In addition, we applied a chiral Kekulé phase modulation to a honeycomb lattice to further engineer the far-field profile. Photonic Majorana zero mode emission with a nontrivial polarization-winding emission profile was achieved. These efforts may inspire more interesting applications of topological photonics and lead to the developments of practical optoelectronic devices.
G277104	**Title:** Tunable liquid crystal metasurface for computational spectropolarimetry **Author(s):** Yibo Ni, Chen Chen, Shun Wen, Xinyuan Xue, Liqun Sun, Yuanmu Yang **Speaker:** Yibo Ni **Affiliation:** Tsinghua University, China **Abstract:** The light field contains rich information, including but not limited to phase, polarization, and spectrum. The detection of multi-dimensional light field information can find its application in many fields. For example, the measurement of the polarization state and spectrum of light can be exploited for material characterization and remote sensing. Conventional polarimetry and spectrometry often require a complicated and bulky system, which hinders their applications in fields requiring miniature optical devices. Simultaneous detection of polarization states and spectra, namely spectropolarimetry, has been developed recently, yet requires an increased form factor and complexity. Metasurface is an emerging class of planar optical elements that can flexibly modulate the amplitude, phase, polarization, and other properties of light at the subwavelength scale. The applications of metasurfaces for polarization or spectral measurements have been widely explored in recent years. Metasurface-based spectropolarimeters have also been demonstrated, where polarization and spectra detection is achieved by splitting the incident light with different polarization components and wavelengths into different spatial locations. However, they require a focal plane array for the spectropolarimetric detection of a single image point and lack the potential for imaging.

	Here, we propose and experimentally demonstrate a novel system that can simultaneously measure the polarization state and wavelength of light using a single-pixel photodetector. The hardware part of the system is an electrically tunable liquid crystal-embedded metasurface. The metasurface is tailored to support multiple high-quality factor guided mode resonances, enabling the metasurface to have rich spectral and polarization features. By applying voltages to the metasurface, polarization and spectral information of the incident light can be encoded to the reflectance response from the metasurface. Combined with a computational reconstruction algorithm based on the nonlinear least square method, the system can reconstruct full Stokes parameters and wavelengths of the incident light with high fidelity. Due to the in-plane uniformity, the metasurface does not perturb the wavefront of the incident light. When integrated with a proper focal plane array detector, the liquid crystal metasurface may be used for spectropolarimetric imaging without sacrificing spatial resolution. The strategy of the proposed metasurface may also be extended to measurements of additional light field information, such as the depth of a target scene or the wavefront of the incident light.
G277106	**Title:** Intracavity spatiotemporal metasurfaces **Author(s):** Wenhe Jia, Chenxin Gao, Liu Li, Shun Wen, Chunping Jiang, Chengying Bao, Changxi Yang and Yuanmu Yang **Speaker:** Wenhe Jia **Affiliation:** Tsinghua University, China **Abstract:** Optical metasurfaces have opened an entirely new avenue to light manipulation. To date, most metasurfaces are designed to spatially modulate the light field in a passive manner. Coupling metasurfaces to materials with strong optical nonlinearity may allow ultrafast spatialtemporal light field modulation. Furthermore, while most metasurfaces act as isolated optical elements working with external light sources, the direct integration of metasurface in a laser cavity may enable better efficiency and ultimate system miniaturation. Here, by inserting an ultrathin plasmonic metasurface strongly coupled to an epsilon-near-zero material into a fiber laser cavity, we experimentally demonstrate simultaneous spatiotemporal control of the laser. While the geometric phase of the metasurface is utilized to tailor the transverse laser mode, the giant nonlinear saturable absorption of the strongly coupled system allows pulsed laser generation via the Q-switching process. As a prototype, microsecond pulsed vortex beam lasers with varying topological charges are generated. The intracavity generation of ultrafast complex structured light fields using the spatialtemporal metasurface may allow new degree of freedom in designing fiber lasers towards emerging applications such as optical communication, laser fabrication, and imaging.

Technical Session on Dec. 10

TS31 Quantum Optics and Information

Chair Ching Eng PNG, Institute of High Performance Computing (IHPC), A*Star, Singapore

Room No.	Room ID	Zoom Link
Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Tongcang Li	Purdue University,USA
10:00-10:30	Invited Talk	Yongmin Li	Shanxi University, China
10:30-11:00	Invited Talk	Jixun Liu	National University of Defense Technology, China

Paper Detail

Invited Talk	**Title:** Optically addressable spin qubits in 2D materials **Speaker:** Tongcang Li **Affiliation:** Purdue University,USA **Bio:** Prof. Tongcang Li is an associate professor of physics and astronomy, and an associate professor of electrical and computer engineering at Purdue University. Before joining Purdue University in 2014, he did postdoctoral research at the University of California, Berkeley during 2011-2014. He obtained his Ph.D. degree from the University of Texas at Austin in 2011. Prof. Li is a pioneer in levitated optomechanics. He has won multiple awards, including the NSF CAREER Award in 2016. Prof. Li has published one book and many high-impact papers in Science, Nature Physics, Nature Nanotechnology, Nature Communications, Physical Review Letters, and other leading journals. He and his colleagues' recent work on GHz rotation of an optically levitated nanoparticle was selected as one of the "Highlights of the Year" of 2018 by the American Physical Society (APS) website Physics. **Abstract:** Spin defects in solids such as diamond have been widely used for quantum sensing and quantum network applications. The recent discovery of spin qubits in hexagonal boron nitride (hBN), a van der Waals layered material, provides new opportunities. Thanks to its layered structure, hBN can be easily exfoliated and integrated with other materials and nanostructures. For example, spin qubits in hBN will be particularly suitable for studying 2D magnetic materials. I will briefly review recent developments with spin defects in 2D materials, and report our works on plasmon-enhanced high-contrast hBN spin defects for quantum sensing [X. Gao, et al. Nano Letters, 21, 7708 (2021)] and optical polarization and coherent control of nuclear spins in hBN [X. Gao, et al. Nature Materials (2022), https://doi.org/10.1038/s41563-022-01329-8].
Invited Talk	**Title:** Continuous variable quantum key distribution with shared partially characterized entangled source **Speaker:** Yongmin Li **Affiliation:** Shanxi University, China **Bio:** Yongmin Li received the Ph.D. degree in optics from Shanxi University in 2003. Since 2003, he has been a Postdoctoral Fellow at University of Tokyo, and a Visiting Fellow at Australian National University. He is currently a Professor at Shanxi University. His research interests include quantum optics and quantum information. He has published more than 90 journal articles in this field, and currently holds 2 U.S. patents and

	19 Chinese patents. **Abstract:** Constructing a high-rate and low-cost secure quantum communication network is an essential task for quantum internet. Locking the sophisticated and expensive entanglement sources at the shared relay node is a promising choice for building a star-type quantum network with efficient use of quantum resources, where the involved parties only need to equip with low-cost and simple homodyne detectors. Here, we demonstrate the first experimental point-to-point continuous variable quantum key distribution (CVQKD) with entanglement source between the two users. We consider a practical partially characterized entangled source and establish the security analysis model of the protocol under realistic conditions. By applying a biased base technology, the higher key rate than the original protocol is achieved. The experimental results demonstrate that the distance between two users can reach up to 60 km over telecom single mode fiber, implying that the feasibility for high-rate and secure communication with shared entangled source at metropolitan distances. Our results constitute an important step toward the realization of a cost-effective, scalable metropolitan quantum communication network.
Invited Talk	**Title:** Quantum Gravimeter **Speaker:** Jixun Liu **Affiliation:** National University of Defense Technology, China **Bio:** Jixun Liu is a lecturer in the College of Intelligence Science and Technology, National University of Defense Technology. His main research interests include atom interferometry and ultracold atom. His current research primarily focuses on quantum gravimeters based on atom interferometry. He holds a Ph.D. and a B.Eng. from Beihang University. **Abstract:** The quantum gravimeter based on atom interferometry measures the acceleration of a free falling ensemble of laser-cooled atoms. The new type of absolute gravimeter has been developed rapidly since three decades ago, and is compact and precise enough to be used for real-world applications, such as the monitoring of volcanoes, absolute airborne and marine gravity surveys. Here the recent advances in quantum gravimeters will be introduced.

Technical Session on Dec. 10

TS32 Fiber-Based Technologies and Applications

Chair Jing Zhang, China University of Geosciences, China

Room No.	Room ID	Zoom Link
Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Wei Yan	Nanyang Technological University, Singapore
10:00-10:30	Invited Talk	Fei Xu	Nanjing University, China
10:30-11:00	Invited Talk	Zinan Wang	University of Electronic Science and Technology of China, China
11:00-11:15	G277103	Shenyi Liu	Harbin Institute of Technology (Shenzhen), China

Paper Detail

Invited Talk

Title: Advanced Multi-material Optoelectronic and Electronic Fiber Devices and Textiles

Speaker: Wei Yan

Affiliation: Nanyang Technological University, Singapore

Bio: Dr. Yan is a jointly appointed Nanyang Assistant Professor (class 2021) at the School of Electrical and Electronic Engineering (EEE) and the School of Materials Science and Engineering (MSE) at the Nanyang Technological University (NTU), Singapore. Prior to his appointment at NTU, he was a postdoctoral associate at the Research Laboratory of Electronics at the Massachusetts Institute of Technology (MIT), Cambridge, USA from September 2018 to December 2021, and a Scientist at the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland from November 2017 to August 2018. He holds a PhD in Materials Science and Engineering from EPFL (2017), for which he was awarded the 2019 Professor René Wasserman Award (the only winner), and the Best Graduate Student at EDMX Research Day, EPFL, Switzerland.

He has published many articles in high-profile international journals, such as Nature (1), Nature Nanotechnology (2), Advanced Materials (4), and Nature Communications (2). He is a co-inventor of 4 US patents. His research work has been highlighted by many prestigious media and journals, such as Nature, Science, Nature Nanotechnology, National Science Review, MIT, EPFL, US Army, Chinese Academy of Sciences, Science and Technology Daily, China, China Science Daily.

He is the finalist for the Falling Walls Science Breakthroughs of the Year 2022 in Engineering and Technology, the recipient of Professor René Wasserman Award in 2019 (the only winner) , IEEE Best Young Scientist Award in 2021, and the finalist of Falling Walls Lab Thailand 2022. He serves as Editorial Advisory Board of "Nanotechnology" (IOP Science) and Editorial Board member of "Advanced Fiber Materials" (Springer Nature).

His research interests focus on human-interfaced fiber electronics and optoelectronics as well as wearable electronics enabling unique solutions to challenges in various fields such as healthcare, medicine, energy, neuroscience, robotics and textiles.

Abstract: Fibers, ancient yet largely underdeveloped forms, are the common building blocks of a broad spectrum of product forms from textiles to aircraft constructs. While ubiquitous, these fibers are produced at scale from essentially single materials. The integration of a variety of electronic and optoelectronic materials

	within thermally-drawn fibers has emerged as an unprecedentedly compelling platform for enabling fibers to evolve into functional devices and smart systems. This approach exploits the thermal drawing of a macroscopic preform, where functional materials or prefabricated devices are arranged at a prescribed position, yielding kilometers of functional fibers with a sophisticated architecture and complex functionalities in a very simple and scalable manner. A single strand of fiber that incorporates materials with disparate electronic, optoelectronics, thermomechanical, rheological and acoustic properties can see objects, hear sound, sense stimuli, communicate, store and convert energy, modulate temperature, monitor health and dissect brains. Integrating these fibers into fabrics, ancient yet largely underdeveloped forms, is setting a stage for fabrics to be the next frontier in computation and Artificial Intelligence. In this talk, I will present the recent progress of smart optoelectronic and electronic fiber devices, and elaborate their unique applications in the fields of sensing, healthcare, robotics, textiles and neuron science as well as their fundamental research in materials science and physics.
Invited Talk	**Title:** All-fiber multifunction-integrated sensing devices **Speaker:** Fei Xu **Affiliation:** Nanjing University, China **Bio:** Dr. Fei Xu received his Ph.D. in Optoelectronics in 2008 from the Optoelectronics Research Centre, University of Southampton, UK. He is currently a professor at the College of Engineering and Applied Sciences, Nanjing University, China. **Abstract:** With the development of materials science and manufacture technology, the conventional homogeneous doped core and pure cladding structures in a silica fiber have evolved with a new paradigm shift by merging the multi-structures and multi-materials. This emerging trends in optical fibers aim to break the fundamental limit by a single structure and material, and extend their photonic and optoelectronic applications. Here we will show some fiber-multifunction-integrated optoelectronic device developed in our labs and their applications in sensors will also be discussed.
Invited Talk	**Title:** Fiber-optic Distributed Acoustic Sensing with Coherent Detection **Speaker:** Zinan Wang **Affiliation:** University of Electronic Science and Technology of China, China **Bio:** Professor Zinan Wang is a recipient of the National Young Top-Notch Talent of the Ten-Thousand Talent Program; he serves as an Associate Editor of IEEE Photonics Technology Letters, and a member of the Fiber Optics and Integrated Optics Professional Committee of the Chinese Optical Society. He has long been engaged in the research of information perception and laser technology, and his representative achievements was selected as one of the annually 30 most exciting optics research by the Optical Society of America (OSA); he has published >50 high-quality papers (3 ESI highly-cited) in major journals such as IEEE Internet of Things Journal, Optics Letters and etc., with more than 2,600 Web of Science citations; he has delivered more than 30 keynote/invited talks in academic conferences such as OFS-25, the flagship conference on optical fiber sensing, and served 16 times in conferences such as OECC/OSA APC/ACP; he is holding 5 US patents and 22 Chinese patents; he has published monographs "Principles and Applications of Random Fiber Lasers" and "Key Components and Technologies of Fiber-optic Sensor Network" Chapter 3 (published by Science Press). **Abstract:** Distributed acoustic sensing (DAS) with fiber has broad application prospects. DAS is usually based on phase-sensitive optical time-domain reflectometry (Φ-OTDR) and similar techniques, which can detect the feature change of in-fiber Rayleigh backscattering light caused by the outside perturbation. Coherent detection, which can preciously recover both the intensity and phase of backscattered light, has contributed to a rapid development of DAS technologies in recent years. In this talk, the recent advancements of DAS based on coherent detection will be discussed.

G277103	**Title:** Process of multimode fiber image transmission **Author(s):** Yunxu Sun, Shenyi Liu **Speaker:** Shenyi Liu **Affiliation:** Harbin Institute of Technology (Shenzhen), China **Abstract:** Multimode fibers (MMFs), different modes produce random phase delay or mode coupling, which leads to light scattering. Therefore, the imaging mechanism of single fiber imaging and scattering medium imaging are related, but with certain differences. It is valuable to theoretically analyze the response of MMFs imaging. The modes of the optical fibers are independent and orthogonal with each other. The relationship between different guiding modes can be expressed as $$\int_s \varepsilon_{vu}(x,y)\varepsilon_{v'u'}^{*}(x,y)dxdy = \delta(v-v',u-u'), \quad (1)$$ where is the transverse mode with radial index u and index v respectively, s is the cross section of MMFs. When light is coupled into MMFs, there are three types of modes of excitation, which are guiding mode, radiation mode and leakage mode respectively. The energy of radiation mode and leakage mode gradually dissipates because of large loss. The optical field distribution and transmission characteristics of guiding mode in MMFs are analyzed. The effective input light field in MMFs can be expressed as the sum of all modes with corresponding excitation coefficient, A_{vu}. $$u_1(x_1,y_1,0) = \sum_{v=0}^{v}\sum_{u=0}^{u} A_{vu}\varepsilon_{vu}(x_1,y_1,0). \quad (2)$$ Because the orthogonality of the guiding modes, the excitation coefficient, A_{vu}, is expressed as $$A_{vu} = \int_s u_1(x_1,y_1,0)\varepsilon_{vu}^{*}(x_1,y_1)dx_1dy_1. \quad (3)$$ Assuming that there is no energy coupling, the distribution of the complex amplitude at the output light field can be expressed as $$u_2(x_L,y_L,L) = \sum_{v=0}^{v}\sum_{u=0}^{u} A_{vu}(x,y)\varepsilon_{vu}(x,y)\times\exp(-j\beta_{vu}L), \quad (4)$$ where β_{vu} is the propagation constant of transverse mode ε_{vu}. From the above equation, the phase of the mode in MMFs varies with the propagation. Considering the influence of phase shift of each mode, the transverse modes have different propagation constant, which is the main reason for the distortion of image transmission in MMFs. We only consider the transmission of light from the object to the other end of the MMFs. By using free space propagation theory, the light field distribution on image plane can be described as $$U_i(\eta,\xi) = \sum_{u=0}\sum_{v=0}\iint_s A_{uv}(x_1,y_1)\varepsilon_{uv}(x_1,y_1)\exp(-j\beta_{uv}Z_L) \exp(\frac{jk}{2Z_i}[(\eta-x_L)^2+(\xi-y_L)^2])dx_Ldy_L, \quad (5)$$ In eq. (5), the field distribution of the imaging plane of MMFs is related to the number of guiding modes inside it. The more modes are included, the greater the freedom degree, and the higher the image resolution on imaging plane.

Technical Session on Dec. 10

TS33 Optoelectronic Devices and Applications

Chair Yuefei Cai, Southern University of Science and Technology, China

Room No.	Room ID	Zoom Link
Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Zhaoyu Zhang	The Chinese University of Hong Kong, Shenzhen, China
10:00-10:30	Invited Talk	Jiawei Wang	Harbin Institute of Technology (Shenzhen), China
10:30-11:00	Invited Talk	Dan Wu	Shenzhen Technology University, China
11:00-11:15	G27745	Marco Moraja	SAES Getters, Italy

Paper Detail

Invited Talk	**Title:** Highly Integrated Silicon-Based Light Source **Speaker:** Zhaoyu Zhang **Affiliation:** The Chinese University of Hong Kong, Shenzhen, China **Bio:** Prof. Zhaoyu Zhang is an Associate Professor in School of Science and Engineering, the Chinese University of Hong Kong, Shenzhen. He is also the Director of Shenzhen Key Lab for Semiconductor Lasers. He received his Ph.D. degree in Electrical Engineering from California Institute of technology in 2007. He worked as a postdoc associate in Chemistry at UC Berkeley and Molecular Foundry at Lawrence Berkeley National Lab from 2008 to 2011. After that, he worked as an Associate Professor at Peking University from 2011 to 2015. He moved to the Chinese University of Hong Kong, Shenzhen in June 2015. Currently, his research interests include monolithic integration of semiconductor lasers with silicon photonics for AR/VR, optical communication and Lidar application, organic light emitting diodes and lasers for display and illumination applications. He is a senior member of IEEE and consultant for various tech companies. **Abstract:** Ultra-dense integration of transistors on silicon chip circuits enables modern high-performance computing circuits on a single chip. However, due to the limitation of bandwidth and gate length, the development of IC in data transmission has been greatly hindered. Highly integrated III-V lasers based on silicon are considered to be good candidate for ultra-compact light sources of the next generation Photonic Integrated Circuits (PICs), which has a broad prospect in the processing, encoding and transmission of analog signals. To achieve robust laser sources for PICs, here, we demonstrate various InAs/GaAs quantum dot microcavity lasers monolithically grown on silicon, including micro-disk lasers, 2D Photonic Crystal with L3 defects lasers, 1D Photonic Crystal nanobeam lasers, Photonic Crystal bandedge lasers, topological corner state lasers, Dirac-vortex topological lasers and vortex lasers based on bound states in the continuum (BIC). In addition, we also make some progress with the light source on a monolithic III-V/SOI platform.
Invited Talk	**Title:** Non-Hermitian Photonics in 3D Optical Microcavities **Speaker:** Jiawei Wang **Affiliation:** Harbin Institute of Technology (Shenzhen), China

	Bio: Wang Jiawei is currently an associate professor in the School of Electronics and Information Engineering, Harbin Institute of Technology (Shenzhen). He received his PhD degree from the Hong Kong University of Science and Technology in 2016, respectively. From 2016 to 2020, he was engaged in post-doctoral research at the Leibniz IFW Dresden, Germany. From 2017 to 2020, he was also a research associate of the Department of Electronics and Information Engineering at Chemnitz University of Technology, Germany. The current main research interests include on-chip micro-nano photonics devices, silicon-based integrated photonic chips, and associated applications. He has published 34 papers in journals such as Science Advances, Laser & Photonics Reviews, Nano Letters, ACS Nano, ACS Photonics, and participated in more than 20 international and domestic well-known conferences and forums such as CLEO, SPIE Photonics West, and FiO+LS. **Abstract:** Optical microresonators have been long explored as an excellent on-chip integrable building block for generating, manipulating, and detecting lightwaves. Optical microcavities made by patterning and self-assembling pre-strained dielectric nanomembranes naturally support 3D whispering gallery mode resonances. In this talk, I will present the latest progress on the monolithic integration of rolled-up microresonators with planar waveguiding devices on a silicon chip, ranging from fundamental research to applications. Primarily, strain-engineering of deposited silicon nitride membranes enables precision shape control of microtubular resonators on top of planar waveguiding devices. The spiral rolling shape with a broken rotational symmetry enables free manipulation of split eigenstates around an exceptional point, and as a consequence, deterministic mode chiralities and light emission directionalities. Leveraging axial resonant modes in 3D microresonators, composite "microtube-microring" coupled systems were explored for mode-selective interactions with adjustable coupling strength. All in all, our recent progress on the integration between 3D microresonators and planar waveguiding devices suggests great potential in 3D photonic integrations and massively parallel optical interconnections.
Invited Talk	**Title:** Interfacial heterojunction construction energized perovskite optoelectronic devices **Speaker:** Dan Wu **Affiliation:** Shenzhen Technology University, China **Bio:** Dan WU is currently an Assistant Professor at Shenzhen Technology University. She received her Ph.D. from Nanyang Technological University, Singapore in 2018. Her research interests include optical field manipulation by micro/nanophotonic structures, inverse nanophotonic optimization, perovskite/quantum dots light-emitting diodes, narrow bandwidth photodetectors. **Abstract:** Organic-inorganic halide perovskites have demonstrated a great potential for optoelectronic devices. Typical optoelectronic devices possess vertical configurations with active layer sandwiched between electron transport layer (ETL) and hole transport layer (HTL). To reduce the unwanted defects and nonradiative recombination centers, interfaces at the perovskite/HTL and perovskite/ETL are intensively investigated by researchers. To further boost the performance of the devices, our focus is put on interfacial heterojunction construction for perovskite optoelectronic devices. First of all, we will present in situ growth of high-quality all-inorganic perovskite single crystal arrays on cubic zinc oxide (c-ZnO) as an inorganic ETL via a facile spin-coating method. Moreover, we will talk about the development of in situ growth methods for the fabrication of high-quality perovskite single-crystal thin films (SCTFs) directly on HTLs. During this talk we will try to unravel the elusive growth mechanism of large-area high-quality SCTFs with thin thickness. Finally, a general design guideline, which is applicable to both inverted and regular structures, is proposed for high-performance perovskite photodiodes through built-in electric field for efficient carrier separation and transport. The built-in electric field generated at the interface between active layer and charge transport layer far from the light incident side is critical for effective charge carrier collection to the electrodes. Manifesting the origin of the built-in electric field stems from the unintentional doping of perovskite, this optimization strategy is compatible with existing materials and device structures, and hence leads to substantial potential applications in perovskite photodiodes and other perovskite-based optoelectronic devices.

G27745	**Title:** Advanced Getter Solutions for Gas Contaminants Absorption in Optoelectronic Devices **Author(s):** Giovanni Zafarana, Enea Rizzi, Luca Mauri, Alessio Corazza, Marco Moraja **Speaker:** Marco Moraja **Affiliation:** SAES Getters, Italy **Abstract:** Sealed optoelectronic devices may experience performance issues, or failures, due to outgassing and release of gas species like H2O, H2, and VOCs during the operating lifetime. Hermetic packaging is the standard solution for sealing opto-electronic devices in order to protect them from external atmosphere or harsh environments, ensuring higher reliability and longer life. Unfortunately, hermeticity is not effective to prevent the release of gases from materials that are inside the sealed device. Accumulation of H2, H2O or VOCs could significantly affect the devices, leading to poor performances and drift over the lifetime. An effective way to fix this issue is to integrate getter materials. The engineered absorbing materials developed by SAES can be integrated into the packages to selectively absorb gases and preserve the device performances.

Technical Session on Dec. 10

TS34 Data Center Optical Interconnects and Networks

Chair Ruijie Zhu, Zhengzhou University, China

Room No.	Room ID	Zoom Link
Room 4	868 4632 7948	https://us02web.zoom.us/j/86846327948

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Honglin Ji	Peng Cheng Laboratory, China
10:00-10:30	Invited Talk	Ji Zhou	Jinan University, China
10:30-11:00	Invited Talk	Shikui Shen	China Unicom,China
11:00-11:30	Invited Talk	Mengfan Fu	Shanghai Jiao Tong University, China

Paper Detail

Invited Talk	**Title:** Self-coherent homodyne receiver without optical polarization control for short-reach optical interconnects **Speaker:** Honglin Ji **Affiliation:** Peng Cheng Laboratory, China **Bio:** Dr. Honglin Ji received a Ph.D. degree from the University of Melbourne, Melbourne, VIC, Australia. He is now working in Peng Cheng Laboratory, Shenzhen, China as an assistant researcher. He has published more than 40 journals and conference papers including Light: Science & Applications, Journal of Lightwave Technology, OFC PDP, etc. His current research interests include mobile fronthaul, coherent optical transmission systems, and large-capacity short-reach optical interconnects based on single- and dual-polarization, few-mode transmission. **Abstract:** Coherent detection has attracted much attention for providing high spectral efficiency transmission for short-reach optical interconnects. However, the expensive high-stable laser sources and computation-intensive DSP stack may preclude its potential application. To balance the high performance and low cost for short-reach optical networks, the self-coherent homodyne receiver structure has been investigated, where the dual-polarization (DP) signal and the remote local oscillator (LO) originating from the same laser source co-propagate over a duplex fiber, enabling a remarkable tolerance of laser linewidth. However, the fast evolution of the state of polarization (SOP) of remotely delivered LO becomes problematic for self-coherent homodyne detection systems. To address this issue, we will talk about the recent progress on the self-coherent homodyne receiver structure without any optical polarization control. The proposed self-coherent homodyne receivers are based on electronic DSP for polarization tracking. We achieved a record polarization tracking speed of 9 Mrad/s with negligible performance degradation for a 630-Gb/s silicon photonics integrated self-coherent homodyne receiver chip.
Invited Talk	**Title:** PAPR optimization for discrete multi-tone in peak-power-constrain optical systems **Speaker:** Ji Zhou **Affiliation:** Jinan University, China **Bio:** Ji Zhou received the B.E. and Ph.D. (with the highest honor) degrees from Beijing University of Posts and

	Telecommunications, Beijing, China, respectively. Since 2021, he has been an Associate Professor with the Department of Electronic Engineering, Jinan University, Guangzhou, China. He received an Excellent Doctoral Dissertation Award from the China Education Society of Electronics. **Abstract:** High PAPR is the major drawback of DMT in peak-power-constrain optical systems. In this talk, the clipping operation and clipping-noise cancellation algorithm are proposed to effectively reduce the PAPR and mitigate the clipping noise in the DMT systems. The clipping operation and CNC algorithm are added following the original digital signal processing, which shows the potential to overcome the drawback in not only DMT but also the other high-PAPR signal.
Invited Talk	**Title:** Discussion of low cost interconnection in data center networks **Speaker:** Shikui Shen **Affiliation:** China Unicom,China **Bio:** SHEN Shikui, PhD, Research Institute of China Unicom, professor senior engineer, received bachelor's degree from Wuhan University in 2006, and doctor's degree from Beijing Institute of Technology(BIT) in 2011, focusing on research, standardization and application of optical fibre/cable, optical module and transport network techniques in China Unicom since 2011, had developed several ITU-T Recommendations and CCSA standards. **Abstract:** Data centers and clouds are the fundamental infrastructure for ICT, how to achieve low cost interconnection for is the main challenge, including intra- and inter- data centers. This report will discuss the requirements and potential solutions.
Invited Talk	**Title:** Probabilistic Shaping and Advanced Modulation Formats in Optical Coherent Transmissions **Speaker:** Mengfan Fu **Affiliation:** Shanghai Jiao Tong University, China **Bio:** Mengfan Fu received her B.E. degree in Information Engineering from Shanghai Jiao Tong University, Shanghai, China in 2019. She is currently pursuing a Ph.D. degree in the State Key Laboratory of Advanced Optical Communication Systems and Networks in Shanghai Jiao Tong University. Her current research interests include coded modulation, fiber Kerr nonlinearity mitigation and compensation, and coherent data center links. She received the Grand Prize for the Corning Outstanding Student Paper Competition in 2020 OFC. **Abstract:** We introduce and discuss various methods to implement probabilistic shaping and advanced modulation formats in optical coherent systems. Different transmission systems including long-haul transmissions, short-reach transmissions with and without optical amplifiers are covered.

Technical Session on Dec. 10

TS35 Silicon Photonics

Chair Hairun Guo, Shanghai University, China

Room No.	Room ID	Zoom Link
Room 5	811 1444 8699	https://us06web.zoom.us/j/81114448699

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Li Shen	Huazhong University of Science and Technology, China
10:00-10:30	Invited Talk	Bhavin Shastri	Queen's University, UK
10:30-11:00	Invited Talk	Yu He	Shanghai Jiao Tong University, China
11:00-11:15	G277116	Hengyu Wang	Shanghai University, China

Paper Detail

Invited Talk	**Title:** Silicon photonic devices for the mid-infrared **Speaker:** Li Shen **Affiliation:** Huazhong University of Science and Technology, China **Bio:** Li Shen received the B.Sc. and M.Phil. degrees from the Huazhong University of Science and Technology (HUST),Wuhan, China, in 2009 and 2012, respectively, and the Ph.D. degree from the Optoelectronics Research Centre (ORC), University of Southampton, Southampton, U.K., in 2015. He is currently an Associate Professor at Wuhan National Laboratory for Optoelectronics within HUST. He has authored or coauthored more than 30 peer-review journal papers. His research interests include novel semiconductor photonic devices, silicon photonics, mid-infrared photonics.
Invited Talk	**Title:** Neuromorphic silicon photonics for training and inference **Speaker:** Bhavin Shastri **Affiliation:** Queen's University, UK **Bio:** Prof. Bhavin J. Shastri is an Assistant Professor of Engineering Physics at Queen's University and a Faculty Affiliate at the Vector Institute. He was an Associate Research Scholar (2016-2018) and Banting and NSERC Postdoctoral Fellow (2012-2016) at Princeton University. He received a Ph.D. degree in electrical engineering (photonics) from McGill University in 2012. He is a co-author of the book Neuromorphic Photonics, a term he helped coin. Dr. Shastri is the recipient of the 2022 SPIE Early Career Achievement Award and the 2020 IUPAP Young Scientist Prize in Optics "for his pioneering contributions to neuromorphic photonics" from the ICO. He is a Senior Member of Optica and IEEE. **Abstract:** Deep learning hardware accelerators based on analog photonic networks are trained on standard digital electronics. We discuss on-chip training of neural networks enabled by a silicon photonic architecture for parallel, efficient, and fast data operations.
Invited Talk	**Title:** On-chip multiplexing technology based on metamaterials **Speaker:** Yu He **Affiliation:** Shanghai Jiao Tong University, China

	Bio: Yu He received the B.S. degree from Nankai University in 2015 and the Ph.D. degree from Shanghai Jiao Tong University in 2020. He is currently working as a the post-doc at Shanghai Jiao Tong University. His research interests include silicon photonics devices and circuits, on-chip mode-division multiplexing, subwavelength grating, metamaterials. **Abstract:** We investigate the coupling mechanism beyond conventional directional couplers (DCs) by leveraging the gradient index metamaterial (GIM) structure . The coupling strength can be effectively tailored by engineering the structural parameters of the GIM waveguides, which enables large flexibilities for designing efficient coupling process. We show its applications in mode-division multiplexing (MDM) scnarios , where dispersion properties vary between waveguide modes, thus limiting the implementations of high-order MDM for conventional asymmetric DC approaches. With the introduction of the GIM structure, it is feasible to design the GIM-based coupler to meet the adiabatic criteria by manipulating the optical properties of the injected light beams. We demonstrate a 15-channel (TE0 ~ TE15) on-chip MDM device, which is the highest mode multiplexing order ever reported .
G277116	**Title:** Double-tip scandium aluminum nitride edge couplers at 1550 nm wavelength **Author(s):** Hengyu Wang, Xingyan Zhao, Shaonan Zheng, Zhengji Xu, Yuan Dong and Ting Hu **Speaker:** Hengyu Wang **Affiliation:** Shanghai University, China **Abstract:** Double-tip scandium aluminum nitride (Al1-xScxN) edge couplers with three different Sc concentrations (x = 0, 0.09, 0.23) working at 1550 nm wavelength are designed. The geometric parameters of the devices are optimized by the particle swarm optimization (PSO) algorithm. It is shown that the double-tip edge couplers have higher coupling efficiencies for both transverse-electric (TE) and transverse-magnetic (TM) modes compared with the single-tip ones with the same tip width and device length.

Technical Session on Dec. 10

TS36 THz Metamaterials and Device Applications

Chair Xudong Liu, Shenzhen University, China

Room No.	Room ID	Zoom Link
Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Liang Wu	Tianjin University, China
14:00-14:30	Invited Talk	Su Xu	Jilin University, China
14:30-15:00	Invited Talk	Yandong Gong	Beijing Information Science and Technology University, China
15:00-15:15	G27742	Hongyi Li	Tianjin University, China

Paper Detail

Invited Talk	**Title:** Ultrabroadband terahertz polarization conversion enabled by all-dielectric grating structures **Speaker:** Liang Wu **Affiliation:** Tianjin University, China **Bio:** Liang Wu obtained his B.Sc. and Ph.D. in optical engineering at Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology. Now he is an associate professor in Tianjin University, and teaches College Physics and Solid-State Physics. His research interest is Terahertz and Metamaterials. **Abstract:** Polarization control of electromagnetic waves has attracted broad interest for years. Despite meaningful efforts in the last decade, how to realize broadband transmissive polarization conversion for terahertz waves is a problem remaining unresolved. Here we propose an innovative strategy of designing an all-silicon grating, and experimentally demonstrate that the designed structure is capable of realizing ultrabroadband cross-linear and linear-to-circular polarization conversions in terahertz regime. Moreover, active control of arbitrary polarization state can be accomplished by mechanically tilting the grating structure. In brief, this work promises a new approach to realizing ultrabroadband conversion in arbitrary polarization state at terahertz frequencies, and is of great significance for terahertz wireless communication technology, polarization imaging and emergent biochemistry research requiring dichroism light.
Invited Talk	**Title:** Reconfigurable Terahertz On-chip Frequency-division Diplexer Based on Topological Photonics **Speaker:** Su Xu **Affiliation:** Jilin University, China **Bio:** Dr. Su Xu is currently an associate professor in College of Electric Science & Engineering, Jilin University. His research interest includes metamaterials and surface-wave devices. He currently cooperates with related industries in the area of metadevices for the beyond-5G wireless communication. He is the reviewer for Nature Communications, Advanced Functional Materials, Laser & Photonics Reviews, Advanced Optical Materials and Optics Letters. He is the Youth Council of metamaterial Association of China, the Associate Editor of the International Journal of Numerical Modelling and the editorial broad member of Progress in Electromagnetics

	Research Journals. **Abstract:** Multiplexing and Demultiplexing are with significant importance for advanced wireless communications even in the 6G era. Here, we report a reconfigurable on-chip frequency-division diplexer operated at the frequency range around 0.1 THz. Based on a bilayer photonic-topological-insulators platform, path-reconfigurable topological switching functionality is realized at varying frequencies. The device is fabricated from high-resistance silicon wafers by a typical lithography process. This device is complementary to conventional electronic (de)multiplexing devices and can be easily scaled to optical frequencies. Benefiting from the backscatter-immunity properties of topological waveguides, our work provides a compact, robust, and controllable approach for on-chip signal routing and flexible (de)multiplexing with cross-division.
Invited Talk	**Title:** Achromatic Broadband Terahertz Waveplate **Speaker:** Yandong Gong **Affiliation:** Beijing Information Science and Technology University, China **Bio:** Yandong Gong received his Ph.D. degree from Beijing Jiaotong University, China in 1998. He worked as post-doc in Nanyang Technological University, Singapore from 2000 to 2002. Later he joined Institute for Infocomm Research, A-STAR, Singapore. Since 2019, he has been with Beijing Information Science & Technology University as a full professor, his current research area includes fiber-optic sensors & Terahertz technology. Till now, he has authored or coauthored more than 200 papers on reputable international journals and conferences. **Abstract:** Achromatic Broadband Terahertz Waveplate is common but fundamental key components in the Terahertz polarization moduation. This paper presents the methodology to design Achromatic Broadband Terahertz Waveplate as well as our latest results.
G27742	**Title:** Chiral-Selective Transmission of Edge States in Terahertz Valley Topological Photonic Crystals **Author(s):** Hongyi Li, Jiajun Ma, Shilei Liu, Yi Liu, Chunmei Ouyang **Speaker:** Hongyi Li **Affiliation:** Tianjin University, China **Abstract:** Topological photonic systems provide a novel platform for controlling the flow of light. Recently, valley photonic crystals have been favored for their friendly of implement. Here, we demonstrate the chiral-selective terahertz transmission in a valley photonic crystal comprised of dielectric rods. The unidirectional propagation of chiral edge states indicated by the slope of energy band dispersion is numerically observed. The proposed regime has potential in multi-functional photonic broadband communication and other on-chip applications in the terahertz region, particularly for 6G communications.

Technical Session on Dec. 10

TS37 Laser Technology

Chair Qiancheng Zhao, Southern University of Science and Technology, China

Room No.	Room ID	Zoom Link
Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Qiancheng Zhao	Southern University of Science and Technology, China
14:00-14:30	Invited Talk	Yanhua Luo	University of New South Wales, Australia
14:30-14:45	G27779	Xu Zhao	Harbin Institute of Technology (Shenzhen), China
14:45-15:00	G277132	Haoguang Liu	Huazhong University of Science and Technology, China

Paper Detail

Invited Talk	**Title:** On Chip Photonic Integrated Optical Reference Cavities **Speaker:** Qiancheng Zhao **Affiliation:** Southern University of Science and Technology, China **Bio:** Dr. Qiancheng Zhao received his Ph.D. degree from the University of California, Irvine, USA, in 2017. He joined the School of Microelectronics as an Assistant Professor in the Southern University of Science and Technology (SUSTech), Shenzhen, China in 2021. Prior to his appointment in SUSTech, he first gained industry experience in Apple Inc. USA, then he joined the University of California, Santa Barbara, as a postdoctoral researcher from 2019 to 2021. **Abstract:** Optical reference cavities play a critical role in laser linewidth narrowing and frequency stabilization. Once tightly locked to the frequency reference, the frequency stability of the laser is largely determined by the stability of the cavity. Traditional benchtop Fabry-Perot reference cavities are not suitable for field deployed applications. Crystalline whispering-gallery-mode resonators have smaller footprints, but their fabrication processes are not CMOS-compatible. It is desirable to miniaturize optical reference cavities using photonic integrated waveguide-based technologies. This talk will introduce the recent progress in the on-chip photonic integrated reference cavities, including the frequency stabilization techniques and their bottlenecks. The development tendency will also be discussed.
Invited Talk	**Title:** Photostability and photobleaching of bismuth active center (BAC) in Bi doped and Bi/Er co-doped optical fibers **Speaker:** Yanhua Luo **Affiliation:** University of New South Wales, Australia **Bio:** Dr Yanhua Luo received his B.E and PhD degrees from University of Science and Technology of China (UTSC) in 2004 and 2009, respectively. Currently, he works as a deputy director of Photonics & Optical Communications at University of New South Wales (UNSW) to maintain the National Joint Fibre Facility at UNSW and develop the next generation functional specialty optical fibers and their devices. So far he has held 2 China patents and co-authored over 250 refereed journal/conference papers and 10 book chapters on these

	subjects. **Abstract:** Bismuth-doped optical fibre (BDF) and bismuth/erbium co-doped optical fibre (BEDF) have attracted more and more attention because of their ultra-broadband NIR luminescence for ultra-broadband photonic network. The evident photobleaching of BAC has been observed in the BDF/BEDF under the laser exposure. In this talk, the photostability and photobleaching effect of bismuth active centres (BACs) related to the NIR luminescence has systematically been demonstrated and summarized, in terms of irradiation intensity, irradiation wavelength, temperature, bleaching mechanism as well as the BAC type.
G27779	**Title:** Effect of diffusion on acoustic deformation potential characterization through coherent acoustic phonon dynamics **Author(s):** Long Li, Feng He, Xu Zhao, Zhen Tong, and Liang Guo **Speaker:** Xu Zhao **Affiliation:** Harbin Institute of Technology (Shenzhen), China **Abstract:** Ultrafast spectroscopy of coherent acoustic phonon (CAP) dynamics has recently been proposed as a method to characterize acoustic deformation potential (ADP), a key standard to quantify carrier–acoustic phonon coupling in semiconductors. In this Letter, we illustrate the importance of addressing the diffusion effect in ADP characterization by this method, using Ge as the demonstration system. It is found that the ADP mechanism and the thermoelastic effect have comparable contributions to CAP generation in Ge. Due to the different dependences on pump photon energies, the roles of these two mechanisms were assessed by varying pump wavelengths, based on which the ADP coupling constant of Ge was obtained. The analysis reveals that the carrier diffusion has a considerable impact on the shape of the CAP wave packet and must be processed cautiously for the ADP characterization for Ge.
G277132	**Title:** Real-time observation of internal distribution of soliton molecules in a passive mode-locked fiber laser **Author(s):** Haouang Liu, Yixiang Sun, Yusong Liu, Siyun Huang, Zhuang Wu, Meng Zou, Cunzheng Fan, Yiyang Luo, Perry Ping Shum, Qizhen Sun **Speaker:** Haoguang Liu **Affiliation:** Huazhong University of Science and Technology, China **Abstract:** Soliton molecule as a fascinating physical phenomenon has attracted intense investigations on ultrashort pulses in passively mode-locked fiber lasers. Stemming from the interaction of repulsive and attractive forces in the time domain, these particle-like soliton singlets can be bound together to form a kind of soliton compound. The research on soliton molecules is motivated to shed new light on the detailed nature of fundamental physics towards ultrafast nonlinear optics and extend much more potential applications of the pulsed light sources. Nevertheless, traditional observing methods of bound-states are restricted to averaging mechanisms of experimental instruments, thus sacrificing the instantaneity. Dispersive Fourier transform (DFT) measurement enables researchers to get shot-to-shot spectral views, which opens new opportunities for long-term real-time spectral observations. Although time-domain information can be obtained through Fourier transform techniques, this side-wind means is out of operation occasionally, mainly when the internal distribution of bound-states is complicated. Thus, it is urgently needed to directly observe the internal arrangement of soliton molecules propagating in fiber oscillators and detailed mutual interactions. Here, we report on the internal distribution of soliton molecules with the assistance of time-lens, a space-time duality based time-domain measurement for ultrashort pulses by temporal amplification. Via analyzing idler light converted from nonlinear effect between the pump and signal light, as well as satisfying phase matching conditions, real-time pulses distribution can get obtained. In our work, a recording length of temporal dynamics over 8000 roundtrips for soliton triplet could be captured, while the amplified interval between each soliton is around 450ps, which means the actual gap is 15ps with 30 times magnification. Relying on this time-lens system, stable distribution of multi-pulse compounds can be achieved, which paves a neoteric way to probe soliton molecules.

Technical Session on Dec. 10

TS38 Optical Communication and Networks

Chair Xueyang Li, Peng Cheng Laboratory, China

Room No.	Room ID	Zoom Link
Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Yongli Zhao	Beijing University of Posts and Telecommunications, China
14:00-14:30	Invited Talk	Yang Yue	Xi'an Jiaotong University, China
14:30-14:45	G27756	Abdulaziz Al-Amodi	King Fahd University of Petroleum and Minerals
14:45-15:15	Invited Talk	Oskars Ozolins	KTH Royal Institute of Technology, Sweden

Paper Detail

Invited Talk	**Title:** Problems to be Solved in Dynamic Optical Satellite Networks **Speaker:** Yongli Zhao **Affiliation:** Beijing University of Posts and Telecommunications, China **Bio:** Yongli Zhao is a full professor at BUPT. During Jan. 2016 to Jan. 2017, he was a visiting scholar at UC Davis. Now, he is a Fellow member of IET, senior member of IEEE and OSA. His current research focuses on optical fiber networks, satellite optical communication networks, and quantum key distribution networks. Up to now, he has published more than 400 international journal and conference papers. He has granted more than 100 patents. He also participated in many international standards works, and he has submitted 90 drafts to ITU-T and IETF. **Abstract:** Satellite communication network is becoming an important information infrastructure for 5G and 6G. Space optical communications will be an inevitable choice for satellite communication networks, especially for inter-satellite communications, due to the capability of high speed and long distance transmission. However, because the satellites are always moving around the earth, the satellite communication networks topology is changing all the time including the inter-satellite link (ISL) distance and ground-satellite link (GSL) connection, which brings many challenges for the satellite communication networks. This talk covers topics of control architecture, routing algorithm, signaling protocol, and survivability mechanism of satellite optical communication networks.
Invited Talk	**Title:** Highly Dispersive OAM Modes in Optical Fibers **Speaker:** Yang Yue **Affiliation:** Xi'an Jiaotong University, China **Bio:** Yang Yue received the B.S. and M.S. degrees in electrical engineering and optics from Nankai University, China, in 2004 and 2007, respectively. He received the Ph.D. degree in electrical engineering from the University of Southern California, USA, in 2012. He is a Professor with the School of Information and Communications Engineering, Xi'an Jiaotong University, China. Dr. Yue's current research interest is intelligent photonics, including optical communications, optical perception, and optical chip. He has published over 200

	peer-reviewed journal papers (including Science) and conference proceedings with >9,000 citations, five edited books, two book chapters, >50 issued or pending patents, >170 invited presentations (including 1 tutorial, >20 plenary and >30 keynote talks). Dr. Yue is a Senior Member of the Institute of Electronic and Electrical Engineers (IEEE). He is an Associate Editor for IEEE Access, and an Editor Board Member for three other scientific journals. He also served as Guest Editor for ten journal special issues, Chair or Committee Member for >80 international conferences, Reviewer for >60 prestigious journals. **Abstract:** Orbital angular momentum (OAM) modes, featured by the unique properties of helical phase front and annular intensity profile, have shown enormous potential for a wide range of applications. Optical fibers with ring-shape high-index core have been experimentally proven to be an ideal medium for stable OAM mode transmission. Chromatic dispersion (CD), which origins from the wavelength-dependent propagation velocity in a transmission medium, is considered as a critical parameter in various applications. In most instances, managing the chromatic dispersion is of vital importance in fiber-based systems. In this talk, we will introduce some specialty optical fibers for supporting highly dispersive OAM modes. First, the background of chromatic dispersion and OAM modes will be introduced. Then, the structures and operating principles of highly dispersive fibers for fundament mode and OAM modes are illustrated and compared. To visualize the coupling process, we present the OAM mode properties in the double ring-core fiber, including the effective refractive index, effective mode area, power integral ratio, chromatic dispersion, and loss. Photonic crystal fiber and triple ring-core fiber for highly dispersive OAM modes will also be introduced. These highly dispersive OAM fiber could potentially find some promising applications in optical fiber systems.
G27756	**Title:** Underwater Wireless Optical Communication Channel Characterization using Machine Learning Techniques **Author(s):** Abdulaziz Al-Amodi, Mudassir Masood, M. Z. M. Khan **Speaker:** Abdulaziz Al-Amodi **Affiliation:** King Fahd University of Petroleum and Minerals **Abstract:** Recently Underwater Optical Wireless Communication (UOWC) has attracted major attention due to its high transmission rate, low link delay, high communication security, and low implementation cost. However, optical signals suffer from severe attenuation loss due to absorption and scattering effects, which impedes the establishment of an effective and reliable UWOC system. Hence, it is important to identify the characteristic of the underwater channel in order to overcome the mentioned challenges. In literature, the combination of the Exponential and the Generalized Gamma Distribution (EGG) has been shown to model the underwater channel environment with great accuracy. EGG is a comprehensive channel model incorporating the effect of temperature-induced turbulence in the presence of air bubbles, in both fresh and salty aqueous environments. In this work, we built a Machine Learning (ML) based system that utilizes Convolutional Neural Network (CNN) to estimate the parameters of the EGG channel model from the received signal. Furthermore, we take one more step and train a separate deep network to predict bubble level and temperature gradient in the UWOC channel using the estimated parameters. The two networks together form a pipeline enabling us to estimate the channel state from the received signal. The results confirm well with the experimental data from the literature.
Invited Talk	**Title:** Optical Amplification-Free High Baudrate Links for Short-Reach Communication **Speaker:** Oskars Ozolins **Affiliation:** KTH Royal Institute of Technology, Sweden **Bio:** Associate professor Oskars Ozoliņš is a Senior Scientist and Technical Lead at the Kista High-speed Transmission Lab (Kista HST-Lab), RISE Research Institutes of Sweden. He is also a Senior Researcher at the Department of Applied Physics, KTH Royal Institute of Technology. Associate professor O. Ozoliņš is an Academician (foreign member) at the Latvian Academy of Science. He is also the Latvian Council of Science Expert in Committees: Engineering, Computer Science, and Physics. His research interests are in the areas of digital and photonic-assisted signal processing techniques, high-speed short-reach communications and

devices, optical and photonic-wireless interconnects, and machine learning for optical network monitoring and Quality of Experience prediction.

In his professional career, Associate professor O. Ozoliņš has been a guest researcher at III-V Lab (Nokia Bell Labs and Thales, France), Keysight Technologies (Böblingen Germany), DTU Fotonik (Technical University of Denmark, Denmark), IDLab (Ghent University – imec, Belgium), OFO (KTH Royal Institute of Technology, Sweden), and FOTON laboratory (University of Rennes 1, France). In total 265 days for external stays.

Associate professor O. Ozoliņš is coholder of several world records reported at conference post-deadline sessions: (1) on optical amplification free highest baud rate for 200 Gbps OOK transmitted with single integrated externally modulated laser at OFC2022, (2) on highest real-time duobinary transmission at ECOC2016, (3) on single-transmitter/single-receiver THz link (0.3-0.5 THz) with a record net data rate of 260 Gbps at IPC2016, (4) a first multigigabit throughput transmission of 9-μm QCL based FSO link in room-temperature with multilevel modulation formats at OFC2022. He is the author of around 222 international journal publications, conference contributions, invited talks/tutorials/keynote/lecture, patents, and book chapters (h index 21, citations 1502).

He has more than 13 years of experience in supervising students. He has supervised 36 bachelor students, 23 master students, 5 Ph.D. students, and 3 postdocs.

Associate professor O. Ozoliņš is a Technical Program Committee (TPC) member of the ECOC2022, Basel Switzerland. He is also a TPC member of OFC2023, Sandiego California, USA.

Abstract: The ever-growing internet traffic demands are setting highly challenging requirements for the high-performance computing (HPC) and the intra-Data Center links. Scaling the Data Center capacity to 1.6 Tbps/link in an economically viable way is the key. Moreover, we need to support low latency requirement for high-speed computing. Multilevel pulse amplitude modulation (PAM) can be used to increase the capacity for bandwidth limited components but sets stringent requirements in terms of linearity and noise tolerance for driving electronics and photonics. Therefore, it is worth reviving interest in on-off keying (OOK) for this type of short-reach application.

Technical Session on Dec. 10

TS39 Near-infrared, Mid-infrared and Far-infrared Technologies and Applications

Chair Lingling Huang, Beijing Institute of Technology, China

Room No.	Room ID	Zoom Link
Room 4	868 4632 7948	https://us02web.zoom.us/j/86846327948

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Qin Chen	Jinan University, China
14:00-14:30	Invited Talk	Xueqian Zhang	Tianjin University, China
14:30-15:00	Invited Talk	Yuanmu Yang	Tsinghua University, China
15:00-15:15	G27722	Yongheng Zhou	Southern University of Science and Technology, China

Paper Detail

Invited Talk	**Title:** Tunable infrared photodetector and on-chip spectroscopy **Speaker:** Qin Chen **Affiliation:** Jinan University, China **Bio:** Professor in Optoelectronics at Jinan University, Guangzhou. His research interests include nanophotonics, photodetectors, on-chip optical sensing and spectroscopy. He graduated from Institute of Semiconductors, Chinese Academy of Sciences with a PhD degree in microelectronics. **Abstract:** On-chip spectroscopy has attracted lots of research interests recently from both academia and industry. It is an important technique for on-site inspection and point-of-care diagnosis. Although various chip-scale microspectrometers have been reported, most of them only work in the visible range. The extension to the infrared range is impeded by the high cost of the photodetector array. In this talk, I will introduce our recent work on tunable infrared photodetectors with a tuning range above 500 nm. Moreover, we discuss the application of on-chip spectroscopy with such a tunable photodector.
Invited Talk	**Title:** Nonlinear-Metasurface-Based Integrated Terahertz Generator-Manipulators **Speaker:** Xueqian Zhang **Affiliation:** Tianjin University, China **Bio:** Xueqian Zhang is an associate professor at Tianjin University, China. He received his BEng degree in electronic science and technology, MEng degree in opto-electronics technology, and PhD in optical engineering from Tianjin University, China, in 2010, 2016, and 2016, respectively. He went for visiting study at University of Birmingham, United Kingdom, and at King Abdullah University of Science and Technology, Saudi Arabia, respectively, between 2013 and 2014. His main research interests are terahertz metasurfaces, surface plasmonic waves, and nonlinear plasmonics. **Abstract:** Conventional terahertz (THz) generation and manipulation are two essential but different processes for THz applications, which are accomplished with spatially separated and different devices. In this talk, we introduce a method that can combining these two processes in a single device based on nonlinear metasurface, which is denoted as THz integrated generator-manipulator. The THz generation is originated from the difference

	frequency generation process in nonlinear metasurface under infrared femtosecond laser pump, while the THz manipulation here is propagation control arisen from the nonlinear Pancharatnam-Berry phase property of the nonlinear meta-atoms. More interestingly, epsilon-near-zero effect in an ultrathin ITO film is also applied to increase the THz generation efficiency, together with the plasmonic resonance effect in the meta-atom. Several THz integrated generator-manipulators are experimentally achieved with good performance. Our method provides a new way for achieving novel and compact integrated THz functional devices for broader applications.
Invited Talk	**Title:** Metasurface for multi-dimensional light field sensing **Speaker:** Yuanmu Yang **Affiliation:** Tsinghua University, China **Bio:** Yuanmu Yang has been a tenure-track associate professor at the Department of Precision Instrument at Tsinghua University since 2018. His research currently focuses on subwavelength optical thin-films and metasurfaces for applications in nonlinear optics and multi-dimensional light field sensing. Before joining Tsinghua, he obtained his bachelor's degree in optoelectronics from Tianjin University/Nankai University in 2011, and his PhD in interdisciplinary materials science from Vanderbilt University in 2015. He was a postdoctoral researcher at Sandia National Laboratories from 2015 to 2017, and was a research scientist at Intellectual Ventures from 2017 to 2018, in an attempt to commercialize the optical metasurface technology. His work has been published in high impact journals such as Nature Photonics and Nature Physics, receiving over 4000 citations. His recognitions include the outstanding oversea student award given by the Chinese Scholarship Council as well as the Forbes China "30 under 30" in 2018. **Abstract:** Optical sensors can play vital roles in emerging applications such as augmented reality and autonomous driving. Conventional optical sensors, such as the smartphone camera, can only acquire light intensity in two dimensions. In order to further obtain the depth, polarization, and spectral information of the target object, it is often required to use bulky and expensive instruments. Metasurface is composed of an array of optical antennas that can manipulate the amplitude, phase, polarization, and spectrum of light at the subwavelength scale. By replacing conventional diffractive of refractive elements with metasurfaces in imaging systems, one may be able to build optical sensors for high-performance multidimensional light sensing with a low size, weight, and power. In this talk, I will present our recent progress towards this goal.
G27722	**Title:** Strong light-magnetic ordering interactions in two-dimensional MnPS3 **Author(s):** Yongheng Zhou, Xiaolong Chen **Speaker:** Yongheng Zhou **Affiliation:** Southern University of Science and Technology, China **Abstract:** Magneto-optical effect has been widely used in light modulation, optical sensing and information storage. Recently discovered two-dimensional (2D) van der Waals layered magnets are considered as promising platforms for investigating novel magneto-optical phenomena and devices, due to the long-range magnetic ordering down to atomically-thin thickness, rich species and tunable properties. However, the investigation on the light emission property and its correlation with antiferromagnetic ordering were scarce, since majority 2D antiferromagnets suffer from low luminescence efficiency which hinders their magneto-optical investigations and applications. Here, we observe a emerged near-infrared photoluminescence (PL) mode (~1.3 eV) in MnPS3 far below its intrinsic bandgap (~2.9 eV). This PL mode shows strong correlation with the Neel ordering and persists down to monolayer thickness. Density-functional theory calculations, and material characterizations suggest this unusual near-infrared PL mode originates from ingap electron transitions assisted by chemically absorbed oxygen element with spin configuration coupled to antiferromagnetic ordering of Mn ions. Moreover, the ingap photoluminescence strength of MnPS3 can be tuned using ultraviolet irradiation in O2 environment, which confirms the origin of this ingap photon emission mode in MnPS3. Our work not only suggests MnPS3 an exciting 2D-material platform for investigating novel light-magnetic

	ordering interactions but also shows that defect-mediated states could be utilized to reveal intrinsic magnetic properties of 2D materials.

Technical Session on Dec. 10

TS40 Fiber-Based Technologies and Applications

Chair Yunqi Liu, Shanghai University, China

Room No.	Room ID	Zoom Link
Room 5	811 1444 8699	https://us06web.zoom.us/j/81114448699

Time	Paper ID	Speaker	Affiliation
13:30-14:00	Invited Talk	Jindong Wang	Chongqing University, China
14:00-14:30	Invited Talk	Changrui Liao	Shenzhen University, China
14:30-15:00	Invited Talk	Ruochong Zhang	A*STAR, Institute of Bioengineering and Bioimaging, Singapore
15:00-15:15	G277121	Haoyang Song	Harbin Institute of Technology (Shenzhen), China

Paper Detail

Invited Talk	**Title:** Accurate measurement of large strain under high-temperature environment based on fiber Bragg grating **Speaker:** Jindong Wang **Affiliation:** Chongqing University, China **Bio:** Jindong Wang is an assistant research fellow and a postdoctoral fellow in College of Optoelectronic Engineering, Chongqing University. He received his B. S., M.S. and Ph. D. in 2016, 2018 and 2021 respectively in engineering at the College of Precision Instruments and Optoelectronic Engineering, Tianjin university. Dr. Wang's research interests are in the area of on-chip soliton microcomb, FBG-based fiber sensing and precious absolute ranging. He has published 18 peer reviewed papers in international journals including Photonics Research、Optics Letters、IEEE Transactions on Industrial Electronics, etc. His first-author paper was selected as the cover article of December 2020 by journal Photonics Research. **Abstract:** Strain measurement technology under high-temperature environment has been a hot and difficult research issue in the field of measurement. On the one hand, conventional resistive strain gauges are susceptible to electromagnetic interference at high temperature. And on the other hand, common fiber sensors will be invalid under high-temperature environment, and may fall off under large strain conditions. In this paper, a precision measurement scheme that combining plasma surface treatment and metal oxide adhesive based on fiber Bragg grating (FBG) of large strain under high temperature environment is proposed, where three types of protection for the grating area of a FBG sensor were established, and a new plasma surface treatment method is theoretical analyzed and experimental studied. Suitable adhesive is also carefully selected according to the characteristics of the sample to be measured. After optimizing the mechanical transfer effect with the proposed method, effective coupling between the surface of the sample to be measured and the fiber grating sensor is realized, and large strain measurement up to 1200με under 1000°C environment is experimentally achieved.
Invited Talk	**Title:** 3D printed fiber-optic microforce sensor **Speaker:** Changrui Liao **Affiliation:** Shenzhen University, China **Bio:** Prof. Changrui Liao currently works in College of Physics and Optoelectronic Engineering at Shenzhen

	University and holds the position of Deputy Director of Guangdong and Hong Kong Joint Research Center for Optical Fiber Sensors (COFS). He obtained his BSc and MEng from Huazhong University of Science and Technology in 2005 and 2007, respectively. He received his PhD in Optical Engineering from the Hong Kong Polytechnic University in 2012. Since 2012, he has been working in Shenzhen University. Prof. Liao's research interests include optical fiber sensor and femtosecond laser micromachining. He authored/co-authored 2 book chapters, ＞170 journal and 100 conference papers, and ＞10 patents in the area of optical fiber devices and sensors. His work were cited ＞5200 times with h-index of 42 (SCIE). He received the National Science Fund for Outstanding Young Scholars (2021), the Distinguished Young Scholar Award of Guangdong Province (2018), the Outstanding Youth Scholar Award of Shenzhen (2020) and the first prize of Shenzhen Natural Science Award (2017). **Abstract:** Optical fiber microstructured devices, which combine the advantages of optical fiber and microstructure, are becoming a new research hotspot. The material and structure of optical fiber used in communication are relatively single, which cannot meet the requirements of various applications of optical fiber sensors. Femtosecond laser micromachining is an advanced maskless micro/nano lithography technology. It is widely used in different kinds of material microfabrication due to its advantages of super diffraction limited processing resolution, high processing quality and three-dimensional processing. This presentation will introduce our recent research progress in femtosecond laser 3D nano-printing of fiber microstructured sensors. Femtosecond laser micromachining provides a broad space for the development of new fiber microstructured devices, which will greatly expand the research field of optical fiber sensors.
Invited Talk	**Title:** Fiber-based Confocal Raman Spectroscopy System for Skin Studies: From Bench to Bedside **Speaker:** Ruochong Zhang **Affiliation:** A*STAR, Institute of Bioengineering and Bioimaging, Singapore **Bio:** Dr Zhang Ruochong received her Bachelor and PhD degree from Nayang Technological University in 2015 and 2020. She joined Agency for Science, Technology and Research (A*STAR) in 2019 as research fellow and was promoted to senior research fellow in 2022. Dr Zhang's research interest covers the development of hybrid optical systems for biomedical applications such as photoacoustic imaging, Raman spectroscopy and fluorescence imaging etc, aiming to translate research from bench to bedside. **Abstract:** Confocal Raman spectroscopy (CRS) has shown great potential in non-invasive skin analysis due to its high specificity, label-free manner and high sensitivity. However, current CRS systems have various shortcomings including limited detection bandwidth, bulky size, non-flexibility, slowness and complexity, which hindered its applications. Herein, I will share with you the development of a fiber-based wideband CRS system for dermatological applications, from idea initialization to clinical study and future commercialization plan.
G277121	**Title:** Research on Multimode Fiber Curvature Sensing Based on CNN **Author(s):** Haoyang Song, Yunxun Sun **Speaker:** Haoyang Song **Affiliation:** Harbin Institute of Technology (Shenzhen), China **Abstract:** Due to mode interference, mode dispersion and other reasons, speckles are generated on the output after light transmitting through multimode fibers(MMFs). Specklegram is very sensitive to environmental disturbances on MMFs, so it can be used to study the sensing of physical quantities such as vibration, displacement and curvature. Here, we propose a deep learning method to sense the curvature of MMFs, by analyzing the specklegrams of MMFs. This method does not need a special sensing structure of MMFs, but uses only a single fiber. We build a specklegram sensing system that is composed of four parts: space light laser, MMF, electric displacement platform and CCD camera. The optical fibers are bended to a specific curvature by the movement of a displacement platform. The CCD camera at the output end of the optical fiber acquires the corresponding specklegrams in real time. Finally, a data set of specklegrams is acquired on a 20-cm-long step-indexed MMF with different 20 curvatures, which is used to train convolutional neural

	network(CNN)) that has strong learning ability of nonlinear relationship. After training CNN, We get the regression model of the relationship between speckle and curvature. According to the well-trained model, any curvature of fiber can be accurately predicted by specklegrams within a certain curvature range. This method only needs to use finite discrete curvatures as the training data set of the CNN, so as to obtain an arbitrary continuous curvature. The experimental results show that, in the range of 0-5.339 fiber curvature change, the curvature prediction error, corresponding to 99.95% of specklegrams, is less than 0.3 for the test set with the same curvatures. With the test set composed of new curvatures of the fiber, the curvature prediction error corresponding to 92.4% of specklegram is less than 0.3. With the total test set, the curvature prediction error corresponding to 97.15% of specklegrams is less than 0.3, which proves that the regression network model has good generalization ability and sensing accuracy. At the same time, the speckle and curvature regression model, obtained by support vector machine(SVM) method, is compared with CNN method. CNN has higher sensing accuracy than SVM method. The sensing scheme proves that the deep learning method is feasible for studying the curvature sensing problem of a single MMF. The experimental system of this method has simple structure and reliable sensing performance.

Technical Session on Dec. 10

TS41 Optoelectronic Devices and Applications

Chair Mohammed Zahed Mustafa Khan, King Fahd University of Petroleum and Minerals, Saudi Arabia

Room No.	Room ID	Zoom Link
Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Xuming Zhang	Hong Kong Polytechnic University, China
16:00-16:30	Invited Talk	Huiyu Li	Beijing Information Science & Technology University, China
16:30-17:00	Invited Talk	Pyry Kivisaari	Aalto University, Finland
17:00-17:15	G27769	Zhiyuan Wang	Shenzhen University, China

Paper Detail

Invited Talk	**Title:** Gold Nanostructures for Plasmonic Enhancement of Visible Photocatalysis **Speaker:** Xuming Zhang **Affiliation:** Hong Kong Polytechnic University, China **Bio:** Xuming Zhang is currently a full professor with Department of Applied Physics, Hong Kong Polytechnic University. He received BEng degree in Precision Mechanical Engineering from the University of Science & Technology of China (USTC) in 1994, and Ph.D. degree from School of Electrical & Electronic Engineering, Nanyang Technological University (NTU) in 2006. His research has produced more than 130 journal papers and has been extensively reported by public media. His current research interests cover mainly plasmonics, microfluidics, artificial photosynthesis, biomimetics and green energy. **Abstract:** Gold nanohole arrays can excite both surface plasmon polariton (SPP) and localized surface plasmon resonance (LSPR) in a single thin film, which has sparked considerable interest in the field of plasmonic. To exert their full potential for the generation of hot electrons in visible light, we have combined the Au nanohole arrays (AuNHA) with thin TiO2 layers and Pt nanoparticles on the surface to form different Pt/TiO2/AuNHA nanocomposites, which enable the combined effect of plasmonic enhancement modes and efficient hot electron injection (HEI). Detailed experimental and mechanism studies have been conducted to examine the plasmonic enhancement in photocurrent, IPCE, and water splitting using solar light.
Invited Talk	**Title:** Subwavelength imaging with cascaded superlens **Speaker:** Huiyu Li **Affiliation:** Beijing Information Science & Technology University, China **Bio:** Dr. Huiyu Li is an associate professor (with tenure) at the School of Instrument Science and Opto-electronics Engineering, Beijing Information Science & Technology University, Beijing, China. She received her Ph.D. in Engineering from the Institute of Applied Optics, Mechanical Engineering, University of Stuttgart, Germany. Dr. Li's research interests are in the areas of subwavelength imaging, metalens and their applications. **Abstract:** Optical microscopy is one of the most important imaging techniques. However, the resolution is

	diffraction limited. To obtain an image with supperresolution, plenty of efforts have been devoted to subwavelength imaging. A cascaded superlens is proposed to directly imaging objects with subwavelength features in the far field at visible spectrum. The superlens achieve superresolution with a wide transverse wave vector coverage and a compression of lateral transverse wavevector. Such a superlens could be useful for the improvement of the resolution of a conventional microscope and the experimental results demonstrate that the resolution could be improved with modulation of the spatial frequency information.
Invited Talk	**Title:** Resonance effects in the radiation transfer of thermophotonic intracavity devices **Speaker:** Pyry Kivisaari **Affiliation:** Aalto University, Finland **Bio:** Pyry Kivisaari received his doctoral degree in computational science from Aalto University, Finland, in 2014. He has been a visiting scholar at UC Santa Barbara and a postdoctoral researcher at Lund University before his present position at Aalto. At Aalto, he focuses especially on III-V based thermophotonics, taking the main responsibility for the related optical, electrical and thermal modeling efforts in the research group. **Abstract:** The currently ubiquitous light-emitting diodes (LEDs) are not merely simple devices converting electricity to light. More broadly, they can be regarded as thermodynamic engines enabling near-reversible conversion between thermal energy, electricity and light. In more concrete terms, LEDs can thus in principle be turned into heat pumps or heat engines, and exploring these possibilities constitutes the field of electroluminescence-driven (EL-driven) thermophotonics. In this work, we investigate EL-driven thermophotonics specifically in a full optical cavity setting, where the source and sink of the radiation are located within an optical cavity and separated by a vacuum nanogap. Carrying out comprehensive fluctuational electrodynamics simulations, we find that the optical power transfer can be tuned by modifying the cavity thickness and thereby the optical mode structure. Moreover, thinning the active layers leads to emission enhancement and thereby a sublinear dependence between the active layer thickness and the optical power transferred. More generally, our work provides fundamental understanding on the dependencies and optical phenomena to expect when exploring EL-driven thermophotonics in a full optical cavity setting.
G27769	**Title:** Visible and infrared luminescence and Applications of Er-doped AlN thin films **Author(s):** Zhiyuan Wang, Honglei Wu, Feihong Zhang, Sergii Golovynskyi, Zhenhua Sun, Baikui Li **Speaker:** Zhiyuan Wang **Affiliation:** Shenzhen University, China **Abstract:** An Er-doped AlN film has been prepared by radio frequency magnetron sputtering and its photoluminescence (PL) characteristics were studied. It shows high PL efficiency in a wide range of the visible (540 and 560 nm) and infrared (817, 864, 980 and 1534 nm) ranges. In the transition of 4f levels of Er3+, the PL from 2H11/2 → 4 I15/2 and 4S3/2 → 4 I15/2 shows obvious temperature dependence, which exhibits a functional relationship between their PL intensity ratio I540nm/I560nm and temperature over 100-550 K. It has a relatively high sensitivity (little above 0.01 K-1) among the currently researched temperature sensing materials and can be used as a new contactless temperature sensor in a harsh environment. In the field of infrared luminescence, 864 and 1534 nm are the low loss transmission window in silica fibers and suitable for communication systems.

Technical Session on Dec. 10

TS42 Data Center Optical Interconnects and Networks

Chair Mengfan Fu, Shanghai Jiao Tong University, China

Room No.	Room ID	Zoom Link
Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Jianxin Ren	Nanjing Univerisity of Information Science and Technology, China
16:00-16:30	Invited Talk	Ruijie Zhu	Zhengzhou University, China
16:30-17:00	Invited Talk	Zuqing Zhu	University of Science and Technology of China, China
17:00-17:15	G27740	Lin Sun	Soochow University, China

Paper Detail

Invited Talk	**Title:** A Mode Division Multiplexing Chaotic Encryption Scheme Based on Key Intertwining and Accompanying Transmission **Speaker:** Jianxin Ren **Affiliation:** Nanjing Univerisity of Information Science and Technology, China **Bio:** Jianxin Ren received the Ph.D. degree in Optical Engineering from the Beijing University of Posts and Telecommunication (BUPT), Beijing, China, in 2021. He is currently a Lecturer with the School of Physics and Optoelectronics, Nanjing University of Information Science and Technology (NUIST), China. His main research interests include high-speed fiber communication systems, optical signal processing, and chaotic encryption. **Abstract:** A mode division multiplexing (MDM) chaotic encryption scheme based on key intertwining and accompanying transmission is proposed. Based on the weakly coupled few-mode fiber (FMF), time-varying keys and data can be accompanied by transmission in two modes, LP01 and LP11, respectively. In order to generate a new key, the current key is XORed with all of the keys from all the preceding moments, one by one. To implement chaotic masking in the digital domain, the three chaotic sequences corresponding to the new key are adapted to encrypt the data at the constellation phase, data symbol block, and subcarrier levels. An 8.89 Gb/s encrypted 16QAM-OFDM signal transmission over 1 km weakly-coupled FMF is experimentally demonstrated. The receiver with the correct key can recover the data normally, while the BER of the illegal receiver remains around 0.5. In the case of the key transmission bit rate of 1 Gb/s, the cracking efficiency threshold of the time-varying key encryption scheme is 5.21×10^6 times that of the time-invariant key encryption scheme, which suggests that the proposed work is a promising candidate for future physical layer security.
Invited Talk	**Title:** Space-terrestrial Integerated Optical Networking for 6G Core Networks **Speaker:** Ruijie Zhu **Affiliation:** Zhengzhou University, China **Bio:** Ruijie Zhu is currently an associate professor in Zhengzhou University. He received the PhD degree in the State Key Lab of Information Photonics and Optical Communication at Beijing University of Posts and

	Telecommunications (BUPT), China. He was a visiting scholar at the University of Texas at Dallas under the supervision of Prof. Jason P. Jue. He has attended more than 10 National projects. He has co-authered more than 60 papers, including TNNLS, JLT, OE, etc. His research interests include Internet of Things (IoTs), 6G satellite communication networks, and intelligent optical networks. **Abstract:** After the commercial use of the fifth-generation (5G) communication technology, several countries have begun to study the sixth-generation (6G) communication technology. It is generally believed that 6G communications should have the following features: seamless land-sea-air-space coverage, ultra-low delay and ultra-large access/transmission capacity. In order to meet these requirements, 6G core networks need to adopt the manner of space-terrestrial integrated optical networking, which would make 6G communication not only involves competition of standards, but also scrambles for high-quality satellite orbits and high-quality spectrum resources. Hence, we should deploy 6G as quickly as possible. In view of this situation, this report discusses the problem of space-terrestrial integrated optical networking for 6G core networks.
Invited Talk	**Title:** Application-aware Configuration of All-optical Interconnects in Hyper-FleX-LION **Speaker:** Zuqing Zhu **Affiliation:** University of Science and Technology of China, China **Bio:** Zuqing Zhu received his Ph.D. degree from the Department of Electrical and Computer Engineering, University of California, Davis, in 2007. He is currently a Full Professor at the University of Science and Technology of China (USTC). He has published more than 260 papers in referred journals and conferences, and has received the Best Paper Awards from ICC 2013, GLOBECOM 2013, ICNC 2014, ICC 2015, and ONDM 2018. He is an IEEE Communications Society Distinguished Lecturer (2018-2019), a Senior Member of IEEE, and a Senior Member of OSA. **Abstract:** Due to the advantages of optical circuit switching (OCS), all-optical interconnects (AOIs) for data center networks (DCNs) have attracted intensive interests recently. Hyper-FleX-LION is a highly-flexible AOI architecture that operates with the OCS based on wavelength-division multiplexing (WDM). In this paper, we present our recent research activities on Hyper-FleX-LION. First, to prove the superiority of Hyper-FleX-LION, we enumerate various communication patterns of distributed machine learning (DML) in DCNs, and analyze the acceleration effect achieved by Hyper-FleX-LION over existing interconnect architectures, such as the hybrid optical/electrical interconnect based on optical cross-connect (HOE-w/OXC). Results show that Hyper-FleX-LION can better accelerate the tasks of DML. Then, we classify network applications in DCNs as bandwidth-intensive and data-intensive ones, and analyze the operational costs and task completion time that Hyper-FleX-LION brings to them and how to optimize the topology design and traffic routing of Hyper-FleX-LION adaptively. The analysis results confirm the importance of designing an application-aware configuration scheme for Hyper-FleX-LION.
G27740	**Title:** Ultra-stable and low-complexity retiming technique for bandwidth-limited 112-Gbps PAM-4 systems **Author(s):** Lin Sun, Luxiao Zhang, Yi Cai, Gangxiang Shen, Gordon Ning Liu, Bin Chen **Speaker:** Lin Sun **Affiliation:** Soochow University, China **Abstract:** We proposed an improved retiming algorithm for optical PAM-4 system by introducing a moving average filter into the conventional Gardner loop. It exhibits an enhanced stability especially when system bandwidth is limited.

Technical Session on Dec. 10

TS43 Silicon Photonics

Chair Wei Jiang, Nanjing University, China

Room No.	Room ID	Zoom Link
Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Jianji Dong	Huazhong University of Science and Technology, China
16:00-16:30	Invited Talk	Zhenzhou Cheng	Tianjin University, China
16:30-17:45	G27720	Zhaoting Geng	Southern University of Science and Technology, China

Paper Detail

Invited Talk	**Title:** Real-time training of photonic neural network chip **Speaker:** Jianji Dong **Affiliation:** Huazhong University of Science and Technology, China **Bio:** Dr. Jianji Dong is a Professor of Wuhan National Laboratory for Optoelectronics (WNLO), Huazhong University of Science and Technology (HUST). His research interests include microwave photonics, silicon photonics, and photonic computing. He has published more than 100 Journal papers, including Nature Communications, Light science and applications, Physical Review Letters, etc. He was honored the Fund of Excellent Youth Scholar by NSFC, China, and honored First award of Natural Science of Hubei Province. He is the editorial member of scientific reports, and executive editor-in-chief of IET Optoelectronics. He is a Senior Member of IEEE. **Abstract:** In this talk, I will introduce some approaches to train the photonic neural network in real time. The photonic neural network structure includes Mach-Zehnder interferometer meshes and diffractive neural network chip.
Invited Talk	**Title:** Foundry-processed grating couplers for mid-infrared wavelengths **Speaker:** Zhenzhou Cheng **Affiliation:** Tianjin University, China **Bio:** Dr. Zhenzhou CHENG (IEEE/Optica/COS/CSOE Senior Member) is currently a professor at Tianjin University. He received his B.S. degree in Physics and M.S. degree in Optics both from Nankai University. In 2010, he joined Prof. Hon Ki Tsang's group to pursue his Ph.D. with the support of the Hong Kong Research Grant Council Ph.D. Fellowship Scheme. He received his Ph.D. degree in Electronic Engineering in 2013 and then joined the Department of Chemistry at the University of Tokyo as an assistant professor. In 2018, he joined the School of Precision Instruments and Opto-Electronics Engineering at Tianjin University as a full professor. His research interests focus on silicon photonics. He is in charge of several projects funded by NSFC and JSPA and published over 90 SCI papers in academic journals, namely, Nature Photonics and Nature Communications. He also received several awards such as the Outstanding Instructor Award, National College Students' Innovation and Entrepreneurship Program (2021), Second-Class Award in Research Achievements, Ministry of Education, China (2014), Young Scientist Award, Hong Kong Institute of Science (2013), and Young

	Scholar Thesis Award, the Chinese University of Hong Kong (2013). **Abstract:** Mid-infrared (2-20 um wavelengths) integrated optics has a wide range of applications in spectral analysis, environmental monitoring, medical diagnosis, free-space communication, and ranging. To date, multi-project wafer (MPW) services have been widely developed for fabricating low-cost, high-density integrated silicon-based optoelectronic devices and integrated systems. However, previous studies mainly focus on the photonic integrated circuits in the telecommunication bands (1.3 and 1.55 microns) and below. In this talk, I introduce the development of short-wavelength mid-infrared silicon-based waveguide coupling techniques based on standard MPW processes, including subwavelength grating couplers, ultrathin grating couplers, and blazed grating couplers. The study is expected to open an avenue to promote the development of mid-infrared silicon photonics.
G27720	**Title:** Flexible Dispersion Engineering in Thin GaP-OI Frequency Comb Resonator Design **Author(s):** Zhaoting Geng, Houling Ji, Zhuoyu Yu, Weiren Cheng, Yi Li, and Qiancheng Zhao **Speaker:** Zhaoting Geng **Affiliation:** Southern University of Science and Technology, China **Abstract:** Thickness-constrained waveguides enable ultralow loss photonics while suffering severe chromatic issues nowadays. We present a concentric ring configuration to reduce the dispersion requirements for the core waveguide thickness. This approach employs a second ring to squeeze light into additional anti-bonding modes to manifest the dispersion profile with lateral coupling parameters such as the 2nd ring width as well as the gap size. We then applied this method to a 200 nm-thick SiO2-passivated concentric coupled GaP-OI resonator design for Kerr soliton frequency comb generation which gives rise to an anomalous dispersion span of 150 nm. The dispersion profile could be further optimized by changing the gap of the coupled rings, demonstrating the design flexibility. Our concentric microrings approach can find anomalous dispersions on thickness-constrained materials, opening the possibilities for novel integrated nonlinear photonic applications.

Technical Session on Dec. 10

TS44 THz Metamaterials and Device Applications

Chair Quan Xu，Tianjin University, China

Room No.	Room ID	Zoom Link
Room 4	868 4632 7948	https://us02web.zoom.us/j/86846327948

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Quanlong Yang	Central South Univeristy, China
16:00-16:30	Invited Talk	Quan Xu	Tianjin University, China
16:30-17:00	Invited Talk	Xudong Liu	Shenzhen University,China
17:00-17:15	G27726	Qianqian Wang	Shanghai University, China

Paper Detail

Invited Talk	**Title:** Terahertz membrane meta-optics **Speaker:** Quanlong Yang **Affiliation:** Central South Univeristy, China **Bio:** Quanlong got obtained PhD degree from Tianjin University in 2018. He was a Postdoc research fellow of Australian National University from 2019 to 2022. He is currently an associate professor in Central South University. His research interests are in terahertz science and technology, all-dielectric metasurfaces, topological photonics and nonlinear photonics. **Abstract:** All-dielectric metasurfaces have become a new paradigm for flat optics as they allow flexible engineering of the electromagnetic space of propagating waves. Such metasurfaces are usually composed of individual subwavelength elements embedded into a host medium or placed on a substrate, which often diminishes the quality of the resonances. The substrate imposes limitations on the metasurface functionalities. We introduced a novel concept of membrane meta-optics to eliminate this limitation, which features an inverted design, and consists of arrays of holes made in a thin membrane of high-index dielectric material, with the response governed by the electric and magnetic Mie resonances excited within dielectric domains of the dielectric membrane. We demonstrated highly efficient transmission up to 91% combined with the 2π phase coverage in the freestanding membranes. Also, we further achieved efficient wavefront control, multifunctional metasurface, bound state in the continuum and topological edge states with the dielectric membrane. Such dielectric membrane provides novel opportunities for efficient large-area meta-devices, which are of great importance for developing efficient meta-optics and on-chip photonics and bring many novel features into terahertz devices.
Invited Talk	**Title:** Research on Terahertz Surface Plasmon Devices **Speaker:** Quan Xu **Affiliation:** Tianjin University, China **Bio:** Quan Xu is currently an associate professor at the Center for Terahertz Waves, Tianjin University, Tianjin, China. His research interests focus on metamaterial/metasurface devices, surface plasmons, and terahertz

	photonics. He has authored more than 50 scientific papers published peer-reviewed journals including Science Advances, Optica, Laser & Photonics Reviews, and Adanvanced Photonics. **Abstract:** With the developments of terahertz near-field microscopes, terahertz frequencies have recently become a promising platform to explore fundamental properties and potential applications of Surface Plasmons (SPs). On the other hand, metasurfaces have emerged as a fascinating tool for fine control of SPs through the design of suitable subwavelength resonators and the prescribed arrangement of their spatial distributions. In this talk, we will show that by taking the resonance response, geometric phase concept, on-chip interference, and near-field coupling effect into consideration, various metasurface-based THz SP devices are achieved, including efficient metacouplers, polarization-controlled launchers, and plasmonic vortex generators. These devices were directly characterized by the near-field scanning THz microscopy system, exhibiting versatility and superior performance.
Invited Talk	**Title:** Terahertz modulation with total internal reflection geometry **Speaker:** Xudong Liu **Affiliation:** Shenzhen University,China **Bio:** Dr. Xudong Liu received his Ph.D. in Electronic Engineering from The Chinese University of Hong Kong in 2017, and joined Shenzhen University in 2018. His research interests include millimeter wave/terahertz modulators, millimeter wave/terahertz near-field/far-field high-speed imaging systems, terahertz time-domain spectral detection, and terahertz deep space detection. He has published tens of papers on high impact journals, including Nature Communications, Photonics Research, Advanced Optics Materials, APL Photonics, Optics Express, etc.. He has completed a Youth Program of NSFC as program supervisor. **Abstract:** Terahertz (THz) modulators are crucial for THz imaging, communication and sensing. THz modulators with high modulation depth, broad bandwidth and high rate are desired. Evanescent wave in the total internal reflection (TIR) geometry has the potential to improve efficiency of THz modulators in a broad bandwidth. Here, we introduce several THz modulators whose performances were greatly improved by the TIR geometry. For example, the modulation depth of a graphene-based THz modulator was improved from ~17% in the transmission geometry to ~40% in the TIR geometry, whose modulation depth was further improved to ~77% by integrating a sub-wavelength metal wire grating with the graphene. The graphene layer was replaced by a GaAs Schottky diode structure, which yielded ~100% modulation depth in the range of 0.4 to 0.6 THz, at operational frequency of ~160 kHz. The TIR geometry was also used for THz polarization rotation by combining a VO2-based grating structure. By electrically controlling the phase transition of the VO2 layer, the device performed an active ultra-broadband quarterwave converter that can be switched between a 45 linear rotator and a quarter wave converter in the 0.8-1.5 THz region.
G27726	**Title:** Tuning Performance and Mechanism of Gate-tuned Graphene Grating for Dynamically Controlling Terahertz Wavefront **Author(s):** Qianqian Wang, Xiaotong Li, Jie Liang, Runze Li **Speaker:** Qianqian Wang **Affiliation:** Shanghai University, China **Abstract:** Recently, dynamically controlling of the terahertz wavefront has attract tremendous attention due to both scientific curiosity and potential applications in many fields. However, the available tunable components in the terahertz band are low efficiency and difficult to integrated with other terahertz components, due to the low light-matter interaction in this frequency range. Here, we design a tunable grating fabricated of graphene combined with metasurface. Coupled-mode-theory (CMT) analyses reveal the underlying physics, that is through the control of the applied voltage, graphene as tunable absorption loss, can realize dynamically controlling on the amplitude and phase of THz wavefront.

Technical Session on Dec. 10

TS45 Fiber-Based Technologies and Applications

Chair Jindong Wang, Chongqing University, China

Room No.	Room ID	Zoom Link
Room 5	811 1444 8699	https://us06web.zoom.us/j/81114448699

Time	Paper ID	Speaker	Affiliation
15:30-16:00	Invited Talk	Yunqi Liu	Shanghai University, China
16:00-16:30	Invited Talk	Gang Xu	Huazhong University of Science and Technology, China
16:30-16:45	G27711	Yefen Wei	Huaqiao University, China
16:45-17:00	G277123	Wenhe Jia	Tsinghua University, China

Paper Detail

Invited Talk	**Title:** Long-Period Fiber Grating Mode Converter **Speaker:** Yunqi Liu **Affiliation:** Shanghai University, China **Bio:** Yunqi Liu received the Ph.D. degrees in Optics from Nankai University, China, in 2000. From 2000 to 2008, he worked as a Research Fellow in School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, in School of Engineering, City University London, U.K., and in Department of Electronic Engineering, City University of Hong Kong, Hong Kong, China, respectively. He joined the School of Communication and Information Engineering, Shanghai University, China, as a full professor in 2008. He was supported by the Program for Professor of Special Appointment (Eastern Scholar) at Shanghai Institutions of Higher Learning, China. He has published more than 200 papers on fiber gratings, fiber optic sensors and optical fiber communications. **Abstract:** We demonstrate the fabrication of long-period gratings (LPFGs) in few mode fiber by using focused carbon dioxide laser and femtosecond laser. The mode coupling and characteristics of the LPFGs written in the specialty fibers were investigated experimentally. The generation and conversion of the orbital angular momentum (OAM) modes were achieved by the special designed gratings. The LPFGs could have promising application as all fiber mode converters for mode-division-multiplexing optical communications and high sensitivity optical sensors.
Invited Talk	**Title:** Emergence of dispersive shock waves in nonlinear optical dynamics **Speaker:** Gang Xu **Affiliation:** Huazhong University of Science and Technology, China **Bio:** Gang Xu (PhD15, MSc12, BSc10) currently works as a full Professor at Huazhong University of Science and Technology. His research interests include nonlinear wave dynamics, ultrafast optics, laser physics, optical solitons and frequency combs. He has published more than 30 peer-reviewed articles, including Nature Communications, Physical Review Letters and Optics Letters. He has also co-authored 35 conference papers and 3 book chapters.

	Abstract: To understand the mechanisms of emergence of localized structures is the center task in the framework of nonlinear optical dynamics. In this communication, we will demonstrate the generation of optical wave singularities, namely the dispersive shock waves during the propagation in nonlinear mediums. More specifically, using the optical-fiber platform as the test bed, we have investigated the wave evolutions with phase or intensity discontinuities, leading to the formation of ultrafast but regular oscillations. From one hand, this peculiar phenomenon is an efficient method for the frequency broadening of short pulses, in regardless of normal or anomalous dispersion of the nonlinear medium. On the other hand, it paves the way to understand the nonlinear complexities not only in optical fibers, but also in fluid dynamics, hot plasmas and Bose-Einstein condensations.
G27711	**Title:** Three-core fiber sensor for multipurpose measurement based on Mach-Zehnder interferometer **Author(s):** Yefen Wei, Xicheng Wang and Zhifang Wu **Speaker:** Yefen Wei **Affiliation:** Huaqiao University, China **Abstract:** We propose a fiber-optic sensor for measurement of twist, refractive index (RI) and temperature using a Mach-Zehnder interferometer by sandwiching a segment of three-core fiber (TCF) between two sections of no-core fibers via fusion splicing technique. The structure of the proposed fiber sensor is shown in Fig.1(a). The cladding diameter and the distance between adjacent cores of the TCF are measured to be 125 and 26.5μm, respectively. And the length of two sections of no-core fiber are less than 5 mm and the length of the TCF is about 1.5cm. Finally, lead-in and lead-out single model fibers (SMF) are connected to two ends of no-core fiber. The first section of no-core fiber acts as a beam splitter and the second one as a beam combiner. The transmission spectrum of the sensor is as Fig.1(b) shows. With twist range from 0 to 62.832 rad/m and temperature range from 25 to 95 ℃, this sensor shows a twist sensitivity of -53.2 pm/(rad⁄(m)) and a temperature sensitivity of 52.19 pm⁄℃, respectively. The strain sensitivity is only 0.5114 pm⁄(με)from 0 to 2000 με. We also characterized this sensing system by immersing the sensor in liquid samples with RI between 1.3482 to 1.3995, and got a RI sensitivity of 115.998 nm⁄RIU. The sensor has a simple and easy to fabricate, and it has the potential application in the fields where temperature, twist and RI measurements are required, respectively.
G277123	**Title:** Broadband terahertz generation from an epsilon-near-zero material **Author(s):** Wenhe Jia, Meng Liu, Yongchang Lu, Xi Feng, Qingwei Wang, Xueqian Zhang, Yibo Ni, Futai Hu, Mali Gong, Xinlong Xu, Yuanyuan Huang, Weili Zhang, Yuanmu Yang and Jiaguang Han **Speaker:** Wenhe Jia **Affiliation:** Tsinghua University, China **Abstract:** Broadband terahertz (THz) spectroscopy is a powerful tool for biochemical sensing as well as material research. Optical rectification in nonlinear crystals has been the most popular method for generating broadband THz pulses. However, the conversion efficiency and spectral bandwidth are typically limited by the phase matching condition in the thick nonlinear medium. Here, we demonstrate broadband THz emission, both in transmission and reflection configurations, via surface optical rectification from a commercially available indium tin oxide (ITO) thin film. We show an enhancement of the generated THz signal when the pump laser is tuned around the epsilon-near-zero (ENZ) region of ITO, due to the pump laser field enhancement associated with the ENZ effect. The bandwidth of the THz signal generated from the ultrathin ITO film is over 3 THz, unrestricted by the phase-matching condition. Our results may open up a new avenue for compact and low-cost nonlinear broadband THz sources.

Technical Session on Dec. 11

TS46 Optoelectronic Devices and Applications

Chair Zhen Chen, Xuzhou GSR Semiconductor, China

Room No.	Room ID	Zoom Link
Room 1	867 3001 0998	https://us02web.zoom.us/j/86730010998

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Wei Jiang	Nanjing University, China
10:00-10:30	Invited Talk	Changzheng Sun	Tsinghua University, China
10:30-10:45	G277117	Huilin He	Southern University of Science and Technology, China

Paper Detail

Invited Talk	**Title:** Silicon Photonic Devices for LIDAR and Communications: Some Recent Advances **Speaker:** Wei Jiang **Affiliation:** Nanjing University, China **Bio:** Wei Jiang is a professor of optical engineering in the college of engineering and applied sciences at Nanjing University (NJU). He serves as an associate director of Optical Communications Systems & Network Engineering Research Center of Jiangsu Province, and associate director of Optical Communications Engineering Research Center of Nanjing University. Prior to working at NJU, he was an associated professor in the department of electrical and computer engineering at Rutgers, the State University of New Jersey, USA. Prof. Jiang's research interests include silicon photonics, photonic crystals, nanophotonics, and their applications in optical interconnects, optical communications, sensing, and optical computing. He proposed a waveguide superlattice and demonstrated high-density low-crosstalk waveguide integration with half-wavelength pitches, which opened the door to a new generation of optical phased arrays. Further theoretical and experimental efforts from his group recently demonstrated a half-wavelength pitch optical phased array based on a waveguide superlattice, with potential applications in solid-state LIDARs and wireless optical communications. He contributed to the fundamental understanding of silicon electro-optic and thermo-optic devices, slow light, superprism effects, and photonic crystal interface physics. In 2007, the first high-speed photonic crystal modulator was demonstrated on silicon through one of his research projects. **Abstract:** Silicon photonics has shown great potential for communication and LIDAR applications. We will review our recent progress on silicon photonic devices for these applications, especially high-performance optical phased arrays and modulators. Silicon-based optical phased arrays (OPAs) can potentially transform LIDAR and wireless optical communications. Superlattice-based optical phased arrays have, for the first time, realized half-wavelength pitch OPAs. But aligning the phases of the elements of an OPA is time-consuming, becoming a bottleneck in real applications. Assisted by artificial neural networks, we have developed a rapid, non-iterative, accurate phase calibration technology for OPAs. High-speed modulators are widely used in optical communications and optical interconnects. While micro-nano/structure-based modulators are often adopted where small sizes and low power are desirable, Mach-Zehnder (M-Z) modulators are widely used for their assumed stable performance, in reality, micro-nano/structure-based modulators sometimes suffer from

	insufficient extinction ratio and/or relatively high driving voltage. The traveling-wave electrodes of M-Z modulators often suffer from fabrication variation, causing impedance mismatch. We will present our recent work towards solving these critical issues.
Invited Talk	**Title:** High-speed Electroabsorption Modulated Lasers **Speaker:** Changzheng Sun **Affiliation:** Tsinghua University, China **Bio:** Changzheng SUN received the B.E., M.E. and Ph.D. degrees in electronic engineering from Tsinghua University, China, in 1995, 1997 and 2000, respectively. He became a faculty member of the Dept. of Electronic Engineering, Tsinghua University, China, in 2000, and was promoted as a full professor in 2010. His research interests include physics and fabrication technologies of high-speed photonic integrated circuits, nonlinear dynamics in semiconductor lasers and nonlinear optics in optical micro-resonators. Up to now, he is the author or co-author of over 100 scientific papers. **Abstract:** In this talk, we will review recent progress in electroabsorption modulated lasers (EMLs) for 100 GbE and 400 GbE applications. And we will also present our work on EMLs based on identical epitaxial layer integration scheme.
G277117	**Title:** Reversible Polarization Modulation of Upconversion Emissions **Author(s):** Yan Jun Liu and Huilin He **Speaker:** Huilin He **Affiliation:** Southern University of Science and Technology, China **Abstract:** Lanthanides doped upconversion nanorods (UCNRs) shows a distinct polarization anisotropy due to the anisotropic crystalline local symmetry surrounding the emitter. Precise control of the orientation of particles shows great significance of exploiting the luminescent polarization and their potential applications. Previously, we demonstrated a facile polypropylene-aided shear-driven method to obtain large-scale orientationally ordered UCNRs (shown in Fig. 1A) and achieved a linearly polarized upconversion luminescence (UCL). Based on the above, we further propose a composite material system to dynamic modulate the polarizations and emissions of these UCNR film. We deliberately design a composite (shown in Fig. 1A) that comprises of an uniaxially aligned UCNR film and a self-organized cholesteric superhelixstructure. Specially, the well-aligned UCNRs film in the composite act as both a polarized emitter and the alignment layer of liquid crystal molecules. By purposely overlapping the bandgap of cholesteric superhelixstructure with emission band of UCNRs, the polarized UCL can be converted into a completely upconversion circularly polarized luminescence (UC-CPL) due to the distinct selectively reflection and circular dichroism of the cholesteric superhelixstructure. To our knowledge, we have achieved the largest dissymmetry factor of 1.92 in the current upconversion-based emission systems. Different from the previous emitter-CLC systems, UC-CPL with bidirectional asymmetric polarizations and emissions can be also achieved in the same composite via forward and backward excitations (shown in Fig. 1B and C) in view of the multi-emissions of UCNR film and asymmetric structure in the composite. Furthermore, since the cholesteric superhelixstructure is sensitive to the external stimuli, the UCCPL can be easily tuned via reversibly shifting bandgap of CLCs by changing the concentration of chiral dopants, heating, or applying an electric field, providing versatile interchange between linear and circular polarizations. Experimental and simulation results suggest that such a composite material system with multi-mode tuned UC-CPL, ultra-high dissymmetry factor and bidirectional asymmetric polarizations and emissions have great potential for the information encryption storage, security, enantioselective synthesis and biological applications.

Technical Session on Dec. 11

TS47 Optoelectronic Devices and Applications

Chair Na Ni, ShanghaiTech University, China

Room No.	Room ID	Zoom Link
Room 2	873 1454 0649	https://us02web.zoom.us/j/87314540649

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Vincenzo Pecunia	Simon Fraser University, Canada
10:00-10:30	Invited Talk	Satoshi Aya	South China University of Techology, China
10:30-11:00	Invited Talk	Xun Guan	Tsinghua-Berkeley Shenzhen Institute, China
11:00-11:15	G27723	Ruoyun Yao	Zhejiang University, China

Paper Detail

Invited Talk

Title: Printable organic semiconductors for high-performance narrowband photodetectors

Speaker: Vincenzo Pecunia

Affiliation: Simon Fraser University, Canada

Bio: Prof. Vincenzo Pecunia is the Head of the Sustainable Optoelectronics Research Group (www.sfu.ca/see/sustainable-optoelectronics) at the School of Sustainable Energy Engineering, Simon Fraser University (Canada). His research covers environmentally-friendly, printable semiconductors, their photoelectronic properties, and their applications in electronics, optoelectronics, and photovoltaics.

Prior to establishing his research group, he spent 6+ years at the Optoelectronics Group of the Cavendish Laboratory, University of Cambridge. Whilst there, he earned his PhD in Physics and worked as a Postdoctoral Research Associate under the supervision of Professor Henning Sirringhaus, FRS.

Prof. Pecunia's research has been published in journals such as Nature, Advanced Materials, Advanced Energy Materials, Advanced Functional Materials, ACS Nano, and Nano Energy. Drawing from his research experience, Prof. Pecunia has also authored the books 'Organic Narrowband Photodetectors' (Institute of Physics Publishing, iopscience.iop.org/book/978-0-7503-2663-6) and 'Organic and Amorphous-Metal-Oxide Flexible Analogue Electronics' (Cambridge University Press, www.cambridge.org/pecunia).

In recognition of his contributions, Prof. Pecunia has been awarded the Fellowship of the Institute of Materials, Minerals and Mining (FIMMM) and the Senior Membership of the Institute of Electrical and Electronics Engineers (SMIEEE).

Abstract: The inherent spectral selectivity of many printable organic semiconductors makes them highly attractive for filterless narrowband photodetection, which is of considerable technological and commercial interest in relation to a wealth of emerging smart sensor applications (e.g., smart healthcare, smart homes, and smart manufacturing) [1-2]. Due to the simplicity of its device architecture and its high manufacturability, a particularly attractive approach involves narrowband-absorption-type (NBA) photodetection, which relies on organic semiconductors that selectively absorb within the target spectral range [3]. To overcome the limitations of fullerene-based systems, which compromise the spectral selectivity of the photodetectors due to the broad absorption tail of fullerenes, we have intensively investigated fullerene-free approaches to high-performance

	NBA photodetectors. By selecting suitable donors in combination with non-fullerene acceptors selectively absorbing in the green or far-red spectral range, we have realized printable NBA photodetectors with cutting-edge performance: our far-red-selective photodetectors achieve the highest specific detectivity for NBA far-red-selective photodetectors and the smallest spectral width of all the printable implementations [3]; our green-selective photodetectors attain the highest peak external quantum efficiency and green-to-blue spectral rejection ratio compared to all prior literature on green-selective printable NBA photodetectors [4]. Additionally, with a view to realizing multi-color light sensors beyond the limitations of conventional pixel architectures involving color-filter arrays, we have demonstrated for the first time a printable, vertically stacked, organic-semiconductor-based pixel architecture capable of independently and concurrently sensing multiple colors, while delivering high photoconversion efficiency and spectral selectivity [5]. Our breakthroughs point to the significant potential of printable narrowband organic photodetectors for easy-to-make, low-cost, and high-performance multi-color sensors and imagers.
Invited Talk	**Title:** Unexpected nonlinear three-wave-mixing processes enabled by emerging helielectric nematics **Speaker:** Satoshi Aya **Affiliation:** South China University of Techology, China **Bio:** Prof. Satoshi Aya received my Ph.D. degree in materials engineering from Tokyo Institute of Technology in 2014. Later, he had worked as an engineer in Hitachi High-Technologies (2014-2015) and postdoctoral researcher in RIKEN Center for Emergent Matter Science (2015-2019) in Japan. Since 2019, he joined to South China University of Technology as a principal investigator. His principal interests are the physicochemical properties of soft matters, particularly in liquid crystal physics, surface science, colloids and electro-optical aspects of materials in liquid crystal states, etc. **Abstract:** Second harmonic generation (SHG) is one of the most historical and technically important nonlinear optical processes among three-wave mixing mechanisms. SHG is the lowest-order nonlinear optical effect, which shows an inherent up-conversion process, producing a doubled-frequency photon at 2f from two input photons at a fundamental frequency of f. For obtaining efficient light field conversion by the SHG process, phase matching condition should be studied and used for device design. Ferroelectric nematic liquid crystals are new classes of liquid crystal states that possess a polarization field. The broken symmetry of head-to-tail equivalence leads to a strong SHG emission. Due to the complex polarization structure, it is urgent to establish theory frameworks to describe the SH process by additionally considering optical anisotropy of mediums such as birefringence, optical rotation and the like. This benefits in exploring new phase matching processes. This presentation introduces a universal phase matching theory and the relevant calculation scheme for predicting SHG output in various polarization structures. We take chiral ferroelectric nematic, dubbed helilelectric nematic, as an example and reveal nontrivial phase matching condition that depends on the polarization structural details. We will discuss the relationship between theory and experiments, validating our approach contributes to a significant advance in diversifying the category of polar materials and structures in nonlinear light physics and device implementation
Invited Talk	**Title:** Silicon Photonics for Optical Access Networks in Post-5G Era **Speaker:** Xun Guan **Affiliation:** Tsinghua-Berkeley Shenzhen Institute, China **Bio:** Xun Guan received the B.Eng. degree from the Huazhong University of Science and Technology, China, in 2012, and the Ph.D. degree in information engineering from The Chinese University of Hong Kong, Hong Kong, China, in 2016. From 2017 to 2022, he has been a Postdoctoral Fellow and then a Research Scientist in Center for Optics, Photonics and Lasers (COPL), Université Laval, Quebec, Canada, where he still holds adjunct professorship. He is now an assistant professor in Tsinghua-Berkeley Shenzhen Institute, Tsinghua Shenzhen International Graduate School, Tsinghua University, China. His research interest lies in optical fiber

	communications, digital signal processing, photonic integrated circuits, optical wireless communications and optical fiber sensing. **Abstract:** Envisaging the next generation telecommunication network, optics-supported radio access network is doubtlessly the major carrier for such a soaring data volume. A leap towards post-5G era also tightens the tolerance to the transmission latency, the power consumption per bit, and the capital and operational expenses for a yet denser and broader network. Silicon photonic (SiP) integrated circuits supporting radio-over-fiber could endow the network edge with intelligence, for both the coordination of antennas and the accessibility of computation power, with low cost, low latency, wavelength-selectivity, and compatibility with conventional traffic. The versatility of SiP further grants it an edge in wavelength-division-multiplexing signal transceiver and downlink-drop-uplink-remodulation, corresponding to the roles of central office and optical network units in an optical access network (OAN). The implementation of SiP in different OAN subsystems inspires our proposal of a general framework of SiP in the next-generation OSA. This talk will provide a comprehensive review of our recent research within this framework. The highlight of several instances of SiP chip designs and experimental demonstrations would lay a foundation to our vision for next generation OAN.
G27723	**Title:** Modeling and Analysis of Zinc Diffusion Effect within InP-Based Mach-Zehnder Modulators **Author(s):** Ruoyun Yao,Wanshu Xiong,Zhangwan Peng,Yiti Xiong,Chaodan Chi, Chen Ji **Speaker:** Ruoyun Yao **Affiliation:** Zhejiang University, China **Abstract:** We investigate the influence of Zinc diffusion on the modulation efficiency and optical insertion loss of InP-based MZI modulators. By analyzing the electric-optical field distribution and free-carrier absorption loss of three types of Zinc diffusion profiles, the mechanisms between Zn diffusion and modulation efficiency and optical insertion loss inside MZI modulators are systematically studied. We show that InP-based MZI modulator modulation efficiency is limited by electro-optic field distribution overlap and optical mode interacts with p-type dopant increases device insertion loss when Zn diffuses during MOCVD epitaxial process.

Technical Session on Dec. 11

TS48 Fiber-Based Technologies and Applications

Chair Yanhua Luo, University of New South Wales, Australia

Room No.	Room ID	Zoom Link
Room 3	848 7078 8439	https://us02web.zoom.us/j/84870788439

Time	Paper ID	Speaker	Affiliation
09:30-10:00	Invited Talk	Kaiwei Li	Jilin University, China
10:00-10:30	Invited Talk	George Yuhui Chen	Shenzhen University, China
10:30-11:00	Invited Talk	Wonkeun Chang	Nanyang Technological University, Singapore
11:00-11:15	G27744	Xianyi Cao	Shanghai Jiao Tong University, China

Paper Detail

Invited Talk	**Title:** Optical fiber probes assisted with silica capillaries for high throughput biochemical analysis **Speaker:** Kaiwei Li **Affiliation:** Jilin University, China **Bio:** Kaiwei Li received the B.E. degree in mechanical engineering from Jilin University, Changchun, China, in 2009, and the Ph.D. degree in mechanical engineering from Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun, China, in 2014. He joined the Centre for Optical Fibre Technology, Nanyang Technological University, Singapore as a Research Fellow in 2015. From 2019 to 2021, he was an Associate Professor at the Institute of Photonics Technology, Jinan University, Guangzhou, China. He is currently an Associate Professor at the Key Laboratory of Bionic Engineering Ministry of Education, Jilin University, Changchun, China. His research interests include optic fiber sensors and multimaterial multifunctional fibers.
Invited Talk	**Title:** Light-sheet skew rays based chemical sensors **Speaker:** George Yuhui Chen **Affiliation:** Shenzhen University, China **Bio:** George Yuhui Chen 博士 2009 年本硕毕业于英国帝国理工学院，2014 年在英国南安普顿大学光电子研究中心获得博士学位。2013 至 2015 年期间在英国 SPI Lasers 有限公司与英国南安普顿大学的联合激光研究实验室从事博士后研究工作。2015 年受邀加入南澳大学光电子激光研究中心组建激光物理与光学器件实验室。George Yuhui Chen 于 2021 年荣获国家第十六批“国家重大人才工程项目”青年项目，加入深圳大学担任特聘教授。George Yuhui Chen 具有丰富的教学经验，2017 年获得山东省政府“外专项目团队专家”在山东科学院/齐鲁工业大学定期进行英语授课。George Yuhui Chen 一直专注于功能材料和特种光纤的新型传感器技术和应用方向的交叉学科研究，已经发表了 52 篇学术论文和 6 个国际会议受邀学术报告，拥有 1 项发明专利。作为第一作者和通讯作者在相关领域的顶级期刊上如 Materials Horizons, Biosensors and Bioelectronics, ACS Sensors, Sensors and Actuators: B. Chemical 发表多篇具有影响力的学术论文。近 5 年来主持和参与多项科研项目其科研经费达 6.6 百万澳元，并带领团队首次发明了具有应用前景的光纤湿度传感器和基于衍射效应的新型光学距离测量仪。在国际光电子学术领域中，享有一定的国际声誉，自 2018 年以来担任光传感器和光纤传感器国际会议（OFS）技术

	委员会成员，主办了该领域最大的两次学术会议。目前担任国际光学期刊 Scientific Reports 的编辑，IEEE 高级会员。 **Abstract:** Food safety is a global issue, and unsafe food containing harmful fungi, bacteria, viruses or chemicals can cause everything from diarrhea to cancer. Food safety detection technology can effectively reduce the occurrence of food-borne diseases and protect public health. Localized surface plasmon resonance (LSPR)-enhanced fluorescence (or metal-enhanced fluorescence) technology has been proven to be an effective method for food safety detection, but it still suffers from poor stability and reusability. In response to these problems, the speaker presents his research progress towards a new fiber-optic chemical sensing technology based on the enhanced fluorescence effect of LSPR, including multimode fiber structures for robustness; reengineered skew rays to improve the sensitivity; and a surface nano-architecture that can stabilize LSPR. The aim is to develop a new type of low-cost and high-performance fiber-optic chemical sensors that can be used for measuring harmful fungi to address the challenge of rapid food safety detection.
Invited Talk	**Title:** Fiber-based method for generating megawatt peak power pulses in mid-infrared **Speaker:** Wonkeun Chang **Affiliation:** Nanyang Technological University, Singapore **Bio:** Wonkeun Chang received the BTech in Optoelectronics and MSc in Physics from the University of Auckland, and subsequently PhD in Physics from the Australian National University. He then joined Max Planck Institute for the Science of Light, where he developed expertise in ultrafast light-matter interactions in hollow waveguides. In 2013, Dr Chang was granted a Discovery Early Career Researcher Award from the Australian Research Council and led a project on complex pulse dynamics and extreme events in ultrafast laser systems at the Australian National University. He is currently a Nanyang Assistant Professor at the School of Electrical and Electronic Engineering in Nanyang Technological University, Singapore. His research interests are in specialty optical fibers, novel light source development, and femtosecond laser systems. **Abstract:** We present a fiber-based approach for generating microjoule-level femtosecond pulses in 3–4 μm. This is achieved by frequency-down converting 2 μm pump in a gas-filled antiresonant hollow-core fiber via nonlinear effects. The wavelength of the mid-infrared is determined by a fiber's geometrical parameter. We obtain femtosecond pulses centered at 3.16 μm with megawatt-level peak power emerging from the fundamental mode of the fiber output. It represents three orders of magnitude increase in the available peak power beyond 3 μm from optical fibers. It offers a potential avenue to realize an all-fiberized high-power mid-IR femtosecond source that is compact and robust.
G27744	**Title:** A solid-state FMCW Lidar system based on lens-assisted beam steering **Author(s):** Xianyi Cao, Kan Wu, Chao Li, Tianyi Li, Jiaxuan Long, Jianping Chen **Speaker:** Xianyi Cao **Affiliation:** Shanghai Jiao Tong University, China **Abstract:** We propose and demonstrate an all solid-state light detection and ranging (Lidar) system based on lens assisted beam steering (LABS) technology. A frequency modulated continuous wave (FMCW) coaxial Lidar system at 1550 nm with 16 scanning directions, 0.35° beam steering step and 1.05° total steering angle is demonstrated. The function of beam steering and 3D imaging are demonstrated. In FMCW ranging experiments, the Lidar system is measured to have 210 m ranging capability. The ranging accuracy can be further improved by applying phase noise compensation. This work proves the potential application of a new integrated beam steering technology in Lidar and demonstrates the way for a fully integrated Lidar system.

Poster Session

Link to check posters: http://www.ipsogc.org/poster.html

Paper ID	Speaker	Affiliation
G27784	Zhuoyuan Huang	South China Normal University, China
G27734	Cong Hu	Huazhong University of Science and Technology, China
G277130	Meng Zou	Wuxi Research Institute, Huazhong University of Science and Technology, China
G27738	Dongpei Shen	Beijing University of Posts and Telecommunications, China
G277119	Dongliang Pei	Tianjin Navigation Instrument Research Institute Tianjin, China
G27746	Tao Shen	Harbin University of Science and Technology, China
G27741	Duanming Li	Shanghai Marine Electronic Equipment Research Institute, China
G27735	Jingwen Li	China University of Geosciences, China
G27762	Boyao Li	Dongguan University of Technology, China
G27749	Weihao Lin	Southern University of Science and Technology, China
G277108	Shuaiqi Liu	Southern University of Science and Technology, China
G27799	Yu Wang	Taiyuan University of Technology, China
G277118	Zongru Yang	Hong Kong Polytechnic University, China
G277102	Minghui Niu	Southern University of Science and Technology, China
G27718	Qing Bai	Shanxi Transportation Technology Research & Development Co., Ltd, China
G27798	Aoyan Zhang	Southern University of Science and Technology, China
G2774	Yandong Pang	Naval Engineering University, China
G27721	Kwai Hei Li	Southern University of Science and Technology, China
G27767	Yu Chen	Anhui University, China
G27748	Tielin lu	Instrumentation Technology and Economy Institute, China
G27759	Gonghui Zhang	Jiangsu Hengtong Optic-electric Co., Ltd., China
W2002	Meng Sun	Southern University of Science and Technology, China
G27785	Hong Cheng	Anhui University, China
G277114	Xuhao Song	Institute of Optical Physics and Engineering Technology, Qilu Zhongke, China

Paper Detail

G27784	**Title:** Er3+-Pr3+-Yb3+ tri-doped La2O3-Al2O3-SiO2 glass double clad fiber for C+L amplification **Author(s):** Zhuoyuan Huang， Weichao Ma, Tong Wu, Jiaao Lu, Jiantao Liu， Changming Xia, Zhiyun Hou, and Guiyao Zhou **Speaker:** Zhuoyuan Huang **Affiliation:** South China Normal University **Abstract:** Er3+-Pr3+-Yb3+ tri-doped double clad fiber was fabricated by the stack-and-draw technology. The fiber core Er3+-Pr3+-Yb3+ tri-doped La2O3-Al2O3-SiO2 glass was prepared using the conventional melting method. The fluorescence properties of fiber were experimentally investigated. The result suggested Er3+-Pr3+-Yb3+ tri-doped double clad fibers are potential material for broadband light source and C+L amplification.
G27734	**Title:** Intra-cavity mode control in a Nd:YAG laser by optimizing the single-mode power factor with a spatial light modulator **Author(s):** Cong Hu, Yu Xiao, Yuhang He, Yusong Liu and Xiahui Tang **Speaker:** Cong Hu **Affiliation:** Huazhong University of Science and Technology **Abstract:** By utilizing customized intra-cavity optical elements including graded-phase mirrors, variable reflectivity mirrors, aspherical mirrors, diffractive optical elements and spatial light modulator, the mode discrimination of the cavity is enhanced and a pre-determined transverse mode, usually flattop beams such as super-Gaussian beams or flattened-Gaussian beams, can be generated in the cavity. The design of such laser cavities oscillating in a predetermined transverse mode is commonly based on the concept of phase conjugation, whereby the desired phase profile of optical element is obtained by reversely propagating the predetermined transverse mode and creating a conjugate field to propagate back. However, this procedure is only accurate under the assumption that the mirror size is infinite and the propagation process is in a lossless manner. Moreover, the parameters of pre-determined mode, such as beam size and amplitude distribution, must be carefully chosen or else non-negligible errors would occur due to finite-size apertures and associated truncation. Here, we report on a simple and effective approach for intra-cavity mode control based on optimizing the single-mode power factor, which represents the total power extracted by a single mode from the active medium. By optimizing the single-mode power factor of the desired mode, the cavity can be designed to operate in mono-mode, increasing the mode purity and improving the brightness significantly. Our method is verified on a digital laser with a spatial light modulator as the rear mirror and the loaded phase profile is acquired by simulated annealing algorithm. As a result, when the singlemode power factor of TEM00 mode is optimized, the resonator operates in a single fundamental mode and the brightness of output beam yields a 240% and 276% improvement, compared with the conventional plane-plane and plane-concave resonator respectively. When the single-mode power factor of the vortex mode with topological charge of 1 is optimized, the output mode purity is close to 100%.
G277130	**Title:** Ultra Narrow Linewidth Distributed Feedback Fiber Laser Based on Self-injection Locking **Author(s):** Meng Zou,Kai Shen,Qizhen Sun,Zhijun Yan **Speaker:** Meng Zou **Affiliation:** Wuxi Research Institute, Huazhong University of Science and Technology **Abstract:** We have reported an ultra narrow linewidth fiber laser based on π phase-shift fiber Bragg grating (π-FBG) and self-injection locking, in which the π-FBG is inscribed on Erbium-ytterbium co-doped fiber with scanning phase mask method. Using self-injection locking, the relaxation oscillation frequency (ROF) peak was reduced about 25 dB from -103 dB/Hz to -128 dB/Hz. The 20-dB linewidth of the laser was suppressed to around 500 Hz.
G27738	**Title:** Dark Current Analysis in Type-II InAs/GaSb Superlattice LWIR Detector with M-structure Barrier **Author(s):** Dongpei Shen, Tong Sun, Pengfei Zhu, Xiaoning Guan, Baonan Jia, Haizhi Song, Pengfei Lu

	Speaker: Dongpei Shen **Affiliation:** Beijing University of Posts and Telecommunications **Abstract:** We designed a long-wave infrared detector using InAs/GaSb and InAs/GaSb/AlSb/GaSb superlattices and further studied the effect of some sensitive parameters on dark current characteristics. We utilize the numerical model to analyze the dark current characteristics of the contact layer and the absorption layer at different doping levels, and also calculate the dark current characteristics of the absorption layer and barrier layer at different thicknesses. By designing different absorption layer and barrier layer, we found that the detector has a hole barrier in the valence band, which effectively reducing the dark current level. Under the optimal detector structure, the dark current at low temperature is maintained at a relatively ideal level about 2.25×10-5 A/cm2 and the quantum efficiency is close to 42%.
G277119	**Title:** A single-laser system for mobile cold atom gravimeter **Author(s):** Pei Dongliang, Kong Delong, Wang Jieying, Chen Weiting, Lu Xiangxiang, Wei Junxin, Liu Weiren **Speaker:** Dongliang Pei **Affiliation:** Tianjin Navigation Instrument Research Institute Tianjin **Abstract:** Improving the environmental adaptability of laser system is the key to realize field measurement for cold atom interference gravimeter. In this paper, a laser system based on a 1560nm fiber laser is described in detail. The output power of trapping laser and Raman laser are 1.1W and 1.9W at 780.2nm, with near-ideal Gaussian mode of TEM00, respectively. Using this compact optical scheme, we achieved the atom gravimeter interference with 2T=140ms, corresponding to an acceleration sensitivity of 610μGal/√Hz, which is limited by vibration conditions. The results of optical frequency locking and power stabilization for laser system meet requirements of high precision mobile gravimeter.
G27746	**Title:** A sensitive material for optical fiber sensor ------ Dy8Fe16-xCox (x=0,2,3): First-principles calculations **Author(s):** Yue Yuan , Tao Shen, Chi Liu , Tianyu Yang ,Ai NaGong **Speaker:** Tao Shen **Affiliation:** Harbin University of Science and Technology **Abstract:** In this paper, the structural, electrical, magnetic and optical properties of Dy8Fe16-xCox (x=0,2,3) compounds have been studied by first principles calculation. Among them, the structural properties show that the atoms of DyFe2, Dy8Fe14Co2 and Dy8Fe13Co3 are symmetrically located, and each layer forms a triangle. In addition, the calculation of electrical properties shows that the three compounds have obvious metal properties and ferromagnetism. At the same time, an interesting phenomenon was found in the magnetic calculation, The magnetic moment of the same electron orbit of the same element is the same on the premise of ensuring the triangle symmetry of each layer. Finally, in order to study the optical properties of Dy8Fe16-xCox (x=0,2,3), We calculated the optical absorption spectra of the three compounds with photon energy. It is found that the absorption spectrum is red shifted in the ultraviolet range. The above basic physical property calculations could provide theoretical guidance for the optical elements of Dy8Fe16-xCox (x=0,2,3). It also lays a foundation for improving the sensitivity of Dy8Fe16-xCox (x=0,2,3) compound optical fiber sensing.
G27741	**Title:** Highly sensitive multi-coating photonic crystal fiber biosensor at near-infrared waveband **Author(s):** Duanming Li, Wei Zhang, Jiangfei Hu, Minxue Gu **Speaker:** Duanming Li **Affiliation:** Shanghai Marine Electronic Equipment Research Institute **Abstract:** A multi-coating photonic crystal fiber with a trapezoid-shaped slot (TS-PCF) for highly refractive index (RI) sensing is proposed. TiO2 and Indium tin oxide (ITO) are coated on the bottom of the polished-area, ITO is used as the plasmonic material. Through the full-vector finite element method (FV-FEM), the wavelength sensitivity of 5000~17000 nm/RIU in the analyte RI range of 1.31 to 1.36 is obtained. Moreover, the maximum amplitude sensitivity of 358.94 RIU-1 is also achieved with the relevant resolution of 2.79E-5 RIU. The proposed fiber sensor can be the suitable candidate for real time detecting in medical diagnostics and biomolecules

	applications.
G27735	**Title:** Characterization of various bound state solitons using linear optical sampling technique **Author(s):** Jingwen Li,Zhichao Wu,Zhe Yu,Chaoyu Xu,Tianye Huang,Songnian Fu **Speaker:** Jingwen Li **Affiliation:** China University of Geosciences **Abstract:** The linear optical sampling (LOS) technique enables the full-field information acquisition of ultra-high speed optical signals with low bandwidth optoelectronic devices. Compared to conventional coherent detection method, LOS is a more powerful tool to monitor ultra-high speed optical signals, since it gets rid of the bandwidth limitation of electronic bottleneck. In this paper, the LOS is proposed to implement the characterization of bound state solitons generated from a passively mode-locked fiber laser. According to our experimental results, it is confirmed that the LOS enables more accurate measurements with much higher resolution in both time and spectral domains than conventional measurement devices.
G27762	**Title:** The micro- control refractive index sensor of dual-metal antiresonance optical fiber **Author(s):** Boyao Li, Tianrong Huang **Speaker:** Boyao Li **Affiliation:** Dongguan University of Technology **Abstract:** With the development of artificial intelligence for complex environment monitoring technology, new sensors based on the combination of diversified customized optical fiber waveguides and functional materials have become an important solution to meet the diverse perceptions in complex environments. Then, for solving the concentration monitoring problem of multi-channel microfluidics, the bimetallic anti-resonant fiber structure is proposed in this paper, which realize the multi-band microfluidic sensor of bimetallic reverse resonant fiber. Theoretical results show that the sensor achieves the surface plasma resonance (SPR) coupling of the core mode and the metal film at multiple bands of 1450 nm, 1650 nm and 1700 nm, then uses this feature to achieve refractive index sensing in three bands. The corresponding results have potential applications in the field of multimetallic microstructure fiber fluid sensing in the air core, and provide new ideas for the design of multi-band SPR resonance sensors, which are expected to be applied in the field of biochemical monitoring.
G27749	**Title:** Isopropanol-sealed Cascaded-Peanut Taper fiber Structure for temperature sensing incorporated fiber laser **Author(s):** Weihao Lin, Siming Sun, Fang Zhao, Jie Hu, Perry Ping Shum, Changyuan Yu, Liyang Shao **Speaker:** Weihao Lin **Affiliation:** Southern University of Science and Technology **Abstract:** In this paper, a new method for ultrasensitive temperature measurement is proposed and demonstrated. The sensor is based on two cascaded peanut structures to form a Mach Zehnder interferometer (MZI) in single mode fiber, and a cone is formed by repeat discharge in the interference region to enhance the evanescent field on its surface. At the same time, isopropanol with high thermal optical coefficient is filled for effective sensitization. The MZI was placed in a fiber ring cavity for filtering and temperature sensing. The results show that the fiber ring laser (FRL) has a narrower 3 dB band width (~0.15nm) and a high signal-to-noise ratio (SNR) (~50dB). In the temperature range of 20℃ to 50℃, the sensitivity reached -285 pm/℃. The sensor has the advantages of high sensitivity, simple structure and low cost. It is expected to be widely used in ocean temperature measurement.
G277108	**Title:** Fast Phase Demodulation Method for Heterodyne Phase-Sensitive OTDR **Author(s):** Shuaiqi Liu, Feihong Yu, Liyang Shao, Mang I Vai **Speaker:** Shuaiqi Liu **Affiliation:** Southern University of Science and Technology **Abstract:** We propose and demonstrate a simple but effective phase demodulation method for heterodyne-detection-based phase-sensitive OTDR systems, which will accelerate the computation process. The

	demodulation principle is based on phase shifting interferometry technique. By exploiting the spatial domain feature of the received beating signal, the orthogonal signal is directly generated from the original signal, without the need for digital I/Q or Hilbert transform operations. The experimental results showed that the proposed method achieved at least 10% computation speed increase compared to conventional methods, while maintaining an equivalent sensing performance. This technique is especially beneficial to on-site deployment of phase-sensitive OTDR system, because of its simpler computation process and faster computation speed.
G27799	**Title:** Interference Fading Suppression for Multi-frequency Φ-OTDR **Author(s):** Yu Wang, Junhong Wang, Bin Liang, Yan Li, Qing Bai, Baoquan Jin **Speaker:** Yu Wang **Affiliation:** Taiyuan University of Technology **Abstract:** In phase-sensitive optical time domain reflectometer (Φ-OTDR), due to interference fading, the intensity of Rayleigh backward scattering (RBS) signals may be close to zero at the fading position and submerged in noise, resulting in the abnormal demodulated phase of vibration signal. In this paper, a multi-frequency Φ-OTDR is proposed for the interference fading suppression. Three acousto-optical modulators (AOMs) are used to generate multi-frequency probe pulses. Data alignment processing is carried to ensure the consistency of multi-frequency beat signals. Rotated-vector-sum method is adopted to aggregate multi-frequency signals. Experimental results show that with the help of data alignment processing, the fading probability of aligned curve can be reduced to 1.90%, and the SNR of positioning curve can reach 16.03dB.
G277118	**Title:** Hollow core Bragg fiber-based gas pressure sensor using parallel Fabry-Perot interferometers **Author(s):** Zongru Yang, Weihao Yuan, Changyuan Yu **Speaker:** Zongru Yang **Affiliation:** The Hong Kong Polytechnic University **Abstract:** An ultra-high sensitivity parallel-connected Fabry-Perot interferometers (FPIs) pressure sensor based on hollow core Bragg fiber (HCBF) and harmonic Vernier effect is proposed and demonstrated. One FPI (FPI-1) acts as the sensing unit while the other FPI (FPI-2) is used as the reference unit to generate the Vernier effect. The FPI-1 was prepared by fusion splicing a section of HCBF between a single-mode fiber (SMF) and a hollow silica tube (HST), and the FPI-2 was fabricated by sandwiching a piece of HCBF between two SMFs. Two FPIs with very different free spectral ranges (FSR) in the fringe pattern were connected to the 3-dB coupler parallelly, which realizes the harmonic Vernier effect and ensures the stability of the interference fringe. Both measurements of the air pressure in the range of 0-0.24 MPa and the temperature in the range of 25-55 ℃ were conducted using the dual FPIs sensor. Experimental results exhibited that high sensitivity of 124.35 nm/MPa with excellent linearity of 0.9967 was achieved by the sensing probe. Moreover, the calculated temperature crosstalk was as low as ~0.072 kPa/℃. The proposed sensor can be a promising candidate for real-time and high-precision gas pressure monitoring.
G277102	**Title:** Taper Optical Fiber for Distributed Light-driven Soft Robots **Author(s):** Minghui Niu, Ziyan Zhao, Jiayuan Min, Jie Hu, Liyang Shao, Huanhuan Liu, Luo Dan, Perry Ping Shum **Speaker:** Minghui Niu **Affiliation:** Southern University of Science and Technology **Abstract:** We have proposed and demonstrated that the taper fiber-enabled motion of soft robots. A thin film with a high refractive index is encapsulated on the top of the taper fiber as well as soft robot. By controlling power of light along the taper fiber, the soft robot can realize a grasping action. Our results may contribute to the effort of exploring distributed light field to drive soft robots.
G27718	**Title:** BOTDR Denoising by Sparse Representation Algorithm with Preformed Dictionary **Author(s):** Yuting Liu, Zhijie Sun, Ning Cui, Qing Bai, Yu Wang, Baoquan Jin **Speaker:** Qing Bai **Affiliation:** Shanxi Transportation Technology Research & Development Co., Ltd

	Abstract: In Brillouin optical time domain reflectometers, the signal-to-noise ratio is a key factor restricting the sensor performance. Using redundancy and correlation of 3D-Brillouin gain spectrum in multi-dimensional domain, sparse representation algorithm can be used to improve signal-to-noise ratio. According to basic principle of sparse representation, a dictionary can be designed to reconstruct valid signals. During reconstruction, random noise will be discarded as residuals. In this paper, discrete cosine transform algorithm is used to design the dictionary, orthogonal matching pursuit algorithm is used to extract the coefficient matrix, and the signal is finally reconstructed to achieve the purpose of noise reduction. The simulation results show that when 5dBm random noise is added, signal-to-noise ratio in the non-temperature-change region is increased by 24.3dB, which provides a new idea for improving signal-to-noise ratio of BOTDR sensor.
G27798	**Title:** Design of a hollow-core microstructured optical fiber with low loss and high polarization-maintaining **Author(s):** Aoyan Zhang,Zhipeng Deng,Jialong Li,Guiyao Zhou,Perry Ping Shum **Speaker:** Aoyan Zhang **Affiliation:** Southern University of Science and Technology **Abstract:** In this paper, a hollow-core microstructured optical fiber is proposed. By adding several rounded hexagonal air-hole arrays to the cladding of the hollow-core polarization-maintaining fiber, the requirements of low loss and high polarization-maintaining are achieved. In the wavelength ranges of 1.540 μm - 1.585 μm and 1.609 μm - 1.653 μm, the confinement loss is less than 0.1 dB/km, and the birefringence is higher than 5×10-5. Such a fiber performance heralds new opportunities for hollow-core anti-resonant fibers in practical applications.
G2774	**Title:** Intensity Compensation of echo pulses for Fiber Interferometers Based on uwFBG Reflectors **Author(s):** Yandong Pang, Junbin Huang, Hongcan Gu, Su Wu, and Zhiqiang Zhang **Speaker:** Yandong Pang **Affiliation:** Naval Engineering University **Abstract:** We report on current theoretical and experimental results of echo pulses based on ultra-weak Fiber Bragg Gratings (uwFBGs), using intensity compensation to solve the signal distortion caused by light pulse delay. Cubic Spline Interpolation is applied, leading to better robustness for the interference intensity. Then the linear compensation value is obtained by comparing the peak intensity in order to correct attenuation in three-way optical path. We report improvements over the conventional demodulation algorithm based on 3×3 coupler with circulator. The experimental results have shown that, when the intensity reduction is existed due to pulse delay, the hydroacoustic field could be reconstructed with high fidelity by using the proposed method. Leading to much lower noise density level for the interference pulse intensity, more than 7 dB when the reference signal is 1rad/√Hz in 5~50 Hz, and the SNR is improved approximately 10 dB@10 Hz. The proposed method exhibits a particularly applicability in passive optical path, which is of great importance for increasing the practicality of the system in complicated environments.
G27721	**Title:** Self-adjusting light source based on a dual-function GaN light-emitting diode **Author(s):** Yumeng Luo, Jiahao Yin, and Kwai Hei Li **Speaker:** Kwai Hei Li **Affiliation:** Southern University of Science and Technology **Abstract:** GaN light-emitting diodes (LED) play a vital role in modern lighting technology, and the further development of smart lighting systems capable of automatically adjusting the brightness has received extensive attention. Herein, we present a simple and elegant approach based on a single GaN LED that can self-adjust the output intensity in response to the changes in ambient intensity. The GaN LED with InGaN/GaN multiquantum wells can operate in both luminescence and photodetection modes, and its electrical and optical performances are thoroughly investigated. Driven by a microcontroller board under pulse-width modulation, the device acts as a detector to provide photocurrent signals that reflect the ambient light intensity at the off state, and provides the desired intensity level at the on state. This work also exhibits a proof-of-concept demonstration of real-time stabilization of blue and white light irradiances at target areas despite large variations in ambient irradiance. The

	proposed novel self-adjusting scheme based on a dual-function LED chip without the need for external photosensors can be an alternative approach for smart lighting applications.
G27767	**Title:** Portable microscopic phase retrieval system using the transport of intensity equation on Android platform **Author(s):** Yu Chen, Hong Cheng*, Zhengguang Tian, Xunting Yang, Fen Zhang and Wei Li **Speaker:** Yu Chen **Affiliation:** Anhui University **Abstract:** The microscope used in the traditional phase retrieval method based on the transport of intensity equation (TIE) is not portable enough. In this paper, a microscopic phase retrieval software and hardware system with good portability, high precision and strong adaptability is designed under the Android system. The intensity images are captured by the system which uses a smart phone with a portable microscope, and controls the lifting and lowering of the stage through a high-precision motor. Then the self-designed Android application software calculate the phase of the obtained image by using TIE method. Finally, the effectiveness of the system is verified by simulation experiments and experimental measurements.
G27748	**Title:** Research and application system design of intelligent inspection of multispectral segment optoelectronic devices based on 5G **Author(s):** Tielin Lu, Lei Yue, Bowen Lu, Xiawei Feng and Hongqi Han **Speaker:** Tielin lu **Affiliation:** Instrumentation Technology and Economy Institute, China **Abstract:** Massive real-time image test results put forward higher requirements for network transmission and intelligent technology. Intelligent detection technology using 5G network has become one of the most important research directions of multi-spectral optoelectronic devices. However, they are still confused about the architecture of the 5G network and how to design the system with unmanned control for different user needs. At present, it is urgent to solve how to overcome the instability of 5G optoelectronic device network structure through multi-spectral segments, achieve high-quality transmission of results, and obtain intelligent optimal results. This paper summarizes the configuration and mode of 5G network, application system of multispectral optoelectronic devices. This paper also analyzes the intelligent detection system based on 5G scheme. Finally, we have developed a case of multi-spectral segment photoelectric detection architecture based on 5G communication structure. We have validated the application scenario of intelligent detection in the design of transmission line detection and the feasibility purpose of intelligent detection in smart grid.
G27759	**Title:** Numerical Simulation of C+L Broadband Single-mode Fiber **Author(s):** Gonghui Zhang, Wei Sun, Fei Lei, Wei Chen, Lin Wang, Yaling Wang, Yongtong Li, Hongfeng Guan, Jianchao Yuan, Zheng Jiang and Qiyue Liu **Speaker:** Gonghui Zhang **Affiliation:** Jiangsu Hengtong Optic-electric Co., Ltd. **Abstract:** A novelty C+L single-mode fiber (CL fiber for short) which can expand L-band communication is proposed to meet the urgent demand of optical fiber transmission bandwidth for large capacity communication system. The influence of L-band attenuation on the optical signal-to-noise ratio (OSNR) of the system is analyzed and calculated; through the simulation of dense wavelength division multiplexing (DWDM) system, the requirements for fiber attenuation warping degree (FAWD) of CL fiber in 100Gbit/s rate DWDM system are obtained; and the CL fiber and its main attenuation parameters are defined. The results show that, the OSNR of L-band for conventional single-mode fiber will be 2dB-2.5dB worse than traditional C-band on 100km span system, so it is very important to limit the FAWD of L-band; if the L-band transmission can meet the link requirements in relevant standards, it is recommended that the FAWD $\triangle\alpha_{1625}$ of CL fiber is suitable to be controlled below 0.015dB/km, and the fiber attenuation warping degree difference (FAWDD) $\triangle\alpha$ is suitable to be controlled below 0.005dB/km.

W2002	**Title:** Low-dose Coherent Modulation Imaging via Generalized Alternating Projection Algorithm **Author(s):** Meng Sun, Tao Liu, George Barbastathis, Yincheng Qi, Fucai Zhang **Speaker**: Meng Sun **Affiliation:** Southern University of Science and Technology **Abstract:** Phase contrast imaging is advantageous for mitigating radiation damage to samples such as biological specimens. For imaging at nanometer or atomic resolution, the dose on samples increases dramatically and can easily exceed the sample damage threshold. Coherent Modulation Imaging (CMI) can provide quantitative sample images of absorption and phase contrast at diffraction-limited resolution with fast convergence. For radiation-sensitive samples, one needs to conduct the CMI experiment under low illumination flux for high resolution, for which the effect of detection noise would become substantial. Here, an algorithmic framework is proposed for CMI involving Generalized Alternating Projection and Total Variation constraint. A five-to-ten-fold lower photon requirement can be achieved when applied to the experiment dataset recorded in near-field or far-field geometries. The work would make CMI more applicable to the dynamics study of radiation-sensitive samples.
G27785	**Title:** GS Iterative Phase Retrieval Algorithm Based on Fusion of Spatial Phase Gradient Descent and Frequency Domain Amplitude Linear Weighting **Author(s):** Hong Cheng, Haonan Zheng, Siwei Sun **Speaker**: Hong Cheng **Affiliation:** Anhui University **Abstract:** For the problems of slow convergence and low accuracy of the traditional linear weighted GS iterative phase retrieval algorithm, a GS iterative phase retrieval algorithm based on the fusion of spatial phase gradient descent and frequency domain amplitude linear weighting is proposed. By zero-padding the image, and then applying phase gradient descent in each iteration of the space domain, the algorithm invokes linear weighting in the frequency domain space, thereby avoiding iterative stagnation while ensuring the convergence speed and improving the accuracy of phase retrieval.
G277114	**Title:** Laser Weld Seam Tracking Sensing Technology Based on Swing Mirror **Author(s):** Tian Changyong, Song Xuhao, Yin Tie, Zhang Yi **Speaker:** Xuhao Song **Affiliation:** Institute of Optical Physics and Engineering Technology, Qilu Zhongke, China **Abstract:** Based on the principle of laser triangulation measurement, a laser welding seam tracking sensor is developed to track U-shaped, V-shaped and flat bottom grooves of pipeline welds in real time. Aiming at the problems of reflection of pipeline welding groove and strong welding arc, which affect the accuracy of U-shaped groove feature recognition, a laser welding seam tracking sensing technology based on swing mirror is developed. The image sensor collects the weld features of the spot-shaped spot area in a cycle, and connects to form a cross-sectional weld feature, which can effectively improve the signal-to-noise ratio of the weld feature identification signal. the actual machine test of pipeline weld tracking is carried out. In the identification test of U-shaped, V-shaped, flat bottom groove, extremely deep and wide weld (40mm depth&30mm width) and extremely deep and narrow weld (40mm depth&12mm width), the sensor has good recognition accuracy and stability.